

https://dspace.org/

The agreement found between the sensory profiles of children 3-10 years and their parents

Geyser, Elsje

2009-10-15T09:20:17Z
http://hdl.handle.net/10539/7361

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

THE AGREEMENT FOUND BETWEEN THE SENSORY PROFILES OF CHILDREN 3-10 YEARS AND THEIR BIOLOGICAL PARENTS

Elsje Geyser

A research report submitted to the Faculty of Health Science, University of the Witwatersrand, Johannesburg,

in partial fulfillment of the requirements for the degree

of

Master of Science in Occupational Therapy

Johannesburg, 2009

DECLARATION

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

Signed_____ _____ day of _____ 2009

To my family

ABSTRACT

Title: The agreement found between the sensory profiles of children 3-10 years and their parents
Author: Elsje Geyser
Promoter: Denise Franszen
School: Therapeutic Sciences
Faculty: Health Sciences
Degree: MSc.OT
Key Concepts: Sensory modulation dysfunction, sensory processing disorder, high threshold, low threshold, sensory profile, low registration behaviour, sensory seeking behaviour, sensory sensitive behaviour, sensation avoiding behaviour.

In order to treat a child with sensory modulation disorder (SMD), the impact of SMD on the child's occupational sphere should be taken into account. This includes the effect of SMD in the parent on the child's development and behaviour. This study determined the probability of agreement between the parent and child's sensory profiles.

A quantitative, cross sectional study design established the sensory profiles of 81 children and their parents. Results indicated a moderate probability that a child with SMD may have a parent with SMD. A moderate to high probability existed for a parent with SMD to have a child with SMD. This supports the supposition that there is a hereditary component to SMD, with learned sedentary behavioural patterns.

The treatment implications include considering the parent's reaction to their own sensory thresholds and the influence this has on the child's treatment and learnt behaviour.

ACKNOWLEDGEMENTS

The Author would like to thank and acknowledge all the parents and children who participated in the study, as well as the various occupational therapy practices and institutions that allowed me to test their children and parents. I also want to thank Denise Franzsen, Paula Barnard and Prof P.Bekker who provided the primary support for this research report. I would like to thank my friends and family, especially my husband, Frik, for their support and wisdom in helping me with this research.

TABLE OF CONTENTS

TITLE PAGE i
DECLARATION ii
DEDICATION iii
ABSTRACT iv
ACKNOWLEDGEMENTS v
TABLE OF CONTENTS vi
LIST OF FIGURES x
LIST OF TABLES xi
NOMENCLATURE xiii
LIST OF ABBREVIATIONS xv

CHAPTER 1: INTRODUCTION 1

1.1. BACKGROUND 1
1.2. STATEMENT OF THE PROBLEM 3
1.3. PURPOSE OF THE STUDY 4
1.4. JUSTIFICATION FOR THE STUDY 4
1.5. AIM AND OBJECTIVES OF THE STUDY 5
1.6. NULL HYPOTHESIS 5
1.7. ASSUMPTIONS 6

CHAPTER 2: LITERATURE REVIEW 7

2.1. INTRODUCTION 7
2.2. SENSORY INTEGRATION THEORY 7
2.3. SENSORY MODULATION 10
2.4. SENSORY MODULATION DYSFUNCTION 11
2.5. SENSORY PROFILES AND MEASUREMENT OF SMD 13
2.6. PHYSIOLOGY UNDERLYING SENSORY MODULATION 15
2.7. BEHAVIOURAL NATURE OF SENSORY MODULATION DYSFUNCTION 18
2.8. TEMPERAMENT AND SMD 21
2.9. HEREDITARY FACTORS AND LEARNED BEHAVIOUR 22

2.10. CONCLUSION 26

CHAPTER 3: METHODOLOGY 28

3.1. INTRODUCTION 28
3.2. RESEARCH DESIGN 29
3.3. SUBJECT SELECTION 29
3.3.1. Exclusion Criteria 30
3.3.2. Inclusion Criteria 30
3.4. RESEARCH TECHNIQUE 31
3.4.1. Ethical Clearance 31
3.4.2. Permission obtained & Questionnaires collected 32
3.4.3. Test Scoring 33
3.4.4. Test Feedback 33
3.5. MEASUREMENT TOOLS AND TECHNIQUES 33
3.5.1. SENSORY PROFILE, Caregiver Questionnaire 34
3.5.2. ADOLESCENT/ADULT SENSORY PROFILE; Self Questionnaire 35
3.6. SCORING OF THE PROFILES TO COMPARE SMD IN CHILDREN AND PARENTS 37
3.7. DATA ANALYSIS 38
3.7.1. Identification of children with and without SMD 39
3.7.2. Comparison of the mean scores and standard deviation 39
3.7.3. Comparison of total modulation scores 39
3.7.4. Quadrant scores of the children relating to those of their parents 40
3.8. CONCLUSION 41

CHAPTER 4: RESULTS 43

4.1. INTRODUCTION 43
4.2. BACKGROUND STATISTICAL ANALYSES 43
4.2.1. Demographic information 43
4.2.2. Identification of children with and without SMD 44
4.2.3. Comparison of Mean Scores and Standard Deviations 45
4.3. TOTAL SCORES 47
4.3.1. Children's Threshold Scores 48
4.3.2. Parents' Threshold Scores 49

4.4. SCORES ACHIEVED IN EACH QUADRANT 50
4.4.1. Low Registration Quadrant 50
4.4.2. Sensation Seeking Quadrant 51
4.4.3. Sensory Sensitive Quadrant 51
4.4.4. Sensation Avoiding Quadrant 52
4.5. THE CORRELATION FOUND BETWEEN CHILDREN WITH SMD AND THEIR PARENTS 53
4.6. THE PROBABILITY OF AGREEMENT BETWEEN CHILDREN WITH SMD AND THEIR PARENTS WITH SMD 54
4.7. THE PROBABILITY OF PARENTS WITH SMD HAVING A CHILD WITH SMD 58
4.8. THE AGREEMENT FOUND BETWEEN PARENTS WITHOUT SMD'S SENSORY PROFILE AND THOSE OF THEIR CHILDREN 64
4.9. SUMMARY 65

CHAPTER 5: DISCUSSION 66

5.1. INTRODUCTION 66
5.2. INFLUENCE OF DEMOGRAPHICS ON THE RESULTS 67
5.2.1. Identification of children with and without SMD 67
5.2.2. Total Scores achieved in each quadrant 67
5.3. AETIOLOGY OF SMD 68
5.4. AGREEMENT OF BEHAVIOURS FOUND BETWEEN THE CHILDREN WITH SMD AND THEIR PARENTS 69
5.4.1. Sedentary behaviour 70
5.4.2. Conflicting behaviour 72
5.4.3. Parents presenting with situation appropriate behaviour 74
5.5. AGREEMENT OF BEHAVIOURS FOUND BETWEEN THE PARENTS WITH SMD AND THEIR CHILDREN 74
5.5.1. Opposite behaviour 75
5.5.2. Sedentary behaviour 75
5.5.3. Conflicting behaviour 77
5.5.4. Active Behaviour 78
5.6. IMPLICATIONS OF THE FINDINGS ON INTER-PERSONAL RELATIONSHIPS AND OCCUPATIONAL PERFORMANCE 78
5.7. IMPLICATIONS FOR TREATMENT WITH A SENSORY DIET 80
5.7.1. Incentive 81

5.7.2. Expectation *83*
5.7.3. Task Selection *83*
5.8. CONCLUSIONS 84

CHAPTER 6: CONCLUSIONS 86

6.1. SUMMARY 86
6.2. NEED FOR FURTHER WORK AND RECOMMENDATIONS 89

CHAPTER 7: REFERENCES 91

CHAPTER 8: APPENDICES 97

LIST OF FIGURES

FIGURE 2-1: THE CIRCULAR PROCESS OF SENSORY INTEGRATION ADAPTED FROM BUNDY, LANE AND MURRAY 8
FIGURE 2-2: CATEGORIES OF SENSORY PROCESSING DISORDERS 9
FIGURE 2-3: DUNN'S QUADRANT PROFILE, ILLUSTRATING THE RELATIONSHIP BETWEEN BEHAVIOURAL RESPONSE/SELF-REGULATION AND NEUROLOGICAL THRESHOLDS. 12
FIGURE 2-4: ADAPTED SUMMARY OF THE PHYSIOLOGICAL AND BEHAVIOURAL RESPONSE TO THE NEUROLOGICAL THRESHOLD 18
FIGURE 3-1: QUADRANT PROFILE BY WINNIE DUNN FROM SENSORY PROFILE, ... 36
FIGURE 4-1: DEMOGRAPHIC REPRESENTATION OF THE STUDY 44
FIGURE 4-2:PERCENTAGES OF CHILDREN WITH AND WITHOUT SMD 45
FIGURE 4-3: REPRESENTATION OF CHILDREN AND PARENT'S TOTAL MODULATION SCORES 48
FIGURE 4-4: REPRESENTATION OF CHILDREN ACHIEVING A MUCH MORE/LESS CLASSIFICATION WITH REGARD TO HIGH AND LOW THRESHOLDS 49
FIGURE 4-5: DISTRIBUTION OF PARENTS' HIGH AND LOW THRESHOLD SCORES 49
FIGURE 4-6: TOTAL SCORES ACHIEVED IN LOW REGISTRATION QUADRANT 50
FIGURE 4-7: TOTAL SCORES ACHIEVED IN SENSATION SEEKING QUADRANT 51
FIGURE 4-8: TOTAL SCORES ACHIEVED IN SENSORY SENSITIVE QUADRANT 52
FIGURE 4-9: TOTAL SCORES ACHIEVED IN SENSATION AVOIDING QUADRANT 52
FIGURE 4-10: THE PERCENTAGE OF CHILDREN WITH SMD'S WHOSE FATHERS PRESENT WITH AND WITHOUT SMD 54
FIGURE 4-11: THE PERCENTAGE OF CHILDREN WITH SMD'S WHOSE MOTHERS PRESENT WITH AND WITHOUT SMD 55
FIGURE 4-12: PROBABILITY OF A FATHER WITH SMD HAVING A CHILD WITH/WITHOUT SMD 59
FIGURE 4-13: PROBABILITY OF A MOTHER WITH SMD HAVING A CHILD WITH/WITHOUT SMD 59
FIGURE 8-1: A FATHER, WHO PARTICIPATED IN THE STUDY'S SENSORY PROFILE 134

LIST OF TABLES

TABLE 2-1: RELATIONSHIP BETWEEN BEHAVIOURAL RESPONSES/SELF-REGULATION AND NEUROLOGICAL THRESHOLDS 20
TABLE 2-2: SIMILARITIES BETWEEN TEMPERAMENT AND SENSORY MODULATION 21
TABLE 3-1: SUMMARY OF RESEARCH METHODOLOGY 28
TABLE 3-2: ALPHA-NUMERICAL REPRESENTATION OF THE QUADRANT CATEGORIES 37
TABLE 3-3: NUMERICAL VALUES GIVEN TO CLASSIFICATIONS 37
TABLE 4-1: COMPARISON OF THE TOTAL ADULT MEAN SCORES AND STANDARD DEVIATIONS 46
TABLE 4-2: COMPARISON OF MEAN SCORES AND STANDARD DEVIATIONS FROM THE TOTAL CHILD SAMPLE 46
TABLE 4-3: PERCENTAGE OF THE SAMPLE WHERE BOTH CHILD AND PARENT ACHIEVED A "SIMILAR TO MOST PEOPLE" CLASSIFICATION 53
TABLE 4-4: CORRESPONDING BEHAVIOURAL PATTERNS BETWEEN THE CHILD AND FATHER WITH SMD 56
TABLE 4-5: CORRESPONDING BEHAVIOURAL PATTERNS BETWEEN THE CHILD AND MOTHER WITH SMD 56
TABLE 4-6: PROBABILITY OF AGREEMENT BETWEEN CHILDREN AND PARENTS SMD BEHAVIOURS WHEN THE CHILD PRESENTS WITH SMD 57
TABLE 4-7: SHARED BEHAVIOURS BETWEEN THE FATHER WITH SMD AND HIS CHILD WITH SMD 60
TABLE 4-8: SHARED BEHAVIOURS BETWEEN THE MOTHER WITH SMD AND HER CHILD WITH SMD 60
TABLE 4-9: PROBABILITY OF AGREEMENT FOUND BETWEEN PARENTS WITH SMD AND CHILDREN WITH SMD 'S BEHAVIOUR IN DESCENDING ORDER. 62
TABLE 4-10: DISTRIBUTION OF SMD IN RELATION TO THEIR PARENT'S SMD PROFILES 64
TABLE 8-1: SUMMARY OF CLASSIFICATIONS AND SCORES AS DEPICTED IN FIGURE 8-1 134
TABLE 8-2: EXAMPLES OF THE CALCULATION OF THE HIGH THRESHOLD AND LOW THRESHOLD SCORES, AND TOTAL MODULATION SCORES, ORIGINAL AND WEIGHTED 135
TABLE 8-3: SYMMETRICAL CORRELATION STUDY OF MOTHER AND CHILD'S TOTAL MODULATION SCORES ... 136
TABLE 8-4: EXAMPLES OF PROBABILITY CALCULATIONS DONE TO DETERMINE THE PROBABILITY OF A PARENT WITH/WITHOUT SMD HAVING A CHILD WITH/WITHOUT SMD 136
TABLE 8-5: SYMMETRICAL CORRELATION STUDY OF HIGH THRESHOLDS OF MOTHER AND CHILD 137
TABLE 8-6: EXAMPLES OF PROBABILITY CALCULATIONS DONE TO DETERMINE THE POSSIBILITY OF A PARENT WITH/WITHOUT SMD HAVING A CHILD WITH/WITHOUT SMD WITH REGARD TO NEUROLOGICAL THRESHOLDS 137
TABLE 8-7: SYMMETRY FOUND BETWEEN CHILDREN AND MOTHERS IN THE LOW REGISTRATION QUADRANT 138

TABLE 8-8: EXAMPLES OF THE CALCULATION OF DESCRIPTIVE PERCENTAGES PERTAINING TO CHILDREN AND THEIR PARENTS AND THE INCIDENCE OF SMD IN VARIOUS COMBINATIONS..... 138

NOMENCLATURE

1. *Habituation:* The recognition by the central nervous system that something familiar has occurred, and no longer needs attention [7].

2. *Learning Disabilities:* A general term referring to a heterogeneous group of disorders, referring to a child or adolescent's deficits in acquiring expected skills in reading, writing, speaking, use of listening, reasoning, or mathematics, compared with other children of the same age and intellectual ability [46].

3. *Neurological Threshold:* This refers to the amount of sensory input required for a neuron or neurological system to respond [7].

4. *Occupational Therapy: "*The prescription of occupations, interactions and environmental adaptations to enable the individual to regain, develop or retain the occupational skills and roles required to maintain personal well-being and to achieve meaningful personal goals and relationships appropriate to the relevant social and cultural setting" [4] (p.18).

5. *Sensitization:* The mechanism used by the central nervous system that enhances potentially important stimuli [7].

6. *Sensory Integration Theory:* A theory of brain-behaviour relationships [1]. The neurological process that organizes sensation from the body and environment and makes it possible to use the body effectively within the environment [20].

7. *Sensory Integration Treatment Approach:* This is based on the following principles of being child directed, individualised therapy with active participation on the child's part [58]. Activities should be purposeful and an adaptive response should be the result. Input varies according to the child's response and the activity should be rich in proprioceptive, vestibular and tactile input. The treatment goals are to improve processing and organising behaviour such that an appropriate adaptive response occurs and not to teach a skill.

8. *Sensory Modulation:* The Central Nervous System's regulation of its own activity [1], through the neural facilitation and inhibition of sensations.[9] In order to respond appropriately in relation to incoming sensory stimuli, rather than under reacting or overreacting to them [5].

9. *Sensory Modulation Dysfunction:* The inability to regulate and organize the degree, intensity, and nature of responses to sensory input in a graded and adapted manner [25].

10. *Sensory Processing Disorder:* Diagnosis of sensory-based processing challenges divided into three classic categories of Sensory Modulation Disorder, Sensory Based Motor Disorder and Sensory Discrimination Disorder [2].

11. *Temperament:* Constitutionally based individual differences in reactivity and self-regulation, observed in the domains of emotionality, motor activity and attention.

LIST OF ABBREVIATIONS

ADHD:	Attention Deficit Disorder with Hyperactivity
ASP:	Adolescent/Adult Sensory Profile
CNS:	Central Nervous System
DSI:	Dysfunction of Sensory Integration
LD:	Learning Disabilities
LR:	Low Registration
MRC:	Medical Research Council
OT:	Occupational Therapy
OT (noun):	Occupational Therapist
OT-SI:	Occupational Therapy using a Sensory Integration treatment approach
SD:	Standard Deviation
SI:	Sensory Integration
SMD:	Sensory Modulation Dysfunction
SOR:	Sensory Overresponsivenes
SPCQ:	Sensory Profile, Caregiver Questionnaire
SPD:	Sensory Processing Disorder
SUR:	Sensory Underresponsiveness

CHAPTER 1: INTRODUCTION

1.1. Background

People find purpose and meaning in life through participation in the everyday occupations. In this participation, they develop skills, life experiences and connections with others [1]. Should an individual present with persistently inappropriate and inflexible behaviours, inconsistent with the situational demands, they might not attain effective social or general skills and competencies needed for participation in daily occupations. These out of place behaviours may have a negative impact on their entire sphere of occupation.

In recent years the behavioural nature of over- or under responding to specifically sensory input, has been associated with Sensory Modulation Dysfunction (SMD) by the occupational therapy community [2]. SMD is defined as the continual inability to regulate and organize the degree, intensity, and nature of responses to sensory input in a graded and adapted manner [3]. The treatment of this dysfunction in South Africa lies within the field of the occupational therapist, using a Sensory Integration treatment approach (OT-SI).

In order to fully understand the process of sensory modulation and the implications of a dysfunction in this system, a short review of the development of this theory is required. Over the last decades, there have been many advances in neurophysiology. This has been accommodated in the occupational therapists' perspective of how Central Nervous System (CNS) functioning relates to meaningful interpersonal relationships and performance in everyday activities, as encompassed in the wider field of human occupation [4].

Based on the work of Dr. A.J. Ayres, occupational therapists have been concerned with the development of the theory of Sensory Integration (SI) [5]. This theory attempts to describe the brain-behaviour relationship. It states that there is sensory intake by the individual, after which a process of sensory integration ensues. Firstly the sensation is registered-, and planning and organisation of behaviour occurs. Physical output follows in which adaptive interaction and learning occurs through evaluating external and internal feedback.

This in essence starts the sensory loop again [6]. According to the SI theory, purposeful occupational performance is dependent on efficient filtering, i.e. modulation of sensations as well as the accurate discrimination of sensory input [7]. Effective sensory modulation is described as, the regulation of neural messages through the facilitation and inhibition of sensory inputs by the CNS [6]. Sensory modulation can thus be defined as the capacity to appropriately grade, regulate and organise the degree and nature of the behavioural responses to incoming sensory stimuli, rather than over or under reacting to stimuli, in order to achieve optimal performance and adaptability to daily life challenges [5] [8].

When there is a constant disparity between the intensity of the stimulus and the behavioural output, it indicates possible SMD. The concept of SMD attempts to explain how inefficient sensory processing can lead to a variety of problems with carrying out activities in occupational performance areas. With SMD, the individual is unable to regulate sensory input successfully and cannot maintain a situation-appropriate state of arousal. As a result the person has difficulty in participating in meaningful occupational performance [9].

For the purpose of this research report, Dunn's model of SMD was used [7], which describes SMD according to the individual's neurological threshold. An individual presenting with a high threshold to sensations, is referred to as dormant, and is likely to fail to attend to relevant stimuli. A low sensory threshold on the other hand indicates that the individual is likely to be hyper alert, and is referred to as sensory sensitive. Individuals can however react by actively countering their neurological threshold. Thus a person with a high neurological threshold may also act in a sensory seeking manner in order to register sensory input. Conversely, an individual with a low sensory threshold may avoid sensations or ultimately "shut down" in an extreme attempt at avoidance.

Examples of this may be seen in behaviour reflecting poor tolerance of changes in daily routines, and aggression, anxiety or avoidance in reaction to a sensory experience on both the part of the parent and child. On the other hand, individuals that present with low energy levels and motivation are often generally unresponsive toward each other [7]. These maladaptive behaviours have an influence on both the parent and child's general occupations, and may create conflict between the parent and child during joint participation in occupational tasks [10].

This behaviour in turn affects the individual's social participation, self-regulation, self-esteem [5], school or work performance and all other functional abilities [11]. The impact on children and their families is consequently extensive, as the relationship between the children and their parents are influenced by the children's ability to process and respond appropriately to sensory input. The parent's ability to reciprocate appropriately to their children's actions has a large influence on the outcome of the parent-child relationship [12].

As with any occupational therapy process, one needs to accurately assess the problem before embarking on the journey of treatment. Good awareness of the sensory make-up and typical behavioural responses of the child receiving occupational therapy treatment, in conjunction with that of the parents in the home setting is thus valuable. This study is therefore devoted to analysing the agreement found between the sensory profiles of children and their parents. This can provide a starting point for the development of treatment strategies to address this central relationship within an OT-SI approach.

1.2. Statement of the problem

The understanding of SMD is still in the early stages and the causes have not yet been adequately established [5]. In this the nature versus nurture debate is evident. Various "high risk" factors such as premature birth, developmental disability in the infant and prenatal drug exposure have been identified as possible precursors for SMD [5].

The possibility of a genetic predisposition through hereditability has also been highlighted in various studies, including studies of children with learning disabilities [13], Attention Deficit Hyperactivity Disorder (ADHD) [14], and dyslexia [15]. All of the above groups portray specific patterns of SMD [16]. In the field of psychology, studies have also indicated some hereditability for at least some factors of temperament and related abilities of self-regulation [17].

In addition, it is postulated that a great deal of behaviour is learnt. A parent with rigid, inappropriate behaviours could carry this over to the child. Out of place behaviours of a child with SMD might further elicit poor adaptive responses in the parents. This causes a vicious cycle of inappropriate behaviour, leading to a breakdown in the parent/child relationship. It has also been found that environmental factors, such as interpersonal relationships and support systems, act as a precursor for various learning and social problems [18].

1.3. Purpose of the Study

The purpose of this study is to investigate the agreement found between the sensory profiles of children who present with SMD and their biological parents. This pertains to the various neurological thresholds as well as the behavioural responses to each threshold. The probability of agreement between parents with SMD and children with SMD will also be considered. This may act as a precursor for further studies on the relationship between the behaviours of the parents and children in relation to the development of learning disabilities or other social problems.

1.4. Justification for the Study

In order to fully grasp the implications of SMD on the relationship between the child and parent, the first step is to establish the probability of both the child and parent presenting with SMD. The various patterns pertaining to SMD and how these interact can then be considered significant. To the researcher's knowledge, no research has been done internationally to establish the sensory modulation profiles of the biological parents of children presenting with SMD without pervasive developmental disorders.

This research is needed to reflect on the effect of how the parent interprets and reacts to the sensory environment in dealing with their child. By finding the agreement between the various behavioural responses of all three parties involved linked to their neurological thresholds, the therapist would have a basis from which to develop and make suggestions concerning the carry over of what is done in the occupational therapy treatment session to the home situation [19].

These suggestions would address the central relationship between the child and parent, and how to manipulate the environment in order to act as a preventative measure to the development of learning and social problems in the child with SMD.

Identifying the agreement of SMD and patterns of SMD in the children and their biological parents may contribute to the understanding of the effect of SMD on the interaction between these children, their parents and the environments they must interact with. This may also shed light into the ways in which sensory modulation dysfunction contributes to life-long problems in the individual's occupational performance.

1.5. Aim and Objectives of the Study

This study aims to establish the agreement between the sensory profiles of children with SMD and their biological parents.

The objectives are thus to:

- Establish the sensory profiles of the children with SMD and those of their biological parents.
- Establish the probability of a child with SMD having a parent with SMD.
- Establish the probability of a parent with SMD having a child with SMD.
- Analyse the agreement between the sensory profiles of the children with SMD and those of their biological parents.

1.6. Null Hypothesis

There is no agreement between the sensory profiles, i.e. patterns of behaviour in response to neurological thresholds, of children and their biological parents.

1.7. Assumptions

In the behavioural and developmental sciences, a traditional nature versus nurture debate has reigned, similarly so with the causes of SMD. In this research report, it is assumed that the basic biological processes underlying SMD may be hereditary, but that many of the behavioural responses to the neurological thresholds are learnt. This may form a base for a study into whether the child with SMD may learn good behavioural adaptations from the parent presenting with or without SMD and whether good adaptive behaviours in reaction to SMD may act as a precursor for the prevention of the development of learning difficulties and other social problems.

Furthermore, it is assumed that SMD in the parent may also lead to a variety of problems in how the parent relates to the child, and parent/child interaction may suffer as a result. It is also proposed that for the parent to accurately portray the world to the child, the parent's behaviour should generally be situation appropriate. In contrast with this ideal, it is supposed that inconsistent behaviour in the parent may have adverse effects on the learnt behaviour in the child. In order to study this aspect in greater detail, a study of the agreement between the child and parents' neurological thresholds and their general behaviour in response to the threshold will be valuable.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

The literature reviewed in this chapter is aimed at exploring the proposed agreement between SMD in the parent and child. Firstly, literature pertaining to the framework of sensory modulation as it developed within the theory of sensory integration is explored. The suggested causes and inferred physiology underlying SMD is also discussed in order to provide a background for the research into the nature of the agreement between SMD in the parent and child.

A discussion of how various behavioural outcomes are observed and measured within the individual will describe the how the sensory profiles of the parents and children are obtained. A brief study of the overlap of between the occupational therapy theory of sensory modulation and the psychological theory of temperament is investigated. This area has been well researched by the school of psychology, and provides an understanding of inherited and learned behaviour. The parent's importance and role in the treatment of sensory modulation dysfunction in the child is also highlighted.

Studying of the effect of SMD on behaviour, occupational performance in the individual and how it affects their interpersonal relationships concludes the literature review.

2.2. Sensory Integration Theory

Ayres first described the theory of sensory integration as the relationship between neural functioning and behaviour [20]. She developed this theory on principles from the developmental frameworks within the fields of neuroscience, biology, psychology and education.

Sensory Integration theory illuminates the potential neurological process of receiving sensory input, modulating and integrating these sensations, and the resulting behavioural and motor output [19]. Ayres defined SI 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"(p4)*[6]

Bundy, Lane and Murray developed a schematic representation of the theory of sensory integration. They state that learning is dependent on the ability to take in, process and organise sensation from internal and external sources, and base the planning and execution of behaviour on organisation of these sensations [6]. Effective learning takes place through accurately discriminating a sensation, modulating these sensations and then organising and planning (praxis) appropriate behavioural output.

Discrimination of sensations mainly occurs in the feedback and sensory intake phases, while planning occurs throughout the process of integrating the sensations, planning and the organising of behaviour and making of an adaptive response. Discrimination and praxis is however by no means limited to only these phases. For the whole process of sensory intake, central nervous system processing and an adaptive response to occur, good sensory modulation is necessary. This is summarised in the Figure 2-1 [6].

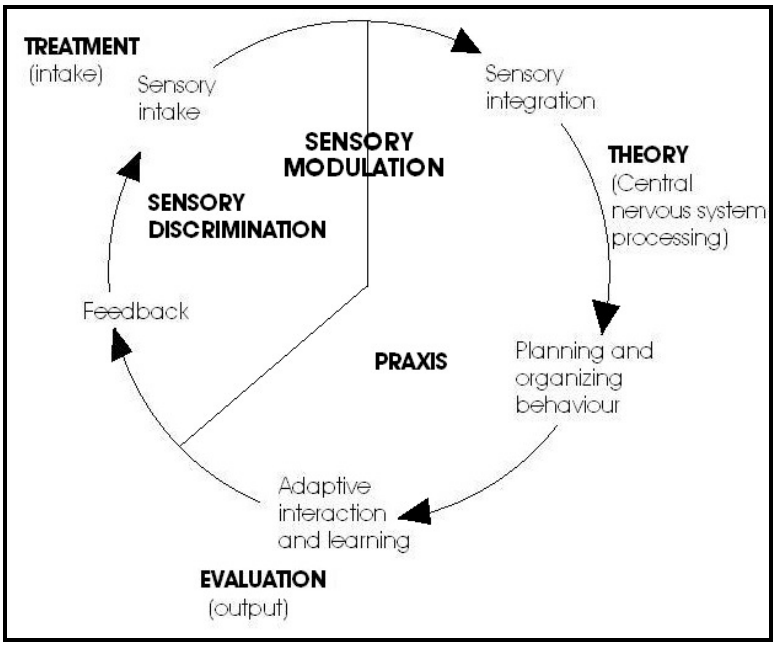


Figure 2-1: The circular process of Sensory Integration adapted from Bundy, Lane and Murray

Dysfunction of Sensory Integration (DSI) thus occurs when the neurological system is limited in its ability to process and integrate the sensory information. DSI results in ineffective behavioural patterns, which are observed in school, play, or activities of daily living [21]. Miller et al proposed new terminology for DSI, suggesting the term Sensory Processing Disorder (SPD) instead of the more commonly used term of DSI.

The work by Miller et all focused on the diagnostic categorization of people with sensory-based processing challenges. According to this proposed new nosology for SPD, there are three classic categories of SPD. These are; sensory modulation disorders, sensory-based motor disorders, and sensory discrimination disorders [2] [6] [22]. This is graphically represented in Figure 2-2.

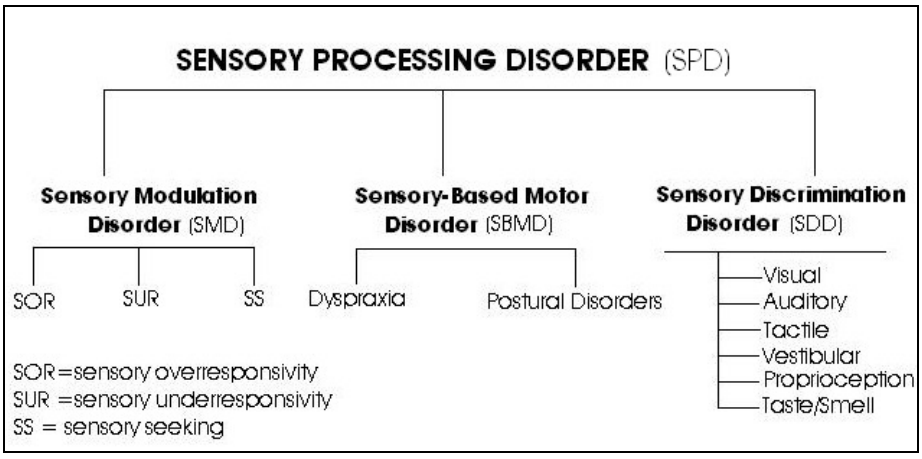


Figure 2-2: Categories of sensory processing disorders

Sensory modulation disorders encompass the inappropriate responses in relation to the degree, nature or intensity of the sensory challenges in any given situation. This refers to the inability of the CNS to actively inhibit and facilitate sensory information selectively [23] [24].

Sensory based motor disorders include dyspraxia and postural disorders. Dyspraxia is defined as the impaired ability to conceive and plan a sequenced or a novel motor action, while postural based disorders refer to difficulty in stabilizing the body during movement or at rest in order to meet environmental demands.

Sensory discrimination disorders can occur in any sensory system, independently from, or in conjunction with the other sensory systems. Here the main problem is the inability to interpret qualities, similarities or differences between sensations within that system [2]. More emphasis will be placed on the discussion of sensory modulation disorders, as this is the main focus of the study.

2.3. Sensory Modulation

In SI theory, modulation is used as a behavioural term, describing the behavioural responses that match the demands of the environment. It is inferred that the CNS's ability to facilitate and inhibit sensory input allows for the regulation and organisation of behaviour in a graded and adapted manner in reaction to sensory input as seen in Figure 2-1 [2] [6] [13].

Sensory modulation, as used in SI theory, can hence be expressed as the intake of sensation, via typical sensory processing mechanisms, such that the quality and intensity of the response is graded in order to match the environmental demand. Optimal performance is thus maintained through appropriate adaptation of behavioural responses [6]. This theory is based on the neuroscience definition of modulation, which describes sensory modulation as the actions of neurotransmitters in the CNS. These neurotransmitters do not directly evoke postsynaptic potentials, but rather modify the cellular response to excitatory postsynaptic potentials and inhibitory postsynaptic potentials generated by other nerves [25]. It is inferred that this neurological process allows for the inhibition of irrelevant stimuli in order to attend to significant stimuli, bringing about situation appropriate behaviour [13].

Studies supporting this belief have been done in which SMD has been related to atypical physiological responses to sensation, inferring that the physiological process of modulation underlies the behavioural responses in reaction to sensations [26].

According to Murray Slutsky, sensory modulation occurs in three phases: First a sensation is registered; in this phase the sensory information is acknowledged. Secondly, one orients toward the sensation by evaluating the significance of the input. Lastly, the individual is aroused toward the sensation and prepares to give attention to the stimulus or prepares for a reaction in response to the stimulus [3]. An appropriate behavioural response occurs only when efficient modulation occurs at all three levels. Behaviour thus occurs in response to the neurological threshold [5].

A person's natural threshold to sensations occurs on multiple dimensions and is portrayed as responsiveness to sensation, and in the individual's general reaction to sensory events [6]. In her research, Dunn uses the neuroscience terms of habituating and sensitisation in relation to the neurological threshold continuum. Indicating the amount of stimulation required for a neuron or neurological system to respond to sensory input [7].

For the purpose of this research report, Dunn's model of sensory modulation was used. This is based on the premise that the individual has a predisposition toward a heightened or lowered neurological threshold.

2.4. Sensory Modulation Dysfunction

Sensory Modulation Dysfunction is therefore defined as the *inability* to regulate and organize the degree, intensity, and nature of responses to sensory input in a graded and adapted manner. As a result, the individual in general cannot achieve or maintain an optimal range of functioning and cannot sufficiently adapt to challenges of daily life [27]. All people experience some of these problems at times, especially when fatigued or stressed, and it is important to distinguish between a temporary over stimulated or under aroused neurological state and overall SMD [28].

Miller et- al proposed diagnosing SMD according to three subtypes, as portrayed in Figure 2-2. These three subtypes consist of sensory overresponsivity, sensory underresponsivity and sensory seeking behaviour. Dunn describes sensory modulation dysfunction according to four different behavioural patterns relating to neurological thresholds. This is illustrated in Figure 2-3, and includes the low registration, sensation seeking, sensory sensitive and sensation avoiding categories. The behavioural implications are discussed in section 2.7.

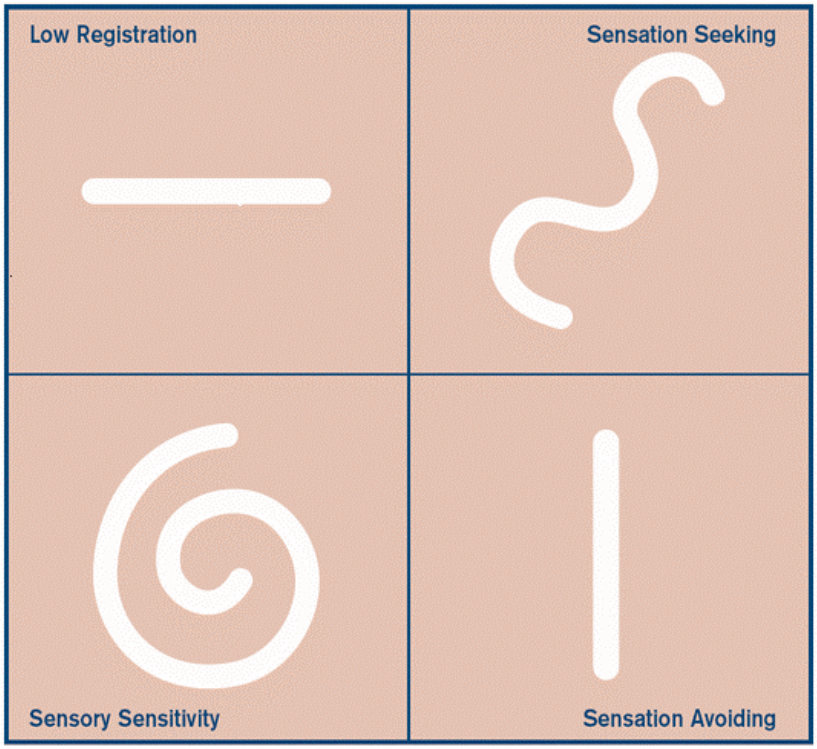


Figure 2-3: Dunn's Quadrant Profile, Illustrating the Relationship between Behavioural Response/Self-regulation and Neurological Thresholds.

From Select Scoring Assistant, Version 1.0.0 Copyright © by Harcourt Assessment, Inc. 2006 [29]

Sensory overresponsiveness is the first subtype, which equates with Dunn's "low threshold" group, combining the sensory sensitivity and sensation avoidance categories [30] [2]. Clinical experience has in addition taught that individuals with a low threshold for sensory input often react by both avoiding certain sensations and reacting in a sensory sensitive manner to those sensations that cannot be avoided. In Dunn's Infant/Toddler Sensory Profile, she too groups sensory sensitivity and sensation avoidance as a combined low threshold score [31]. This corresponds with the use of a combined sensory overresponsiveness category.

The second and third groups, sensory underresponsivity and sensory seeking respectively, relate to Dunn's "high threshold" group [30][2]. Dunn terms sensory underresponsiveness as low registration, while both schools of thought share the sensation seeking category.

Although these thresholds seem very clear-cut, SMD is a wide-ranging problem, in which the individual does not necessarily persistently react in an over- or under responsive manner to input, as the person's behaviour in general reflects poor adaptive responses to sensory input [6]. Occupational functioning is thus influenced in that the individual may be efficient at some tasks, but use ineffective ways of carrying out others, or not take part in some tasks at all.

Various factors have been implied as causes for SMD. The physiology underlying limbic system functioning, stress and level of arousal has been described as having an influence on SMD [6]. Heredity factors have also been identified as being a factor in the development of SPD of which SMD is a component. In a pilot study on 27 children with SPD by Miller, 92% of the children had at least one parent with SPD symptoms [22]. Other factors, such as premature birth and birth trauma have also been identified as contributing to the development of SMD [32] [33].

2.5. Sensory Profiles and Measurement of SMD

In order to assess SMD in the study sample, Dunn's model of sensory modulation was used. She developed the Sensory Profile, Caregiver Questionnaire, Short Sensory Profile, Adult/Adolescent Sensory Profile, Infant/Toddler Sensory Profile, as well as the Sensory Profile, School Companion.

These profiles are sensory history questionnaires with normative data and have been statistically analysed to determine behaviour patterns in reaction to sensory input. The occupational therapy community has welcomed this tool, as previous OT evaluations relied on subjective observation and history taking alone. The sensory profiles have been scientifically researched and identify SMD pragmatically [34].

Although the sensory profiles are self-report and parent-report questionnaires, various studies have found them to be reliable [21] [35] [36]. In the development of the profiles, it was found that the test-retest reliability and internal consistency reliability of the Adolescent/Adult Sensory Profile (ASP) and Sensory Profile Caregiver Questionnaire (SPCQ) was good [30] [37].

The sensory profile has been used with 89% accuracy when discriminating among children without disabilities, children with autism and children with ADHD [38]. These profiles have a coherent factor structure and a high internal reliability [7] [30]. The low cost and practicality of self-report and parent-report questionnaires justify their use, as it would be near impossible to place children and parents in every situation necessary for observation and accurate diagnosing of SMD for the purpose of the study [39].

The research on the SPCQ took place over a period of six years, including more than 1 200 American children between the ages of three and fourteen, both with and without disabilities [7]. The ASP developed from the SPCQ in order to assess sensory processing difficulties in adolescents and adults. Items applicable to adults from the SPCQ were selected and rewritten into a self-report format. New items were also added in order to accurately represent all quadrants. The test was standardised on a sample of 950 adolescents and adults between the ages of 11 and 97 [30].

A correlation between the subscales of the ASP and the New York Longitudinal Scales, Adult Temperament Questionnaire was of moderate strength. The convergent validity of the ASP with skin-conductance responses was also statistically significant [30]. These reliability and validity studies indicate that these profiles are accurate in testing what they intend to and are appropriate for use in testing the parents and children's sensory profiles.

Dunn and Brown state that SMD can be identified if the individual has either a high threshold with regard to sensory input or the individual's threshold for certain sensations is too low [30]. High threshold behaviours include low registration and sensation seeking behaviours. Low threshold behaviours on the other hand include sensory sensitivity and sensation avoiding. This is illustrated in Figure 2-3 where the top quadrants represent a high threshold, while the bottom quadrants represent a low threshold.

The quadrants of low registration and sensory sensitivity are to the left of the quadrant and represent a passive responding to sensations. These individuals thus behave more consistently with their neurological thresholds. The right hand side of the quadrant, as illustrated in Figure 2-3, represents active responding. Those who are classified as sensory seeking and sensation avoiding act in order to purposefully counter their thresholds. They actively try to control the amount of sensory input they receive and work against their neurological threshold [30].

In the standardization of both the Sensory Profile, Caregiver Questionnaire and the Adolescent/Adult Sensory Profiles, behaviours carried out by between 16% and 84% of the study population were classified as being similar to most people who would sensitise and habituate to sensations appropriately [7] [30].

2.6. Physiology Underlying Sensory Modulation

In SI theory, it is inferred that physiological aspects underlie the maladaptive behaviour observed in SMD [13]. Studies are currently being done to verify the physiological differences between typically developing children and children with SMD. They have identified that significantly different physiological responses occur in reaction to sensory stimuli in a population with SMD to that of children without SMD [24]. Children with SMD tend to show a stronger reaction to a stimulus, with poor cessation of these physiological reactions over time, leading to sensory accumulation. Another study using similar testing of electrodermal responses (EDR) showed that children who had atypical EDR responses had more parent-reported abnormal behavioural responses to sensation [26].

Various physiological causes have been theorised in literature, as having an influence on the individual's ability to modulate sensations. The physiology underlying the working of the limbic system, level of arousal and stress are among these [6]. In the following section this internal grid-work and its physical manifestation in behaviour through the ability to modulate sensations is explored.

Breidbach states that an individual measures relative sensory input against their personal internal references, given that there is no external scale to measure this by. He further states that this is not a static relationship, but constantly changes [40]. It is thus hypothesised that the process of sensory modulation differs from person to person, depending on past experiences and neurological make-up. Although SMD presents differently in different people [30], certain aspects of sensory modulation dysfunction are stable across different cultures [41] [42].

Modulation of sensations occurs throughout the entire CNS. The first level of modulation includes the firing potential of the receptor cells, where this action potential has either an inhibitory or excitatory effect on the CNS. Myelination and the diameter of the nerve axon also play a role through providing certain rates of conduction for certain inputs. Various neurological processes contribute to modulation in the CNS, among these is the gate control theory, in which the perception of pain is suppressed through proprioceptive input [43].

In the CNS, modulation occurs according to the neurological thresholds and this refers to the amount of sensory input needed for a neuron or neuron system to respond [31]. The brain regulates the neural messages by facilitating and inhibiting responses [7]. Habituation is the ability to recognize a familiar sensation, and to decrease the amount of attention given to the stimulus. Without habituation the individual will be distracted, inattentive and agitated by excessive sensory input. Sensitization on the other hand describes the CNS's ability to enhance potentially important stimuli. Without sensitization, the person would seem disinterested and slow to react to a stimulus [31]. In SMD excessive sensitisation may occur without sufficient habituation, leading to sensory accumulation [44]. In this process the CNS recognises stimuli as harmful and important and increases behavioural responsivity.

It has been implied that the level of arousal affects sensory modulation through increasing or decreasing habituation and sensitisation to sensory input. Appropriate arousal, also described as a calm-alert state, allows the individual to perceive both internal and external environments, and respond in a suitable manner [45].

The reticular formation plays an important role in the level of arousal, especially with relation to the sleep/wake cycle [46]. Consciousness is dependent on activity within the reticular activating system. In addition, the intensity of the stimulus determines the amount of arousal experienced. The level of activity of the reticular formation is also influenced by the cortex, via corticoreticular fibres in reaction to a novel stimulus (sensitisation). The level of arousal can be inhibited by habituation caused by familiar repeated stimuli.

It is theorized that individuals who are over–aroused tend to over-respond to sensory input, and have a limited ability to modulate sensations. This could also lead to "shut-down" in an attempt to prevent over-arousal. Those who are under-aroused are conversely under-responsive and do not react to sensory input [6].

Therapists treating SMD have understood that anxiety as a result of stress amplifies sensory defensive behaviour [6]. The automatic nervous system is indicated in this response. Stress responses begin with the release of corticotrophin releasing factor, from the paraventricular nucleus of the thalamus, which in turn stimulates the hypothalamus to release adrenocoricotropin hormone, stimulating the release of cortisol from the adrenal gland. Activation of the stress response however depends on the individual's ability to compare actual input with expected input [6].

The hypothesis is therefore that when incoming and expected inputs are mismatched, the level of arousal is increased, and more attention is given to the stimulus. This results in a defensive or "over-excited" response. SMD occurs when the individual is thus constantly experiencing stress, which increases the level of arousal and results in an excessive behavioural response in proportion to the sensory input experienced.

In SMD these behaviours are constant and maladaptive, impairing participation in daily life activities [24]. Learning, remembering, responses to subjective feelings and defensive behaviour such as fear, anger and anxiety may play a role in SMD, implicating the limbic system in these behaviours [46]. The limbic system consists of three cortical areas, the cingulated gyrus, septum, and parahippocampal gyrus, as well as the gray matter of the hippocampus and amygdala.

Rooyen and Lane first identified the limbic system's influence on SMD [20]. They suggested that limbic system's involvement accounts for the emotional difficulties, often associated with tactile defensiveness, as well as a sensory sensitivity or dormancy. This explains the extreme fluctuation in behavioural responses observed within an individual with regard to their sensory systems. The limbic system is also implicated in learnt maladaptive behaviour as well as the subjective and often defensive feelings as observed in SMD.

The theorised relationship that physiology has with behaviour is summarised in Figure 2-4. Further study is however necessary to substantiate all the abovementioned theories regarding physiology.

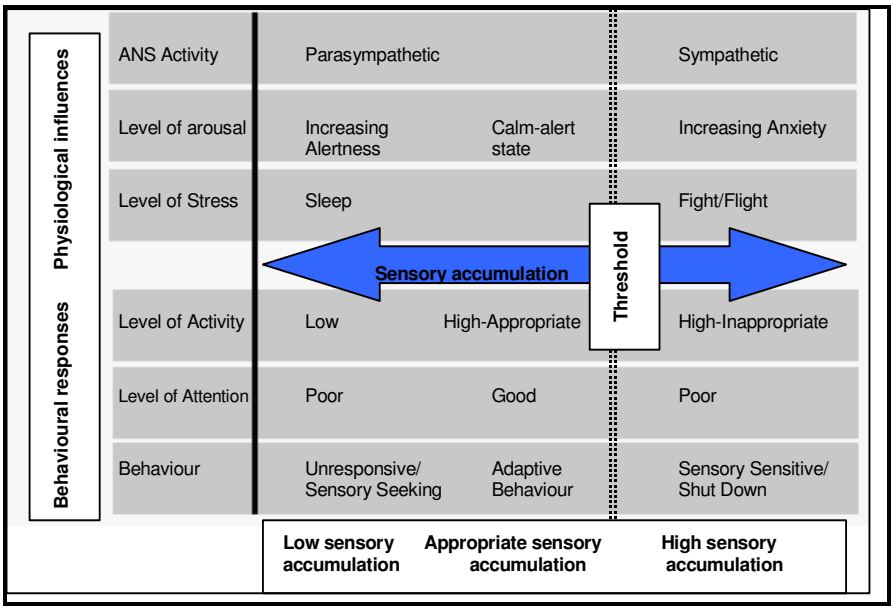


Figure 2-4: Adapted summary of the physiological and behavioural response to the neurological threshold

[47]

2.7. Behavioural Nature of Sensory Modulation Dysfunction

In OT, SMD is observed through looking at the individual's behavioural reaction to the internal and external environment according to their neurological thresholds [7]. Goal directed behaviour occurs as a result of previous experience and inner drive [30]. Certain behavioural patterns are considered to be normal, adaptive behaviour, while maladaptive behavioural patterns result in unsuccessful performance. These maladaptive behaviours range from passive responses to sensory sensitive or sensory seeking reactions and ultimately to sensation avoiding in the form of rigid rituals interfering with the flow of daily life [31]. The diagnosis of SMD should however only be made, when sensory modulation difficulties significantly impair daily routines or roles [2], including the relationship between a parent and child.

According to the model of SMD developed by Miller et al, behaviour in both the adult and the child occurs in relation to external and internal dimensions [13]. The internal dimensions include sensory processing, emotion and attention. The level of arousal, stress, and the limbic system thus readily influence the internal dimensions.

The external dimensions, as described in the model, include relationship expectations, task expectations, environmental expectations and cultural expectations. SMD thus occurs when there is a disparity between the expected behaviour (in the external dimension) and the individual's (internal) abilities [24].

Goal-directed behaviour is influenced by previous experiences, and an incentive to act in a certain way [30]. Large ranges of responses support adaptive behaviour [7]. Efficient sensory modulation thus takes place when a person on average responds consistently with the demands of any given situation. These individuals, in general, are flexible in adapting to sensory challenges and they can maintain a developmentally appropriate range of emotional responses, as well as maintain a situation appropriate level of attention [2].

When looking at SMD in adults according to Dunn's classifications, individuals with a high threshold may react either with low registration or by actively seeking sensation. People with low registration take longer to respond to sensory input than others. They may also take long to understand a joke and have trouble to react to a low intensity stimulus. These individuals also battle to appropriately register and discriminate a quickly presented stimulus, often reacting in an inappropriate manner or not reacting at all. Most of their behavioural patterns are sedentary and quiet in nature.

Dunn also postulates that those with sensory seeking behaviour act in order to counter their high threshold and regard sensory experiences as pleasurable. Their general behaviour bay be described as reactive, and actively seek out sensations. They may be easily bored and may find low-stimulus environments intolerable.

Individual's with a low threshold for sensations, on the other hand, may be distractible and suffer from discomfort as they experience most stimuli as very intense. They thus react in a sensory sensitive manner. Others may react in a sensory avoiding manner, in order to counter their neurological threshold. They thus make use of rituals to increase the predictability of sensory input, by actively reducing environmental stimuli around them [30].

Maladaptive behaviour, as seen in the child with SMD, spans across the whole spectrum of occupation. It may result in poor sleeping patterns, eating disorders, poor independent play as well as excessive emotional outbursts, especially after sensory input.

Low registration behaviours of children with SMD include low activity levels, difficulty in making transitions from one activity to another, they may also seem oblivious to pain. Sensory seeking behaviours include excessively daring behaviour with markedly high activity levels.

A child with a low threshold on the other hand may present with an inability to calm down or unwind; difficulty in making transitions from one activity to another; as well as aversion to certain foods, clothing textures and being touched by others [31]. It also includes overreacting to certain sounds, smells and sights. They may also have excessively high activity levels; disturbed sleep patterns and present with delayed speech development. The child with a lowered threshold may present with an exaggerated dislike of changes in routine, have difficulty concentrating in a noisy environment; and become overly anxious on playground equipment [32]. The following table (Table 2-1) summarizes some of the more common behavioural patterns.

Table 2-1: Relationship between behavioural responses/self-regulation and neurological thresholds

		Behavioural Response/Self-Regulation Continuum	
		PASSIVE	ACTIVE
Neurological Threshold Continuum	HIGH (habituation)	**Low Registration** Lethargic Uninterested in tasks Perseverate on tasks Over focussed Dull affect Withdrawn Overly tired Appears apathetic and self-absorbed Not aware when face/hands are messy Does not notice objects, appears clumsy Does not respond when name is called Poor sustained attention	**Sensation Seeking** Touches others too often, too hard Touches/mouths hair, or objects constantly Overactive, continually seeks movement by running and jumping Engages in risky behaviours Bangs or taps head, arms and legs Constantly squeezes and bangs objects Constantly pursues sensory input Fidgets Variable affect
	LOW (sensitisation)	**Sensory Sensitivity** Irrational response to touch Motion sickness Over responds to deep pressure, such as hugs, unexpected/loud noises and squints in light Picky eaters Becomes overly excitable during movement activity Jumps from one activity to another so that it interferes with play Has difficulty paying attention	**Sensation Avoiding** Withdraws from unexpected touch or avoids activities where unexpected touch might occur, such as sand & water play Fears movement, or when feet leave the ground, e.g. playgrounds Moves away or strikes out with stimulation Resistant to change Reliant on rigid rituals

From Adult/Adolescent Sensory Profile User's Manual © Harcourt Assesment 2002. Adapted to include examples of typical behaviours for each quadrant (*sources: Dunn; Lombaard; Miller et all; Smith et all)*

2.8. Temperament and SMD

Associated concepts of behavioural reactions are found in the occupational therapy and psychological fields. This phenomenon is described as temperament by the psychologists, and has been likened to SMD in previous articles on sensory modulation [33]. Derberry and Rothbart define temperament as;

> "*Constitutionally based differences in reactivity and self-regulation, observed in the domains of emotionality, motor activity and attention"* (p.82) [18].

Compare that to the definition of Sensory Modulation, as used in SI theory, which is*;* the CNS's regulation of its own activity [6], through the neural facilitation and inhibition of sensations, in order to respond appropriately in relation to incoming sensory stimuli, rather than under reacting or overreacting to them [20]. In reading these definitions, it is apparent that both the psychological perspective on temperament and the OT perspective on sensory modulation share similar thoughts. This is summarized in the Table 2-2.

Table 2-2: Similarities between temperament and sensory modulation

	TEMPERAMENT	SENSORY MODULATION
Origin	Constitutionally based	Central Nervous System based
Process of regulation	Self-regulation *(defined by Rothbart as modulating reactivity, including approach, avoidance inhibition and attentional self-regulation)*	Regulation *(through neural facilitation and inhibition of sensations, as well as the active or passive behavioural response)*
Observed output	Emotionality, Motor Activity and Attention	Behavioural reaction to sensory input. Whether appropriate, under- or overreacting to input

Thomas and Chess categorized children into three categories, the easy, difficult and slow-to-warm up child. The *difficult child* sleeps and eats irregularly and with difficulty, the child adjusts poorly to change, reacts strongly to stimuli and cries often. The researcher assumes that this describes a child with a low neurological threshold. While the *slow to warm up child* on the other hand is inactive, reacts slowly to stimuli and tends to be withdrawn [48]. This can be equated to a child with a high neurological threshold.

The field of OT and psychology however differ on the classification system used for SMD and temperament. In OT, SMD is seen as maladaptive behaviour in reaction to the neurological thresholds, described as three categories of sensory-overresponsiveness (sensation avoiding and sensory sensitive behaviour), sensory underresponsiveness (low registration) and sensation seeking behaviour [2]. While the field of psychology does not acknowledge a specific "behavioural style" as described by Thomas and Chess any longer, but rather focus on specific systems related to adaptation. These include fear, frustration and positive approach motivation, which the psychologists term the affective-motivational system. According to Rothbart, temperament is concerned with the what, why and how of behaviour [42]. This is similar to the concern of the influence of SMD on occupation and why the child reacts to sensory input in a particular way.

Distinction between problematic temperament and SMD also occurs in the assumption that SMD is more than just the individual's "style" and that treatment is usually indicated in an individual with SMD [33]. As the definitions and descriptions of temperament and sensory modulation are indeed so similar, regardless of the classification systems, the researcher has included literature on temperament in the study of the agreement between SMD in the child and parent.

2.9. Hereditary Factors and Learned Behaviour

Much study has been done in the field of clinical psychology on the hereditary nature of temperament. It was found that the basic biological processes underlying temperament appear to be similar across cultures, though the behaviour varies, depending on cultural values and experiences [42]. It may thus be argued that although a neurological threshold may be inherited, the active and passive responses to this threshold may be influenced by cultural values and learning in the home environment as well as by other experiences.

A population based twin study of parentally reported tactile and auditory defensiveness in young children done by Goldsmith et al-, suggested that there were moderate correlations between the twins' behaviour. It was found that not all areas of defensiveness were shared equally. Tactile defensiveness correlated to a far greater extent than did auditory defensiveness [39]. This study also identified that a shared prenatal environment was only a marginally significant precursor to SMD.

Genetic factors have also been implied in the etiology of ADHD [49]. Children with ADHD display more aspects of SMD than do typically developing children [14]. A study mentioned by Nigg, Goldsmith and Sachek indicates that environmental factors play a role in the development of behavioural problems as they found that a shared environment does not necessarily lead to the development of ADHD. However ADHD with conduct disorder occurs more frequently in a shared environment [50], indicating that learning of behaviour plays a role.

Psychologist have ascribed five properties to temperament traits, they state that

(1) *"Traits are expected to be manifested in an organised fashion during early life although not necessarily from the earliest months of infancy.*

(2) *Traits should be relatively stable during significant periods of life although not necessarily across major normative transitions or after traumatic experiences.*

(3) *Traits should be relatively consistent across situations with related incentive values.*

(4) *Most researchers believe that temperament differences have characteristic neurophysiological underpinnings*

(5) *Traits are usually expected to be partially inheritable" (p.43) [50]*

The last statement confirms the supposition that temperament, and by association SMD has partially inheritable properties.

From the abovementioned discussion, it is thus safe to say that there may be a modest percentage of SMD carried over genetically, but a large part of the behaviour is learnt and influenced by external factors.

Rothbart lists ways in which temperament might be involved in the risk of developing psychopathology (p.82) [18]. A direct extract of the factors that were found to be significant for the purpose of this study are listed bellow:

1. *"Temperament characteristics evoking reactions in others that can increase or buffer the risk of psychopathology.*

2. *Characteristics influencing the person's choice of settings and relationships that may create greater or lesser risk for psychopathology.*

3. *Temperamental biases in information processing that can influence cognitions about the world, self or others.*

4. *Temperamental regulation or buffering against the effects of risk factors or stress.*

5. *Heightened or lower responsiveness to environmental events.*

6. *Interaction among temperamental characteristics that can influence outcomes as temperament develops.*

7. *Different temperamental dispositions that may shape different developmental pathways to a given outcome, and individual dispositions that may influence multiple outcomes.*

8. *Temperament characteristics and care giving environments that may make independent contributions to outcomes, or may interact in increasing or decreasing risk of disorder"* (p.82) [18].

From this, it can be assumed that SMD in the individual predisposes that individual to the development of psychopathology and that the individual may experience the environment in a biased manner. The environment in which the individual finds himself, along with relational interaction may either increase this risk or buffer the person against the development of psychopathology. Previous discussion has highlighted that there is some aspect of hereditability to behaviour, but that environmental factors also have an influence on behaviour.

Clinical experience has taught that the parent/child interaction has a profound influence on the level of arousal and stress experienced by both parties, both negative and positive, and can be assumed to affect sensory modulation [6]. Optimal development of attachment occurs when there is "goodness of fit" between the child and the parents, and baby's behaviour matches the environmental influences. Touch for example plays a vital role in the development of human bonding [41], and feelings of rejection may surface if a child with a low threshold for tactile input resists being held or cuddled [23].

The baby's behaviour thus does not match the environmental influence (behaviour=crying and extending away from parent; environmental influence=cuddles of love from the parent) and it is theorised that the "goodness of fit" is compromised in this situation. Stress levels in both the parent and child increases, further aggravating SMD in parent and/or child as described by the ANS involvement in SMD.

Should the parent of this child also have a low threshold for sensory input, the parent may experience excessive anxiety in this situation. This interferes with efficient functioning, and appropriate adaptive responses [44]. It is hypothesised that this has an even greater impact on the development of the relationship between the child and the parent.

As a child with SMD may typically present with developmental delays and problems with discipline, the parents may also feel inadequate about their parenting skills [23]. Many of the parents of a child with SMD may feel pressurised into thinking that their "bad parenting" results in unruly children, whereas the child's behaviour is in actual fact a symptom of SMD [22]. This places further pressure on such parents.

Children with tactile defensiveness also often refuse to eat a variety of food, causing tension between parent and child. Parents might feel responsible for their children's bad eating habits and are often embarrassed when their children have an emotional outburst related to food in a social setting [54]. As mentioned before, should the mother or father also have a low sensory threshold, they might be prone to anxiety and be uncomfortable in a social setting, it is thus hypothesised that this might alienate them from a social setting all together.

When either the child or parent experiences stress in an interpersonal relationship, the ANS, specifically the sympathetic system, limbic system as well as the reticular activating system reactions are heightened. This leads to an even greater disparity in sensory modulation [6]. And thus could lead to even greater socio-emotional difficulties.

If one refers to the first point in Rothbart's commentary it would be safe to assume that a parent without SMD, who grasps the child's over stimulated state and reacts accordingly would prevent psychopathology from developing, while the converse may also be true.

From the above example it could be assumed that such a parent may avoid contact with the child, in order to maintain a stable emotional state, while the caregiver should in fact be consistent, sensitive and responsive to the child's needs in order to form a good attachment bond [48]. This could then also lead to the development of psychopathology in the child and parent as seen in the second point of Rothbart's summary.

These temperamental biases, such as unfounded feelings of rejection and failure as a good child or parent, concerning the inappropriate behaviour as a result of SMD may also lead to the development of difficulties. It is thus apparent that the reactions by the parent to the child's behaviours as a result of SMD, the stress involved and the care-giving environment may be a precursor for the development of psychopathology and visa versa.

It is hypothesised that a supportive environment may act as a buffer to the development of psychopathology. This emphasises the need to educate the parent of a child with SMD regarding the risks involved, substantiating the need for an in depth study of the most common behavioural patterns found between children and their parents.

2.10. Conclusion

Ayers first developed the SI theory in order to explain underlying neurological causes for problems with occupational performance, in order to determine an optimal mode of treatment [20]. In this chapter we explored how the neurological processes underlying SMD influence behaviour in the individual. Sensory modulation was defined as the behavioural responses that match the demands of the environment. Referring to the ability of the central nervous system to regulate and organise behaviour in a graded and adapted manner in reaction to sensory input [2] [6].

SMD occurs when the CNS is therefore unable to regulate the input and an inappropriate behavioural output is the result. It was also found that stress, or anxiety, the ANS and limbic system functioning have been implicated in the development of SMD. Dunn's model of SMD was explored, and the reliability and validity of the sensory profiles to measure SMD was discussed. As it was found to be reliable and valid, Dunn's model of SMD was adopted for use in this study. The high threshold categories of low registration, and sensation seeking behaviour were explored, as well as the low threshold categories of sensory sensitive and sensation avoiding behaviours. The influence of behaviour on interpersonal relationships and the development of psychopathology were also investigated.

It was found that the internal dimensions of a low or high threshold, along with internally generated and learned emotional symptoms of aggression, anger, tearfulness, withdrawal anxiety and depression as well as attentional symptoms lead to poor adaptive responses. External dimensions further influence these behavioural responses, namely; relational expectations, task expectations, environmental expectations as well as cultural expectations.

The similarities and differences of temperament and SMD were investigated. This allowed for a background for the study of bonding, and poor coping mechanisms, which may result in psychopathology in the child and parent with SMD. It was established that there may be an agreement between the sensory profiles of the children and their parents, and warrants the research. The need for a study of the agreement of the SMD profiles of the parent and child are thus essential, before one can determine the specific effect that the individuals in the family have on one another and develop a treatment modality for each.

CHAPTER 3: METHODOLOGY

3.1. Introduction

The study was aimed at exploring the agreement between children's behavioural responses in response to their neurological thresholds, and that of their biological parents. This was done in order to shed light on whether modulation difficulties in children and parents are related. It also intended to identify modulation difficulties, which may influence the parent-child interaction and relationship. The following chapter is aimed at describing how the researcher carried out the study, and includes a description of the research design, subject selection, measurement tools and testing procedure. A description of the development of the data analysis is also included. A brief summary of the methodology followed is summarised in Table 3-1.

Table 3-1: Summary of research methodology

Research Design	Quantitative, descriptive cross sectional study
Study Population & Sampling	Purposive sampling of 81 children and their biological parents
Subject Selection	Children between the ages of 3 years 0 months and 10 years 11 months with at least one available biological parent were selected, and informed consent was obtained. Children with and without SMD were included
Data Gathering Instruments & Techniques	Adolescent/Adult Sensory Profile was completed by at least one biological parent Sensory Profile Caregiver Questionnaire of the child, completed by the parents Scored using: Sensory Profile Select Scoring Assistant, Version 1.0.0 Copyright © 2006 by Harcourt Assessment, Inc.
Data Analysis	Data was analysed using: *Stata Statistical Software, Version 10 ©*; by the MRC in Pretoria and by the researcher using *Microsoft® Excel 2000.*
Ethical Considerations	Ethical clearance obtained on 28 March 2006 from the University of Witwatersrand Ethics Committee for Research on Human Subjects. Confidentiality was maintained Participation in the study was voluntary and informed consent was obtained to use Sensory Profiles, Caregiver Questionnaire of the child and the Adolescent/Adult Sensory Profiles of both biological parents.

3.2. Research Design

The sensory profiles of the children and parents are classified in a similar way. This allowed for a quantitative, cross sectional study in which the agreement of the child and parents' sensory profiles was explored. The cross sectional study [51] of the standardised quadrant factor scores of both parent in relation to the quadrant factors by the child at the same point in time allowed for descriptive statistics. Descriptive statistics explored the various agreements found between the quadrants, high and low thresholds as well as total modulation scores.

The probability of a child with SMD having a parent with SMD was also investigated. Similarly, the probability of a parent with/without SMD having a child with SMD was also researched.

3.3. Subject selection

This was an exploratory study. The aim was to assess the agreement between dysfunction in the child and parent. Hence for an anticipated prevalence of 75%, a sample size of at least 73 subjects was needed to estimate the agreement of dysfunction within 10% with 95% confidence level.

81 children and their biological parents were selected through purposive sampling according to the criteria discussed below. In the original study design, the children would already be receiving occupational therapy from occupational therapy private practices and schools, and would have been assessed for SMD. An incidence of 75% of SMD was needed, while only approximately 5-15% of the general population presents with some form of SPD [22], indicating the need for a population group likely to have a high percentage of SMD.

Changes were however implemented to include children without learning disabilities, in order to obtain a viable sample size for statistical purposes. An additional change made for the same reason was to increase the age band from children between the ages of five and ten years of age to between three and 10 years of age. Seven families where the biological father did not complete the questionnaire for a variety of reasons were also included.

3.3.1. Exclusion Criteria

- Parents who had shown a lack of insight into the child's behaviour relating to sensory input on completion of the initial Sensory Profile Caregiver Questionnaire done by the treating occupational therapist.
- Any person who did not want to divulge personal information, or give consent to take part in the study.
- In the case of adoption, as neither biological parents were available.
- Any person who could not complete the questionnaire in English, as the Sensory Profile, Caregiver Questionnaire and Adolescent/Adult Sensory Profiles are standardised in English, and translating the questionnaire could influence the results.

3.3.2. Inclusion Criteria

- Children between the ages of 3 years 0 months and 10 years 11 months.
- Children who have been referred to occupational therapy and were being treated for a variety of learning disabilities.
- Children at a variety of nursery schools, equitherapy centres, mother's groups and primary schools whose parents' agreed to give consent and complete the questionnaire.

3.4. Research Technique

3.4.1. Ethical Clearance

Ethical clearance (Appendix A) was obtained on 28 March 2006 from the University of Witwatersrand Ethics Committee for Research on Human Subjects (M060224). During the scoring process, a number identified each parent/child group and names were not used, ensuring that confidentiality was maintained at all times.

The information obtained by the researcher was kept confidential and was only available to parents who wished to be informed of the result. As the treating therapist used the original Sensory Profile with her client, she was privy to this knowledge before the researcher. Parents gave informed consent, and the researcher could access the child's sensory profiles, after which the mother and father were required to complete their own sensory profiles. Since these are self-report questionnaires, completion of these was taken as informed consent. The treating therapist was informed of the Adult Sensory Profiles, only if the parent had stated that this information might be shared with her.

The parents also understood that they could withdraw themselves and their children from the study at any time, without any detrimental consequences. When any problems in the child or parent were identified from the group of children who were not receiving OT, a list of SI qualified therapists in their area was provided. The onus rested upon the parents to decide whether or not to then take the child for a complete OT assessment. The researcher also answered any questions that the parents may have had regarding their, their partner (when consent was given) or their children's profiles. She also provided them with verbal guidance which could be followed up should they feel necessary.

3.4.2. Permission obtained & Questionnaires collected

Several occupational therapy practices and schools working with children with learning disabilities were identified and contacted telephonically. These practices and schools were familiar with the Sensory Profile, Caregiver Questionnaire and were using them in their initial OT assessments. Only eleven practices responded and written permission (See Appendix B) was obtained from the person in charge of the practices. One practice from the Bloemfontein area, two from the Krugersdorp area, one from the Centurion area and seven practices from Pretoria took part in the study. No schools for children with learning disabilities responded. An information and consent sheet (see Appendix C) was given out to clients and all of those who gave consent were included in the study, in order to gain a viable sample.

The treating occupational therapists used the Sensory Profile, Caregiver Questionnaire (see Appendix D), as a part of their assessment process. The researcher collected these along with the informed consent forms, and re-scored the tests using the Sensory Profile Select Scoring Assistant [29]. Either one, or both parents of the child had completed this questionnaire.

The biological parents were also required to each complete an Adolescent/Adult Sensory Profile, Self Questionnaire (Appendix E). These questionnaires are discussed in greater detail in Section 3.5.

As the sample size was still too small after approximately one year of collecting data, it was decided to contact a variety of nursery schools, an equi-therapy centre, mother's groups and primary schools for children with or without learning disabilities. An information and consent sheet (Appendix F) was given out to the parents and all of those who gave consent were included in the study, in order to gain a viable sample.

Once the parents' had both given informed consent they were asked to complete a Sensory Profile, Caregiver Questionnaire for the child as well as an Adolescent/Adult Sensory Profile each.

Questionnaires were obtained from the Pretoria, Johannesburg, Krugersdorp, Bloemfontein, Margate, Uvongo and Port Shepstone areas. The researcher collected the questionnaires from the various therapists and institutions, either personally or by registered post. The researcher covered all postage expenses made by the participants.

3.4.3. Test Scoring

The tests were all scored using the Sensory Profile Select Scoring Assistant [29]. This generated raw scores as well as quadrant classifications, for each subject.

3.4.4. Test Feedback

A computer-generated report of both parents and the child's profiles (Appendix G & Appendix H) were also created for those parents who had requested the results of the test. The original test sheets (used as part of the therapists' personal initial assessment of the child) and reports were returned to the therapists.

3.5. Measurement Tools and Techniques

The Sensory Profile, Caregiver Questionnaire (SPCQ) was used to determine the children's sensory profiles, while the Adolescent/Adult Sensory Profile (ASP) was used to test the parents' sensory profiles.

Although the sensory profiles are standardised in this manner and exclusion criteria was designed to exclude those reports that the treating therapist found inconsistent with her clinical view of the child, parental report questionnaires do have their limitations. Sensory modulation problems do however not carry a negative social stigma, had this been the case, it may have caused the parents to purposefully hide the truth.

As the parent observes the child in a range of social situations outside of the OT setting, it can be assumed that most of the information gathered is reliable. It could also be assumed that as most of the sensory profiles gathered were in fact part of an OT evaluation, the parents would have been truthful as they are looking for help regarding SMD.

Another limitation could be that a parent with e.g. sensory avoiding tendencies, might not find it strange that her child avoids touching certain surfaces and thus does not report this to be a problem. The sensory profiles try to circumvent this problem by rather reporting frequencies of behaviours than how maladaptive the parent might find it. Several studies have however noted that parents are a reliable source in reporting their child's behaviour [20] [26] [34] [35].

3.5.1. SENSORY PROFILE, Caregiver Questionnaire

This standardized normed test was used to determine how well the children processed sensory information in everyday situations and to profile the sensory system's effect on functional performance. Caregivers (in this case- either the mother, father or both parents) completed the 125-question profile, reporting the frequency with which their child responds to various sensory experiences [7].

The scoring process for the SPCQ took place as follows. The frequency of behaviours is determined from a Likert scale where an *almost always* (100% of the time) answer is scored with 1 point, *Frequently* (at least 75% of the time) 2 points, *Occasionally* (50%) 3 points, *Seldom* (25%) 4 points, and *Almost never* (0%) 5 points. The parent marked behaviours according to the frequency with which they occur. Item scores were then transferred to the quadrant grid and totalled. A raw score was obtained and converted into a classification of the sensory threshold and behavioural continuum.

Scores at the lower end of the scoring continuum indicate that the child displays disproportionately more behaviours for that particular section than most children their age. Larger scores are also indicative of a problem as the child displays less behaviours pertaining to that specific quadrant. Scores in the middle section are referred to in the test as achieving "typical performance" for that section. There are four sections used for the purposes of this study, referred to as the "Quadrants", namely Low Registration, Sensation Seeking, Sensory Sensitivity and Sensation Avoiding. An example of the conversion into raw scores and classifications is attached in Appendix I.

3.5.2. ADOLESCENT/ADULT SENSORY PROFILE; Self Questionnaire

The parents completed the ASP, a standardized self-questionnaire, identifying possible contributions of sensory processing on their individual daily performance. This test consists of 60 questions, in which the individual reports the general frequency of certain behaviours in reaction to a sensory input [30]. (Appendix E)

Scoring of the ASP follows a similar process to the SPCQ; the numerical value for each answer is however reversed. An answer of *Always* scores 5 points, *Frequently* 4 points, *Occasionally* 3 points, *Seldom* 2 points, and *Never* 1 point, consistent with the majority of self reporting questionnaires. These use a higher score to represent a greater frequency of the aspect being measured. The adult profile also excludes the "almost" from the "always" and "never" answers. An example of the conversion from the adult profile into raw scores and classifications is attached in Appendix J.

In the ASP, a high score in any given quadrant indicates that the individual displays more of the behaviours pertaining to that quadrant than the general population. A small score on the other hand indicates that the certain set of behaviours occur less frequently than in most cases. In this profile a score in the middle section was not referred to as typical performance, but rather as being "similar to most people". The term "similar to most people" will be used synonymously with "typical performance" throughout for the purposes of this research report. This is done to match the other terms of more/much more- and less/much less than other people, and in order to avoid possible confusion as interpreting the two terms as having different meanings.

The original questionnaires were collected and the scoring process was carried out using the Sensory Profile Select Scoring Assistant [29]. This included software with a scoring assistant for the SPCQ as well as for the ASP.

The child and parents' sensory profiles were then plotted on the quadrant profile, developed by Dunn (see Figure 3-1). This quadrant profile is the same for the adults and children, and relates the person's behavioural response to their neurological threshold. The quadrant divides up into low registration, sensation seeking, sensory sensitivity and sensation avoiding groups. The individual's score was either "much less than most people", "less than most people", "similar to most people", synonymous with "typical performance", "more than most people", or "much more than most people" in each quadrant. In the analysis of the quadrants, each quadrant is interpreted independently from the other quadrants, as it has been found that SMD does not necessarily occur on a continuum between a high and low threshold [6].

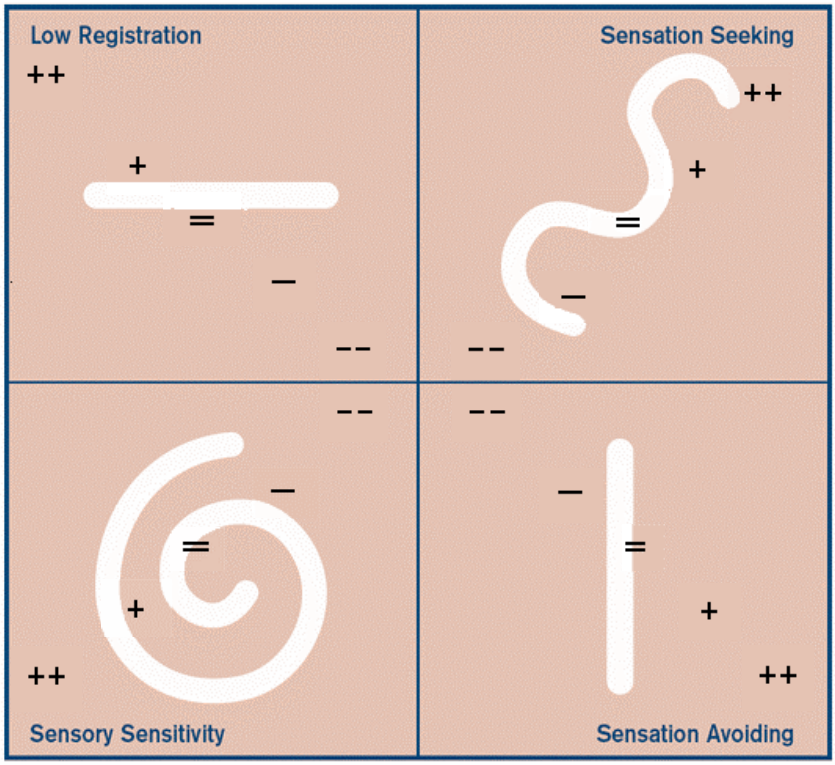


Figure 3-1: Quadrant Profile by Winnie Dunn from Sensory Profile,

From: Select Scoring Assistant, Version 1.0.0 Copyright © by Harcourt Assessment, Inc. 2006 [29]

By using the similar classification systems of the SPCQ and ASP, the researcher was able to compare the scores of the parent and child in all the quadrants, by means of a quantitative, cross sectional descriptive study.

3.6. Scoring of the profiles to compare SMD in children and parents

The researcher converted the classifications into numerical values in order to enter the data into an Excel score sheet, using *Microsoft® Excel 2000*. Each family was given a numerical value in order to identify them. In the families where there was more than one child, the eldest child was child A, the next child was named, child B, and so forth (e.g. 4A; 4B; 4C). The child's sex and age as well as the parents' ages were also entered into the table.

The categories were given numerical values. Low registration was Category 1; Sensory Seeking was Category 2; Sensory Sensitivity, Category 3; and Sensation Avoiding, Category 4. C1 thus referred to the child's low registration score, M1 referred to the mother's low registration score and F1 referred to the father's low registration score, and so forth. This is depicted in Table 3-2.

Table 3-2: Alpha-numerical representation of the quadrant categories

	Categories			
	Low Registration	Sensory Seeking	Sensory Sensitive	Sensation Avoiding
Father	F1	F2	F3	F4
Mother	M1	M2	M3	M4
Child	C1	C2	C3	C4

The researcher converted the classification scored in each category into a numerical value as depicted in Table 3-3.

Table 3-3: Numerical values given to classifications

Symbol	Classification	Numerical Value
- -	Much less than most people (MLTM)	-2
-	Less than most people (LTM)	-1
=	Similar to most people (STM)	0
+	More than most people (MTM)	1
++	Much more than most people (MMTM)	2

3.7. Data Analysis

Dr. PJ Becker from the Medical Research Council (MRC) of South Africa in the Pretoria Office assisted in the analysis of the data using Stata Statistical Software, Version 10 [52]. The following aspects were analysed, and a detailed description follows.

- The groups of children presenting with SMD and children without SMD were identified.
- A t-test, comparing the mean score and standard deviation from this study population with that of Dunn's findings in the standardisation of the original test was done.
- Symmetrical correlation studies of the child and mother's, as well as child and father's scores within the quadrants were done. Correlations across all quadrant combinations, high and low thresholds and total modulation scores were done.
- A probability study was done to assess whether a child with SMD is likely to have a parent with SMD or not. The probability of a parent with SMD having a child with SMD was also analyzed. The probability of a parent with SMD having a child with or without SMD was calculated. These probabilities pertained to the total modulation score or high and low threshold scores.
- Once the probability of SMD was calculated, the percentages of children with SMD whose parents tested with SMD in a particular quadrant were calculated. The incidence of children with SMD for that quadrant, whose parents do not have SMD was also computed. This was also done for each child's quadrant in relation to the same quadrant of the parent, as well as the other three quadrants. These percentages provided the researcher with data pertaining to the behaviour relating to the neurological thresholds and how child and parent interact accordingly.
- Similarly percentages of parents with SMD whose children present with SMD in a particular quadrant were also determined. In addition, the percentages of parents without SMD whose children have SMD were calculated. Once again these percentages were calculated across all combinations of the four quadrants.

Below, a description of the methodology pertaining to each section follows. The results are described in further detail in Chapter 4, while the implications of the results are discussed in Chapter 5.

3.7.1. Identification of children with and without SMD

In the original study design, only children with learning disabilities currently receiving OT were included. This was done, as a learning disabled group was more likely to present with SMD. As the researcher then included children without known learning disabilities, it was decided to establish the percentage of children who did in fact present with SMD. This was done to determine how this would influence the statistical analysis of the abovementioned studies of agreement of the sensory profiles.

3.7.2. Comparison of the mean scores and standard deviation

The mean scores and standard deviations for all quadrants of the parents were compared to those used in the standardisation of the original Adolescent/Adult Sensory Profile. This was also done for the children's mean scores and standard deviations. The reason for the comparison was to determine whether the study population was representative of a normal population or a population predominant in SMD. Thereby allowing the researcher to further analyse the data with regard to the probability of a parent with SMD having a child with SMD or not.

3.7.3. Comparison of total modulation scores

In order to obtain a total modulation score, all four quadrant scores were added to form a modulation score between 0 and 8 (0 being no problem with sensory modulation and 8 being the most extreme form of SMD). Only absolute values were used. See Appendix K for all calculations. The child's modulation score was then compared with both the father and mother's total modulation score.

For the purpose of this study, individuals who achieved a score between zero and two were considered as not presenting with SMD. An individual, who achieved a score of three and up, was considered as having SMD. Borderline scores of one, two and three were initially obtained, but the contribution was found to be irrelevantly small and thus not taken into account as a separate entity.

A descriptive analysis was done to determine the probability of agreement between a child with/without SMD and a parent with/without SMD. It was however important to also assess the fathers or mothers with SMD's predisposition to having children with SMD, as this would indicate a hereditary aspect to SMD. This would require only analyzing the data pertaining to the isolated group of mothers and fathers with SMD and how their profiles agree with those of their children.

The calculations of the probability of agreement between the children's and their parents' behaviours were based on the initial correlation studies. This is illustrated in Appendix K, Table 8-3 and Table 8-4

3.7.4. Quadrant scores of the children relating to those of their parents

Further comparison of the quadrant scores shed light on the behavioural nature of SMD in the parent/child relationship. Initially only quadrant scores from similar quadrants were correlated (e.g. C1:M1 and C1:F1 and so forth). Further analysis included comparing all quadrants of the child to all other quadrants of both parents, (e.g. C1:M2; C1:M3; C1:M4 and C1:F2; C1:F3; C1:F4, and so forth).

Only absolute values were calculated, grouping the "less/much less than others" together with the "more/much more than others" classifications as a single indication of a problem in that quadrant. The small sample size placed limitations on how reliable the data would be if it were in fact split into even smaller groups. This may act as a limitation in the study as these behaviours are in fact on opposite extremes of the spectrum. The frequency with which the classifications occurred were however taken into account in the discussion of the agreement found between the various quadrants.

After the correlation studies were completed, descriptive percentages were obtained from the correlation studies. This described the percentage of children with/without SMD whose mothers/fathers experience/did not experience SMD in a particular quadrant. After which the percentages of parents, with/without SMD whose children presented with/without SMD were also calculated. Once again, similar analysis was made of every quadrant in relation to all other quadrants. (Appendix K in Table 8-7 and Table 8-8)

The percentages from the child's perspective will be discussed together, thereby determining the probability of a parent presenting with/without SMD when the child presents with SMD. This data is valuable in that the child with SMD is often the first contact that the OT has with the family, and the possibility of this child's parents having SMD needs to be estimated. Secondly, once a parent with SMD was identified, the probability that this parent would have a child with/without SMD for any particular quadrant was considered.

3.8. Conclusion

For the study of the agreement of the children's sensory profiles with that of their biological parents, children between the ages of 3 years 0 months and 10 years 11 months were selected using purposive sampling. A minimum group of 73 subjects was needed for a 95% confidence interval within an accuracy of 10%. 81 children from various institutions, both learning disabled and without learning disabilities, were purposively selected and their parents completed the Adolescent/Adult Sensory Profile and Sensory Profile Caregiver Questionnaire. The Adolescent/Adult Sensory Profile provided the researcher with information regarding the mother and father's sensory profiles, while the Sensory Profile, Caregiver Questionnaire gave insight into the child's sensory profile.

These tests were scored using the Sensory Profile Select Scoring Assistant [29], and this provided standardised data pertaining to the sensory thresholds and behavioural responses of the family. This data was analysed with the help of Dr Becker from the Medical Research Council of South Africa, using the Stata Statistical Software [52] and by the researcher, using *Microsoft® Excel 2000.*

Data analysis included a comparative study of the occurrence of SMD in the child participants. The similarity of the mean score and standard deviations of the quadrant scores from this study for the child population and parent population with that of Dunn's findings in the standardisation of the original tests were also explored.

Other analysis of the data focused on the correlation between the children's classification scores in the various quadrant categories to those of their parents; correlation of low threshold and high threshold scores; as well as the correlation of total modulation scores. Descriptive percentages were also obtained from these correlation studies, for total modulation scores, high and low thresholds and children with/without SMD with parents' with/without SMD and visa versa, for all quadrants. Probability studies were also done to determine the probability of agreement between a parent with SMD and a child with SMD.

The following chapter will provide the reader with information regarding the findings of the aforementioned processes.

CHAPTER 4: RESULTS

4.1. Introduction

A sample of 81 children with or without sensory modulation dysfunction participated in the study. These were from 60 families who consented to take part in the study of the agreement between the sensory profiles of children and their parents.

Assessment data was collected over a period of two years and scored using Sensory Profile Select Scoring Assistant [29]. The data was analysed by the MRC of South Africa's, Biostatistics unit, using the Stata Statistical Software [52] as well as by the researcher using *Microsoft ® Excel 2000* and confirmed by the bio-statistician.

Findings in this chapter include the agreement found between the children with SMD's sensory profiles and that of their parents'. After which the group of parent's with SMD and their children's profiles were compared. The tendency of a child to inherit SMD was analysed. Further breakdown of the data revealed the probability of agreement between the children's behaviour patterns in the sensory sensitivity, sensation avoiding, sensation seeking and the low registration quadrants in relation to their father and mother's behavioural patterns.

4.2. Background Statistical Analyses

4.2.1. Demographic information

Eighty-one children between the ages of 3 years 0 months and 10 years 11 months participated in the study, of which 26 were girls and 55 were boys. Their mean age was 6 years 5 months.

Sixty families participated in the study, with 43 families having only one child participating in the study, 13 families having two children participating in the study, and four families having three children participating in the study. Seven families where the biological father did not complete the questionnaire for a variety of reasons were also included. Figure 4-1 illustrates this data.

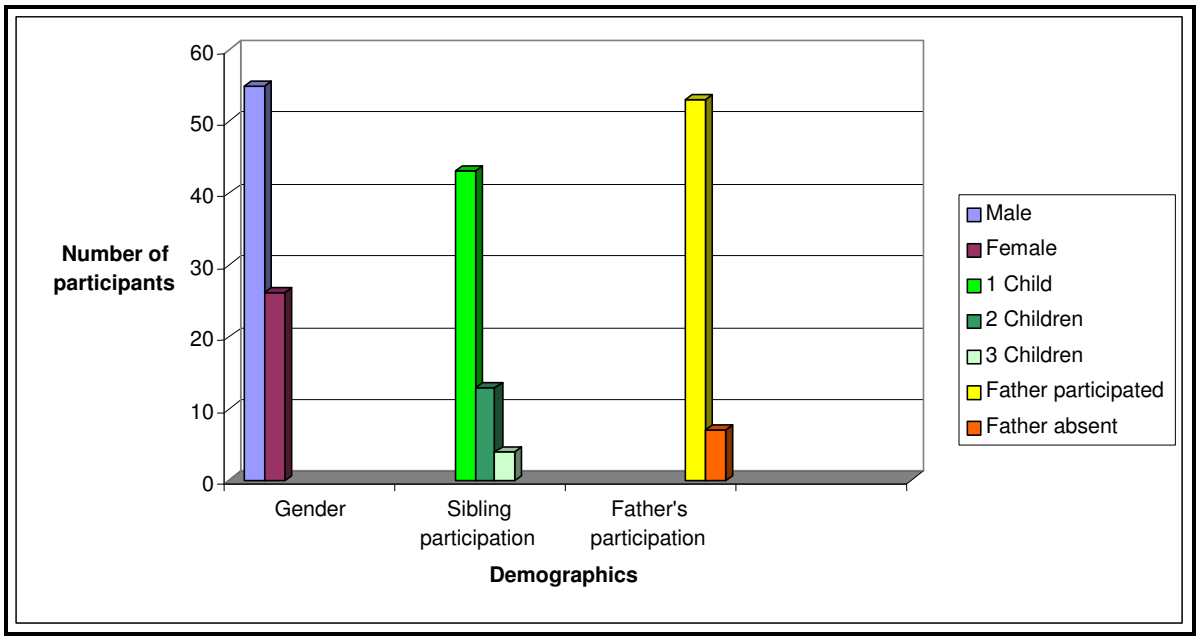


Figure 4-1: Demographic representation of the study

4.2.2. Identification of children with and without SMD

A total modulation score was obtained by adding all the quadrant scores together, (see APPENDIX K for the calculation of the total SMD score). Of the 81 children, 27 (32%) achieved a score of 2 or less. For the purpose of this study these children were classified as not presenting with SMD. The largest group of children (68%) did present with varying degrees of SMD (Figure 4-2).

The inner circle in Figure 4-2 represents scores that the groups of children achieved, starting at a score of 0 and increasing in a clockwise direction. The outer circle represents the classification of children without SMD and children with SMD.

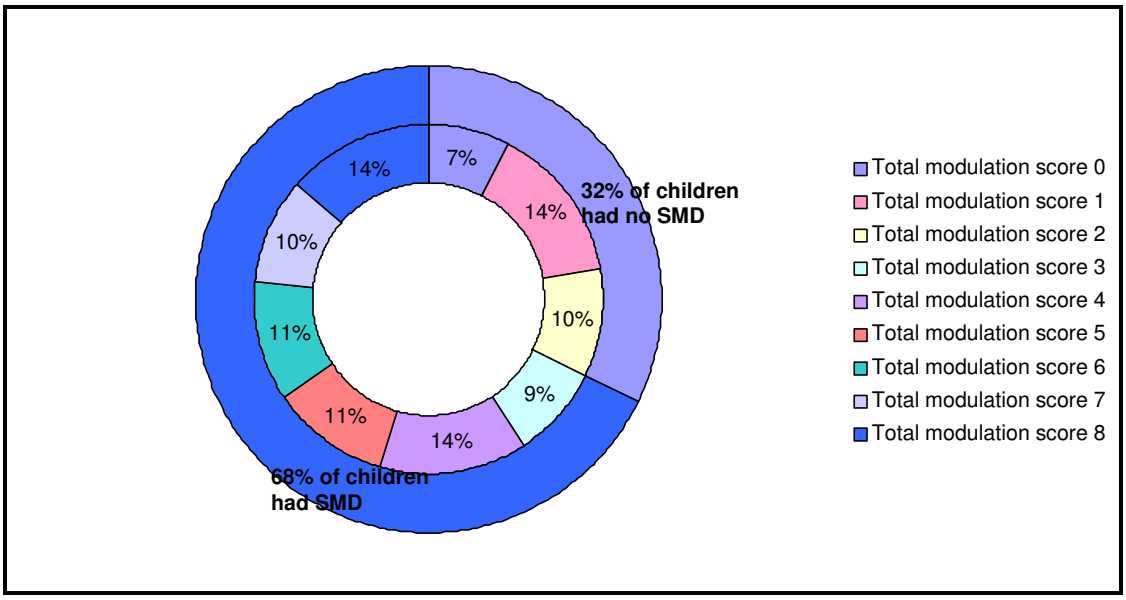


Figure 4-2:Percentages of children with and without SMD

The percentages of children with/without SMD in Figure 4-2 have been calculated in relation to the 81 mothers who participated in the study. Of the seven fathers who did not participate in the study, four had children without SMD and five with SMD. Thus 30% of these fathers had children without SMD and 70% had children with SMD.

Children with SMD were identified both from OT practices were they were receiving therapy and from other groups were they were not receiving occupational therapy. These children have been grouped together as no significant differences in the demographics were identified.

4.2.3. Comparison of Mean Scores and Standard Deviations

As the study was designed to measure the agreement between the sensory profiles of children with SMD in relation to their parents sensory profiles, a comparative analysis was done in order to determine whether the study population was representative of a normal population. Previous research has determined that there is 5-15% prevalence for SPD, of which SMD is a sub-type [22].

In this study 42% of the mothers and 26% of the fathers presented with SMD. Sixty eight percent of the children in the study presented with SMD. The following results are summarised in Table 4-1 and Table 4-2.

In Table 4-1, the mean scores and Standard Deviations (SD) of the parents were compared to the mean scores and SD found for the age group 18-64 years as described in the Adolescent/Adult Sensory Profile manual [30]. The group was significantly different from the typical population (Pr≤0.001) with 57.5% of the total parents presenting with SMD.

Table 4-1: Comparison of the total adult mean scores and standard deviations

	Total Adult Sample from this study		Adult Sensory Profile normative sample		Pr Value
	Mean	SD	Mean	SD	
Low Registration	32.66	7.98	30.29	6.25	<0.001
Sensation Seeking	46.54	7.77	49.91	6.83	<0.001
Sensory Sensitivity	38.02	8.66	33.71	7.63	<0.001
Sensation Avoiding	37.38	8.41	34.57	7.34	<0.001

Table 4-2: Comparison of Mean Scores and Standard Deviations from the total child sample

	Total Child Sample from this study		Sensory Profile Care giver Questionnaire normative sample		Pr Value
	Mean	SD	Mean	SD	
Low Registration	59.81	9.39	68.24	5.09	<0.001
Sensation Seeking	93.77	15.3	113.26	11.37	<0.001
Sensory Sensitivity	75.59	12.74	87.86	7.77	<0.001
<0.001Sensation Avoiding	109.78	14.19	123.13	10.75	<0.001

Table 4-2 compares the total of the mean scores and SD of the raw scores achieved by all the children in the study sample with the standardisation in the Supplementary Sensory Profile [37], where the results from the SPSQ were converted into quadrant classifications. Sixty-eight percent of the children in the study presented with SMD. Table 4-2 indicates that the study population does indeed include significantly more children with SMD than does the normal population ($Pr \leq 0.001$)[1].

This indicates that the study did indeed look at a population with predominant SMD, rather than a study sample across a normative curve. This was achieved through the conditional probability set out in the inclusion and exclusion criteria as well as through purposive sampling.

4.3. Total Scores

Figure 4-3 illustrates the percentages of total scores achieved by the children and their parents for the whole study. Here it is seen that the largest group of parents as well as children scored a "more/less than others" classification for one quadrant. While the second largest group of fathers presented with no problem with SMD, and mothers achieved a score of "much more/less than others" classification for one quadrant. Two equal groups of children achieved a total modulation score of four and eight indicating that they achieved a "much more/less than others" classification in two or all four quadrants respectively.

[1] $P \leq 0.05$ indicates a statistically significant difference between two groups

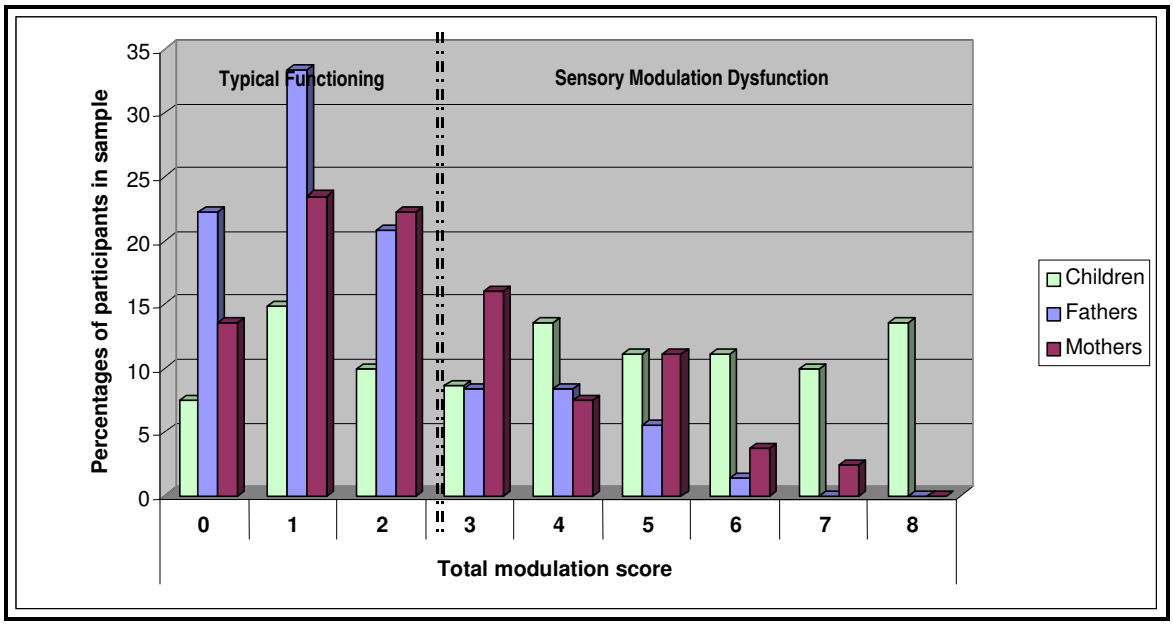


Figure 4-3: Representation of children and parent's total modulation scores

4.3.1. Children's Threshold Scores

Figure 4-4 illustrates the representation of children across a high and low neurological threshold. Here only the weighted scores are illustrated, indicating that most children achieved a "similar to most people" or a "more/less than others" classification in both quadrants pertaining to a high or low neurological threshold. The largest group of children achieved a "much more/less than others" for only one quadrant in the high threshold group. In the low threshold group however, the largest group of children achieved a "much more/less than others" classification for both the sensory sensitive and sensation avoiding categories.

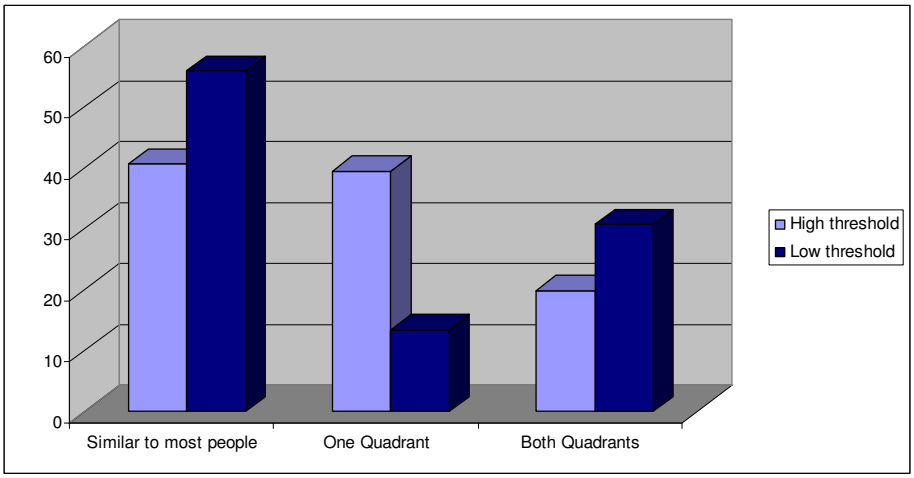


Figure 4-4: Representation of children achieving a much more/less classification with regard to high and low thresholds

4.3.2. Parents' Threshold Scores

Figure 4-5 similarly describes the representation of the parents' classification scores. Most parents scored "similar to most people" according to a high and low threshold, with only 2.7% of fathers scoring "much more than most people" in both low threshold quadrants and none in the high threshold quadrants. Slightly more mothers achieved this classification in both quadrants, with the majority of parents scoring "much more than others" in only one quadrant.

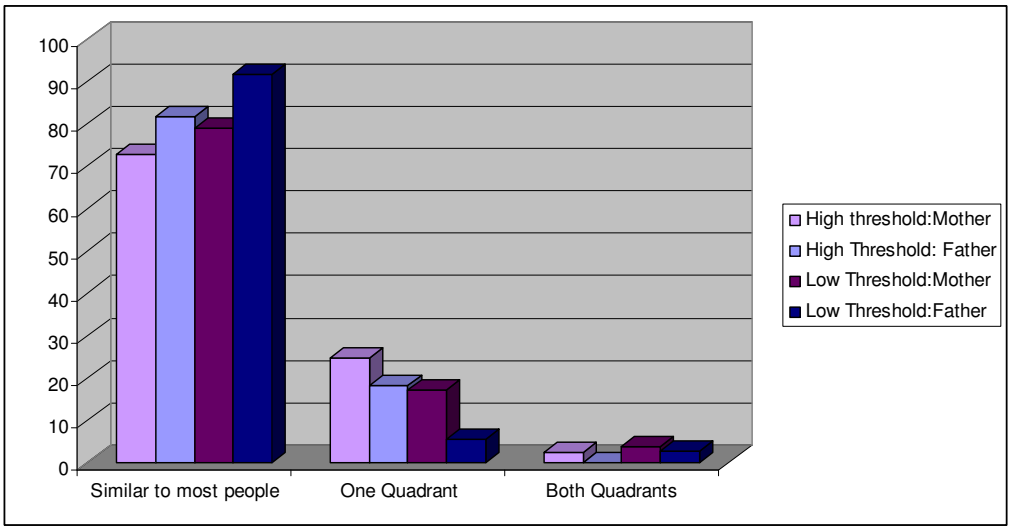


Figure 4-5: Distribution of parents' high and low threshold scores

4.4. Scores achieved in each quadrant

4.4.1. Low Registration Quadrant

Figure 4-6 depicts the classifications achieved by all the participants in the study in the low registration quadrant. The largest percentage of children scored "much more than others", while the largest group of parents achieved a "similar to most people" classification in this quadrant. In this quadrant the majority of parents who scored more than 1SD from the mean scored in the "more than others" classification.

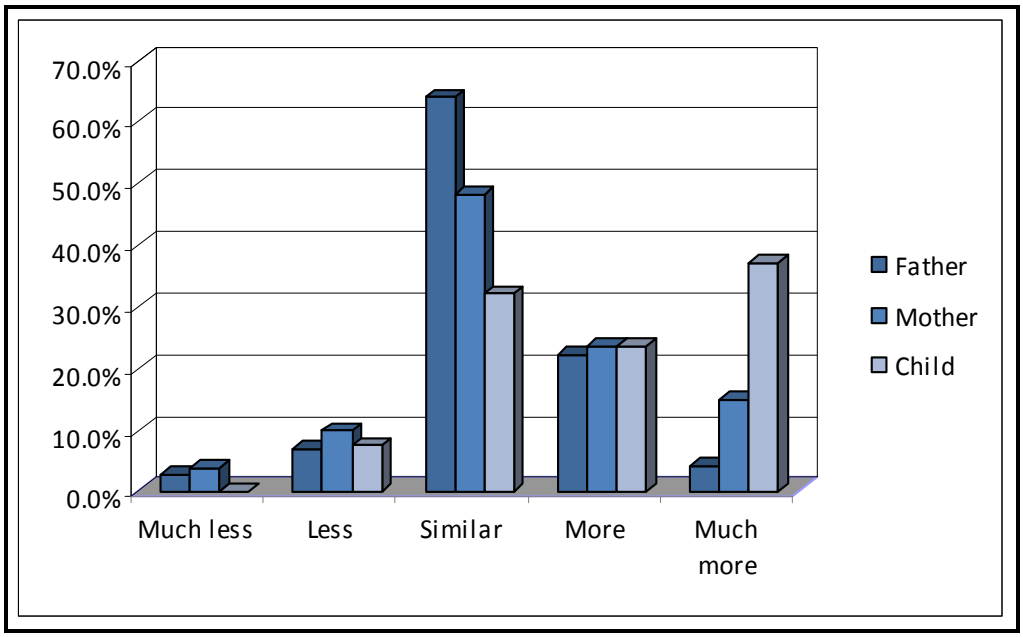


Figure 4-6: Total scores achieved in Low Registration Quadrant

4.4.2. Sensation Seeking Quadrant

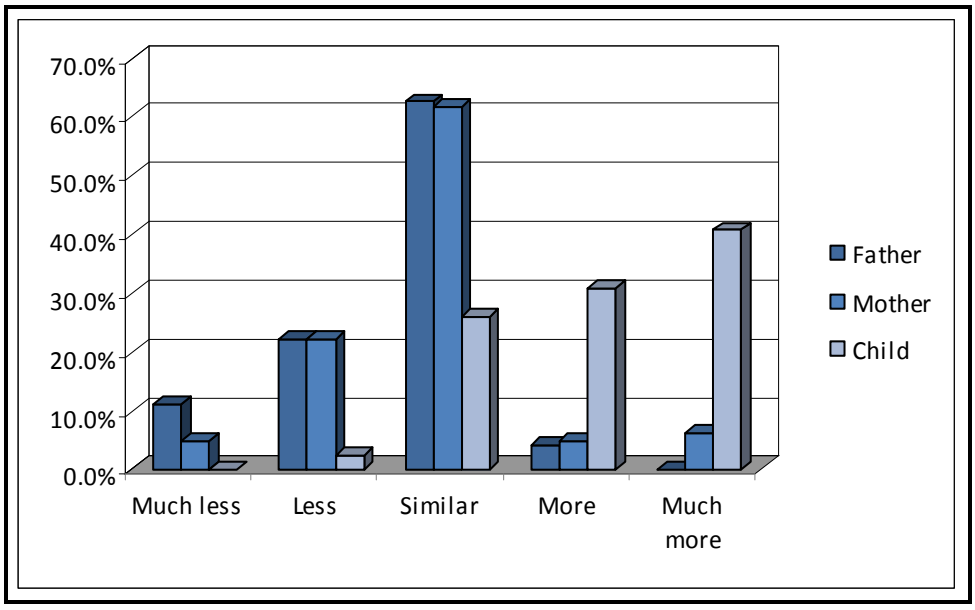


Figure 4-7: Total scores achieved in Sensation Seeking Quadrant

Most parents once again achieved a "similar to most people" score in the sensation-seeking quadrant, with the second largest group achieved "less/much less than others" scores in the sensation-seeking quadrant (Figure 4-7). The largest group of children once again achieved a score in the "much more than others" classification with regard to sensation seeking behaviour. In this quadrant the majority of parents who scored more than 1SD from the mean scored in the "less than others" classification.

4.4.3. Sensory Sensitive Quadrant

When looking at the sensory sensitive quadrant, most parents yet again achieved a "similar to most people" classification, with a relatively large group achieving a "more than others" classification. Equal groups of children achieved a "similar to most people" and "much more than others" classification in the sensory sensitive quadrants (Figure 4-8). In this quadrant most parents who scored 1SD from the mean again achieved a "more than others" classification.

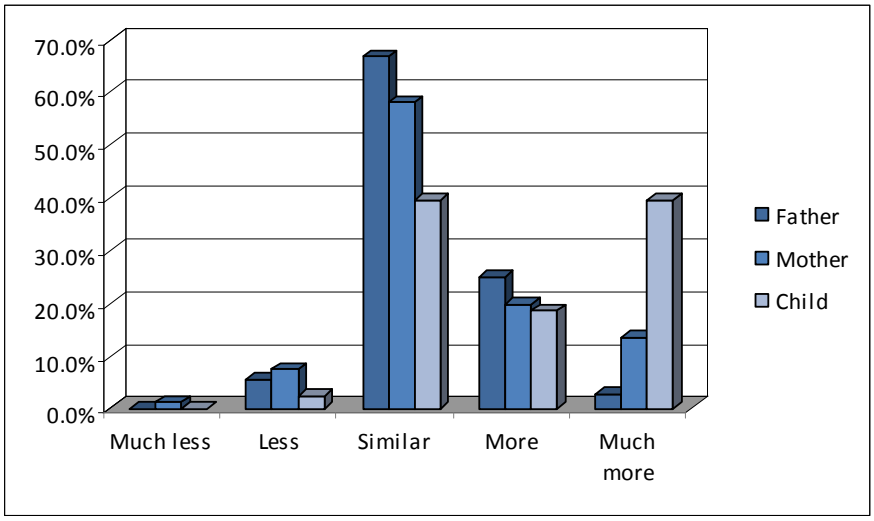


Figure 4-8: Total scores achieved in Sensory Sensitive Quadrant

4.4.4. Sensation Avoiding Quadrant

In the sensation avoiding quadrant (Figure 4-9), the largest group of children and parents achieved a "similar to most people classification". A relatively large group of parents achieved a "more than others" classification, with the second largest group of children achieving a "much more than others" classification in the sensation-avoiding quadrant.

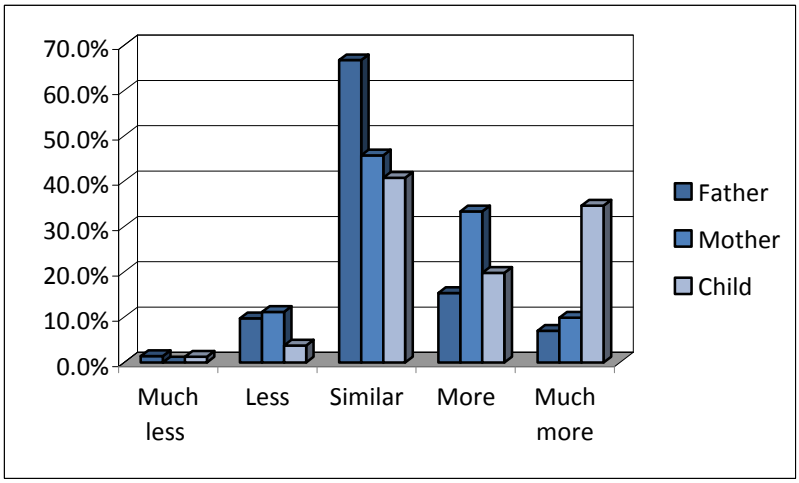


Figure 4-9: Total scores achieved in Sensation Avoiding Quadrant

4.5. The correlation found between children with SMD and their parents

The correlation between the child and parents' classifications was poor, that when comparing the parent and child for "less/much less than others"; "similar to most people" as well as "more/much more than others" in a particular quadrant. This was described in Kappa values of less than 0.4 ($K \leq 0.4$)[2] for all the correlation studies between the quadrants, high and low thresholds as well as total modulation scores. The symmetry found between the child and parent is summarized in Appendix L.

The largest group that correlated in every quadrant between the child and parent was in the similar to most people score. (Appendix L) The percentages where both children and parents achieve a similar to most people classification are depicted in Table 4-3.

Table 4-3: Percentage of the sample where both child and parent achieved a "similar to most people" classification

	CLASS	Low Registration		Sensation Seeking		Sensory Sensitive		Sensation Avoiding	
		Mother	Father	Mother	Father	Mother	Father	Mother	Father
CHILD	Low Registration	16.05%	20.83%	18.51%	15.27%	20.98%	22.22%	11.11%	19.44%
	Sensation Seeking	18.52%	26.39%	14.81%	13.89%	12.35%	22.22%	11.11%	19.44%
	Sensory Sensitive	18.52%	26.39%	23.46%	20.83%	23.46%	27.78%	20.99%	27.78%
	Sensation Avoiding	22.22%	25.00%	27.16%	22.22%	27.16%	27.78%	22.22%	26.39%

[2] $0.0 \leq K \leq 0.4$ (poor agreement); $0.4 \leq K \leq 0.75$ (moderate agreement); $0.75 \leq K \leq 1.0$ (excellent agreement)

4.6. The probability of agreement between children with SMD and their parents with SMD

No statistically relevant results were obtained from correlation studies, prompting a descriptive analysis of the percentage of children with SMD and their parents, based on the correlation tables (e.g. Table 8-3 in Appendix K). The probability of agreement was calculated for all analysed data, this allowed for a descriptive representation of the data.

For the purpose of this report, probability of agreement between 0.00 - 0.40 was considered to be a low probability, 0.41 – 0.74 was considered a moderate probability and 0.75 – 1.00 a high probability. Since no previous research on the agreement between sensory profiles has been done, there is no precedent for the interpretation of these percentages. These values are based on the probability of agreement as described by a Kappa value, based on a correlation study.

Figure 4-10 and Figure 4-11 present the probability that a child with SMD (that is a total modulation score of between 3 and 8) will have a parent with SMD.

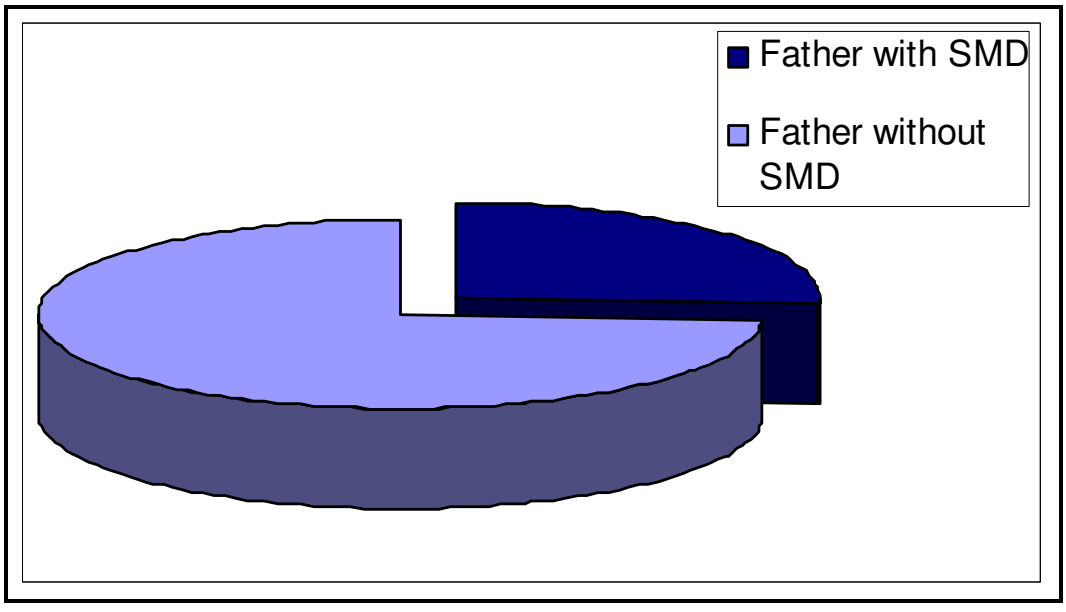


Figure 4-10: The percentage of children with SMD's whose fathers present with and without SMD

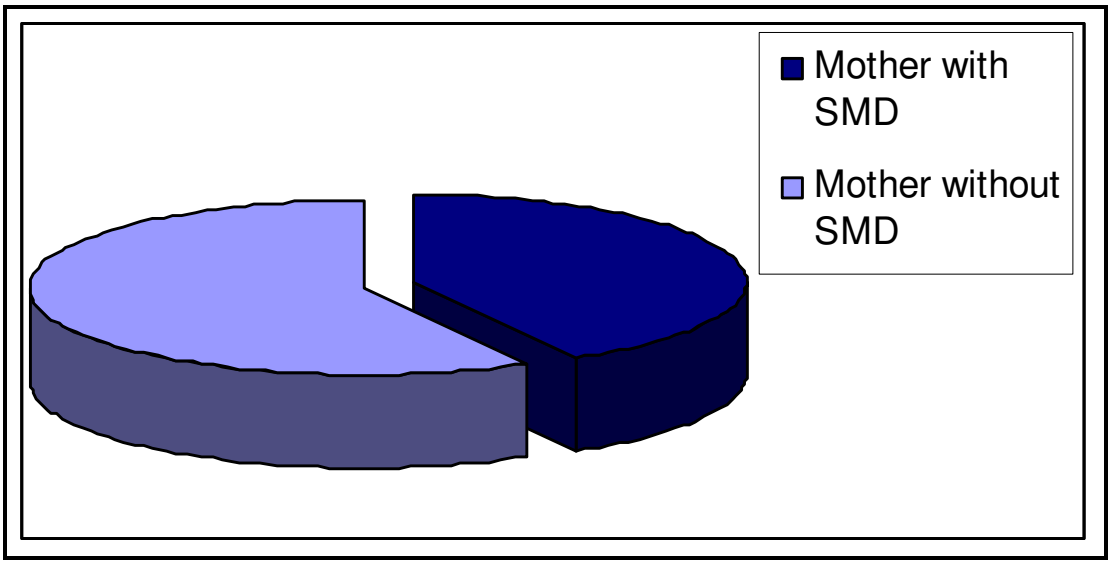


Figure 4-11: The percentage of children with SMD's whose mothers present with and without SMD

In this study, there was a 0.42 probability of a child in therapy having a mother with SMD and 0.26 for a father with SMD. There was a slightly larger probability of 0.58 of the mother not presenting with SMD and even larger probability (0.74) of the father not presenting with SMD. It would thus seem that there is a moderate probability of agreement between the child with SMD and the mother with SMD. A much smaller probability of agreement was found between the child with SMD and the father with SMD.

In a study of the agreement between the child and parents' neurological thresholds, it was found that the child with SMD's father will not likely present with SMD, regardless of the neurological threshold. It seemed most likely that, should the father and child experience SMD that the father would present with a heightened threshold to input and the child with a lowered threshold. There is a moderate probability that a child with a low threshold for sensory input may either have a mother with a heightened or lowered threshold for sensory input. In this test group, it would seem unlikely, though not impossible that a child with a heightened threshold will have a mother with SMD.

In Table 4-4 and Table 4-5, the relationship between the child and parents' behaviour in response to their thresholds is illustrated. These figures are from the population of children with SMD and their parents with SMD.

Table 4-4: Corresponding behavioural patterns between the child and father with SMD

			FATHER			
			High Threshold		Low Threshold	
			Low Registration	Sensory Seeking	Sensory Sensitive	Sensation Avoiding
CHILD	High Threshold	Low Registration	0.42	0.29	0.40	0.36
		Sensory Seeking	0.36	0.33	0.33	0.34
	Low Threshold	Sensory Sensitive	0.40	0.39	0.38	0.36
		Sensation Avoiding	0.34	0.35	0.38	0.34

Areas with moderate probability for agreement highlighted in blue

From the fathers' point of view there was a poor probability of agreement between the behaviours according to the neurological thresholds. There was however a small but moderate probability of agreement between the child with low registration behaviours and the father with low registration behaviours (Table 4-4).

Table 4-5: Corresponding behavioural patterns between the child and mother with SMD

			MOTHER			
			High Threshold		Low Threshold	
			Low Registration	Sensory Seeking	Sensory Sensitive	Sensation Avoiding
CHILD	High Threshold	Low Registration	0.53	0.48	0.51	0.56
		Sensory Seeking	0.36	0.37	0.37	0.42
	Low Threshold	Sensory Sensitive	0.45	0.38	0.43	0.48
		Sensation Avoiding	0.56	0.53	0.59	0.60

Areas with moderate probability for agreement highlighted in blue

The results of the agreement of probability studies, between the child and mother's behaviour in the various quadrants is illustrated in Table 4-5. It was found that there is a moderate probability of agreement between a child with low registration behaviours, and a mother whose behaviours reflect either behavioural quadrant, with the highest agreement with the mother's sensory avoidance behaviour. The highest probability of agreement between children with sensory seeking behaviour was with sensation-avoiding behaviours from the mother.

Table 4-6: Probability of agreement between children and parents SMD behaviours when the child presents with SMD

Probability of Agreement between the Child and Father's behaviour			Order of probability	Probability of Agreement between the Child and Mother's behaviour		
Child	Agreement	Father		Child	Agreement	Mother
Low Registration	0.42	Low Registration	1	Sensation Avoiding	0.60	Sensation Avoiding
Low Registration	0.40	Sensory Sensitive	2	Sensation Avoiding	0.59	Sensory Sensitive
			3	Sensation Avoiding	0.56	Low Registration
			4	Low Registration	0.56	Sensation Avoiding
			5	Sensation Avoiding	0.53	<Sensory seeking
			6	Low Registration	0.53	Low Registration
			7	Low Registration	0.51	Sensory Sensitive
			8	Low Registration	0.48	<Sensory seeking
			9	Sensory Sensitive	0.48	Sensation Avoiding
			10	Sensory Sensitive	0.45	Low Registration
			11	Sensory Sensitive	0.43	Sensory Sensitive
			12	Sensory Seeking	0.42	Sensation Avoiding

Areas with shared sedentary behaviour: yellow

Areas with conflicting agreement, child has active behaviour and parent has sedentary behaviour: blue

Areas with shared active behaviour: purple

Areas with conflicting behaviour, child has sedentary behaviour and parent has active behaviour: green

As seen in Table 4-6 the highest probabilities of agreement for the sensory sensitive child was with the sensation avoiding behaviours of the mother, while the probability of agreement with the mother's sensory sensitive and low registration behaviours were also noteworthy. It also came to light that the group of children with sensation avoiding behaviours showed a moderate probability of agreement with mothers presenting with low registration, sensory seeking, sensory sensitive and with the largest group corresponding with the mothers' sensation avoiding behaviours.

Of the children without SMD, there was a far greater probability of the parent not presenting with SMD. This is illustrated in the high probability of agreement between a child with SMD and a father without SMD (0.82), while a moderate probability of agreement of 0.62 exists between the child with SMD and the mother without SMD.

A limitation to this study was that the relationship between the mother and father's SMD was not taken into account. It may thus be possible that a child presents with SMD as inherited from the mother with SMD, and when looking from the perspective of a father without SMD seems to indicate that it was not inherited when it was in actual fact. Further study with a larger population will shed light on this relationship.

In summary, one can deduce that there is a higher probability of agreement between the parents without SMD and the children with SMD, than a parent presenting with SMD.

When considering the child without SMD, there is an even greater probability of agreement between the parents' and children's adaptive behaviours. From these results, one can assume that although hereditability plays a role in the development of SMD, it is not the only cause of SMD for the population of children who present with SMD.

4.7. The probability of parents with SMD having a child with SMD

The data in the previous section was analyzed from the child presenting with SMD's perspective. Only 23.61% of the fathers in this study presented with SMD. And from this group, a very small group of the fathers with SMD had children without SMD. This indicated that there is a high probability of agreement between a father with SMD and with a child with SMD. This is illustrated in Figure 4-12.

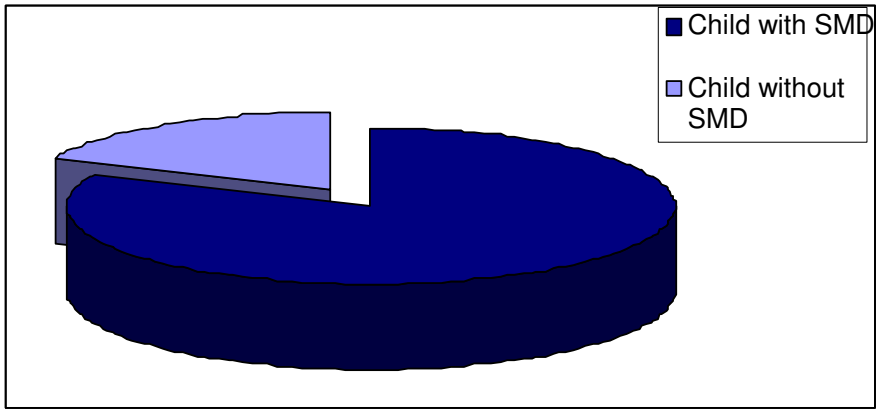


Figure 4-12: Probability of a father with SMD having a child with/without SMD

A slightly larger group of mothers from the study sample presented with SMD (40.74%). From this group, the moderate probability of agreement between a mother with SMD and a child with SMD was calculated at 0.7, as illustrated in Figure 4-13.

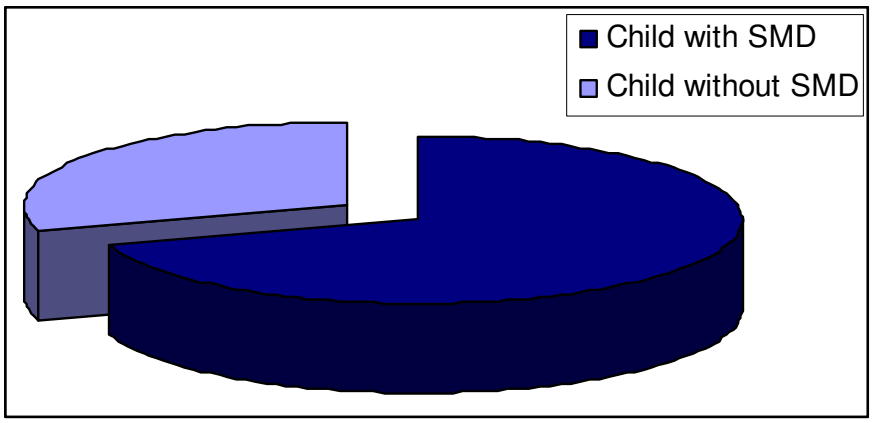


Figure 4-13: Probability of a mother with SMD having a child with/without SMD

From the data analysis, it was found that a moderate probability of agreement between a father with a high threshold and a child with a high or low threshold exists, while it would seem that a high probability of agreement between a father with a low threshold and either a child with a high threshold or low threshold exists. Table 4-7 summarizes the agreement found between the child and father's behaviours, in the analysis of the probability of agreement studies.

Table 4-7: Shared behaviours between the father with SMD and his child with SMD

			FATHER			
			High Threshold		Low Threshold	
			Low Registration	Sensory Seeking	Sensory Sensitive	Sensation Avoiding
CHILD	High Threshold	Low Registration	0.85	0.58	0.69	0.62
		Sensory Seeking	0.70	0.63	0.56	0.56
	Low Threshold	Sensory Sensitive	0.88	0.83	0.71	0.67
		Sensation Avoiding	0.75	0.75	0.71	0.63

Areas with moderate probability for agreement highlighted in blue

Areas with high probability of agreement highlighted in green

Further analysis showed that there was a moderate probability of agreement between the mother with a low neurological threshold and a child with a heightened threshold for input. A moderate probability of agreement was also found where both the mother and her child presents with a low threshold as well as for a heightened threshold. The smallest group was found between a mother with a low threshold and a child with a lowered threshold for input (Table 4-8).

Table 4-8: Shared behaviours between the mother with SMD and her child with SMD

			MOTHER			
			High Threshold		Low Threshold	
			Low Registration	Sensory Seeking	Sensory Sensitive	Sensation Avoiding
CHILD	High Threshold	Low Registration	0.69	0.69	0.60	0.64
		Sensory Seeking	0.64	0.71	0.58	0.64
	Low Threshold	Sensory Sensitive	0.74	0.68	0.62	0.68
		Sensation Avoiding	0.70	0.73	0.66	0.66

Areas with moderate probability for agreement highlighted in blue

When considering the probability of agreement between sensory seeking behaviours of the parents and the child's behaviours, it would be helpful to remember that 89% and 71%of the fathers and mothers respectively, who presented with a problem in this quadrant, achieved a "*less/much less that others"* classification in the sensory seeking quadrant (Figure 4-7). This may be a larger indicator for sedentary behaviour rather than a heightened threshold [53], and will be interpreted as such in the discussion.

From Table 4-9 on p.62, it can be seen that the highest probability of agreement between parents and children existed between the conflicting behaviours of low registration (sedentary) behaviours in the parent and sensory sensitive (reactive) behaviour in the child. This was calculated at 0.88 for fathers and 0.74 for mothers.

The next greatest probability of agreement was between sedentary behaviour. This was seen in shared low registration behaviours by the father and child and less sensory seeking behaviour in the mother and sensation avoiding behaviour in the child.

In the group with the third largest agreement of probability, the parents once again presented with sedentary behaviour, in the form of less sensation seeking behaviour. The children presented with sensory sensitive behaviour in relation to the fathers and sensory seeking behaviour in relation to the mothers.

The fourth largest probability of agreement was found between the sedentary behaviour of parents with low registration and children with sensation avoiding tendencies.

When looking at the probability of agreement between the father and child, the reactive sensory sensitive behaviours were shared as the sixth highest probability. Conflicting behaviours where the father reacted sensitively to input and the child in a sedentary fashion (either by avoiding sensation or low registration) followed. After which the father reacted in a sedentary manner (low registration, sensation avoiding, less sensory seeking behaviour) while the child presented with sensation seeking behaviour. The last largest group of agreement (12^{th} –14^{th}) was found between sedentary behaviours in the father and the child.

Table 4-9: Probability of agreement found between parents with SMD and children with SMD 's behaviour in descending order.

Probability of Agreement between the Father and Child's behaviour			Order of probability	Probability of Agreement between the Mother and Child's behaviour		
Father	Agreement	Child		Mother	Agreement	Child
Low Registration	0.88	Sensory Sensitive	**1**	Low Registration	0.74	Sensory Sensitive
Low Registration	0.85	Low Registration	2	<Sensory seeking	0.73	Sensation Avoiding
<Sensory seeking	0.83	Sensory Sensitive	3	<Sensory seeking	0.71	Sensory Seeking
Low Registration	0.75	Sensation Avoiding	**4**	Low Registration	0.70	Sensation Avoiding
<Sensory seeking	0.75	Sensation Avoiding	5	Low Registration	0.69	Low Registration
Sensory Sensitive	0.71	Sensation Sensitive	6	<Sensory seeking	0.69	Low Registration
Sensory Sensitive	0.71	Sensory Avoiding	7	Sensation Avoiding	0.68	Sensory Sensitive
Low Registration	0.70	Sensory Seeking	8	<Sensory seeking	0.68	Sensory Sensitive
Sensory Sensitive	0.69	Low Registration	9	Sensation Avoiding	0.66	Sensation Avoiding
Sensation Avoiding	0.67	Sensory Sensitive	10	Sensory Sensitive	0.66	Sensation Avoiding
<Sensory seeking	0.63	Sensory Seeking	11	Low Registration	0.65	Sensory Seeking
Sensation Avoiding	0.63	Sensation Avoiding	12	Sensation Avoiding	0.65	Sensory Seeking
Sensation Avoiding	0.62	Low Registration	13	Sensation Avoiding	0.64	Low Registration
<Sensory seeking	0.58	Low Registration	14	Sensory Sensitive	0.61	Sensory Sensitive
Sensation Avoiding	0.56	Sensory Seeking	15	Sensory Sensitive	0.60	Low Registration
Sensory Sensitive	0.56	Sensory Seeking	**16**	Sensory Sensitive	0.58	Sensory Seeking

Areas with shared sedentary behaviour: yellow

Areas with conflicting agreement, child has active behaviour and parent has sedentary behaviour: blue

Areas with shared active behaviour: purple

Areas with conflicting behaviour, child has sedentary behaviour and parent has active behaviour: green

Probability of agreement between mothers and children followed a slightly different pattern, with sedentary behaviour agreeing mostly as demonstrated in the fifth group of agreement with shared low registration behaviour. This was followed by less sensory seeking behaviour in the mother and low registration behaviour by the child.

The seventh and eighth probability of agreement was found in conflicting behavioural patterns, where the mother presented with sedentary behaviour (sensation avoiding and less sensation seeking) and the child with reactive sensory sensitive behaviour. Shared sensation avoiding behaviour in mother and child and sensory sensitive behaviour in the mother and sensation avoiding behaviour in the child followed this.

Smaller probability of agreement was found between shared reactive sensory sensitive behaviours. Conflicting behaviour where the mother presents with reactive behaviour and the child presented with low registration behaviour was second last.

The least likely probability of agreement was found for both fathers and mothers with sensory sensitive behaviour and a child with sensory seeking behaviour (0.56 for fathers and 0.58 for mothers).

In summary, it would seem that the distribution of probability of agreement of the behavioural patterns was similar for the first, fourth and last groups in both the mother and father. It would seem that there is a larger probability for agreement of sedentary behaviour between the mother and child, while a larger agreement for conflicting sensory sensitive behaviour was identified in the father with sedentary behaviour in the child.

A limitation to this study was that a population with a high percentage of children presenting with SMD was targeted, and this may have influenced the high incidence of SMD in children when parents have SMD. A study with a larger population with a distribution more similar to a normal population distribution will give a clearer picture in this regard.

4.8. The agreement found between parents without SMD's sensory profile and those of their children

Table 4-10: Distribution of SMD in relation to their parent's SMD profiles

Distribution of SMD in parents	Children without SMD	Children with SMD
No parents present with SMD	45.45%	36.00%
Only mothers present with SMD	36.36%	38.00%
Only fathers present with SMD	13.64%	20.00%
Both parents present with SMD	4.55%	6.00%

When considering the parents without SMD and their children, there was a moderate probability of agreement of 0.68 for a father without SMD and a child with SMD, and 0.53 for the mother. These probabilities must be viewed in light that this study sample included high percentages of children with SMD. This is not representative of a normal population distribution (Table 4-1 and Table 4-2).

Table 4-10illustrates the distribution of children with SMD in relation to their parents with SMD. There is a relatively similar distribution of children without SMD to with SMD when only the mother or father presents with SMD. It could be safe to say that some overlap between children presenting with SMD as a result of the father presenting with SMD, while the mother does not. Further scrutiny of this aspect however fell outside the analysis done for this study.

4.9. Summary

In this chapter the findings from the data analysis of the agreement between the children's sensory profiles and their parents' sensory profiles was examined. The following deductions were made. This study was based on a population predominantly with SMD and did not correspond with the distribution of SMD across a normal population. The largest group of children presented with SMD, while almost half of the mothers and a small amount of fathers presented with SMD. This reached the objective of establishing the sensory profiles of the children and their parents.

The second objective was to establish the probability of a child with SMD having a parent with SMD. Here it was found that there is a moderate probability of parents of children with SMD will not present with SMD themselves. When considering the child without SMD, there is a high to moderate probability of the parents' behaviours being similar to most people. From these results, one can assume that although hereditability plays a role in the development of SMD, it is not the only cause of SMD for the population of children who present with SMD.

The third objective was to find the probability of a parent with SMD having a child with SMD. A high probability of agreement was found between a father presenting with SMD and a child with SMD. A moderate probability of agreement was found between a mother and child with SMD. In the analysis of the behavioural quadrants, the distribution of probability of agreement of the behavioural patterns was similar for the first, fourth and last groups in both the mother and father. A larger probability for agreement of sedentary behaviour between the mother and child existed, while a greater agreement for conflicting sensory sensitive behaviour was identified in the father with sedentary behaviour in the child. This analysis of the agreement supports the initial hypothesis that an agreement would be found between sensory profiles of children and their parents.

Further analysis of the causes of SMD and hereditability of SMD will be done in the next chapter. The interplay between the behaviours and thresholds between the parents and children will be investigated in greater depth. This discussion will also look at the inherited and learned behaviour, and interplay between the child and parents behaviour. The impact of SMD on the neurological threshold and interpersonal relationship between the child and parent will be investigated.

CHAPTER 5: DISCUSSION

5.1. Introduction

This study was designed to explore the agreement of the sensory profiles of a sample of children with and without SMD and those of their parents, in order to investigate any existing relationship. The aim of the study was to establish the probability of the parents and children having co-existing SMD and therefore the possible hereditary nature of SMD. The study also reviewed the possible influences on interpersonal relationships, bonding and behaviour in reaction to the other party when the sensory profiles of the parent and child with SMD were similar or different.

A relatively small sample of 81 children and most of their biological parents participated. In order to gain a viable sample size some families were included whose fathers had not completed their questionnaires. They were selected through purposive sampling as only 5-15% of the population presents with SMD. Children from all parents who responded were included with the intention of reaching the required prevalence of SMD, for the confidence interval of 95% within 10% accuracy.

The data was analysed by the MRC's Biostatistics department, and a variety of probabilities of agreement was found. The following chapter is devoted to exploring these agreements and the implications that the interplay between behavioural patterns may have on the relationship between the parent and child and the development of coping mechanisms.

In discussing the comparisons of the parent and child's sensory profiles, examples were used to reflect on the possible interactions between the specific types of behaviour within this relationship. It should be kept in mind that these profiles may not be reflective of the relationship between the parent and child, and that both the child and parent's SMD may present in other situations and be influenced by other sources such as social settings, work and school.

5.2. Influence of demographics on the results

5.2.1. Identification of children with and without SMD

The study was aimed at identifying the agreement between sensory profiles of children and their parents. In order to find children with SMD, only children receiving OT-SI in order to treat SMD were included in the original study design. As the population was not large enough for a viable study sample, children with and without behavioural and learning problems from various schools and other institutions were included.

The incidence of SMD in the children and parents was significantly higher than the 5-15% found in a normal population distribution as indicated in prevalence studies of SPD. The results of the t-test comparing the study sample and the normative data from the sensory profiles indicated a significant difference (Table 4-1 and Table 4-2).

When interpreting these results, one should keep in mind that this study is not representative of a population with a normal distribution of SMD, and is in fact a skewed population with a greater occurrence of SMD as the majority of the child population was referred to OT for treatment.

5.2.2. Total Scores achieved in each quadrant

In the analysis of the total classifications achieved by the study population in each quadrant, it was found that the greatest group of adults achieved a “similar to most people” classification across all the quadrants. The greatest percentage of children reached a “similar to most people classification” in the sensation-avoiding category only.

The largest group of children scored a “much more than others” classification in the low registration and sensation seeking categories. An equal amount of children achieved a “much more than others” and “similar to most people” classification in the sensory sensitive category. While in the sensation avoiding quadrant, the second largest group of children achieved a “much more than others” classification.

This disparity between the children and parents' classification influenced the statistical correlation studies between the parent and child and no significant correlations were found. As a result a descriptive analysis was undertaken in order to interpret the behavioural relationship between the child and parent, rather than looking at correlations.

When interpreting the distribution in the sensory seeking quadrant (Figure 4-7), it is important to note that more parents showed a tendency to "less than others" and a "much less that others" behaviours in this category. According to this interpretation, they displayed a greater tendency to avoid extreme sensory input (e.g. *I almost never* add spice to my food, enjoy being around people with strong smelling perfume, or enjoy how it feels to move about, e.g. dancing & running). Lombaard, who conducted a pilot study in Cape Town, South Africa, found a similar distribution across the sensory seeking category in her adult population using the ASP [55].

This might suggest that the ASP may not be as indicative of sensory seeking behaviour in a South African adult population as in an American population. Cultural differences may account for the different behaviours. Lombaard is currently undertaking a substantially larger study of the sensory profiles of call centre workers in South Africa using the ASP. This may provide more information on the use of this tool in a South African population [56].

The distribution of behaviour of parents and children in reaction to sensation across all quadrants was taken into account when considering the probable agreement between the child and parent's behaviours.

5.3. Aetiology of SMD

A probability of 0.58 and 0.74 existed that the mother and father, respectively, of a child with SMD would not present with SMD. This placed emphasis on the postulate that hereditability is not the only cause of SMD. Various other factors such as prenatal conditions and prenatal drug exposure, prematurity, birth trauma, developmental disability as well as a variety of environmental factors have been identified in the literature as possible precursors to the development of SMD [5] [22].

A high to moderate probability of 0.82 for the father and 0.7 for the mother with SMD of having a child with SMD was found (Section 4.6). This indicates that should other causes for SMD be excluded, hereditability may play a role in the development of SMD in the child, supporting the hypothesis that SMD may be inherited [5] [20] [22].

A limitation to the study is that most of the children in the study group did in fact present with SMD, and that the results could be skewed. When considering the ratio of children with SMD: without SMD in the total study population was 2.1:1 while the ratio in the population whose mothers had SMD was 2.3:1 and fathers with SMD was 3.25:1. This would suggest that the ratio between children and parents with SMD is greater, but research where the adult population is identified as presenting with SMD and their children will provide a more accurate description.

5.4. Agreement of behaviours found between the children with SMD and their parents

Table 4-6 illustrates the descending order in which the probability of agreement occurred between the large group of children with SMD and their parents who presented with SMD. From this table it would seem that there is a large agreement between sedentary behaviours in the children and their parents, more so with the mother. Some conflicting behavioural patterns were also evident, mostly with the parent presenting with a sedentary behaviour and the child with an active behaviour. Only the agreements that were moderate and high will be discussed.

For the purpose of this study the behaviours in the low registration, sensation avoiding and less sensation seeking quadrants were considered to be sedentary. This was based on the premise that low registration behaviours are often inactive in nature, or slower in occurring. While sensation avoiding may be purposely sedentary or ritualistic in an attempt to avoid an over-aroused state. Less sensation seeking behaviours may be a reaction to avoid an over-aroused state (if co-occurring with a “more/much more than others” classification in the sensation avoiding quadrant) or simply as an inability to create additional sensory stimuli [30].

Sensation seeking and sensory sensitive behaviours were considered to be active behaviours. People, who score a “more/much more than others” classification in the sensation-seeking quadrant, tend to actively create additional stimuli or look for environments that provide sensory input. Sensory sensitive behaviour is also active in nature, as these behaviours readily occur in response to sensory input. These behaviours include distractibility and discomfort [30].

5.4.1. Sedentary behaviour

In Table 4-6 it was found that the greatest agreement between children with SMD and their parents seem to be sedentary behaviours, be it low registration or sensation avoiding behaviours. The probability of agreement for shared sensation avoiding behaviour in child and mother was 0.60. Shared low registration behaviour in the child and parents was 0.53 for mothers and 0.42 for fathers. It is assumed that the child learns sedentary behaviour by following the parents’ sedentary lifestyles of reading, TV watching, etc. thereby rarely reaching a calm-alert state in which they are ready for active participation in tasks. The sensation-avoiding mother on the other hand might not encourage her child with a heightened threshold to explore or may actively limit the child’s participation in the environment, leading to low registration behaviour.

The greatest agreement is found in the shared sensation-avoiding behaviour of the mother and child, which is often ritualistic and may be emotionally destructive in nature. It is hypothesised that the child and parent alike impose their rituals on the rest of the family. Through experience the child and parent have learnt that stress is avoided when sticking to the rituals and that they can enforce these rituals on the rest of the family through emotional outbursts [7] [30] [31] [55].

These rituals are often observed in self-care activities (such as bathing, dressing, nail cutting, eating) in which the mother who generally acts as the primary care giver is involved. The family's entire occupational sphere is however influenced [57]. For example, a mother with sensation avoiding tendencies may avoid activities that involve rotation, such as a merry-go-round. Just looking at a child spinning on a merry-go-round may make her feel ill. When she takes her child to the park she may discourage him from going on the merry-go-round. Should the child attempt going on the merry-go-round, and have a sensory sensitive reaction to the movement, the mother may overreact vocally and run to her child's rescue. This reaction discourages the child from gaining an adaptive response such as actively controlling the speed by keeping one foot on the ground to propel/stop the merry-go-round, and may in turn instil a fear for moving playground equipment. Through this process the child may learn to react in a sensation-avoiding manner.

Some agreement was also found in the child with sensory avoiding behaviour and the mother with less sensory seeking behaviour (Table 4-6). Keep in mind that more than twice the amount of mothers in the sensation seeking category achieved a "less/much less than others" rather than a "more/much more" classification, making it safe to assume that this indicates learnt sedentary behaviour.

Once again the sedentary behaviour is found in the child with sensation avoiding tendencies and the mother with low registration behaviour, it is hypothesised that both find it easier to "keep a low profile" thereby reducing stress experienced by the family. If one uses the merry-go-round scenario again, the mother may notice the child getting upset on the merry-go-round, and not react appropriately. She does not get up and slow the movement or teach the child to control the movement himself. The child's level of distress increases, as he cannot stop the momentum of the merry-go-round or get off. The child learns to either avoid such a situation altogether or overreact immediately in order to gain sufficient attention and prevent him from reaching his threshold.

A mother with sensation avoiding tendencies with a child with a heightened threshold may discourage the child continually from going on "wild" equipment such as the merry-go-round, and encourage him to slide down the small slide, or swing while she controls the movement, as her child might be quite clumsy. As her perception of the movement is not necessarily "fun" she does not encourage her child to try out new ways of playing on the playground equipment. After one or two taxing outings she may even decide not to take the child again. As the child's threshold is heightened and all attempts to reach the threshold are countered, the child may lose the motivation to try out all the equipment and starts to present with increasing low registration behaviours.

Should the mother and child both present with low registration behaviour, she might not find it strange that he does not explore the environment that much, and be quite happy if the child only plays in the sandpit. She might feel that it was adequate "outside play" and leave the park without encouraging the child to try out the other equipment.

5.4.2. Conflicting behaviour

An almost similar agreement was found between the child with sensation avoiding behaviour and the parent with sensory sensitive behaviour as between the child and parent with sensation avoiding behaviour. As sensation avoiding and sensory sensitive behaviour is so often seen in similar frequency in any given individual, (as supported by the current trend of diagnosing sensory overresponsiveness) these findings further uphold this trend.

Some agreement was also found between the child with low registration behaviour and the parent (0.51 for mothers and 0.40 for fathers) with sensory sensitive behaviour (Table 4-6). A child with low registration behaviour may not register the mother's sensory sensitive reaction to his actions, and will not learn from them accordingly. This might place strain on the relationship between the child and parent. The parent may perceive the child to be ignoring them when spoken to, or get frustrated with the child's clumsiness.

In the child with sensory sensitive and sensation seeking behaviour the largest agreement was once again found with sensation avoiding mothers, although this presented as a low-moderate probability (0.48 for sensory sensitive children and 0.42 for sensory seeking children). In this case mothers seem unable to cope with a child with sensory seeking or sensory sensitive behaviours, leading to her avoidance of certain situations. This might be in reaction to the child's busy behaviour, in an attempt to avoid reaching her neurological threshold too often.

Referring back to the merry-go-round scenario, the mother may avoid the situation by not taking the child to the park. Should she take him to the park, she might try to actively control the child's choice of equipment, in reaction to every sensory sensitive reaction by the child. The sensory seeking child might present a greater challenge as his need to reach his threshold goes unmet through her limitations set on him, and he reacts by attempting even wilder games. Upon which the mother may avoid this scenario by walking away and trying to calm herself, or by shouting at the child and overreacting emotionally.

Parents with low registration behaviours may also not react to the sensory sensitive behaviour in the child immediately or effectively, and may miss important behavioural cues that could lead them to reduce the stress that the child experiences. In this instance the mother may think her child will enjoy the merry-go-round and propel it quickly before the child is ready. This is not a "just right challenge" and prevents the adaptive responses from occurring, as the mother is controlling the input. When the child cries out for her to stop, she may reason that he will start enjoying it in a little while, and not heed to his fears immediately. This also instils a fear for movement. When the child reacts very emotionally the mother doesn't necessarily grasp why he does not enjoy this fun activity, but stops the ride. The child learns to overreact immediately in order to prevent him from reaching his threshold.

Parents presenting with similar or conflicting behaviour to their child's sensory profiles will benefit from gaining insight into their own and their children's reaction to their neurological threshold. With proper insight and adaptive principles and tools, the parent may feel better equipped to handle certain situations.

Keep in mind that all above examples are based on the premise that SMD occurs within the home setting and influences the behaviour between the parent and child. Other internal and external influences do however play a role in the development of the nature of SMD in any given individual [24]. Further studies on how SMD in the child and parent influences the relationship between them will shed light on this subject.

5.4.3. Parents presenting with situation appropriate behaviour

Predominantly the child with sensory seeking behaviour has a moderate probability of having parents who generally present with appropriate behavioural responses in relation to sensory input. For all of the above-hypothesised situations there is also a moderate probability of agreement between children with SMD and parents who present with appropriate behaviour in response to sensory input. This is very positive when considering the treatment of SMD in the child in the home situation through a prescribed sensory diet.

It is assumed that the parent with a situation appropriate level of behaviour might more easily gain insight into how the child's SMD presents. This parent may easily recognise a child's distress or disinterest as stemming from SMD. When such a parent is presented with good principles, as how to handle certain situations will find it easier to react appropriately. Encouraging the child to make an adaptive response and learn from the situation, rather than promote the inappropriate behaviours.

5.5. Agreement of behaviours found between the parents with SMD and their children

It was found that hereditability plays a role in the development of SMD in the child. It would thus be safe to assume that maladaptive behaviour as a result of SMD may be carried over from the parents to the children. Table 4-9 similarly describes the probability of agreement between the smaller group of parents with SMD and their children's SMD behaviour. These probabilities are explored in greater detail in the following sections.

5.5.1. Opposite behaviour

In Table 4-9, the largest agreement between the parents with SMD and a child with SMD was found in the parents with low registration behaviour and the child with sensory sensitive behaviour (87.5% for fathers and 73.53% for mothers). The effect of this on the parent child relationship may be equally positive and negative. Such parents might not be easily frustrated by the child's behaviour.

Likewise they may not recognise the child's distress as soon as it occurs, and may not assist the child by limiting or removing the sensation, or helping the child to adapt to the situation. This may lead to extreme sensitive behaviour or even sensory avoidance and "shut down". When this occurs the child does not learn to socialise or acquire adaptive responses as a result.

5.5.2. Sedentary behaviour

Once again the tendency for the parents' sedentary behaviour being learned by the child is seen in the large agreement between parents and children with low registration behaviour. Moderate agreement was also found between low registration parents and sensation-avoiding children.

The smallest agreement between a parent with low registration behaviour and the child with SMD was with sensory seeking behaviour. This indicates that it is not so much the neurological threshold that is inherited, rather a general tendency to present with SMD. It also shows that learned behaviour, especially sedentary behaviour plays an important role in how SMD presents in the child.

A probability of agreement of 0.73 was found between less sensory seeking behaviour in the mother with a child with sensation avoiding behaviour (Table 4-9). This might also indicate the mother's limiting of the sensory repertoire within the home and social setting (such as excessive washing of hands, avoidance of messy play or limiting participation in "dangerous" gross motor play on playground equipment, always wearing shoes). This could then teach the child certain sensory avoidance habits, similarly so with the shared sensation avoiding category.

The ratio of agreement between the parents' and children's behaviours were high to moderate, and similar in both sensory sensitive and sensation avoiding categories. This justified the discussion of the combined sensory sensitive and sensation avoiding as low threshold behaviours. When considering agreement between low threshold behaviour in the parent and child, the largest agreement was found with a child with sensory avoidant behaviour. This may indicate the parent's need to structure their environment well in order to deal with their children's busy behaviour along with other sensory challenges faced in life in general.

The next agreement in this group was found with children with sensory sensitive behaviour, once again pointing to how sensation avoiding and sensory sensitive behaviour occurs in similar frequency in an individual with a lowered threshold for input. Learning of certain rituals and avoidance of certain sensory input may also play a role in this agreement.

The smallest agreement, though still moderate was found between children with sensory seeking behaviour and parents with a lowered threshold for input. This may indicate that there is a possibility of inheriting a heightened threshold from a parent with a lowered threshold for input, while a more passive response can be expected from the child should this indeed occur.

The parent population (89% of fathers and 79% of mothers as identified as having a problem with sensory seeking behaviour) in this study indicated that they almost never or seldom engage in sensory seeking behaviour. It was decided to use the parents' sensory seeking category as an indication of sedentary, avoidant activity, as a significant cluster of maladaptive behaviour in this regard was observed. These behaviours seem to correspond with the frequency of the sensation avoiding category scores, and often occur in conjunction with this quadrant, keeping in mind however that Dunn cautions one not to over interpret the "less/much less than others" classifications.

The parents' "less than others" sensation seeking behaviours corresponded with the low threshold behaviours in the child, with the largest group being between the father in this category and the child with sensory sensitive behaviour. This may indicate the possible protective mechanism on the part of the father to avoid unnecessary input that may lead him to reaching his neurological threshold. A substantial group of mothers and children also showed this agreement. The agreement between the child with sensory seeking behaviour and the father with "less/much less than others" seeking behaviours was also high. This suggests that parents may adapt their behaviour in response to how their children react to sensory input. A longitudinal study of whether the ASP's of people stay the same before they get married, once they do get married and to a partner with/without SMD and their reaction to their children and stress in the workplace might be insightful.

The agreement between the mother with less sensory seeking behaviours however showed a slightly different pattern in that it was most probable to have a child with sensation avoiding behaviours. This indicates that learned behaviour may play a role. The next probability of agreement was with a child with sensory seeking behaviour, which may indicate avoidance of general over-aroused state in response to child's busy behaviour. Probability of agreement between low registration behaviour in the child followed with the smallest probability of agreement occurring with the child's sensory sensitive behaviour.

Although the frequency in which behaviours were shared between mothers and children with SMD was smaller than with fathers and children with SMD, the ratio in which these behaviours occurred was very similar. This is indicative that there is a tendency for certain behavioural patterns to occur.

5.5.3. Conflicting behaviour

A set of agreement (0.88 and 0.83) between conflicting sedentary behaviour by the father and sensory seeking and sensory sensitive child was more prominent than shared sedentary behaviours in the father and child. These behavioural patterns are also found in the mother and child to a lesser degree. Similar to point 5.5.1, the parents may not respond to the child's sensory seeking behaviour quickly, or attempt to avoid these behaviours. Inappropriate socialisation of the child's behaviour may result. Frustration may also increase when the sensory seeking or sensitive child reacts with overbearing behaviour, and the parents' thresholds have already been reached.

5.5.4. Active Behaviour

Shared sensory sensitive behaviours show high probability of agreement between the child and father with SMD. This may indicate some aspect of hereditability, as well as learning the reactions to sensations from the father. This also occurs to a much lesser degree between the mother and child. The smallest though moderate probability of agreement was found between sensory sensitive behaviour in the parent and sensory seeking behaviour in the child (0.56 for fathers and 0.58 for mothers). This may also initiate a vicious cycle, in which the parent reacts to the wild behaviours in the child, which may ultimately lead to sensation avoidance in the parent. The probability of agreement between sensation avoidance in the mother and sensory seeking behaviour in the child was greater and presented in a moderate probability of 0.56 for the fathers and 0.65 for mothers.

5.6. Implications of the findings on inter-personal relationships and occupational performance

Goal directed behaviour and occupational performance occurs in response to the CNS's ability to process and modulate sensory input gained from sensory experiences in the environment. Through these processes, behavioural responses are learnt and there is discovery of the individual's capacity to act [55]. When SMD occurs, individuals are no longer able to sufficiently adapt these behavioural responses to match the sensory environment in which they find themselves.

The largest agreement in this study was found between parents and children with sedentary behaviour, be it low registration or sensation avoiding behaviour. This is of particular importance as maladaptive learning takes place when the CNS is not filtering and processing sensory input correctly. When faced with an impoverished sensory environment a child with an adequate internal environment cannot learn appropriate behaviour, so much more for the child with sensory modulation deficits [55]. When the parent limits his/her sensory environment in accordance to their own personal reactions to thresholds, which might be unfavourable for the children's development.

It is hypothesised that the child and parent alike is thus ill equipped to deal with the various challenges presented in daily life. These internal characteristics and care giving environments may interact in an increasing risk of developing a disorder, be it emotional, relational or functional [18].

This may lead to poor performance in expected tasks that are specific to that person's culture, age and gender. For example, a parent who is displaying sensory sensitive behaviour in reaction to the traffic and general commotion occurring when picking children up from school. She sincerely loves her child, but may experience irritation on seeing the child as a result of her lowered threshold. The automatic reactions of socialisation may not occur (such as smiling, positive verbalisation, embrace). She may try to over-ride her "sensory overload" and want to embrace her child.

The child, who may also display sensory avoidant behaviours after an overwhelming day at school, is happy to see her mother, smiles, runs to her, but cries and lashes out when embraced in an attempt to avoid tactile input. Upon which the mother may feel rejected and may react by shouting at the child, who then either shuts down or has an even greater emotional outburst. These conflicting behaviours leave parents and children hurt and confused, initiating a complex maladaptive interaction process increasing the risk of developing psychopathology [18] [24].

The persons' cognitions about self, others and the world are also affected by SMD and the feedback that they receive [18]. The role of touch in bonding has been well established, and a strong inverse relationship has been identified between tactile defensiveness and self-esteem [41]. It is proposed that parents and children who either avoid touching as a result of low registration behaviour or avoidance may not bond as effectively. While negative responses to touching may in fact have a detrimental effect on the person's self-esteem, bonding with significant others and view of the world as an unsafe place.

When the parent does not accurately mirror the child's behaviour as they either do not register it, or are actively trying to avoid the behaviour this further limits the child's learning. By not responding to the child's distress or out of control behaviour, the parent does not teach the child situation appropriate responses. The child might also feel misunderstood as they think that their behavioural cues should be adequate to get a response from the parent.

If the parent actively limits the sensory world to which the sensory sensitive or seeking child is exposed, they also do not learn important social lessons in behaviour. For example, the parent does not take the child to the park or shopping centre for fear of the child's disruptive behaviour. The child does not experience the social boundaries in order to learn from them, and his behaviour remains disruptive, possibly even if receiving OT-SI.

Any combination of SMD in the parent and child thus has a significant impact on their interpersonal relationships (e.g. Unable to tolerate expected closeness, fights, poor participation in family routines and outings), task expectations (needs structure for participation), interaction with the environment (situation specific environmental adaptations are needed for appropriate arousal) and cultural participation (going to and productively participating in school, parties, sport, church, library, market place) [24].

5.7. Implications for Treatment with a Sensory Diet

Treatment of the child with SMD is extensive. OT-SI in South Africa often occurs on a weekly basis of 30-45 minutes. Sensory integration treatment is based on the following principles of being child directed, individualised therapy with active participation on the child's part [58]. Activities should be purposeful and an adaptive response should be the result. Input varies according to the child's response and the activity should be rich in proprioceptive, vestibular and tactile input. The treatment goals are improving processing and organising behaviour such that an appropriate adaptive response occurs and not to teach a skill.

It was found that OT-SI treatment is enhanced when an appropriate sensory diet is also followed at home [19]. This involves the therapeutic use of sensation in the context of daily activities. Wilbarger first described the sensory diet in 1993, to treat sensory defensiveness [6] and involved sensory-based activities as well as a brushing and deep pressure protocol. Today the sensory diet is not used only for children with sensory defensiveness (low neurological threshold) but includes activities for children with low registration and sensation seeking behaviour as well. The Wilbarger brushing protocol is also not followed with all children as part of the sensory diet. Popular books such as *The Out-of-Sync Child Has Fun* includes a variety of activities for children with SPD [59], which is commercially available to parents, teachers and therapists.

The following of a sensory diet encourages the parents to create the necessary sensory motor experiences throughout the child's natural environment. This supports the therapeutic input that the child receives at OT, as well as helping the child to be more functional when participating in daily occupations [19].

When prescribing a sensory diet to the family the parent needs to be motivated to follow this program. Motivation for treatment within the family context is influenced by the parent's need and value placed on the goal (incentive). The parent should also understand and believe that performance of task will lead to the desired goal (expectation), and then only task selection in order to achieve the goal successfully can be done [55]. When motivating the parent to participate in a home program the parent's needs should be taken into account, as well as impressing upon them that this program is for the child, so as not to expect things that the child will not do.

A positive aspect that was identified in this study was that a large group of parents with children with SMD do in fact present with appropriate behavioural responses to sensory input. A substantial group of parents did however present with SMD. For effective intervention within the family context, some form of intervention should be offered for the parent with SMD. Financial constraints often limit a parent's willingness to go for treatment for themselves. In the interest of the child, the treating OT should at least provide guidelines in consultation for these parents as part of her treatment of the child.

5.7.1. Incentive

In order to effectively follow a sensory diet with the child, the parent should also be well modulated. A positive adaptive response when engaging in sensory activities only occurs when enjoyment is experienced. It is very hard for a child to enjoy an activity when the parent is frustrated or forcing the child to participate out of guilt.

In order to address SMD in the parents, they should firstly gain insight into their own behavioural responses to their neurological threshold [60]. When the parent is more aware of their own behaviour they will be able to see how this influences the child's behaviour. For example a family where TV watching is encouraged and excessive as the parent either does not feel the need to move about (low registration behaviour) or where the parent avoids input, the children will follow suit.

A parent with low registration who does not immediately respond to the child with sensory seeking behaviour and sensory sensitive behaviour should be made aware of how the child communicates his distress and how to act in order to avoid extreme avoidant behaviour. Recognising sensory seeking behaviour in the child and teaching the parent how to appropriately channel this behaviour will also assist in teaching the child socially acceptable behaviour.

Coping mechanisms and modulating activities should also be offered to the sensory avoiding parent with a sensory sensitive or sensation seeking child. These may include daily and regular sensory input, as well as engaging in physical activities of choice with tactile, vestibular and proprioceptive input [60]. Insight into the child's SMD and behaviour is also important in order to provide the parent with guidelines as to addressing the root of the problem. Misinterpretation by the adult of the child's aversion to sensory input as fear may lead to unnecessary avoidance of certain situations [24]. A child with sensory seeking behaviour may be viewed as being out-of-control on the other hand and be excessively punished. Appropriately channelled sensory input may assist in avoiding the conflict and improving parent/child relationships.

Proper insight thus acts as an incentive for participation in the programme as the parent will realise that these behaviours are not "just the way we are". This insight into OT-SI and the following of a sensory diet will offer hope for a family under enormous pressure.

5.7.2. Expectation

The expected therapeutic outcomes should be communicated between the therapist and parent. The program should not illicit false hopes (such as a 9 year old child with oral defensiveness eating anything offered to him within two weeks of following the program). The OT's treatment goals should be made clear to the parents and should encompass what the parent desires from therapy. Participation will be enhanced if the parent understands why they are doing certain tasks and if they see realistically set goals being reached.

5.7.3. Task Selection

Only when the first two areas are covered, task selection can occur. The parent should be made aware of why tasks are selected. For example they should understand that when the CNS is not processing information correctly, the child cannot learn from the environment. In an impoverished environment (in the case of a parent with low registration or sensation avoiding behaviour) the child may not be presented with opportunities to develop knowledge for acting even with an adequate internal environment [55].

Roughhousing and messy play, which may have been previously avoided, will have to form an important role in expanding the child's sensory repertoire. In order to encourage this, the parent's SMD should be taken into account. For example, a parent who avoids having dirt on her will never expect this of her child, and a child will follow the mother's avoidant body language even if she forces him to "get dirty", removing the fun element.

Sensory stimulation as described in sensory diets is useful in addition to intervention based on the principles of SI. State changes however occur rapidly and parents should be made aware of them, especially parents with a high threshold for input. In the child, feelings of fear, anger and sadness may not be so clearly differentiated. Distress is then experienced as a blend of fear and anger, with inconsistent behavioural signals [24].

Parents should understand how to read these signals of distress and any autonomic nervous responses. They need to understand that continuing with activities under these circumstances is harmful and that they are to stop the particular task immediately. These automatic responses include flushing, blanching, perspiring, nausea, yawning, changes in eating & sleeping patterns, or significant maladaptive changes in activity level [6]. The parent should be equipped with techniques with which they can safely inhibit these reactions when they occur.

Appropriately adapting activities and grading the intensity of the input is important in order to continue participation in this program. Teaching the parent simple principles of keeping activities SAFE (S: Sensory-Motor; A: Appropriate; F: Fun; E: Easy) [59] and providing a "just right" challenge will assist them in adapting their own lifestyles and not just doing the games required of them in the sensory diet.

5.8. Conclusions

The deduction can thus be made that various factors may cause SMD, but that when either parent has SMD, the probability of the children presenting with either a heightened or lowered threshold in response to sensation is moderate to high. Various behavioural problems arise as a result of the interplay between the parent and child's behaviour and their general reaction to each other.

Moderate to high probability of agreement was found between sedentary behaviours, be it in reaction to a lowered or heightened threshold. Indicating that parents may reduce the environmental stimuli actively, such in the case of a sensation-avoiding parent, or passively as seen in the parent with low registration behaviour. This leads to an impoverished sensory environment, where the child is not encouraged to learn and explore. As a result these children who already have a genetic tendency toward maladaptive behaviour in reaction to sensory input, do not participate in their environment effectively.

A moderate probability of agreement was also found between the parent with low registration behaviour and the child with sensory sensitive or sensation avoiding behaviour. This would lead to problems in the parent identifying the child's distress or over-the-top behaviours and the parent will not act accordingly. Thereby the child does not learn to inhibit these behaviours, reinforcing the maladaptive behavioural pattern.

Agreement between the sensation-avoiding parent and children with reactive behavioural patterns such as sensation seeking and sensory sensitive behaviour was also found. This could indicate that the parent will structure their environment in an attempt to avoid reaching their neurological threshold often. This might be a cause of great stress for the parent and the parent-child interaction may suffer as a result.

Intervention through providing the parent with insight into how they react to sensory input and the influence this has on the child with SMD will be valuable. As all people have a unique set of interests, skills and preferences about how to spend their time [30], these should be taken into account when treating within the family context.

CHAPTER 6: CONCLUSIONS

6.1. Summary

Hagedorn defines Occupational Therapy as:

> "*The prescription of occupations, interactions and environmental adaptations to enable the individual to regain, develop or retain the occupational skills and roles required to maintain personal well-being and to achieve meaningful personal goals and relationships appropriate to the relevant social and cultural setting"* [4] (p.18).

In order to successfully treat a child with SMD using an OT-SI approach, treatment should be aimed at attaining the child's personal goals and relationships within the relevant cultural settings. This implies that the parent's goals for bringing the child to therapy also need to be addressed. The need for developing effective environmental adaptations within the home setting in treating the child with SMD prompted the study into the agreement of SMD in the child and parent. A study of the agreement of the sensory profiles of the parents and children was carried out in order to reveal aspects of the sensory make-up of the family, which contribute to the underlying complexities of the parent-child relationship.

In the statistical analysis, the children and parents' behavioural patterns in the low registration, sensory seeking, sensory sensitive and sensation avoiding categories were compared to each other. Descriptive statistics found that in this study population of 81 children and their parents there was a moderate to high probability of agreement between parents with SMD having a child with SMD. Indicating that hereditability may play a role in the development of SMD in the child. The probability of a child with SMD having a parent with SMD was also moderate, leading to the conclusion that although hereditability plays a role in the development of SMD, it is not the only causative factor. These factors include birth trauma, premature birth, prenatal conditions and prenatal drug exposure, developmental disability as well as a variety of environmental factors.

The hypothesized influence that SMD in these combinations may have on the interpersonal relationship and bonding between child and parent and implications of the combinations for treatment within the family context was explored. Supplementary research topics will be highlighted.

As the field of OT-SI grows, and the population in general becomes more aware of SMD and the impact on the family, it would be useful to have this information available to parents who wonder if their children are at risk of developing the same problems that they had as children. Once again, sufficient knowledge of the most likely probabilities will allow for effective preventative measures for the development of pathological behaviours in relation to SMD to be put in place.

Behaviour in SMD was found to be individualized to a degree, and not merely a reflection of nervous system functioning, or else all people would behave exactly alike. General maladaptive tendencies do however exist in which the individual may either act in accordance to their neurological threshold or actively try to counter it. It was however found that the child with SMD displays a tendency to learn behavioural patterns from their parents with SMD.

The most pronounced learning occurred with regard to sedentary behaviour, irrespective of the neurological thresholds. It was hypothesized that a parent with sedentary behaviours would model passive responses, or active avoidance of sensory rich situations to their children. The children then learn these maladaptive behavioural patterns from their parents.

The children might also not be exposed to sensory stimuli needed for sufficient learning. Learning and exploring may be either actively limited by the parent, or the parent may just not see the need for the child to explore. Insufficient processing of sensory input may thus be aggravated through this sensory deprivation.

Another interesting agreement was also found between the parent with low registration behaviour and a child with active behaviours, be it sensation seeking or sensory sensitive behaviour. This leads to the suggestion that the parent might not react to the child's unruly behaviour as soon as it occurs which may have a detrimental effect on socialisation of the child.

The parent might also not react appropriately to the sensitive reactions of a child. An emotional outburst might ensue, or the child may feel misunderstood and not significant enough for the parent. A child with sensation seeking behaviour may on the other hand be disruptive in a social setting, and the parent might not teach the child socially and culturally acceptable behaviours effectively.

When considering the sensation avoiding fathers' children, 67% presented with sensory sensitive behaviour and 56% presented with sensory seeking behaviour. 68% of the sensation avoiding mothers had children with sensory sensitive tendencies and 65% had children with sensation seeking tendencies. This illustrated the need for the parents with a lowered threshold to control their sensory world, as they might find their children overbearing. Trying to create a limited sensory environment, while the child craves input in order to reach a calm-alert state might create stress in both the parent and the child, once again limiting the adaptive learning responses from occurring in both the child and parent.

From the above summary it is evident that for the OT to prescribe effective occupations, interactions and environmental adaptations to treat SMD in the child, the parents' reaction to the sensory input required must be taken into account. The effect of the behavioural nature of SMD on interpersonal relationships was found to be greater than merely the sum of its parts. Previous learning by the parent, stress experienced in the workplace and other relational problems may also influence the way in which the parent relates to the child. Similarly stress at school, problems making friends and low self-esteem, all influenced by SMD may also affect the parent-child relationship.

A positive aspect of the study indicated that a moderate probability of agreement occurred between children with SMD and parents who present with good adaptive responses to sensory input. This may indicate that with effective treatment of SMD, development of other serious behavioural and learning psychopathology may be prevented. Ideally a parent with good adaptive responses might choose settings and social circles where the child is at a lesser risk for developing a problem. This parent might have an accurate representation of cognitions regarding self and the world and teach this to the child. There will be relatively little maladaptive interaction on the parent's behalf, which will not reinforce maladaptive behaviour in the child. The care giving environments should also be such that it should act as a buffer to decrease the risk of disorder.

For the parent who however responds in a maladaptive manner, effective intervention in the child with SMD may require intervention in the parent. The parent should understand the role that they play in teaching the child certain behaviours, and the effect that SMD has on their relationship with the child. Once they can effectively address SMD in their lives, they might better understand their child, and achieve a calm-alert state more frequently where they can assist in the treatment of the child with SMD.

The individual also has choices to make in reaction to every sensation experienced, making SMD very personal. The onus and "fault' thus does not lie with the parent alone, and treatment of SMD in the child remains a social responsibility. The teachers, therapists, extended family and friends of the family all have a role to play in helping the child. A great responsibility however lies with the parents as other relationships with teachers and friends tend to come and go, while being a parent to the child remains a lifelong bond.

6.2. Need for further work and recommendations

From this body of work, several areas with a shortage of information in occupational therapy literature was found. Further work that is recommended includes:

- An in depth study into the causality of SMD, such as prenatal factors, co-morbidity, prematurity, etc.
- A study of the overlap and differences of theory and treatment between SMD in the occupational therapy field and temperament in the field of psychology.
- Standardisation of both the Sensory Profile Caregiver Questionnaire and the Adolescent/Adult Sensory Profile on a South African population. This will allow for greater reliability when used in OT evaluations or studies of SMD in a South African population, as well as a comparison between the American and South African population.
- A larger study sample will allow for a more in depth analysis of the agreement between the quadrants, where the more/much more than others categories can be split from the less/much less than others categories. A larger study sample would also allow for an analysis of the influence of SMD in either or both parents on the child, as well as family dynamics, e.g. how many of the children present with SMD, and what are the predominant behavioural patterns in siblings with SMD and their parents.

- An interesting study would also be to look at whether there is an incidence of SMD in a population of children without learning disabilities or psychopathology. As well as an investigation into the support systems that these children have, and how this could be introduced into OT-SI treatment.

- A study of the environmental contributors and support systems for a child with SMD that could prevent learning disabilities from developing.

- A study of the most common behavioural interactions and bonding between a parent with SMD and a child with SMD, and how this differs between a parent without SMD with a child with SMD. An investigation into whether any of these behavioural patterns may act as a preventative measure to developing serious psychopathology and how to implement these within the OT-SI treatment.

- A longitudinal study of SMD in individuals, exploring whether maturation, development and experience has an influence on SMD and behaviour.

- A longitudinal study of the adults' behavioural patterns according to the quadrant profile, and whether this changes at all when a partner or child with SMD is introduced into the family, e.g. does a parent with sensory sensitive behaviour start avoiding sensation in general more when faced with a sensory sensitive or sensation seeking child.

CHAPTER 7: REFERENCES

[1] Engel-Yeger B, Jarus T, Law M. Impact of Culture on Children's Community Participation in Israel. The American Journal of Occupational Therapy. 2007. Vol.61, No.4. p.p.421- 427

[2] Lane SJ, Miller LJ, Anzalone ME, Cermak SA, Osten ET. Concept Evolution in Sensory Integration: A Proposed Nosology for Diagnosis. The American Journal of Occupational Therapy. 2007. Vol.61. No.2. p.p.135-140

[3] Murray Slutsky C, Paris BA. Exploring the Spectrum of Autism and Pervasive Developmental Disorders. United States of America: Therapy Skill Builders, A Harcourt Sciences Company. 2000

[4] Hagedorn R, Occupational Therapy, Perspectives and Processes. New York: Pearson Professional Limited. 1995

[5] Wilbarger J, Stackhouse TM. Sensory Modulation: A Review of the Literature. http://www.ot-innovations.com/sensory_modulation.html (accessed 8/19/2005)

[6] Bundy AC, Lane SJ, Murray EA. Sensory Integration, Theory and Practice 2nd Edition. Philadelphia: F.A. Davis Company. 2002

[7] Dunn W. Sensory Profile, User's Manual. United States of America: The Psychological Corporation. USA. 1999

[8] Miller LJ, Lane SJ. Toward a consensus in terminology in Sensory Integration theory and practice: Part 1 Taxonomy of neurophysiological processes. SI Special Interests Section. 2000. Vol.23. No.1. p.p.1-4

[9] Vaxa; Signs, Symptoms and Background Information on Sensory Integration. http://www.incrediblehorizons.com/sensory-integration.html (accessed 29/10/2005)

[10] Miller LJ, McIntosh DN. The diagnosis, treatment and etiology of sensory modulation disorder. Sensory Integration Special Interest Section Quarterly. 1998. Vol.21.No.1. p.p.1-3

[11] Cohn ES, Miller LJ & Tickle-Degnen L. Parental hopes for therapy outcomes: Children with Sensory Modulation Disorders. American Journal of Occupational Therapy. 2000 Vol.54. p.p.36-43

[12] Parham LD, Mailloux Z, Sensory Integration. In: Case-Smith J, Allen AS& Pratt PN, Occupational Therapy for Children 4th Edition. St. Louis: Mosby. 2000

[13] Smith Roley S, Blanche EI, Schaaf RC. Understanding the Nature of Sensory Integration with Diverse Populations. United States of America: Therapy Skill Builders. 2001

[14] Mangeot SD, Miller LJ, McIntosh DN, McGrath J. Sensory modulation dysfunction in children with attention-deficit-hyperactivity disorder. Developmental Medicine and Child Neurology. 2001 Vol.43. No.6. p.p.399 –406

[15] Messina J, Messina C, Tools for Early Identification and Intervention, 0-5 years Sensory Modulation Training. http://www.coping.org/intervention/sensory/sensorymod.html (accessed 17.11.2005)

[16] Dunn W, Bennet D. Patterns of Sensory Processing in Children With Attention Deficit Hyperactivity Disorder. The Occupational Therapy Journal of Research. Winter 2002. Vol.22. No.1. p.p.4-14

[17] Zeanah CH, Fox NA. Temperament and Attachment Disorders. Journal of Clinical Child and Adolescent Psychology. 2004. Vol.33 No.1. p.p 32-41

[18] Rothbart K, Commentary: Differentiated Measures of Temperament and Multiple Pathways to Childhood Disorders. Journal of Child and Adolescent Psychology. 2004. Vol. 33. No.1. p.p. 82-87

[19] Schaaf RC, Miller LJ. Occupational Therapy using a Sensory Integrative Approach for Children with Developmental Disabilities. Mental Retardation and Developmental Disabilities Research Reviews. 2005. Vol. 11. p.p.143-148

[20] Fisher AG, Murray EA, Bundy AC. Sensory Integration, Theory and Practice. Philadelphia: FA Davis Company. 1991

[21] White BP, Mulligan S, Merrill K, Wright J, An Examination of the Relationships Between Motor and Processing Skills and Scores on the Sensory Profiles. The American Journal of Occupational Therapy. March/April 2007. Vol. 61. No. 2. p.p.154-159

[22] Miller, LJ. Sensational Kids, Hope and Help for Children with Sensory Processing Disorder (SPD). New York: A Perigree Book. 2006

[23] Watson Genna C. Tactile Defensiveness and Other Sensory Modulation Difficulties. Leaven. June-July 2001. Vol. 37 No 3.

[24] Miller LJ, Robinson JA, Moulton D. Sensory Modulation Dysfunction: Identification in Early Childhood. From Handbook of Infant, Toddler, and Preschool Mental Health Assesment, Edited by DelCarmen-Wiggins R, Carter A. New York: Oxford University Press. 2004

[25] Bear MF, Connores BW, Paradiso MA. Neuroscience, Exploring the brain, Canada: Williams & Wilkins. 1996

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

[27] Roley SS, Blanche EI, Schaaf RC. Understanding the nature of sensory integration with diverse populations. USA: Therapy Skill Builders 2001.

[28] Lombaard A. Sensory Modulation. SAISI News. 2001. Vol.11. No.1. p.p.7-12

[29] Harcourt Assessment. 2006. Sensory Profile Select Scoring Assistant. Version 1.0.0. Copyright © Harcourt Assessment. Inc.

[30] Brown CE, Dunn W. Adolescent/Adult Sensory Profile User's Manual. San Antonio, USA: The Psychological Corporation. 2002

[31] Dunn, W. Infant/Toddler Sensory Profile, User's Manual. San Antonio, USA: The Psychological Corporation. 2002

[32] Richardson, A. Toddler Sense, Understanding your toddler's sensory world, the key to a happy, well balanced child. South Africa: Metz Press. 2005

[33] Anzelone, ME. Some thoughts on applying Sensory Integration to children from birth to three years of age. SAISI Newsletter, Vol.18.Nr.3. p.p. 17-21

[34] Mulligan S. An analysis of score patterns of children with attention disorders on the Sensory Integration and Praxis Test. American Journal of Occupational Therapy. 1996. Vol. 50. p.p.647-54

[35] Bundy AC, Shia S, Qi L, Miller LJ. How Does Sensory Processing Dysfunction Affect Play? The American Journal of Occupational Therapy. March/April 2007. Vol. 61. No.2 p.p.201-207

[36] Dimitriades S, Lombaard P, Robinson K, Swanepoel C, van Schalkwyk M, Van Jaarsveld A, Van der Merwe T, Bester I. The Probability of Sensory Modulation Disorders in middle-childhood aged children in Mangaung, Free State diagnosed with Attention Deficit Disorder. SAISI News. 2005. Vol.15. No.1.

[37] Dunn W. Sensory Profile Supplement Users Manual. San Antonio, USA: The Psychological Corporation, A Harcourt Assessment Company. 2006

[38] Ermer J, Dunn W. The Sensory Profile: A Discriminant Analysis of Children With and Without Disabilities. The American Journal of Occupational Therapy, April 1998, Vol.52 No.4. p.p.283-290

[39] Goldsmith HH, Van Hulle CA, Arneson CL, Schreiber JE, Gersbacher MA. A Population-Based Twin Study of Parentally Reported Tactile and Auditory Defensiveness in Young Children. Journal of Abnormal Child Psychology. June 2006. Vol.34. No.3. p.p.393-407

[40] Breidbach O. Neurosemantics, neurons and system theory. Theory Biosci. 2007. Vol.126 p.p.23-33

[41] Rooyen C, Mu K. Stability of tactile defensiveness across cultures: European and American children's responses to the Touch Inventory for Elementary School Aged Children (TIE). Occupational Therapy International. 2003. Vol. 10 No.3. p.p.165-174

[42] Rothbart MK. Temperament, Development and Personality. Association for Psychological Science. 2007. Vol.16 No.4

[43] Ganong, W.F. Review of Medical Physiology, 17th Edition, United States of America: Prentice-Hall International Inc, 1995

[44] Pfeiffer B, Kinnealey M. Treatment of sensory defensiveness in adults. Occupational Therapy International. 2003. Vol 10 No 3, p.p.175-184

[45] Faure M, Richardson A. Baby Sense, South Africa: Metz Press, 2002

[46] Kiernan, JA. Barr's: The Human Nervous System, An Anatomical Viewpoint, International Student Edition, 7th Edition, Philadelphia: Lippencott-Raven Publishers, 1998

[47] Barnard P. Processing Systems, Registration, Orientation, Arousal and Attention, Class Notes, Johannesburg: University of Witwatersrand, January 2005

[48] Low DA, van Ede DM, Low AE. Human Development, 2nd edition. Pretoria: Kagisho Publishers, 1998

[49] Sadock BJ, Sadock VA. Kaplan & Sadock's Synopsis of Psychiatry Behavioural Sciences/Clinical Psychiatry 9th Edition. Philadelphia: Lippencott Williams & Wilkins, 2003

[50] Nigg JT, Goldsmith HH, Sachek JJ. Temperament and attention deficit disorder: The development of a multiple pathway model. Journal of Child and Adolescent Psychology. 2004. Vol. 33. No.1. p.p. 42-53

[51] Statistics.com. Statistical Glossary, Cross sectional data. http://www.statistics.com/resources/glossary/c/crossdat.php (accessed 03/11/08)

[52] StataCorp. 2007. Stata Statistical Software. Release 10. College Station. Tx: StataCorp. LP.

[53] Dunn W. Understanding Sensory Processing. www.psychcorp.com, The Psychological Corporation, A Harcourt Assessment Company. 2003

[54] Smith AM, Roux S, Naidoo NT, Venter DJL. Food choices of tactile defensive children. SAISI Newsletter. 2006. Vol.16. No.1.

[55] Lombaard A. Sensory Modulation A Daily Phenomenon in Adults, SAISI Newsletter. 2004. Vol.14. No.2.

[56] Lombaard A. Sensory Intelligence: Why it matters more importantly than IQ and EQ, South Africa: Metz Press. 2007

[57] Dunn W. The Impact of Sensory Processing Abilities on the Daily Lives of Young Children and Their Families: A Conceptual Model, Infancy and Young Children, Apsen Publishers, Inc. 1997. Vol. 9. No.4. p.p. 23-35

[58] Cermak SA, Henderson A. The Efficacy of Sensory Integration Procedures. Sensory Integration Quarterly. March 1990

[59] Kranowitz MA. The Out-of-Sync Child Has Fun, Activities for Kids with Sensory Integration Dysfunction. New York: Berkley Publishing Group, a division of Penguin Putnam Inc. 2003

[60] Pheiffer B, Kinnealey M. Treatment of sensory defensiveness in adults. Occupational Therapy International. 2003. Vol. 10 No.3. p.p. 175-184

CHAPTER 8: APPENDICES

APPENDIX A

COPY OF THE ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Geyser

CLEARANCE CERTIFICATE	PROTOCOL NUMBER M060224
PROJECT	The Correlation of the Sensory Profiles of Children 5-10 Years with Learning Disabilities and Those of Their Biological....
INVESTIGATORS	Mrs E Geyser
DEPARTMENT	Occupational Therapy Dept
DATE CONSIDERED	06.02.24
DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 06.03.28 CHAIRPERSON .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Mrs D Franzsen

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. I agree to a completion of a yearly progress report.

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX B

LETTER TO OCCUPATIONAL THERAPISTS

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy

7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
E-mail: franzsend@therapy.wits.ac.za

Dear Occupational Therapist

I am Elsje Geyser, I am doing a study as part of my Masters degree in Occupational therapy. This study is aimed at determining the agreement in the sensory profiles of children 3-10 years and those of their biological parents. This will be done using the Sensory Profile, Caregiver Questionnaire and the Adolescent/Adult Sensory Profile.

Should you want to take part in the study, you will be required to gain consent from both biological parents of the children that you have assessed using the Sensory Profile. Once you have collected the consent forms, some of the children will be randomly selected to take part in the study. The biological parents of the children that have been selected will be asked to complete the adolescent/adult Sensory Profile. The researcher will provide the original Sensory Profile, Caregiver Questionnaire and Score Sheet, as well as the Adolescent/Adult Sensory Profiles. The researcher will score the tests.

No parents will be asked to complete a questionnaire should they not give informed consent. If any problem areas are identified, the parents will be informed, should they wish to know the result. As you are the treating therapist, you will be informed of the child's score on the test, should you not have calculated the results in your initial assessment. You will be informed of the parents' results should they give permission for the information to be divulged.

Thank you for your assistance in this regard

_____

Elsje Geyser

Occupational Therapist (B.Occ Ther. UFS)

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy

7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
E-mail: franzsend@therapy.wits.ac.za

I hereby declare that:

- I am participating in this study, entitled, *THE AGREEMENT FOUND BETWEEN THE SENSORY PROFILES OF CHILDREN 3-10 YEARS AND THEIR BIOLOGICAL PARENTS* on my own accord;
- I give permission to the researcher to include children that attend occupational therapy at my practice, in the study;
- I will answer truthfully so that the information will reflect the situation accurately and will contribute to the research;
- I understand why the research is being done;
- I understand that all the information will be treated confidentially and that neither my nor my practice's name will be mentioned in the study or any publications of the results;
- I understand that I have the right to inquire about the results of the Sensory Profile, Caregiver Questionnaire that the parents have completed. And that I will adapt my therapeutic treatment of the child according to the results of the questionnaire.
- I understand that I will only be informed of the parents' Adolescent/Adult Sensory Profile results should they give permission.

Contact details: Name: _____ (for contact purposes only)

Tel (h): _____ (w): _____ (c): _____

_____ _____

Signature Eye witness

_____

Date

APPENDIX C

LETTER OF PERMISSION FROM PARENTS, WHOSE CHILDREN ATTEND OCCUPATIONAL THERAPY

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy

7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
E-mail: franzsend@therapy.wits.ac.za

Dear Father and Mother

I am Elsje Geyser, I am doing a study as part of my Masters degree in Occupational therapy. This study is aimed at determining the agreement between the sensory profiles of children 3-10 years with learning disabilities and those of their biological parents. This will be done using the Sensory Profile, Caregiver Questionnaire and the Adolescent/Adult Sensory Profile.

Should you want to take part in the study, you will be required to give permission for the results of your child's Sensory Profile, that you have completed as part of the initial assessment, to be made known to the researcher. Should you be randomly selected to take part in the study, you will be asked to complete the Adolescent/Adult Sensory Profile, Self Questionnaire. This is not as lengthy as the Sensory Profile, Caregiver Questionnaire and will take approximately 10 minutes to complete. The researcher will score the tests.

You will not be asked to complete a questionnaire should you not give informed consent. If any problem areas are identified, you will be informed, should you wish to know. The treating occupational therapist will continue to treat your child according to the results of your child's Sensory Profile. The therapist will only be informed of the results of your Sensory Profile should you give permission for the information to be divulged. The researcher will provide counseling to you, should you not want to divulge your information to the treating therapist.

Thank you for your assistance in this regard

_____

Elsje Geyser

Occupational Therapist (B.Occ Ther. UFS)

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy
7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
E-mail: franzsend@therapy.wits.ac.za

I _____, mother of, _____ hereby declare that:

- I am participating in this study, entitled *THE AGREEMENT FOUND BETWEEN THE SENSORY PROFILES OF CHILDREN 3-10 YEARS AND THEIR BIOLOGICAL PARENTS* on my own accord;
- I give permission to the treating occupational therapist to reveal the results of the Sensory Profile, Caregiver Questionnaire to the researcher
- I will answer truthfully so that the information will reflect the situation accurately and will contribute to the research
- I am the biological mother of _____ (child's name)
- I understand why the research is being done
- I understand that all the information will be treated confidentially and that neither my, nor my child's name will be mentioned in the study or any publications of the results.
- I understand that I may withdraw from the study at any time, without negatively influencing my child's OT treatment
- I understand that I have the right to inquire about the results of the questionnaire that I completed and that once I have received the information I will receive counseling from the researcher or treating occupational therapist, if I have given consent for information regarding my sensory profile to be divulged, should it be necessary.
- I understand that the treating occupational therapist will not be informed of the outcome of my Sensory Profile, unless I give consent.

Contact details: Name: _____ (for contact purposes only)

Tel (h): _____ (w): _____ (c): _____

Do you wish to know the outcomes?	**YES**	**NO**
Do you give permission for the treating occupational therapist to be informed of the results of the Adolescent/Adult Sensory Profile Self Questionnaire that you have completed?	**YES**	**NO**

Signed_____ at_____;_____/_____/2006(Date)

Eyewitness _____

For office use only				1-3

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy

7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
E-mail: franzsend@therapy.wits.ac.za

I _____, father of, _____ hereby declare that:

- I am participating in this study, entitled *THE AGREEMENT FOUND BETWEEN THE SENSORY PROFILES OF CHILDREN 3-10 YEARS AND THEIR BIOLOGICAL PARENTS* on my own accord;
- I give permission to the treating occupational therapist to reveal the results of the Sensory Profile, Caregiver Questionnaire to the researcher
- I will answer truthfully so that the information will reflect the situation accurately and will contribute to the research
- I am the biological father of _____ (child's name)
- I understand why the research is being done
- I understand that all the information will be treated confidentially and that neither my, nor my child's name will be mentioned in the study or any publications of the results.
- I understand that I may withdraw from the study at any time, without negatively influencing my child's OT treatment
- I understand that I have the right to inquire about the results of the questionnaire that I completed and that once I have received the information I will receive counseling from the researcher or treating occupational therapist, if I have given consent for information regarding my sensory profile to be divulged, should it be necessary.
- I understand that the treating occupational therapist will not be informed of the outcome of my Sensory Profile, unless I give consent.

Contact details: Name: _____ (for contact purposes only)

Tel (h): _____ (w): _____ (c): _____

Do you wish to know the outcomes?	**YES**	**NO**
Do you give permission for the treating occupational therapist to be informed of the results of the Adolescent/Adult Sensory Profile Self Questionnaire that you have completed?	**YES**	**NO**

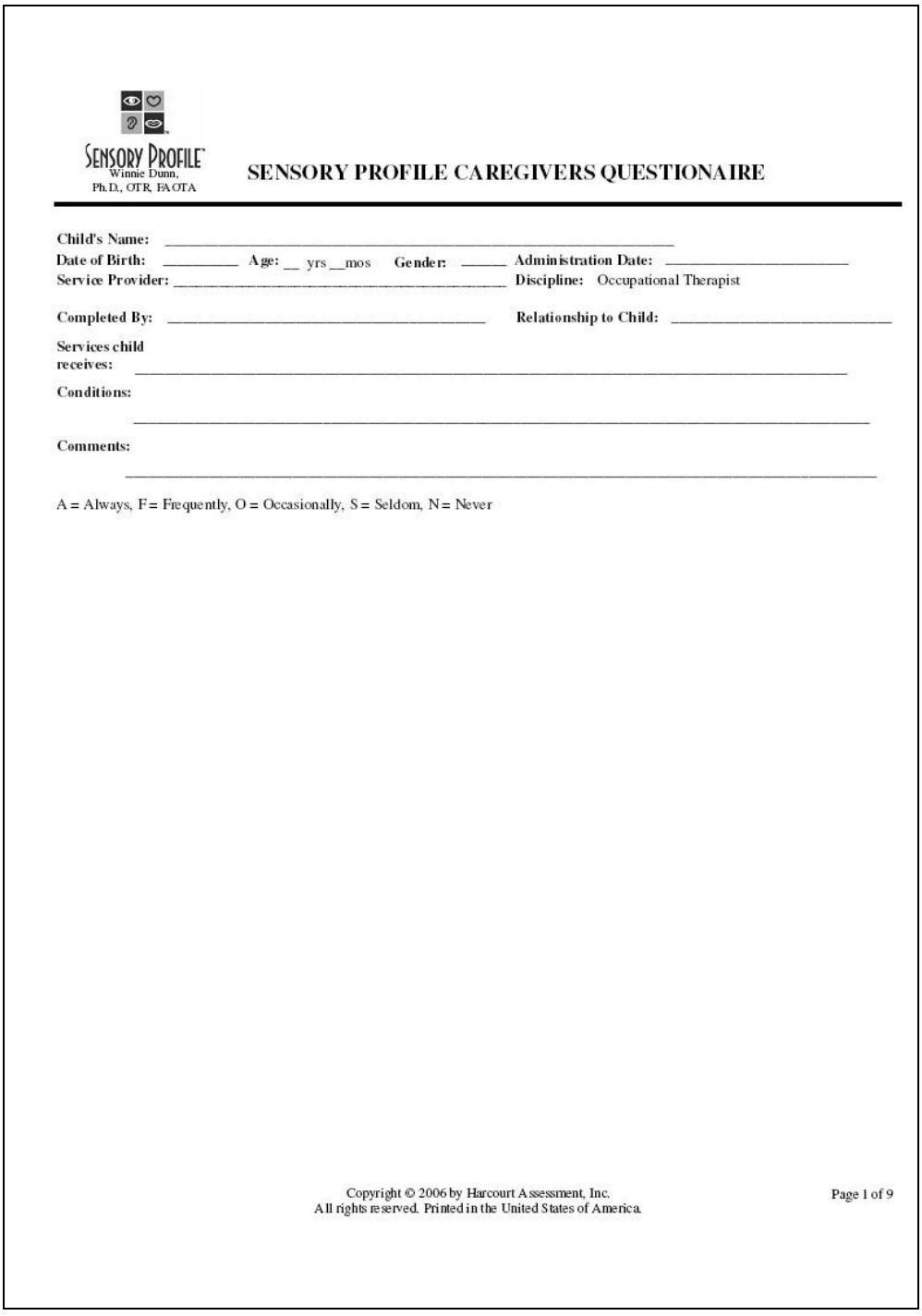
Signed_____ at_____; _____/_____/2006(Date)

Eyewitness _____

For office use only				1-3

APPENDIX D

COMPUTER GENERATED SENSORY PROFILE, CAREGIVER QUESTIONAIRE, ITEM ANALYSIS



SENSORY PROFILE
Winnie Dunn, Ph.D., OTR, FAOTA

SENSORY PROFILE CAREGIVERS QUESTIONAIRE

Child's Name: _____
Date of Birth: _____ Age: __ yrs __mos Gender: _____ Administration Date: _____
Service Provider: _____ Discipline: Occupational Therapist

Completed By: _____ Relationship to Child: _____

Services child receives: _____

Conditions:

_____

Comments:

_____

A = Always, F = Frequently, O = Occasionally, S = Seldom, N = Never

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Page 1 of 9

Sensory Processing

Item		A. Auditory Processing	A	F	O	S	N
	1	Responds negatively to unexpected or loud noises (for example, cries or hides at noise from vacuum cleaner, dog barking, hair dryer)					
	2	Holds hands over ears to protect ears from sound					
	3	Has trouble completing tasks when the radio is on					
	4	Is distracted or has trouble functioning if there is a lot of noise around					
	5	Can't work with background noise (for example, fan, refrigerator)					
	6	Appears to not hear what you say (for example, does not "tune-in" to what you					
	7	Doesn't respond when name is called but you know the child's hearing is OK					
	8	Enjoys strange noises/seeks to make noise for noise's sake					
		Section Raw Score Total					

Item		B. Visual Processing	A	F	O	S	N
	9	Prefers to be in the dark					
	10	Expresses discomfort with or avoids bright lights (for example, hides from sunlight through window in car)					
	11	Happy to be in the dark					
	12	Becomes frustrated when trying to find objects in competing backgrounds (for					
	13	Has difficulty putting puzzles together (as compared to same age children)					
	14	Is bothered by bright lights after others have adapted to the light					
	15	Covers eyes or squints to protect eyes from light					
	16	Looks carefully or intensely at objects/people (for example, stares)					
	17	Has a hard time finding objects in competing backgrounds (for example, shoes					
		Section Raw Score Total					

Item		C. Vestibular Processing	A	F	O	S	N
	18	Becomes anxious or distressed when feet leave the ground					
	19	Dislikes activities where head is upside down (for example, somersaults, roughhousing)					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

	20	Avoids playground equipment or moving toys (for example, swing set, merry-go-round)					
	21	Dislikes riding in a car					
	22	Holds head upright, even when bending over or leaning (for example, maintains a rigid position/posture during activity)					
	23	Becomes disoriented after bending over sink or table (for example, falls or gets dizzy)					
	24	Seeks all kinds of movement and this interferes with daily routines (for example, can't sit still, fidgets)					
	25	Seeks out all kinds of movement activities (for example, being whirled by adult, merry-go-rounds, playground equipment, moving toys)					
	26	Twirls/spins self frequently throughout the day (for example, likes dizzy feeling)					
	27	Rocks unconsciously (for example, while watching TV)					
	28	Rocks in desk/chair/on floor					
		Section Raw Score Total					

Item		**D. Touch Processing**	A	F	O	S	N
	29	Avoids getting "messy" (for example, in paste, sand, finger paint, glue, tape)					
	30	Expresses distress during grooming (for example, fights or cries during haircutting, face washing, fingernail cutting)					
	31	Prefers long-sleeved clothing when it is warm or short sleeves when it is cold					
	32	Expresses discomfort at dental work or toothbrushing (for example, cries or fights)					
	33	Is sensitive to certain fabrics (for example, is particular about certain clothes or bedsheets)					
	34	Becomes irritated by shoes or socks					
	35	Avoids going barefoot especially in sand or grass					
	36	Reacts emotionally or aggressively to touch					
	37	Withdraws from splashing water					
	38	Has difficulty standing in line or close to other people					
	39	Rubs or scratches out a spot that has been touched					
	40	Touches people and objects to the point of irritating others					
	41	Displays unusual need for touching certain toys, surfaces, or textures (for example, constantly touching objects)					
	42	Decreased awareness of pain and temperature					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

	43	Doesn't seem to notice when someone touches arm or back (for example, unaware)					
	44	Avoids wearing shoes; loves to be barefoot					
	45	Touches people and objects					
	46	Doesn't seem to notice when face or hands are messy					
		Section Raw Score Total					

Item		**E. Multisensory Processing**	A	F	O	S	N
	47	Gets lost easily (even in familiar places)					
	48	Has difficulty paying attention					
	49	Looks away from tasks to notice all actions in the room					
	50	Seems oblivious within an active environment (for example, unaware of activity)					
	51	Hangs on people, furniture, or objects even in familiar situations					
	52	Walks on toes					
	53	Leaves clothing twisted on body					
		Section Raw Score Total					

Item		**F. Oral Sensory Processing**	A	F	O	S	N
	54	Gags easily with food textures, or food utensils in mouth					
	55	Avoids certain tastes or food smells that are typically part of children's diets					
	56	Will only eat certain tastes					
	57	Limits self to particular food textures/temperatures					
	58	Picky eater, especially regarding food textures					
	59	Routinely smells nonfood objects					
	60	Shows strong preference for certain smells					
	61	Shows strong preference for certain tastes					
	62	Craves certain foods					
	63	Seeks out certain tastes or smells					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

	64	Chews or licks on nonfood objects			X		
	65	Mouths objects (for example, pencil, hands)			X		
		Section Raw Score Total					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Item		G. Sensory Processing Related to Endurance/Tone	A	F	O	S	N
	66	Moves stiffly					
	67	Tires easily, especially when standing or holding particular body position					
	68	Locks joints (for example, elbows, knees) for stability					
	69	Seems to have weak muscles					
	70	Has a weak grasp					
	71	Can't lift heavy objects (for example, weak in comparison to same age children)					
	72	Props to support self (even during activity)					
	73	Poor endurance/tires easily					
	74	Appears lethargic (for example, has no energy, is sluggish)					
		Section Raw Score Total					

Item		H. Modulation Related to Body Position and Movement	A	F	O	S	N
	75	Seems accident–prone					
	76	Hesitates going up or down curbs or steps (for example, is cautious, stops before moving)					
	77	Fears falling or heights					
	78	Avoids climbing/jumping or avoids bumpy/uneven ground					
	79	Holds onto walls or banisters (for example, clings)					
	80	Takes excessive risks during play (for example, climbs high into a tree, jumps off tall furniture)					
	81	Takes movement or climbing risks during play that compromise personal safety					
	82	Turns whole body to look at you					
	83	Seeks opportunities to fall without regard to personal safety					
	84	Appears to enjoy falling					
		Section Raw Score Total	40				

Item		I. Modulation of Movement Affecting Activity Level	A	F	O	S	N
	85	Spends most of the day in sedentary play (for example, does quiet things)					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

	86	Prefers quiet, sedentary play (for example, watching TV, books, computers)					
	87	Seeks sedentary play options					
	88	Prefers sedentary activities					
	89	Becomes overly excitable during movement activity					
	90	"On the go"					
	91	Avoids quiet play activities					
		Section Raw Score Total					

Item		**J. Modulation of Sensory Input Affecting Emotional Responses**	A	F	O	S	N
	92	Needs more protection from life than other children (for example, defenseless physically or emotionally)					
	93	Rigid rituals in personal hygiene					
	94	Is overly affectionate with others					
	95	Doesn't perceive body language or facial expressions (for example, unable to interpret)					
		Section Raw Score Total					

Item		**K. Modulation of Visual Input Affecting Emotional Responses and Activity Level**	A	F	O	S	N
	96	Avoids eye contact					
	97	Stares intensively at objects or people					
	98	Watches everyone when they move around the room					
	99	Doesn't notice when people come into the room					
		Section Raw Score Total					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Item		L. Emotional/Social Responses	A	F	O	S	N
	100	Seems to have difficulty liking self (for example, low self-esteem)					
	101	Has trouble "growing up" (for example, reacts immaturely to situations)					
	102	Is sensitive to criticisms					
	103	Has definite fears (for example, fears are predictable)					
	104	Seems anxious					
	105	Displays excessive emotional outbursts when unsuccessful at a task					
	106	Expresses feeling like a failure					
	107	Is stubborn or uncooperative					
	108	Has temper tantrums					
	109	Poor frustration tolerance					
	110	Cries easily					
	111	Overly serious					
	112	Has difficulty making friends (for example, does not interact or participate in group play)					
	113	Has nightmares					
	114	Has fears that interfere with daily routine					
	115	Doesn't have a sense of humor					
	116	Doesn't express emotions					
		Section Raw Score Total					

Item		M. Behavioral Outcomes of Sensory Processing	A	F	O	S	N
	117	Talks self through tasks					
	118	Writing is illegible					
	119	Has trouble staying between the lines when coloring or when writing					
	120	Uses inefficient ways of doing things (for example, wastes time, moves slowly, does things a harder way than is needed)					
	121	Has difficulty tolerating changes in plans and expectations					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

	122	Has difficulty tolerating changes in routines					
		Section Raw Score Total					

Item		**N. Items Indicating Thresholds for Response**	A	F	O	S	N
	123	Jumps from one activity to another so that it interferes with play					
	124	Deliberately smells objects					
	125	Does not seem to smell strong odors					
		Section Raw Score Total					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

APPENDIX E

COMPUTER GENERATED ADOLESCENT/ ADULT SENSORY PROFILE, ITEM ANALYSIS



Item Analysis Report

Examinee's Name: _____

Date of Birth: _____ **Age:** _____ **Gender:** _____ **Administration Date:** _____

Comments:

_____
_____
_____

AN = Almost Never, S = Seldom, O = Occasionally, F = Frequently, AA = Almost Always

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Sensory Processing

Item		A. Taste/Smell Processing	AN	S	O	F	AA
	1	I leave or move to another section when I smell a strong odor in a store (for example, bath products, candles, perfumes).					
	2	I add spice to my food.					
	3	I don't smell things that other people say they smell.					
	4	I enjoy being close to people who wear perfume or cologne.					
	5	I only eat familiar foods.					
	6	Many foods taste bland to me (in other words, food tastes plain or does not have a lot of flavor).					
	7	I don't like strong tasting mints or candies (for example, hot/cinnamon or sour candy).					
	8	I go over to smell fresh flowers when I see them.					

Item		B. Movement Processing	AN	S	O	F	AA
	9	I'm afraid of heights.					
	10	I enjoy how it feels to move about (for example, dancing, running).					
	11	I avoid elevators and/or escalators because I dislike the movement.					
	12	I trip or bump into things.					
	13	I dislike the movement of riding in a car.					
	14	I choose to engage in physical activities.					
	15	I am unsure of footing when walking on stairs (for example, I trip, lose balance, and/or need to hold the rail).					
	16	I become dizzy easily (for example, after bending over, getting up too fast).					

Item		C. Visual Processing	AN	S	O	F	AA
	17	I like to go to places that have bright lights and that are colorful.					
	18	I keep the shades down during the day when I am at home.					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

	19	I like to wear colorful clothing.					
	20	I become frustrated when trying to find something in a crowded drawer or messy room.					
	21	I miss the street, building, or room signs when trying to go somewhere new.					
	22	I am bothered by unsteady or fast moving visual images in movies or TV.					
	23	I don't notice when people come into the room.					
	24	I choose to shop in smaller stores because I'm overwhelmed in large stores.					
	25	I become bothered when I see lots of movement around me (for example, at a busy mall, parade, carnival).					
	26	I limit distractions when I am working (for example, I close the door, or turn off the TV).					

Item		D. Touch Processing	AN	S	O	F	AA
	27	I dislike having my back rubbed.					
	28	I like how it feels to get my hair cut.					
	29	I avoid or wear gloves during activities that will make my hands messy.					
	30	I touch others when I'm talking (for example, I put my hand on their shoulder or shake their hands).					
	31	I am bothered by the feeling in my mouth when I wake up in the morning.					
	32	I like to go barefoot.					
	33	I'm uncomfortable wearing certain fabrics (for example, wool, silk, corduroy, tags in clothing).					
	34	I don't like particular food textures (for example, peaches with skin, applesauce, cottage cheese, chunky peanut butter).					
	35	I move away when others get too close to me.					
	36	I don't seem to notice when my face or hands are dirty.					
	37	I get scrapes or bruises but don't remember how I got them.					
	38	I avoid standing in lines or standing close to other people because I don't like to get too close to others.					
	39	I don't seem to notice when someone touches my arm or back.					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Item		E. Activity Level	AN	S	O	F	AA
	40	I work on two or more tasks at the same time.					
	41	It takes me more time than other people to wake up in the morning.					
	42	I do things on the spur of the moment (in other words, I do things without making a plan ahead of time).					
	43	I find time to get away from my busy life and spend time by myself.					
	44	I seem slower than others when trying to follow an activity or task.					
	45	I don't get jokes as quickly as others.					
	46	I stay away from crowds.					
	47	I find activities to perform in front of others (for example, music, sports, acting, public speaking, and answering questions in class).					
	48	I find it hard to concentrate for the whole time when sitting in a long class or a meeting.					
	49	I avoid situations where unexpected things might happen (for example, going to unfamiliar places or being around people I don't know).					

Item		F. Auditory Processing	AN	S	O	F	AA
	50	I hum, whistle, sing, or make other noises.					
	51	I startle easily at unexpected or loud noises (for example, vacuum cleaner, dog barking, telephone ringing).					
	52	I have trouble following what people are saying when they talk fast or about unfamiliar topics.					
	53	I leave the room when others are watching TV, or I ask them to turn it down.					
	54	I am distracted if there is a lot of noise around.					
	55	I don't notice when my name is called.					
	56	I use strategies to drown out sound (for example, close the door, cover my ears, wear ear plugs).					
	57	I stay away from noisy settings.					
	58	I like to attend events with a lot of music.					
	59	I have to ask people to repeat things.					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

	60	I find it difficult to work with background noise (for example, fan, radio).					

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

APPENDIX F

LETTER OF PERMISSION FROM PARENTS OF CHILDREN FROM OTHER SOURCES

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy

7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
E-mail: franzsend@therapy.wits.ac.za

Dear Father and Mother

I am Elsje Geyser, I am doing a study as part of my Masters Degree in Occupational therapy. This study is aimed at determining the agreement of the sensory modulation of children 3-10 years and those of their biological parents. This will be done using the Sensory Profile, Caregiver Questionnaire and the Adolescent/Adult Sensory Profile.

I would like to invite you to take part in the study relating to the causes of sensory modulation dysfunction. Sensory Modulation refers to the brain's ability to filter out unnecessary sensations and attend to important sensations. A well modulated individual adapts to changes in the environment easily, and has a level of attention appropriate for activity participation. The person then responds to sensations in direct proportion to the input.

Individuals with sensory modulation dysfunction may be distracted and overly active. It may also lead to extreme need for personal space and a need for rigid routines, as well as motion sickness and fear of heights. On the other hand one may be inattentive and generally clumsy. How you and your child relate to sensations also influence how you relate to each other. For instance, if your child is generally sensory seeking, your child will want to cuddle and play often. If you on the other hand tend to avoid touch sensations, this constant touching will irritate you and place strain on your relationship. An understanding of how you and your child relate to sensations will benefit how you relate to each other and positively influence your relationship.

Should you volunteer to take part in the study, you will be required to complete a Sensory Profile, Caregiver Questionnaire. This is a questionnaire with 125 questions relating to how your child reacts to sensations. You will both be asked to complete the Adolescent/Adult Sensory Profile, Self Questionnaire. This relates to how you react to sensations. This is not as lengthy as the Sensory Profile, Caregiver Questionnaire and will take approximately 10 minutes to complete.

The questions will evaluate reactions to tastes and smells, movement, visual input, touch and sounds. The researcher will score the tests using a computer program called the Sensory Profile Select Scoring Assistant.

The sensory profiles will plot your and your child's behavioural reactions to touch, visual, sound, smell, taste and movement sensations. This will determine whether you are likely to be more sensitive, or dormant to sensory input.

Computer generated reports will be given to you should you wish to know the outcomes of the tests.

Please understand that even if you give consent you may withdraw from the study at any time with out any detriment to yourselves or your child.

If any problem areas are identified, you will be informed, should you wish to know. A list of Occupational Therapists trained in sensory integration treatment is available on request from the researcher, in case you require a full evaluation to be done. This test only constitutes a small part of an Occupational Therapy evaluation. The researcher will provide counseling to you, should you not want to consult another therapist.

Thank you for your assistance in this regard

_____

Elsje Geyser
Occupational Therapist (B.Occ Ther. UFS)

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy
7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
E-mail: franzsend@therapy.wits.ac.za

_____, mother of, _____ hereby declare that:

- I am participating in this study, entitled *THE AGREEMENT FOUND BETWEEN THE SENSORY PROFILES OF CHILDREN 3-10 YEARS AND THEIR BIOLOGICAL PARENTS* on my own accord;
- I will answer truthfully so that the information will reflect the situation accurately and will contribute to the research
- I am the biological mother of _____ (child's name)
- I understand why the research is being done
- I understand that all the information will be treated confidentially and that neither my, nor my child's name will be mentioned in the study or any publications of the results.
- I understand that I may withdraw from the study at any time, without negatively influencing my child's OT treatment
- I understand that I have the right to inquire about the results of the questionnaire that I completed and that once I have received the information I will receive counseling from the researcher or treating occupational therapist, if I have given consent for information regarding my sensory profile to be divulged, should it be necessary.

Contact details: Name: _____ (for contact purposes only)

Tel (h): _____ (w): _____ (c): _____

Do you wish to know the outcomes?	**YES**	**NO**
Do you give permission for the treating occupational therapist to be informed of the results of the Adolescent/Adult Sensory Profile Self Questionnaire that you have completed?	**YES**	**NO**

Signed_____ at_____;_____/_____/2006(Date)

Eyewitness _____

For office use only				1-3

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy

7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
E-mail: franzsend@therapy.wits.ac.za

I _____, father of, _____ hereby declare that:

- I am participating in this study, entitled *THE AGREEMENT FOUND BETWEEN THE SENSORY PROFILES OF CHILDREN 3-10 YEARS AND THEIR BIOLOGICAL PARENTS* on my own accord;
- I will answer truthfully so that the information will reflect the situation accurately and will contribute to the research
- I am the biological father of _____ (child's name)
- I understand why the research is being done
- I understand that all the information will be treated confidentially and that neither my, nor my child's name will be mentioned in the study or any publications of the results.
- I understand that I may withdraw from the study at any time, without negatively influencing my child's OT treatment
- I understand that I have the right to inquire about the results of the questionnaire that I completed and that once I have received the information I will receive counseling from the researcher or treating occupational therapist, if I have given consent for information regarding my sensory profile to be divulged, should it be necessary.

Contact details: Name: _____ (for contact purposes only)

Tel (h): _____ (w): _____ (c): _____

Do you wish to know the outcomes?	**YES**	**NO**
Do you give permission for the treating occupational therapist to be informed of the results of the Adolescent/Adult Sensory Profile Self Questionnaire that you have completed?	**YES**	**NO**

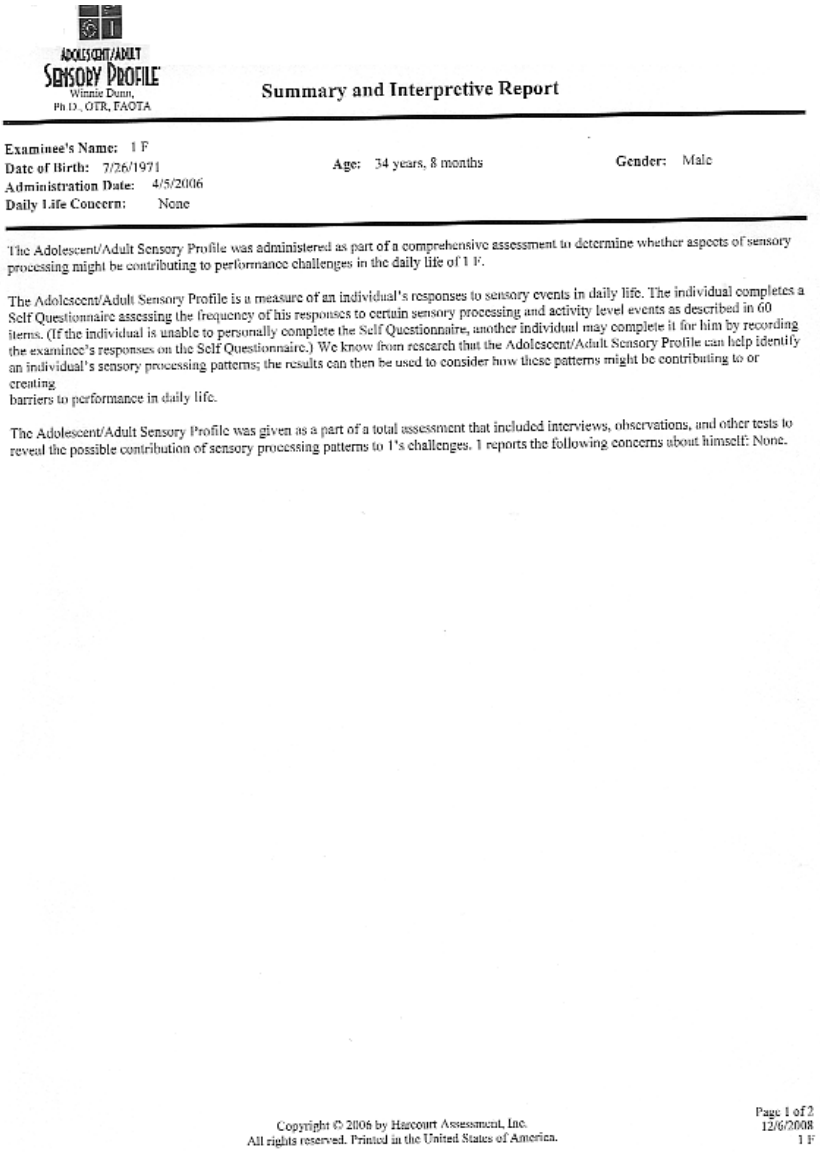
Signed_____ at_____;_____/_____/2006(Date)

Eyewitness _____

For office use only				1-3

APPENDIX G

EXAMPLE OF COMPUTER GENERATED REPORT OF ADOLESCENT/ADULT SELF QUESTIONAIRE GIVEN TO PARENTS UPON REQUEST



ADOLESCENT/ADULT SENSORY PROFILE
Winnie Dunn, Ph.D., OTR, FAOTA

Summary and Interpretive Report

Examinee's Name: 1 F
Date of Birth: 7/26/1971 **Age:** 34 years, 8 months **Gender:** Male
Administration Date: 4/5/2006
Daily Life Concern: None

The Adolescent/Adult Sensory Profile was administered as part of a comprehensive assessment to determine whether aspects of sensory processing might be contributing to performance challenges in the daily life of 1 F.

The Adolescent/Adult Sensory Profile is a measure of an individual's responses to sensory events in daily life. The individual completes a Self Questionnaire assessing the frequency of his responses to certain sensory processing and activity level events as described in 60 items. (If the individual is unable to personally complete the Self Questionnaire, another individual may complete it for him by recording the examinee's responses on the Self Questionnaire.) We know from research that the Adolescent/Adult Sensory Profile can help identify an individual's sensory processing patterns; the results can then be used to consider how these patterns might be contributing to or creating
barriers to performance in daily life.

The Adolescent/Adult Sensory Profile was given as a part of a total assessment that included interviews, observations, and other tests to reveal the possible contribution of sensory processing patterns to 1's challenges. 1 reports the following concerns about himself: None.

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Summary of Scores

The following paragraphs describe 1's performance on the Adolescent/Adult Sensory Profile. Please also refer to the Summary Score report for a visual summary of his scores.

Quadrant Scores

1 obtained scores indicating performance similar to most people in:

- Sensory Sensitivity
- Sensation Avoiding

1 scored in the Less than Most People and More than Most People range in these quadrants which indicates the possible need for further testing in these areas:

- Low Registration
- Sensation Seeking

Individuals with low registration tend to miss or take longer to respond to stimuli that others notice. In general, they may have trouble reacting to rapidly presented or low-intensity stimuli. They may not detect a smell that bothers everyone else in the room, or may be the last one in the room to understand a joke. On the other hand, such individuals find it easier to focus on tasks of interest in distracting environments.

Individuals with "Much Less than Most People" and "Less than Most People" scores in Low Registration do not miss sensory stimuli; however this does not necessarily mean that they are sensitive; they are not likely to overlook stimuli in their environment.

Individuals with sensation seeking behaviors create additional stimuli or look for environments that provide sensory stimuli. They have an
interest in exploring the environment and generally regard sensory experiences as pleasurable. These individuals also may tend to become
easily bored and may find low-stimulus environments intolerable.

Individuals with "Much More than Most People" and "More than Most People" scores in the Sensation Seeking quadrant may strive to increase sensory experiences to the point that performance in activities of daily life are impacted. Their behavior may be disturbing to others.

Interpretation of Scores

1 is having difficulty with some aspects of the activities of daily life. He indicated that he is having difficulty in the following areas: None.
The Adolescent/Adult Sensory Profile scores reveal that 1 can successfully use and understand some sensory information, and has difficulty understanding and using other sensory information.

Whenever possible, the team needs to use 1's areas of strength to support his performance. His strengths lie in the areas of:

- Sensory Sensitivity
- Sensation Avoiding

1 is having difficulty with other ways of processing sensory information and these are likely to be interfering with activities of daily life. He is having difficulty with:

- Low Registration
- Sensation Seeking

Quadrant Interpretation

Individuals with a "less than others" low registration pattern can profit from more familiar surroundings, and learning how to screen out background stimuli so that their noticing does not interfere with their daily experiences. With more familiar sensory input, these individuals can continue to pay attention to a task and stay with an activity for a longer period of time before moving on to another activity
or task.

Individuals with a "more than others" sensation seeking pattern can more easily engage in the demands of a task by obtaining additional sensory input before and during the task. They can obtain more sensory input by incorporating something new into a daily routine, or by engaging in physical activity before participating in task that does not require movement.

Other assessments, interviews, and observations should augment the information obtained from the Adolescent/Adult Sensory Profile results to identify 1's sensory processing features. Information will be made available to those who interact frequently with 1 to construct additional plans to support 1's participation in daily activities, with a special focus on sensory processing needs.

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

APPENDIX H

EXAMPLE OF COMPUTER GENERATED REPORT OF SENSORY PROFILE, CAREGIVER QUESTIONAIRE GIVEN TO PARENTS UPON REQUEST

SENSORY PROFILE™
Winnie Dunn, Ph.D., OTR, FAOTA

Summary and Interpretive Report

Child's Name: 2 C
Date of Birth: 6/9/2000
Age: 5 years 10 months
Service Provider: Sanmarie Bongers

Gender: Male
Administration Date: 4/29/2006

Discipline: Occupational Therapist

Completed by: 2M

Relationship to Child: Mother

Daily Life Concern: None

The Sensory Profile was administered as part of a comprehensive assessment to determine whether aspects of sensory processing might be contributing to performance challenges in the daily life of 2 C.

The Sensory Profile is a measure of children's responses to sensory events in daily life. The caregiver completes the Sensory Profile by assessing the frequency of a child's responses to certain sensory processing, modulation, and behavioral/emotional events as described in 125 items. We know from research that the Sensory Profile can help identify a child's sensory processing patterns; the results can then be used to consider how these patterns might be contributing to or creating barriers to performance in daily life.

The Sensory Profile was given as a part of a total assessment that included interviews, observations, and other tests to reveal the possible contribution of sensory processing patterns to 2's challenges. 2M, 2's mother, reports the following concerns about 2: None.

Summary of Scores

The following paragraphs describe 2's performance on the Sensory Profile. Please also refer to the Summary Score report for a visual summary of his scores.

Sensory Processing

2 obtained scores that indicate typical performance in the following section:

- Visual Processing

Typical performance indicates that 2 uses these sensory inputs successfully.

Therefore, 2 uses Visual input effectively to make sense of what is going on around him.

2 has difficulty in the following sections:

- Auditory Processing
- Vestibular Processing
- Touch Processing
- Multisensory Processing
- Oral Sensory Processing

These areas are most likely to provide challenges for 2. When children have difficulty in a sensory system, it means that this form of sensory input is confusing, upsetting, or not meaningful to the child. In any case, difficulty with sensory input can interfere with 2's ability to complete important activities as successfully as other children do. The team will need to conduct additional observations to determine the contribution of these areas to his performance challenges.

Modulation

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

The following scores for Modulation sections are within the Probable Difference – More than Others and/or Probable Difference – Less than Others ranges:

- Sensory Processing Related to Endurance/Tone
- Modulation of Movement Affecting Activity Level
- Modulation of Sensory Input Affecting Emotional Responses
- Modulation of Visual Input Affecting Emotional Responses and Activity Level

Further evaluation is recommended, particularly additional skilled observation to determine how 2 modulates input during the demands of daily life.

He has difficulty with:

- Modulation Related to Body Position and Movement

This means the child will have problems in the following areas:

- Sitting for long periods, remaining alert and maintaining participation with peers.
- Anticipating how to move around safely, without clumsiness, incoordination, or frequent injuries.
- Determining the appropriate responses for situations, being too excited or too withdrawn for demands of tasks at different times.
- Responding appropriately to social and environmental cues, becoming inflexible or upset by situations more easily than others.
- Understanding the meaning and usefulness of visual information resulting in inappropriate responses.

Behavioral and Emotional Response

The following sections were in the Definite Difference – More than Others and/or Definite Difference Less than Others sections:

- Difficulty with Emotional/Social Responses indicates that 2 becomes frustrated or upset easily. These responses can sometimes be related to confusing information from the sensory systems. In some cases, 2's nervous system is not interpreting the input in a meaningful way, leading to his sense of disruption with what is going around him.
- Difficulty with Behavioral Outcomes of Sensory Processing indicates that 2 may have difficulty completing tasks or may produce poor quality work. When sensory processing is also difficult for him, a poor score here suggests a relationship between performance demands and ability or efficiency in performing tasks.
- Difficulty with Items Indicating Thresholds for Response indicates that 2 is having difficulty identifying relevant stimuli. That is, he may need support in order to notice the most important stimuli and react appropriately to those stimuli.

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Quadrant Summary

2 obtained scores in the Probable Difference – More than Others, and/or Probable Difference – Less Than Others ranges in this quadrant which indicates the need for further testing in this area:

- Registration

2 obtained scores in the Definite Difference – More than Others, and/or Definite Difference – Less Than Others ranges in these quadrants:

- Seeking
- Sensitivity
- Avoiding

Children with a Registration pattern tend to miss or take longer to respond to stimuli that others notice. In general, they may have trouble reacting to rapidly presented or low-intensity stimuli. These children may appear withdrawn, uninterested, have low energy levels and act as if they are overly tired all the time.

When children have a "more than others" score in the Registration pattern, this means they notice things less than others. They may not be bothered by things that bother others, but they also may not respond when you call them and have a harder time getting tasks completed in a timely manner.

Children with a Seeking pattern are active and continuously engaged in their environments. These children add sensory input to every experience in daily life. They may appear excitable or seem to lack consideration for safety while playing.

When children have a "more than others" score in the Seeking pattern, this means that they enjoy sensory experiences and seek sensory input. Their interest in sensory events might also lead to difficulties with task completion because they may get distracted with new sensory experiences and lose track of daily life tasks.

Children with a Sensitivity pattern have a high ability to notice what is going on in their environment. They tend to be distractible and may display hyperactivity. They have a pattern of directing their attention to the latest stimulus that presents itself, which draws them away from whatever they are trying to accomplish.

When children have a "more than others" score in the Sensitivity pattern, this means that they notice things more than others, picking up on more details in life. They can be bothered by things that others may not even notice. However, noticing more can also mean these children get interrupted from getting tasks completed in a timely manner.

Children with an Avoiding pattern cope with stimuli by keeping it at bay, either by withdrawing from the stimuli or by engaging in an emotional outburst that enables them to get out of the threatening situation.

When children have a "more than others" score in the Avoiding pattern, this means that they notice and are bothered by things much more than others. They may enjoy being alone or in very quiet places. When environments are too challenging, these children may withdraw and therefore not get activities completed in daily life.

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Interpretation of Scores

2 is having difficulty with some aspects of the activities of daily life. 2M, his Mother, indicated that 2 is having difficulty in the following area: None. The Sensory Profile scores reveal that 2 can successfully use and understand some sensory information, and has difficulty understanding and using other sensory information

2 is having difficulty with other ways of processing sensory information and these are likely to be interfering with activities of daily life. He is having difficulty with

- Auditory Processing
- Vestibular Processing
- Touch Processing
- Multisensory Processing
- Oral Sensory Processing
- Sensory Processing Related to Endurance/Tone
- Modulation of Movement Affecting Activity Level
- Modulation of Sensory Input Affecting Emotional Responses
- Modulation of Visual Input Affecting Emotional Responses and Activity Level
- Emotional/Social Responses
- Behavioral Outcomes of Sensory Processing
- Items Indicating Threshold for Response
- Registration
- Seeking
- Sensitivity
- Avoiding

Quadrant Interpretation

Children with a "more than others" score in the Registration pattern can profit from more intensity in sensory experiences during daily life With more intensity of sensory input, these children can continue to pay and maintain attention to the activities of their daily lives.

Children with a "more than others" score in the Seeking pattern can profit from more intensity in experiences as part of daily life so they do not have to stop engaging in daily activities to get the extra sensory input they desire. With more intensity of sensory input, these children can continue to pay attention and stay with an activity for a longer period of time before moving on to another activity.

Children with a "more than others" score in the Sensitivity pattern can profit from more structured patterns of sensory experiences during daily life. With more structure of sensory input, these children can continue to pay attention and stay with an activity for a longer period of time before moving on to another activity.

Children with a "more than others" score in the Avoiding pattern will be better able to participate in everyday life when there is less sensory input available in the environment. When the environment is "quiet," these children can continue to pay attention and stay with an activity for a longer period of time before moving on to another activity.

Other assessments, interviews, and observations should augment the information obtained from Sensory Profile results to identify 2's sensory processing features. Sanmarie Bongers will provide input to 2's teachers and caregivers to construct additional plans to support 2's participation in daily activities, with a special focus on sensory processing needs.

Sanmarie Bongers
Occupational Therapist

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

APPENDIX I

EXAMPLE OF COMPUTER GENERATED QUADRANT GRID, RAW SCORES/CLASSIFICATIONS FOR THE SENSORY PROFILE, *CAREGIVER QUESTIONAIRE*

SENSORY PROFILE
Winnie Dunn, Ph.D., OTR, FAOTA

Caregiver Questionnaire (Full) Report

Child's Name: 1 C
Date of Birth: 10/5/1998 **Age:** 6 yrs 10 mos **Gender:** Male **Administration Date:** 8/8/2005
Service Provider: Sanmarie Bongers **Discipline:** Occupational Therapist

Completed by: 1M **Relationship to Child:** Mother

Services:
None

Conditions:
None

Comments:
None

Section Comments:
None

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Quadrant Raw Scores/Classifications

	← Less than Others*			More than Others → *		
Quadrants	**Quadrant Raw Score Total**	**Definite Difference**	**Probable Difference**	**Typical Performance**	**Probable Difference**	**Definite Difference**
1. Registration	47/75	**	75 ------- 73	72 ------- 64	63 ------- 59	58 ---X--- 15
2. Seeking	85/130	**	130 ------- 124	123 -------	102 ------- 92	91 ---X--- 26
3. Sensitivity	63/100	**	100 ------- 95	94 ------- 81	80 ------- 73	72 ---X--- 20
4. Avoiding	96/145	145 ------- 141	140 ------- 134	133 -------	112 ------- 103	102 ---X--- 29

*See Expanded Cut Score Theory explanation in Sensory Profile Supplement.
**There can be no Definite Difference for this quadrant.

Classifications are based on the performance of children without disabilities (n = 1,037).

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Quadrant Grid

Quadrant 1		
Registration		
Item		Raw Score
	6	2
	7	1
	47	4
	50	4
	53	4
	66	4
	67	3
	68	4
	69	3
	70	3
	71	2
	72	4
	73	2
	74	3
	75	4
Quadrant Raw Score Total		47

Quadrant 2		
Seeking		
Item		Raw Score
	8	4
	24	3
	25	3
	26	4
	27	4
	28	4
	40	4
	41	4
	44	4
	45	4
	46	3
	51	3
	59	4
	60	2
	61	2
	62	2
	63	4
	80	3
	81	3
	82	3

Quadrant 3		
Sensitivity		
Item		Raw Score
	3	3
	4	1
	14	4
	18	4
	19	4
	21	4
	30	3
	31	4
	32	2
	33	4
	34	4
	39	4
	48	3
	49	1
	55	4
	56	2
	57	4
	58	4
	77	1
	78	3

Quadrant 4		
Avoiding		
Item		Raw Score
	1	4
	2	4
	5	4
	9	4
	10	4
	11	4
	15	4
	20	4
	22	4
	29	4
	36	4
	37	4
	54	3
	76	3
	85	2
	86	2
	87	4
	88	4
	93	4
	103	3

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

	83	4
	84	4
	89	1
	90	4
	94	4
	123	1
Quadrant Raw Score Total		85

Quadrant Raw Score Total	63

	104	2
	105	1
	107	2
	108	1
	109	2
	110	3
	111	4
	112	4
	114	4
Quadrant Raw Score Total		96

Icon	Description
	Auditory
	Visual
	Activity Level
	Taste/Smell
	Body Position
	Movement
	Touch
	Emotional/Social

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

APPENDIX J

EXAMPLE OF COMPUTER GENERATED QUADRANT GRID, RAW SCORE AND CLASSIFICATIONS AND BEHAVIOURAL RESPONSE CONTINUUM FOR THE ADOLESCENT/ADULT SENSORY PROFILE

ADOLESCENT/ADULT SENSORY PROFILE
Winnie Dunn, Ph.D., OTR, FAOTA

Self Questionnaire (Full) Report

Examinee's Name: 1 F
Date of Birth: 7/26/1971 **Age:** 34 yrs 8 mos **Gender:** Male **Administration Date:** 4/5/2006

General Comments:
None

Section Comments:
None

Quadrant Raw Scores/Classifications*

Quadrants	Quadrant Raw Score Total	Much Less Than Most People	Less Than Most People	Similar To Most People	More Than Most People	Much More Than Most People
		--	—	=	+	++
1. Low Registration	21/75	15 ------- 18	19 ---X-- 23	24 ------- 35	36 ------- 44	45 -------
2. Sensation Seeking	61/75	15 ------- 35	36 ------- 42	43 ------- 56	57 ---X-- 62	63 -------
3. Sensory Sensitivity	29/75	15 ------- 18	19 ------- 25	26 ---X--- 41	42 ------- 48	49 -------
4. Sensation Avoiding	36/75	15 ------- 19	20 ------- 26	27 ---X--- 41	42 ------- 49	50 -------

*Classifications are based on the performance of individuals without disabilities (n = 496).

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

Quadrant Grid

Quadrant 1	
Low Registration	
Item	Raw Score
3	1
6	1
12	1
15	1
21	1
23	5
36	1
37	3
39	1
41	1
44	1
45	1
52	1
55	1
59	1
Quadrant Raw Score Total	21

Quadrant 2	
Sensation Seeking	
Item	Raw Score
2	5
4	5
8	5
10	5
14	5
17	5
19	5
28	5
30	3
32	5
40	5
42	3
47	2
50	1
58	2
Quadrant Raw Score Total	61

Quadrant 3	
Sensory Sensitivity	
Item	Raw Score
7	1
9	1
13	1
16	2
20	5
22	1
25	1
27	2
31	1
33	5
34	1
48	1
51	1
54	5
60	1
Quadrant Raw Score Total	29

Quadrant 4	
Sensation Avoiding	
Item	Raw Score
1	1
5	5
11	1
18	1
24	1
26	1
29	5
35	5
38	4
43	2
46	3
49	4
53	1
56	1
57	1
Quadrant Raw Score Total	36

Legend



= Low Registration

= Sensation Seeking

= Sensory Sensitivity

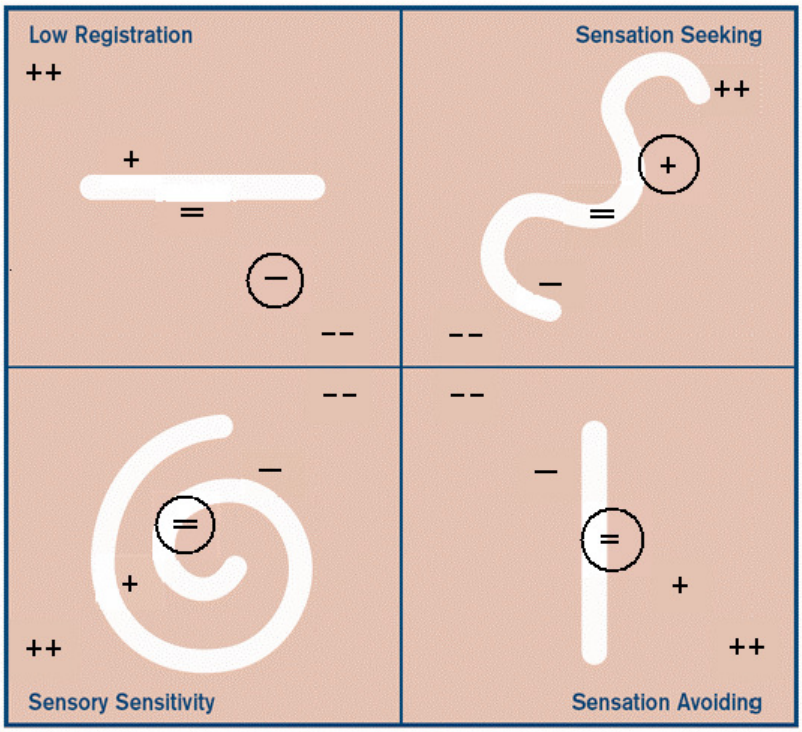
= Sensation Avoiding

Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

The following symbols are used to represent the classifications on the Quadrant Profile:

−− Much Less Than Most People
− Less Than Most People
= Similar to Most People
\+ More than Most People
++ Much More Than Most People

Quadrant Profile



Copyright © 2006 by Harcourt Assessment, Inc.
All rights reserved. Printed in the United States of America.

APPENDIX K

CALCULATIONS USED IN STUDY

All examples of calculations are based on the father's sensory profile depicted in Figure 8-1. The father achieved the following classifications:

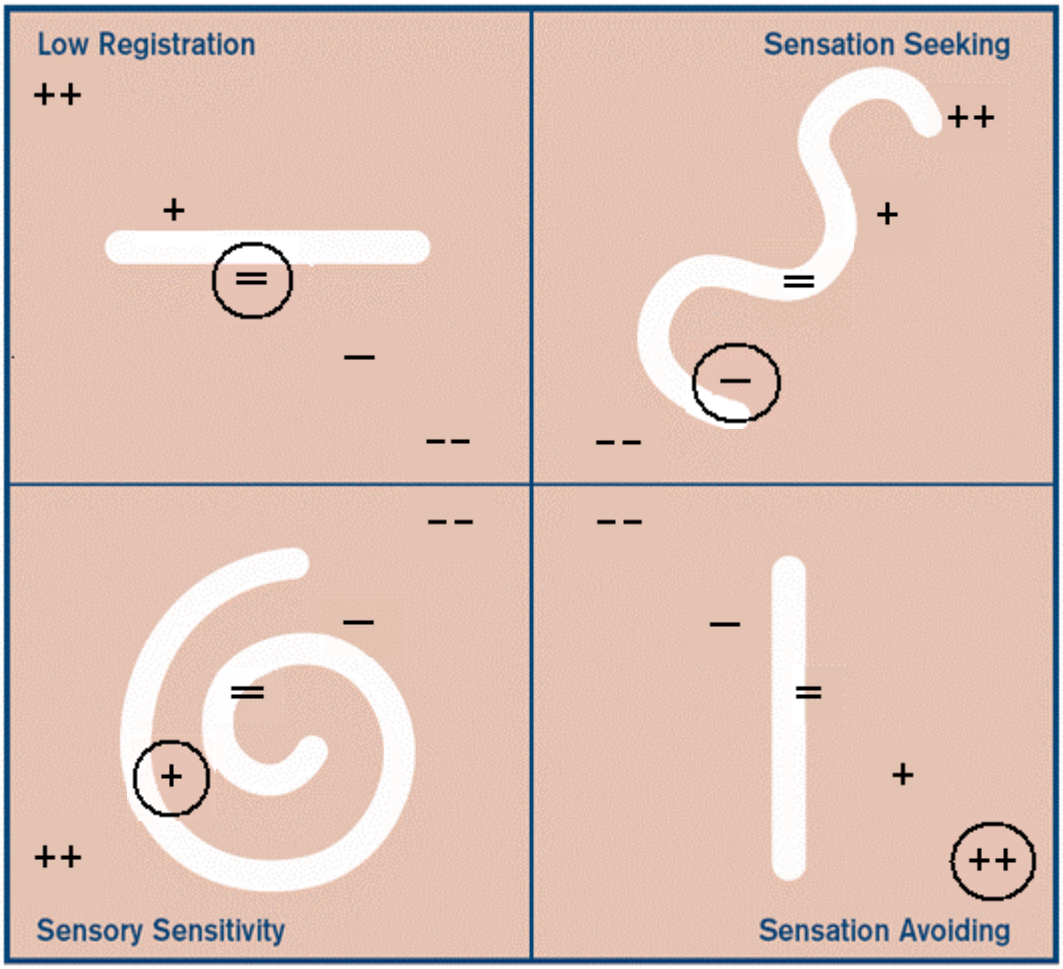


Figure 8-1: A father, who participated in the study's sensory profile

Generated by *The Select Scoring Assistant, Version 1.0.0 © Harcourt AssessmentInc. 2006*

Table 8-1: Summary of classifications and scores as depicted in Figure 8-1

CATEGORY	QUADRANT	CLASSIFICATION	SCORE
F1	Low Registration	Similar to most people	0
F2	Sensation Seeking	Less than most people	-1
F3	Sensory Sensitivity	More than most people	1
F4	Sensation Avoiding	Much more than most people	2

When creating the total modulation scores, all four-quadrant scores were added together to form a modulation score between 0 and 8 (0 being no problem with sensory modulation and 8 being the extreme of SMD). Only absolute values were used. See Table 8-2 for examples of how the total modulation score was calculated, based on values from a father in the study's quadrant profile as seen in Figure 8-1. The child's total modulation score was then compared with both the father and mother's total modulation score.

Table 8-2: Examples of the calculation of the high threshold and low threshold scores, and total modulation scores, original and weighted

	CALCULATION
Total Modulation Score	= F1+F2+F3+F4 = 0+1+1+2 = 4
Total Modulation Score (weighted)	= F1+F2+F3+F4 =0+0+0+2 =2
High Threshold Score	= F1+F2 = 0+1 = 1
High Threshold Score (weighted)	= F1+F2 = 0+0 = 0
Low Threshold Score	= F3+F4 = 1+2 = 3
Low Threshold Score (weighted)	F3+F4 = 0+2 = 2

Table 8-3 depicts the correlations found between the mothers and children in this study. The probability studies are based on this correlation study and are illustrated in Table 8-4. Scores of 0 – 2 were considered as not having a problem with SMD. Scores 3 and up were seen as a problem with SMD.

Table 8-3: Symmetrical correlation study of mother and child's total modulation scores

C_Total: M_Total											
	MOTHER										
			A	B	C	D	E	F	G	H	I	J
			0	1	2	3	4	5	6	7	8	TOTAL
CHILD	1	0	1	1	3	0	0	1	0	0	0	6
	2	1	2	2	2	3	3	0	0	0	0	12
	3	2	0	4	1	1	0	2	0	0	0	8
	4	3	1	3	1	2	0	0	0	0	0	7
	5	4	2	4	2	1	0	0	2	0	0	11
	6	5	3	0	2	1	1	0	1	1	0	9
	7	6	0	1	1	3	0	3	0	1	0	9
	8	7	1	1	4	1	0	1	0	0	0	8
	9	8	1	3	2	1	2	2	0	0	0	11
	10	TOTAL	11	19	18	13	6	9	3	2	0	81

Table 8-4: Examples of probability calculations done to determine the probability of a parent with/without SMD having a child with/without SMD

	CALCULATION
Example used	
Probability of a mother with SMD having a child with SMD	**=P(C/M)** **=P(C and M)/P(M)** **=[Sum(E5+F5+G5+H5+I5+E6+F6+G6+H6+I6+E7+F7+G7+H7+I7+E8+F8+G8+H8+I8+E9+F9+G9+H9+I9)/J10]/[Sum(E10+F10+G10+H10+I10)/J10]** =[(0+0+2+0+0+1+0+1+1+0+0+3+0+1+0+0+1+0+0+0+2+2+0+0)/81]/[(6+9+3+2+0)/81] =[14/81]/[20/81] =14/20 =0.7
Probability of a mother without SMD having a child with SMD	**=P(C/$\overline{M}$)** **=[Sum(A5+B5+A6+B6+A7+B7+A8+B8+A9+B9)/J10]/[Sum(A10+B10)/J10]** =[(2+4+3+0+0+1+1+1+1+3)/81]/[(11+19)/81] =[16/81]/[30/81] =16/30 =0.53

Table 8-5 depicts the correlations found between the mothers and children with heightened thresholds in this study. The probability studies are based on this correlation study and are illustrated in Table 8-6. Scores of 0 – 1 were considered as not having a heightened threshold. Scores 2 and up were seen as a heightened threshold.

Table 8-5: Symmetrical Correlation Study of High Thresholds of mother and child

C_High:M_High								
			MOTHER					
	"justification"		A	B	C	D	E	F
		SCORES	0	1	2	3	4	TOTAL
CHILD	1	0	3	3	0	2	0	8
	2	1	6	7	2	3	0	18
	3	2	7	5	2	7	1	22
	4	3	6	4	3	2	1	16
	5	4	7	7	2	1	0	17
	6	TOTAL	29	26	9	15	2	81

Table 8-6: Examples of probability calculations done to determine the possibility of a parent with/without SMD having a child with/without SMD with regard to neurological thresholds

	CALCULATION
Example used	Symmetrical correlation study of children and mothers pertaining to a heightened threshold for neurological input
Probability of mother without a high threshold having a child without a high threshold	**=Sum(A1+B1+A2+B2)/Sum(A6+B6)** =(3+3+6+7)/(29+26) =19/55 =0.35
Probability of a mother without a high threshold having a child with a heightened threshold	**=Sum(A3+B3+A4+B4+A5+B5)/Sum(A6+B6)** =(7+5+6+4+7+7)/(29+26) =36/55 =0.65
Probability of a mother with a high threshold having a child without a high threshold	**=Sum(C1+D1+E1+C2+D2+E2)/Sum(C6+D6+E6)** =(0+2+0+2+3+0)/(9+15+2) =7/26 =0.27
Probability of a mother with a high threshold having a child with a high threshold	**=Sum(C3+D3+E3+C4+D4+E4+C5+D5+E5)/Sum(C6+D6+E6)** =(2+7+1+3+2+1+2+1+0)/(9+15+2) =19/26 =0.73

Table 8-7depicts the correlation study of the mother and child's low registration quadrants. The highlighted values in the table indicate the symmetry found. Table 8-8 describes how the various percentages were calculated. Scores of –2; -1; 0; 1 and 2 were considered as having SMD while a score of 0 meant that there was no SMD present for that particular quadrant.

Table 8-7: Symmetry found between children and mothers in the Low Registration Quadrant

C1:M1 (LOW REGISTRATION CHILD : LOW REGISTRATION MOTHER)								
			MOTHER					
	"justification"		A	B	C	D	E	F
		SCORES	-2	-1	0	1	2	TOTAL
	1	-2	0	0	0	0	0	**0**
	2	-1	1	1	4	0	0	**6**
	3	0	1	3	13	7	2	**26**
CHILD	4	1	0	2	7	5	5	**19**
	5	2	1	2	15	7	5	**30**
	6	TOTAL	**3**	**8**	**39**	**19**	**12**	**81**

Table 8-8: Examples of the calculation of descriptive percentages pertaining to children and their parents and the incidence of SMD in various combinations

	CALCULATION
Example used	Symmetry C1:M1
Probability of agreement between children with SMD whose mothers have SMD	**=Sum of children with SMD whose mothers have SMD/Total amount of children with SMD** =Sum(A1+B1+A2+B2+A4+B4+A5+B5+D1+E1+D2+E2+D4+E4+D5+E5)/Sum(F1+F2+F4+F5) =(0+0+1+1+0+2+1+2+0+0+0+0+5+5+7+5)/(0+6+19+30) =29/55 =0.5273
Probability of agreement between children without SMD whose mothers have SMD	**=Sum of children without SMD whose mothers have SMD/Total amount of children without SMD** =Sum(A3+B3+D3+E3)/F3 =(1+3+7+2)/26 =13/26 =0.5
Probability of agreement between mothers with SMD whose children present with SMD	**=Sum of mothers with SMD whose children have SMD/Total amount of mothers with SMD** =Sum(A1+B1+A2+B2+A4+B4+A5+B5+D1+E1+D2+E2+D4+E4+D5+E5)/Sum(A6+B6+D6+E6) =(0+0+1+1+0+2+1+2+0+0+0+0+5+5+7+5)/(3+8+19+12) =29/42 =0.6905
Probability of agreement between mothers without SMD whose children present with SMD	**=Sum of children with SMD whose mothers do not have SMD/ Total sum of mothers without SMD** =Sum(C1+C2+C4+C5)/ C6 =(0+4+7+15)/39 =26/39 =0.6667

As seen in Table 8-8, the probability of agreement between children with SMD and mothers with SMD (0.5273) and the probability of agreement between mothers without SMD and their children who have SMD (0.6667) do not add up to 1. This is because these probabilities of agreement are from the child and mother's perspectives respectively and not both from the child's perspective and similarly not both from the mother's perspective. Likewise, the probability of agreement between children without SMD and mothers with SMD (0.50) and the probability of agreement between mothers with SMD whose children have SMD (0.6905) are not from the same source, and should not be confused when discussing the interpretation.

APPENDIX L

NUMBER OF CORRELATIONS OF THE QUADRANT CLASSIFICATIONS FOUND BETWEEN CHILD AND MOTHER AS WELL AS CHILD AND FATHER

Child	Class	Mother				Father			
		Low Registrat.	Sensory Seeking	Sensory Sensitive	Sensation Avoiding	Low Registrat.	Sensory Seeking	Sensory Sensitive	Sensation Avoiding
Low Registration Child	Much Less	0	0	0	0	0	0	0	0
	Less	1	1	1	2	1	1	3	1
	Similar/ typical	13	15	17	13	15	11	16	13
	More	5	0	4	6	6	0	4	2
	Much More	5	3	7	3	2	0	2	5
Sensation Seeking Child	Much Less	0	0	0	0	0	0	0	0
	Less	0	1	1	2	0	0	0	0
	Similar/ typical	8	12	10	9	9	10	16	14
	More	6	2	4	6	2	0	7	3
	Much More	5	2	6	2	2	0	1	3
Sensory Sensitive Child	Much Less	0	0	0	0	0	0	0	0
	Less	1	0	0	1	0	1	2	1
	Similar/ typical	15	19	19	17	19	15	20	20
	More	1	0	4	4	4	0	5	1
	Much More	5	3	7	4	2	0	1	4
Sensation Avoiding Child	Much Less	0	0	0	0	1	0	0	0
	Less	0	1	0	1	0	0	1	0
	Similar/ typical	18	22	22	18	18	16	20	19
	More	4	1	3	3	4	0	3	0
	Much More	5	3	6	5	2	0	1	4