SENSORY OVER-RESPONSIVITY IN CHILDREN OF 3-5 YEARS: A DESCRIPTIVE, ANALYTICAL STUDY

DISSERTATION SUBMITTED TO THE FACULTY OF HEALTH SCIENCES, UNIVERSITY OF CAPE TOWN, IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE MASTER OF SCIENCE IN OCCUPATIONAL THERAPY

ANN FRANCES WATKYNS

GRVANN001

SUPERVISORS:

Dr. Pamela Gretschel and A/Prof. Helen Buchanan

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DECLARATION

I, Ann Frances Watkyns, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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Date: 20 July 2019

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ABSTRACT

BACKGROUND: Sensory over-responsivity (SOR) is a type of Sensory Modulation Disorder (SMD), where the individual has an over-responsive behavioural reaction to non-harmful or non-threatening sensory stimulation, which is out of proportion to the stimulus. SOR can negatively impact a child's engagement and performance in their daily life. SOR is frequently diagnosed by occupational therapists, and deep pressure is an important facet of the treatment of SOR by occupational therapists. Prior research (Alberts & Ronca, 2012) indicates that the component of pressure in the vaginal birth process aids the infant's neurophysiological adaption to extra-uterine life. This component is absent in elective caesarean section births. This study therefore set out to determine whether method of birth could be associated with SOR, as well as investigating demographic and other variables linked to SOR. It was hypothesised that there would be a higher prevalence of SOR in children aged 3-5 years born by elective caesarean section compared to those born by vaginal birth. The study objectives were:

- To establish a profile (demographic and variables linked to SOR) of participants (mother-child dyads) by birth method group (CS or vaginal delivery)
- To determine the prevalence of SOR by birth method
- To establish if there is a statistically significant difference in SOR and birth method
- To establish which variables (for example birth weight, jaundice, birth complications) are associated with SOR

METHOD: A quantitative, descriptive, analytical study was conducted with a sample of 91 children between the ages of 3 years 0 months and 4 years 11 months. Children across various language, cultural and socio-economic groups were recruited and allocated to two groups based on their method of birth - vaginal delivery and elective caesarean section. Caregivers of each child completed the Short Sensory Profile 2 (SSP2) questionnaire as well as a demographic information questionnaire. The scores for SOR were calculated for each participant, and prevalence of SOR between the two birth method groups was compared. Demographic variables were tested for significance between the two groups. The variables showing a significant difference were further analysed to determine any association with SOR.

RESULTS: There were 91 participants, 58 in the VB group and 33 in the CS group. Mothers in the VB group gave birth at a younger age ($U = 499.0$, $p < .001$), were of a lower income level (chi-square = 11.49, df = 2, $p = .003$) and more likely to be single (Fishers exact p (2-tailed) = .037). The children in the VB group were of a greater gestational age ($U = 472.5$, $p = .001$), had a shorter time period before the first breastfeed ($U = 478.0$, $p = .006$), and had fewer sleeping difficulties (Fishers exact p (2-tailed) = .003).

The prevalence of SOR for the total sample was 22%. There was a significant association in SOR prevalence and birth method (Fishers exact p (2-tailed) = .034), with greater prevalence in the VB group (29%) as opposed to the elective CS group (9%). There were statistically significant associations between SOR and maternal age ($U = 380.5$, $p = .004$), marital status (Fishers exact p (2-tailed) = .003) and time after birth to the first breastfeed ($U = 394.5$, $p = .049$).

CONCLUSION: There was a statistically significant difference in SOR between the two birth method groups, with higher prevalence in the VB group. This was thought to be linked to cultural and language challenges associated with the use of the SSP2, and the impact of low socio-economic circumstances on child development and the ability to regulate sensory input. Recommendations include developing and validating a culturally appropriate sensory profile questionnaire, available in the most common official languages to facilitate the accurate assessment of sensory modulation of all children living in South Africa. In addition, there is a need to test the birth method hypothesis in demographically balanced groups.

Key words: Sensory over-responsivity, caesarean section, vaginal birth

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ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
ASD	Autism Spectrum Disorder
CS	Caesarean Section
CT	Cape Town
ECD Centre	Early Child Development Centre
fMRI	Functional magnetic resonance imaging
GAD	Generalized Anxiety Disorder
NICU	Neonatal intensive care unit
OT	Occupational therapy/therapist
PPD	Postpartum depression
SA	South Africa
SD	Standard Deviation
SMD	Sensory modulation disorder
SOR	Sensory over-responsivity
SP	Sensory Profile
SPD	Sensory processing disorder
SS/C	Sensory seeking or craving
SP2	Sensory Profile 2nd edition
SSP2	Short Sensory Profile 2nd edition
SUR	Sensory under-responsivity
VB	Vaginal birth

GLOSSARY OF TERMS

Caesarean Section: This is defined as major abdominal surgery under anaesthetic, where an incision is made in the abdominal and uterine walls to deliver the baby.

Caregiver: In this study, a caregiver refers to an adult who consistently, but particularly over the past 12 months, is the most permanent and present carer of the child.

Child: In this study, a child refers to a young person under the age of 18 years of age (Human Research Ethics Committee - Faculty of Health Sciences, 2013; Human Science Research Council - Research Ethics Committee, 2012).

Early Child Development centre: A number of different terms are used to name educational sites for this age group, such as playschool, crèche, preschool, daycare centre, Early Child Development centres (ECDs). For ease of readability, the term ECDs will be used, being the term used by the City of Cape Town in their preschool centres listing.

Maternal Regulation: This regulation is modulated indirectly for the individual by the mother, and occurs mainly in newborns, as they have not yet developed the ability to regulate themselves (Bergman, 2014; Hofer, 2005). It involves the sleep/wake/feed cycles. Regulation occurs through the mothers touch, breastfeeding, rocking, etc. Maternal regulation decreases as the infant develops self-regulation.

Pressure: This is one of the treatment techniques used by occupational therapists in the treatment of SOR. It typically comprises pressure exerted through heavy brushing techniques, therapy balls, massage, weighted blankets, jackets and collars.

Self-regulation: This regulation is modulated by the individual themselves, involving the functioning of many areas of the brain, but particularly the midbrain structures (Dunn, 2014; Miller, Anzalone, Lane, Cermak, & Osten, 2007).

Sensory Modulation Disorder: This is a regulatory disorder where an individual responds inappropriately (either over-or under-responding) to sensory input from any of the sensory systems (Interdisciplinary Council on Developmental and Learning Disorders, 2005; Miller, Anzalone, et al., 2007). There are four types of sensory modulation disorders identified by

Dunn (2014) – sensory over-responsivity, sensory under-responsivity, sensory avoiding and low registration. Sensory over-responsivity will be defined further in this section, as this component is the subject of my study. The other three will be defined in the literature review.

Sensory Over-responsivity: This is one type of Sensory Modulation Disorder, where the individual has an over-responsive behavioural reaction to non-harmful or non-threatening sensory stimulation which is out of proportion to the stimulus (Interdisciplinary Council on Developmental and Learning Disorders, 2005; Miller, Anzalone, et al., 2007). The term sensory over-responsivity is used in this thesis. A similar term, sensory over-reactivity is also commonly used in the literature. The term sensory over-responsivity was chosen, as this is the term used in the nosology of sensory processing disorders.

Sensory Processing Disorder: This is the diagnostic term currently used to describe the difficulties people have with processing sensory information (Ayres, 1974; Miller, Anzalone, et al., 2007). It has three diagnostic categories, namely sensory modulation disorders, sensory based motor disorders, and sensory discrimination disorders (Miller, et al., 2007).

Sensory Regulation: This refers to the process of facilitation and inhibition of sensory input in order to enable the individual to function in a well-modulated, calm, alert fashion which is appropriate for the situation (Dunn, 2014; Murray-Slutsky & Paris, 2000). This may take the form of self-regulation or maternal regulation.

Standardisation: This is the most commonly used measure of variability, reflecting how far individual scores vary from the mean. It is used to create uniform testing and scoring procedures for a psychometric test, with statistical analysis used to develop a mean and standard deviation. This allows the test results to be compared to norms of performance (Kielhofner, 2006).

Vaginal Birth: This is defined as a birth where the baby passes from the uterus, down the birth canal, which comprises the cervix and vagina.

CHAPTER ONE ORIENTATION TO THE STUDY

INTRODUCTION

Occupational therapists are increasingly being called on to assess and treat children with sensory over-responsivity (SOR). SOR is an over-responsive behavioural reaction to certain sensory stimuli, and appears to be linked to neurophysiological features (Miller, Anzalone, et al., 2007). SOR has a profound impact on the child's quality of life, impacting emotional status, behaviour, sleep, concentration, socialising and occupational performance areas of school, work, play and self-care (Reynolds & Lane, 2009; Schaaf et al., 2014; Schaaf et al., 2015; Sensory Processing Disorder Scientific Work Group, 2008). The child's behaviour also negatively impacts those close to them, be it parents, peers or teachers. The causes of SOR are not known, although it has been proposed that prematurity and prenatal complications may be factors (Keuler, Schmidt, Van Hulle, Lemery-Chalfant, & Goldsmith, 2011; May-Benson, Koomar, & Teasdale, 2009). The literature addressing this aspect of SOR is sparse. This study hoped to provide some insight into one of the possible factors associated with the aetiology of SOR, namely birth method.

PROBLEM STATEMENT

There has been an increase over the past 20 years in the number of caesarean births worldwide (Habiba et al., 2006; Kapellou, 2011; Swain et al., 2008; Ye et al., 2016), as well as in the private and public health care institutions in South Africa (Barron, Day, Massyn, Padarath, & Peer, 2015; Council for Medical Schemes, 2016b, 2016a). The medical benefits of caesarean section (CS) are well known (Chu et al., 2012; Gibbons et al., 2010), however, a limited amount of research has been done exploring the possible negative effects of CS (Kapellou, 2011). Obstetricians may recommend a CS for medical or non-medical reasons, and pregnant mothers are frequently given the option of a CS, where no medical reasons exist (Habiba et al., 2006). CS may be presented to the mother as a safer option, with limited discussion of the medical implications of major surgery and the possible medical and

developmental sequelae for the infant (Kapellou, 2011). Potential problems linked to the CS may be subtle and not immediately evident (Olza-Fernández, Gabriel, Gil-Sanchez, Garcia-Segura, & Arevalo, 2014).

In all CS births other than emergency CSs, the baby does not experience uterine contractions and the passage down the birth canal. The implication of this is that the component of pressure is absent in these deliveries (Alberts & Ronca, 2012). The component of pressure is used by occupational therapists in their treatment of sensory over-responsivity, featuring as one of the most effective treatment techniques used (Ayres, 1974; Dunn, 2014; Fisher, Murray, & Bundy, 1991; Knickerbocker, 1980; Reynolds, Lane, & Mullen, 2015; Roley, Blanche, & Schaaf, 2001). The pressure acts as an inhibitory stimulus on the over-stimulated nervous system present in sensory over-responsivity (SOR), by activating the inhibitory dorsal column medial lemniscal (DCML) system (Ayres, 1974; Dunn, 2014).

Anecdotal evidence from the researcher's own practice observations, that of colleagues and an expert OT in the field (T. A. May-Benson, personal communication, January, 26, 2017) as well as a recent research study (Langkilde, 2015), have shown a marked increase in sensory processing disorder (SPD), sensory modulation disorder (SMD), and particularly sensory over-responsivity (SOR) in recent years. The researcher hypothesised that this increase in SOR was associated with the increase in elective CS births, and that the absence of pressure during the birth process of a CS may play a role. The question arises as to whether deep pressure, and therefore birth method, has significance in the aetiology of SOR. Through investigating this link, the researcher aimed to develop a better understanding of the causes of SOR, and any links with birthing methods, specifically the component of pressure.

RESEARCH QUESTION

Is sensory over-responsivity in children aged 3 – 5 years associated with birth mode of delivery, and if so, what is the strength of the association?

AIM

The aim of the study was to determine whether the birth mode of delivery is associated with sensory over-responsivity in a group of children aged 3 – 5 years, as measured by the Short Sensory Profile 2 Questionnaire.

OBJECTIVES

The specific objectives of the study were

- To establish a profile (demographic and variables linked to SOR) of participants (mother-child dyads) by birth method group (CS or vaginal birth)
- To determine the prevalence of sensory over-responsivity by birth method
- To establish if there was a statistically significant difference in SOR and birth method
- To establish which variables (for example birth weight, jaundice, birth complications) were associated with SOR

The researcher hypothesised that there would be a higher prevalence of sensory over-responsivity in children aged 3-5 years born by elective caesarean section compared to those born by vaginal birth.

RATIONALE FOR THE STUDY

SOR is the most common form of SMD, accounting for 82% of cases (Mcintosh, Miller, Shyu, & Hagerman, 1999; Mitchell, Moore, Roberts, Hachtel, & Brown, 2015; Sensory Processing Disorder Scientific Work Group, 2008). SMD, and particularly the component of SOR, has been extensively studied, and the treatment techniques are well documented (Ayres, 1974; Fisher et al., 1991; Reynolds et al., 2015; Roley et al., 2001). Deep touch pressure is widely and successfully used as a treatment technique to reduce SOR (Bhopti & Brown, 2013; Kimball et al., 2007; Reynolds et al., 2015).

As noted earlier, the rate of CS is increasing throughout the world, and South Africa has not been exempt from this trend. While in certain cases the health advantages to the mother and/or the baby are clear, and in this case a CS is a life-saving procedure, little attention has been paid to the health disadvantages of a CS done for non-medical reasons. In the last 10 years, a body of research has begun to explore these disadvantages (Bentley et al., 2016; Habiba et al., 2006; Kapellou, 2011). The disadvantages include increased risk of respiratory

morbidity, breastfeeding failure, asthma, childhood onset diabetes and developmental sequelae. Only one of these studies investigated the effect of elective CS on sensory processing disorder, including sensory modulation (Langkilde, 2015). The researcher used a retrospective record review of a group of 35 children with diagnosed sensory processing disorders, and found those born by elective caesarean section had worse scores in all areas of SPD than those born by vaginal birth (VB), including sensory modulation (ibid). One of the differences between an elective CS and VB is the presence of pressure stimulation in a VB (Alberts & Ronca, 2012). The positive influence of pressure in rats on respiration and suckling has been explored by Alberts and Ronca (2012), and raised the question of whether this principle also applied to the neonate. Possible links of pressure to self-regulation have been explored (Bergman, 2014; Bystrova et al., 2009; Hofer, 2005, 2006; Olza-Fernández et al., 2014), however, the contribution of elective CS to SOR had not yet been studied. A link between pressure, and therefore birthing method, and SOR - either directly or indirectly by the influence on maternal regulation and then self-regulation of the infant - had also not been explored. It was hoped that investigating the factors that have been linked to SOR and birth method, would contribute to a better understanding of the causes of SOR, and possible links to birthing method.

PURPOSE

This research study is significant for a number of reasons. As far as the researcher is aware, this is the first study internationally to explore birthing method as a possible factor in the aetiology of SOR. It also contributes to the very small number of studies exploring sensory modulation in the South African context, particularly in low socio-economic areas where the majority of the South African population reside. Furthermore the information generated by this study is intended to inform policy, practice and research in the areas described below.

1. Policy:

   This research study aims to expand the body of knowledge around birthing practices, including the advantages and disadvantages of both CS and VB methods. Information generated will be disseminated to doctors, midwives and mothers-to-be, to enable mothers to make informed choices, with their clinicians, regarding birthing methods.

The results of this research will be presented to the South African Institute for Sensory Integration, which governs the training in sensory integration, and aims to provide access to and promote awareness of sensory integration in South Africa (South African Institute for Sensory Integration, 2018). This knowledge base can be used to influence policy directions for sensory integration in the South African context.

2. Occupational therapy practice:

   Infants born by CS may be considered potentially vulnerable to the development of SOR in childhood, and at risk for future motor, cognitive and behavioural disturbances. The research aims to inform the development of an occupational therapy treatment protocol related to the application of pressure after birth, as well as protocols for early intervention by OTs in the form of assessment and treatment of SOR.

3. Research:

   This study intends to inform further research into the need for, and possible development of a pressure protocol to be used with infants immediately post-natally, as well as the development of an early intervention assessment and treatment protocol for all CS babies.

CONCLUSION

This chapter introduced the study, explaining the problems experienced in practice by the researcher, which led to this study being initiated. The research question, aim and objectives of the study were then outlined. The rationale provided the motivations for undertaking the study. The chapter concluded with the outcomes expected as they relate to policy, occupational therapy practice and research. The following chapter describes the literature which was reviewed while conducting this research. The areas covered relate to birth method (VB and CS) and sensory over-responsivity in children.

CHAPTER TWO LITERATURE REVIEW

INTRODUCTION

The aim of this literature review is to review what has been written about the relationship between birthing method and the presence of sensory over-responsivity in children. The review will focus on exploring the relevant research studies on the characteristics and differences between the CS and VB methods, and exploring possible links between elective CS and SOR. The researcher will explore the characteristics of elective CS and VB, together with the positive and negative sequelae of each for the caregiver-child dyad. Lastly, literature related to SMD and SOR will be reviewed, looking at their characteristics, aetiology, assessment and treatment.

LITERATURE SEARCH STRATEGY

The search engines used were CINAHL, PubMed, Africa Wide Information, ERIC, PsychINFO, Scopus, OTSeeker and Cochrane.

The key words used were: “Sensory sensitivity” OR “sensory over-respons*” OR “sensory overrespons*” OR “Sensory disorder*” OR “Special senses disorder*” OR “Sensation disorder*” OR “sensory dysfunction” OR “Sensation” OR “Sensory modulation disorder*” OR “Sensory respons*” OR “Sensory modulation” OR “Sensory defens*” OR “Sensory system disorder*” OR “Sensory processing disorder*” OR “SPD” OR “Sensory integration dysfunction” OR “tactile defensiv*” OR “tactile sensitiv*” OR “auditory defensiv*” OR “auditory sensitiv*” OR “nervous system disorder*” OR “childhood development” OR “infant development” **AND** “Cesarean” OR “caesarean” OR “obstetrical anesthesia” OR “obstetrical anaesthesia” OR “method* of delivery” OR “mode* of delivery” OR “birthing method*” OR “normal delivery” OR “normal birth” OR “natural birth” OR “physiologic* birth” OR “active birth” OR “normal vertex delivery” OR “NVD” OR “vaginal delivery” OR “vaginal birth” OR “birth* complication*” OR “childbirth” OR “obstetric* complication*” OR “birth trauma”.

The **inclusion criteria** were:

- peer-reviewed articles
- articles in English, as translation was not feasible
- articles from 2006 – 2016. The increased rate of caesarean section births is a recent phenomenon, and sensory modulation disorders were only identified in the late 1990's, making the more current literature the most relevant.

Search results using the above criteria identified 439 articles. When the abstracts of these articles were reviewed, 17 articles met the criteria for inclusion. However, many of the articles uncovered additional articles that did not appear in the initial searches. Further sources were also gathered following recommendations from supervisors and colleagues. No meta-analyses or systematic reviews were identified. Once the initial literature search was completed, an EbscoHost alert was activated to identify articles published subsequent to the initial search. Mendeley notifications linked to the reading material in the researcher's Mendeley library were also reviewed.

BIRTHING METHODS

In this section, the two birthing methods (CS and VB) will be described in detail. The researcher will describe the advantages and risks factors linked to each birth method, and the possible reasons for their occurrence in different contexts and within different groups of people.

Vaginal Birth

Vaginal birth refers to a birth which involves the passage of the fetus from the uterus and through the cervico-vaginal birth canal. This downward progression results from uterine contractions and the active motor participation of the fetus. The labour may progress with no medical intervention or it may be induced or augmented (labour is assisted by medication to progress faster), pain medication may or may not be used, the presentation may be a cephalic presentation (vertex, face or brow), or breech, and there may be assistance in the delivery (vacuum or forceps).

The pressure exerted on the baby during the birth process is a significant component of labour and birthing. Pressure is provided over the whole body by the uterine contractions during the first stage of labour, and then a considerable amount of pressure is applied to the

fetal head and the brain over a period of a few hours as the baby passes down the birth canal. This pressure, although intermittent, is considerable, and can be as high as 2kg cm^{-2} (Bergqvist, Katz-Salamon, Hertegard, Anand, & Lagercrantz, 2009). This pressure causes a significant activation of the sympathetoadrenal axis, with release of noradrenaline, vasopressin and other hormones (Olza-Fernández et al., 2014), which have various effects on the mother and infant during the peri-natal period. The effects are summarised in Table 2-1.

TABLE 2-1 HORMONES RELEASED DURING THE VAGINAL BIRTH PROCESS AND THEIR EFFECTS

Hormone	**Effects**
Catecholamines (norepinephrine and epinephrine) (Alberts & Ronca, 2012)	• clears fluid from the neonatal lungs immediately after birth to aid respiration • aids with maturation of the infant lungs (American College of Nurse-Midwives, Midwives Alliance of North America, & National Association of Certified Professional Midwives, 2012; De Weerth & Buitelaar, 2007)
Oxytocin (Bigelow, Littlejohn, Bergman, & McDonald, 2010; Olza-Fernández et al., 2014)	• protects neonatal brain from delivery hypoxia • exerts an analgesic effect on the infant • influences olfactory recognition of the nipple by the infant • facilitates maternal behaviours • stimulates the release of dopamine and prolactin (American College of Nurse-Midwives et al., 2012)
Dopamine	• facilitates maternal feelings of well-being, love and self-confidence (Bigelow et al., 2010; Olza-Fernández et al., 2014; Strathearn, 2011)
Prolactin	• stimulates milk production (Olza-Fernández et al., 2014)
Cortisol	• facilitates mother's recognition and attraction to baby odours (Feldman, Rosenthal, & Eidelman, 2014; Olza-Fernández et al., 2014)
Vasopressin (Olza-Fernández et al., 2014)	• facilitates maternal care and protective behaviours towards the infant (Olza-Fernández et al., 2014)
Noradrenaline	• facilitates infant alert state • activates lungs for respiration • stimulates infant olfactory learning immediately after birth (Bergman, 2014, Olza-Fernández et al., 2014)

Vagal stimulation after birth, produced as a result of skin-to-skin contact and early suckling, then resolves the hormonal changes which have occurred (Olza-Fernández et al., 2014). Further understanding of the influence of pressure on function immediately after birth has been gained from studies on rat pups.

Alberts and Ronca (2012) explored the significance of pressure in rats during the birth process. The researchers identified four types of sensory stimuli common to vaginal births – compression during the birth process and afterwards under the weight of the mother's body; tactile and vestibular stimulation provided by licking, handling and moving the pups immediately after birth; and temperature changes, with rapid cooling during licking, and then reheating from the mother's body once the birth process of all the pups had been completed and nesting and suckling had begun. They then quantified the compression, tactile and temperature stimuli as being the most significant, and developed a regime for artificially providing these stimuli in a "simulated birth" experience with caesarean-delivered pups.

The researchers were then able to add or remove these stimuli in order to gauge the effect of each type of stimulation on functions required by the newborn immediately after birth. The rate of successful suckling in rat pups born by CS but provided with compression was 89%, and this dropped to 44% when compression was omitted from the protocol of sensory stimuli provided. These experiments showed that compressions which mimicked labour contractions played a major role in enabling the rat pups to successfully transition to the extra-uterine environment (Alberts & Ronca, 2012). Rat pups delivered by CS failed to make the transition to a newborn successfully. However, if they were provided with the stimuli involved in the VB experience, in particular compression, then it was possible to create the conditions for this successful transition (Alberts & Ronca, 2012).

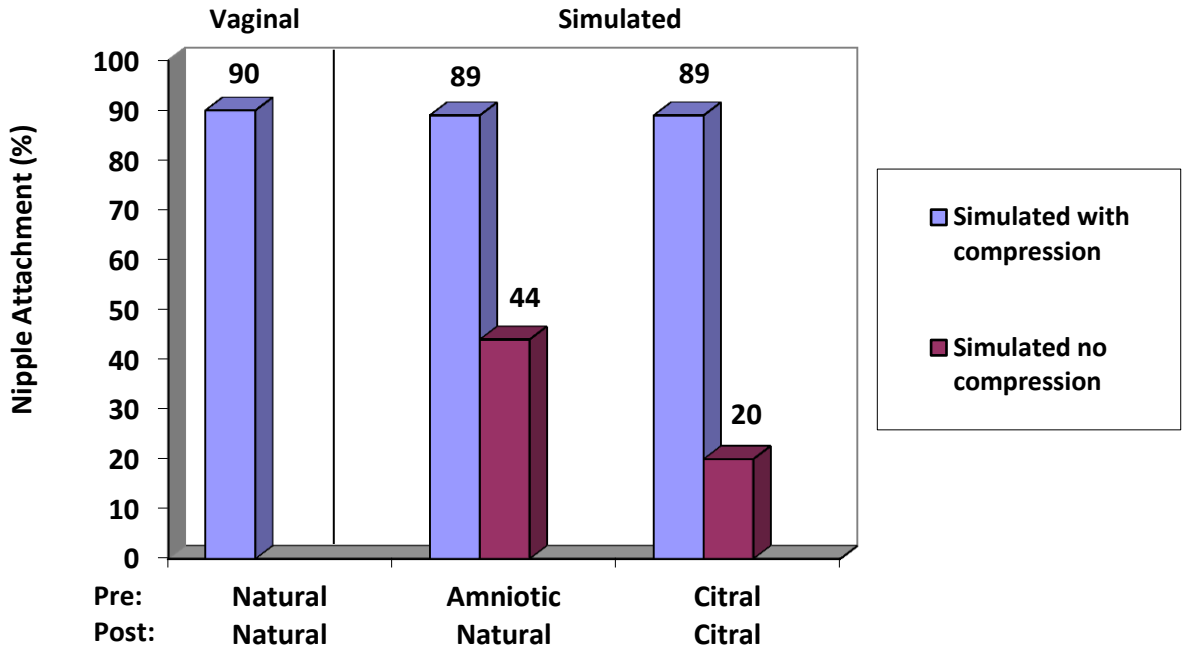


FIGURE 2-1 HISTOGRAPH OF RESULTS – PERCENTAGE OF PUPS ATTACHING TO A DAM'S NIPPLE (ALBERTS & RONCA, 2012)

Successful suckling and the regularity of maternal milk supply and tactile input have been found in experiments on rat pups to regulate the duration of sleeping and waking, as well as the ease of transition between them (Hofer, 2005). It would seem that, in humans, successful breastfeeding provides many regulators through the mother's own body, such as maternal milk supply, touch and warmth which provide the infant with a maternal homeostatic regulating system immediately after birth (Bergman, 2014; Hofer, 2005, 2006). Over time, this maternal regulation helps the infant develop the functioning of his/her own behavioural, neuroendocrine and autonomic systems, which is the beginning of self-regulation (Bystrova et al., 2009; Hofer, 2005).

It can be seen that the process of labour results in a "cascade" of physiological, hormonal, neural and behavioural changes that assist the neonate to successfully adjust to the extra-uterine environment (Alberts & Ronca, 2012). It also aids in the development of maternal regulation and then self-regulation (Bergman, 2014; Hofer, 2005, 2006).

Caesarean Section

CS was introduced to save the life of the mother or the baby during delivery (Gibbons et al., 2010). It is major surgery, in which an incision is made in the abdominal and uterine walls to deliver the baby. This is done under anaesthetic, which is usually a spinal or epidural block, although in some instances, a general anaesthetic may be given. A CS may be performed as an elective procedure or an emergency. An elective CS is planned, with the date and time set by the gynaecologist, at times in conjunction with the mother. A before-due-date delivery may be planned to prevent spontaneous labour occurring. An emergency CS is performed when labour has begun, but there is an increased risk to the fetus and/or the mother's health. In the case of an emergency CS, the baby may experience some of the benefits and risks of labour. While an emergency CS is unplanned and performed for medical reasons, an elective CS may be done either for medical or non-medical reasons. Postpartum pain medication is given in all types of CSs. Antibiotics are administered prophylactically to the mother post-CS and may be given pre-CS if indicated (Department of Health, 2015).

The World Health Organization has determined acceptable CS rates of between 10 – 15% of deliveries, to provide for cases where it is medically necessary (World Health Organization, 1985). However, the rates of CS are increasing worldwide (Kapellou, 2011; Swain et al., 2008; Ye et al., 2016). In South Africa (SA), the rates vary considerably between the public and private health sectors, with the majority of mothers (85%) delivering in public health settings (Matshidze, Richter, Ellison, Levin, & McIntyre, 1998). In the private health sector, the Council for Medical Schemes reported that in 2015 the CS rate stood at almost 70% (67,48%) for those on Medical Aid (Council for Medical Schemes, 2016a, 2016b). In the public sector, the average CS rate was 24.1% in 2015/2016 (Massyn et al., 2016), but varied considerably between districts, with metropolitan districts generally having higher rates (up to 41%) than rural districts, and rates also being highest in the wealthiest districts (Massyn et al., 2016). The higher rates in metropolitan areas is likely to be in part due to the fact that hospitals with the staff and facilities to perform CSs are frequently situated there, and these hospitals also tend to be referral centres for higher risk pregnancies. The latest 2016/2017 edition of The District Health Barometer did not include a section on CS, therefore no statistics were

available for this period (Massyn, Padarath, Peer, & Day, 2017). In the public sector, a CS without a medical reason is not an acceptable practice (Department of Health, 2015; Massyn et al., 2016). It can be seen that the rates of CS in private health facilities are more than double the rates in public health facilities. The World Health report (Gibbons et al., 2010) estimated the cost of unnecessary CSs. They put the cost for SA in 2008 to be 12,2 million US dollars. Some of the medical and non-medical reasons for elective CSs will be discussed below.

Medical reasons for performing a CS include obstructed labour, poor fetal presentation, previous CS, maternal anaemia or diabetes, fetal distress, maternal or fetal infection, intrauterine growth restriction, cord prolapse, uterine rupture, antepartum haemorrhage and pre-eclampsia/eclampsia (Bentley et al., 2016; Chu et al., 2012; Thomopoulos et al., 2015). Non-medical reasons may be linked to the doctor or to the mother (Ye et al., 2016). Doctors may fear litigation, or CS may be their preference due to convenience in that they may feel that they have better control over the labour process (Bentley et al., 2016; Habiba et al., 2006). Broomberg and Price (1990) have suggested that financial gains by doctors could account in part for the increase. Low staffing levels and organisational factors in maternity units may also be a factor (Kapellou, 2011; Paranjothy, Frost, & Thomas, 2005). A recent trend of women giving birth when older, as well as excessive weight gain during pregnancy may be additional reasons (Bentley et al., 2016; Swain et al., 2008; Thomopoulos et al., 2015). Mothers may perceive a CS as a safer option, and as the rate is high, it may be considered the current norm, or fashionable choice, after several celebrities have had planned CSs (Kapellou, 2011).

Fear of childbirth in women who were already generally more anxious and depressed was found by two studies to be a particularly important factor in choosing a CS (Habiba et al., 2006; Hildingsson, Rådestad, Rubertsson, & Waldenström, 2002). The often patriarchal structures of medicine and unequal power relationships may also result in the woman feeling subservient and powerless to make an independent decision (Bewley & Cockburn, 2002). Some ethical issues are pertinent in this respect. Some doctors feel that autonomy is important, and therefore the mother has an ethical right to exercise her choice to have a CS (Bewley & Cockburn, 2002; Habiba et al., 2006). However, informed consent is another

aspect of the principle of autonomy. For the mother's decision to be informed, she needs to be provided with sufficient information on the nature of the proposed intervention with its risks and benefits, and information about alternative possible interventions and their risks and benefits, and only then can her decision be called "informed" (Finkelstein, Smith, & Faden, 1993; Jelsma & Clow, 2005). This is not routinely done, with the risks of a CS frequently not being explained, or being downplayed (Bentley et al., 2016; Bewley & Cockburn, 2002). It is however the doctor's ethical duty to provide this information (Finkelstein et al., 1993; Kapellou, 2011). It is clear that in certain cases, an elective CS may do more harm than good (Bewley & Cockburn, 2002), and a number of studies have been done in recent years to explore this (Bentley et al., 2016; Sakalidis et al., 2013; Swain et al., 2008; Toda et al., 2013).

The majority of elective CSs are performed at 38 weeks to prevent the labour process starting. Recent studies show that a shorter gestational age (GA) is more important for a number of reasons than was previously thought, and that a baby born at any less than 39 weeks GA is at risk (Bentley et al., 2016; Boyle, 2013; Budin, 2012; Kapellou, 2011; Olza-Fernández et al., 2014; Wilcox & Skjoerven, 1992). Furthermore, for each additional week of lower GA, the risk of developmental sequelae increases (Bentley et al., 2016). It has been shown that birth at 37-38 weeks is associated with increased mortality, both in infancy, and through to young adulthood (Boyle, 2013). In these young adults, the deaths appear to be associated with congenital abnormalities, diabetes and other endocrine disorders (Boyle, 2013). Kapellou (2011) stated that before 39 weeks there is an increased risk of respiratory morbidity. This is linked to lower levels of catecholamines in the infant, which are important for lung maturation (De Weerth & Buitelaar, 2007). The incidence of respiratory morbidity could be halved for each additional week that the fetus remains in utero (Kapellou, 2011). Infants born at 37-38 weeks are also more likely to develop asthma and use corticosteroids than those born at 39-41 weeks (Boyle, 2013). There is also an increased risk of future neurodevelopmental symptoms as a result of the early interruption of the intrauterine brain maturation process (Bentley et al., 2016). Likelihood of hospital admission in the first nine months is also greater, with the most common reasons being gastrointestinal and respiratory problems (Boyle, 2013). Parents of the 37-38 week group of infants are also more likely to

describe their children's health as being poor (Boyle, 2013). Examining percentages of children requiring special needs education show that 5.5% of these result from deliveries between 37 and 39 weeks, and that this percentage then drops with increasing GA, up to 41 weeks GA (Kapellou, 2011). An extensive study of over a million infants over a 35 year period found an increase in the risk of cerebral palsy in children born at 37-38 weeks when compared to those born at 40 weeks (Moster, Wilcox, Vollset, Markestad & Lie as cited in Boyle, 2013, p. 125). These studies suggest that clinical guidelines should be altered so that planned CSs are not performed before 39 weeks gestational age (Kapellou, 2011). In South Africa, a 37 week old infant is described as being born at term, however some practitioners in other parts of the world are reserving "born at term" for infants of 39-41 weeks GA (Boyle, 2013) in response to these latest research findings. No studies could be found comparing SOR rates in children according to their method of birth, however studies have been done comparing other factors to these two birth method groups.

A number of studies have looked at the influence of birthing method on breastfeeding. Sakalidis et al. (2013) explored sucking in a small sample of babies born by VB and CS at three and 20 days postpartum (n = 34). The results showed that there were statistically significant differences between the two birthing methods groups – reduced secretory activation, delayed maternal breast fullness, and differences in tongue movements during suckling in the CS group. The authors postulated that the delayed secretory activation was linked to oxytocin release, which was higher during breastfeeding in the VB group. A study by Nissen et al. (1996) examined oxytocin, prolactin and cortisol levels during breastfeeding between an emergency CS and VB groups. There were significantly higher oxytocin and prolactin levels during breastfeeding in the VB group. This was postulated to be due to two factors – that the CS group of infants bypassed the second stage of labour, and delayed first skin-to-skin contact. These resulted in a delayed first suckling occasion, which was more common in the CS group. The lowered oxytocin levels in the CS group as well as the delayed first suckling occasion correlated with a shorter duration of exclusive breastfeeding (Olza-Fernández et al., 2014). The lower oxytocin levels influenced prolactin release, and the lower prolactin levels negatively affected milk production. The CS group did not experience the noradrenaline peak, and the lowered noradrenaline levels impaired olfactory learning and breastfeeding

during the first hour of birth (Olza-Fernández et al., 2014). Cortisol levels and systolic blood pressure dropped in both groups, indicating that breastfeeding is associated with a release of tension and a lowering of anxiety. The many physiological changes that have been described above, contribute to the high breastfeeding failure in CS mothers. Another factor to be considered is the separation of mother and infant in the first two hours after CS.

In the management of CS, the infant is usually removed immediately after birth, sometimes for a number of hours (Langkilde, 2015). When the sensitive period of the first few hours is spent with the mother and infant separated, there are harmful stresses, autonomic nervous system activation and high cortisol levels, and dysregulation effects in the newborn, with greater irritability, a poorer quality of mother-baby interaction at one year, and reduced maternal sensitivity to the child (Bergman, 2014; Bigelow et al., 2010; Bystrova et al., 2009; Olza-Fernández et al., 2014). At two days old, sleeping in a cot rather than skin-to-skin, resulted in autonomic nervous system activation which was three times that of babies co-sleeping, with higher cortisol levels, indicating stress (Bergman, 2014). These autonomic responses are linked to a perceived threat, hypervigilance and avoidance activation. This is a state of high arousal of the nervous system. Changes in neural responses between birthing methods have also been identified.

In a study by Swain et al. (2008), functional magnetic resonance imaging (fMRI) was used to compare the neural responses of mothers to their infant's cry at 2 – 4 weeks postpartum. The brains of six VB mothers and six elective CS mothers were analysed in response to recordings of their own baby's cry. These were interspersed with other baby's cries, and then the recording was repeated 10 times with a 10 second rest between each recording. Different neural responses were identified in the two groups. Some areas of the brain with heightened responses in VB mothers were: anterior cingulate and insula, concerned with emotional responses; posterior cingulate, concerned with decision-making; amygdala and head of the caudate concerned with arousal and reward; superior temporal cortex, concerned with the mental states of others; hypothalamus and areas of the pons, thalamus and cortex concerned with neurohormonal regulation. These brain responses may assist the mother to recognise the infant's mental state, develop caring behaviours and parent-infant bonding, motivation and reward, stress regulation and breastfeeding. Taken as a whole, these

responses are likely to result in the CS mother being less sensitive to her baby, with less effective maternal regulation of the baby, and may contribute to a number of maternal psycho-social problems, including postpartum depression (PPD) (Olza-Fernández et al., 2014; Swain et al., 2008). PPD in turn has been linked to lower cognitive abilities in the child at 18 months and at 7 years, and further increased mental health risks into the next generation (Swain et al., 2008). The only area of the brain which was more responsive to own baby-cry in the CS group compared to the VB group, was a region of the insula which has a role in processing pain which is thought to be different after a VB. Mothers in the two groups had very similar demographic profiles, and the findings were statistically significant, however a limitation of the study was that the sample size was small.

Very few studies have looked at the effect of the mode of delivery on cognitive and brain development of the baby/child. Toda et al. (2013) showed that the postnatal development of the somatosensory cortex in rat pups was slower in those delivered by CS, due to changes in the serotonin levels in the brain (Toda et al., 2013). Adler and Wong-Kee-You (2015) explored reflexive, spatial attention in 3 month old infants, between the two birthing methods, and found that this was slower in infants born by CS. The authors postulated that this reflected the functioning of the somatosensory cortex, thus affecting cognitive processes that rely on spatial attention, which then may affect individuals with autistic spectrum disorder (ASD) and children with Attention Deficit and Hyperactivity Disorder (ADHD) (Adler & Wong-Kee-You, 2015; Olza-Fernández et al., 2014). A large, recent population-based study with 153 730 live births from 32 weeks GA was analysed to compare development at 4 – 6 years of age (Bentley et al., 2016). The one domain assessed was physical health, and the other four were linked to cognitive skills and language. The results indicated increasing risks of poor developmental outcomes in the five domains proportional to decreasing GA in all types of birth other than VB with spontaneous onset of labour.

Another factor which needs to be taken into consideration is the effect of pain medication, which can impact both the mother and the infant. Pain medication is used in all CSs, either in the form of a general anaesthetic, or spinal or epidural anaesthesia, and is also used postoperatively. Postoperative pain relief is often unsatisfactory, with women reporting high levels of pain, particularly in the first 24 hours (Karlstrom, Engstrom-Olofsson, Norbergh,

Sjoling, & Hildingsson, 2007). Pain negatively impacts on recovery of the mother, and may result in maternal complications such as impaired respiration, immobility and resultant venous thrombosis (Karlstrom et al., 2007). Mothers also report that pain impairs their ability to breastfeed (Karlstrom et al., 2007).

In addition to the effect of pain medication on the mother, the medication can also adversely impact on the newborn. Neonates absorb opioids, a component of fentanyl intrapartum anaesthesia, through the placenta and ingest them in the colostrum, and they have a longer elimination half-life than when used with adults (Jordan, Emery, Bradshaw, Watkins, & Friswell, 2005). Due to the delayed elimination, these substances accumulate in the central nervous system, prolonging their depressive effects, and causing neuro-behavioural changes. The infant may therefore be less responsive, muscle tone and reflexes may be affected, causing difficulties with suckling, which then results in pain for the mother, which can reduce her motivation to continue breastfeeding (Jordan et al., 2005; Olza-Fernández et al., 2014). However, there is not clarity on these results, as two other studies have shown no adverse effects, although there were confounding factors which may have influenced the results (Jordan et al., 2005). A study done in 2010 on rats, found that there was a possible impact on neuronal development, with significant amounts of neuronal deletion in certain areas of the brain (Jevtovic-Todorovic, 2010). Researchers have recommended that further studies be done to improve understanding of neurotoxicity from anaesthetic agents (Jevtovic-Todorovic, 2010; Jevtovic-Todorovic et al., 2003). A study investigating differences in behavioural or physiological responses to pain in neonates between the two modes of delivery, found that those born by VB showed less behavioural (facial expressions and vocalisations) and physiological (increased heart rate) responses after a painful stimulus was applied within four hours after the birth (Bergqvist et al., 2009). This dampened response suggests that VB infants remain in a state of inhibition for a short period immediately after birth. The authors postulated that VB stimulates the release of high levels of catecholamines, which may have an analgesic effect on the infant.

As evident from the above review, there is insufficient literature available to help women make informed choices regarding mode of birth delivery (Habiba et al., 2006). Research exploring the risks and benefits of each mode of delivery has been done, but the findings are

conflicting, and the information is not readily available for mothers or conveyed to mothers by health professionals. However, an increasing body of recent research indicates that there are significant hormonal and neurophysiological changes that are stimulated by the passage of the fetus down the birth canal, and that the disruption of this process may result in an increased risk of cognitive, learning, socialisation and personality disorders in later life (Olza-Fernández et al., 2014). Although much new research has been done on the risks and benefits of both modes of delivery, many authors motivate for more (Bewley & Cockburn, 2002; Habiba et al., 2006). In addition to current accurate and clear information, pregnant women also require good quality counselling (Bentley et al., 2016; Bewley & Cockburn, 2002) to enable them to make these decisions, which may impact both their and their infant's future**.**

SENSORY OVER-RESPONSIVITY

Sensory over-responsivity is one aspect of sensory modulation. Sensory modulation will therefore be described first. Two models of sensory modulation drawn on in this research, and the neurophysiology underlying the disorder will be described. Sensory over-responsivity will then be described, and prevalence rates, possible causes, assessment and intervention strategies outlined.

The evolution of sensory modulation and sensory over-responsivity

Dr A. Jean Ayres, an occupational therapist, psychologist and neuroscientist (Miller, Anzalone, Lane, Cermak, & Osten, 2007), first used the term **tactile defensiveness** in 1964 to describe children who showed aversive responses to certain types of tactile input (Ayres, 1974; Knickerbocker, 1980; Murray-Slutsky & Paris, 2000), usually light touch. These children may react with an exaggerated emotional response such as hostility or fear. She linked this phenomenon with behaviours such as distractibility, hyperactivity, anxiety, aggression and emotional lability (Ayres, 1974). She stated that the auditory, olfactory and occasionally the visual systems may also be affected (Ayres, 1974).

Knickerbocker (1980), extended on Ayres' work, and introduced the term **sensory defensiveness**, as she hypothesised that this oversensitivity was not confined to the tactile

system, but could also affect other sensory systems. She coined the phrase "the Olfactory-Tactile-Auditory Sensory Triad" to describe sensitivities in the olfactory, auditory and tactile systems, which she thought were often seen as a group (Knickerbocker, 1980). She also identified and described the clinical features of under-responsiveness (Knickerbocker, 1980).

In 2000, the term **sensory modulation disorder (SMD)** began to be used, referring to an individual who responded inappropriately to sensory input from any sensory system. The term was developed by a group of occupational therapists experienced in sensory integration (Miller & Lane, 2000). This remains the term most predominantly in use. Some have categorised SMD into three types – over-responding (hypersensitivity), under-responding (hyposensitivity) or fluctuating between the two (Miller, Robinson, & Moulton, 2004; Murray-Slutsky & Paris, 2000; Van Hulle, Lemery-Chalfant, & Goldsmith, 2015). Others have categorised SMD into over-responsivity, under-responsivity and sensory seeking/craving (Miller, Robinson, & Moulton, 2004; Miller, Anzalone, et al., 2007). This appears to be the most commonly used categorisation at present, and is included in the latest editions of both the Diagnostic Manual for Infancy and Early Childhood (Interdisciplinary Council on Developmental and Learning Disorders, 2005) and the Zero to Three Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood (Zero to Three, 2016).

Sensory modulation disorders are represented on a continuum, reflecting a spectrum of responses to sensory stimuli. Therefore it is imperative that, for the child to warrant a diagnosis of SMD, the behaviours present must be significantly impairing some, if not all, aspects of the individual's life (Bar-Shalita, Vatine, & Parush, 2008; Miller, Anzalone, et al., 2007; Schoen, Miller, Brett-Green, & Nielsen, 2009). Behaviours that appear to be particularly associated with SMD are difficulties with concentration, sleeping and eating issues, bladder and bowel concerns, behaviour and socialisation problems. One study found that parents reported that children with SMD had many somatic complaints, showed a tendency to withdrawal, anxiety and depression, and had difficulty adapting, probably as they perceived their environment to be unpredictable and overwhelming (Miller, Nielsen, & Schoen, 2012). A link has been demonstrated between SMD and attachment, suggesting that these children have difficulty forming healthy attachments to their caregivers (Whitcomb,

Carrasco, Neuman, & Kloos, 2015). This is as a result of abnormal behavioural responses from the child to normal parental handling which may cause the child to cry or pull away from the caregiver, which over time, can negatively impact on the attachment relationship (Levit-Binnun, Szepsenwol, Stern-Ellran, & Engel-Yeger, 2014; Whitcomb et al., 2015) . Studies that have looked at the risk to daily living activity participation (personal activities of daily living, school and play) found that children with SMD demonstrated considerably lower levels and frequency of participation, and gained significantly less enjoyment from them, than typically developing children (Bar-Shalita et al., 2008; Chien, Rodger, Copley, Branjerdporn, & Taggart, 2016). Although some recent studies of neurophysiological measures have shown that SMD is a distinct diagnosis (Yochman, Alon-Beery, Sribman, & Parush, 2013), there remains widespread scepticism amongst some health care professionals as to whether SMD exists as a distinct disorder (Koziol & Budding, 2012). Neither SPD or SMD are reflected in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (Miller et al., 2012; Tavassoli et al., 2016). However, sensory reactivity ("hyper-or hypo-reactivity to sensory input") was included as a criterion for diagnosis of ASD in the DSM-5 (American Psychiatric Association, 2013; Conelea, Carter, & Freeman, 2014; Dunn, 2014; Mailloux & Miller-Kuhaneck, 2014; Schaaf & Lane, 2015; Tavassoli et al., 2016).

Models of sensory modulation disorder

There are two models of sensory modulation commonly described in the literature which will be presented here - Dunn's Model of Sensory Processing and the Ecological Model of Sensory Modulation. Dunn's model provides the theoretical basis for the four categories of sensory modulation used in this study. This provides the foundation on which she developed her assessment tool for testing sensory modulation, which is the assessment tool used for data collection in this study. The Ecological model provides an understanding of the environmental factors influencing the development of sensory modulation. This researcher explored the factor of birth method as an aetiological factor, however this model highlights the many other environmental factors which can influence the development of SMD. These factors are important to bear in mind when considering the results obtained in this study.

Dunn's model of sensory processing (Dunn, 2014) is based on the two continua of neurological thresholds (high and low) and self-regulatory behavioural responses (active and passive). The interrelation between these, results in four sensory processing patterns. These are registration, sensory seeking, sensory sensitivity and avoiding. Registration represents a high threshold and passive self-regulation, where the child misses or ignores sensory cues which others would notice (Dunn, 2014). Sensory seeking represents a high threshold and active self-regulation, and these children actively seek more sensory input than others (Dunn, 2014). Sensory sensitivity represents a low threshold and passive self-regulation (Dunn, 2014), and will be discussed in detail below, as it is the focus of this study. Sensory avoiding represents a low threshold and active self-regulation, and these children actively avoid sensory input, often choosing to work or play alone (Dunn, 2014).

A second model is **the Ecological Model of Sensory Modulation (EMSM)** (Miller et al., 2004; Roley et al., 2001). It is based on the premise that a child does not function in isolation, but that the behaviour of a child with SMD is related to a number of contextual factors. These are known as the external dimensions, and include: Culture (the societal norms and expectations), Environment (the physical and sensory surroundings), Relationships (the interconnections with others), and Task (the child's occupation, which includes play, selfcare, school, sleep, socialisation). The internal dimensions are the aspects which are internal to the child, and include: Sensation (the ability to receive and manage sensory stimuli), Emotion (the ability to perceive emotion and respond appropriately), and Attention (the ability to sustain attention on tasks and relationships). The internal dimensions are each divided into quadrants representing oversensitivity, normal sensitivity, undersensitivity and fluctuating sensitivity (Miller et al., 2004).

Each of the external dimensions interact with each of the internal dimensions. For the child to be able to function optimally, there needs to be a good fit between the external and internal dimensions, and when there is not a good fit, problems arise in the form of maladaptive behaviours. If the external demands are too great for the child, dysregulation may occur. For example, cultural demands may require quietness from the child, but if he/she is active and impulsive, the child would find it difficult to function optimally within that milieu. The internal dimensions are also affected by the external dimensions, for

example the perception of the sound of footsteps would vary if one was in sunlight as opposed to walking on a dark night.

Numerous studies have sought to ground sensory modulation disorders in alterations in neurophysiology.

Neurophysiology of sensory modulation disorder

To date, there is still little understanding about the underlying neural mechanisms involved in SMD and SOR, and some doubt whether any links can be established neuroanatomically (Koziol & Budding, 2012). Many recent and current studies are focussing on understanding the probable neurological underpinnings for these conditions (Brett-Green, Miller, Schoen, & Nielsen, 2010).

Tactile stimuli pass up to the brain via two tracts - the dorsal column medial lemniscal (DCML) system (transmitting vibration, touch pressure and proprioception) or the anterolateral system (transmitting light touch, pain and temperature). The DCML is a discriminative system, and the anterolateral is a protective system. The DCML synapses in the brainstem in the thalamus and the reticular formation, and then in the primary and secondary somatosensory cortex and areas five and seven of the posterior parietal lobe. The anterolateral system also synapses in the thalamus and reticular formation, as well as the hypothalamus (responsible for the autonomic nervous system responses) and the limbic system (responsible for emotional tone). When this protective system is activated, it results in the production of adrenaline from the thalamus, the fight and flight response of the autonomic nervous system, and production of facilitatory neurotransmitters, resulting in high arousal.

Ayres' initial neurological theories to better understand SOR were based on the early work of Sherrington from 1906, Head in 1920 and Melzack and Wall in 1965 (Ayres, 1974). She hypothesised that children with, what at that stage she called "tactile defensiveness", had an imbalance between these two somatosensory systems, with insufficient inhibitory mechanisms from the DCML system to dampen down irrelevant sensory information. This caused excessive central nervous system arousal in response to typical stimuli, with activation of the autonomic nervous system fight and flight response (Ayres, 1974; Baranek & Berkson,

1994). On the basis of this hypothesis, Ayres postulated that the inhibitory influence of the DCML could be activated by deep pressure and proprioceptive input (Ayres, 1974; Baranek & Berkson, 1994; Murray-Slutsky & Paris, 2000). More recent research has disagreed with this hypothesis, and suggested that, although SOR was linked to faulty inhibition, it was suggested that this inhibition occurred at higher centres in the CNS (Baranek & Berkson, 1994). However, neither of these theories has been proven to date.

Studies comparing physiological measures between SMD and typically developing children have found differences in electrodermal responses (EDRs), event-related potential patterns and parasympathetic responses (Davies, 2010; Pérez-Robles et al., 2013; Schoen et al., 2009). Preliminary evidence shows the involvement of both the sympathetic and parasympathetic systems (Schaaf et al., 2015; Schoen et al., 2009). Some physiological differences have also been identified between children with SOR and sensory under-responsivity (Reynolds & Lane, 2008). Various neurophysiological mechanisms have been measured by different researchers (Reynolds & Lane, 2008), and the most commonly tested physiological measures are reflected in Table 2-2 below.

TABLE 2-2 COMMON PHYSIOLOGICAL MEASURES STUDIED IN SMD

Physiological measure	Measuring tool	Rationale	Summary of findings
P50 & N100	EEG	Reflect two aspects of sensory gating	Less P50 gating in SOR children & less N100 gating in SMD children
Electrodermal response/activation (EDR/A)	Electrodes on the skin measure sweat gland activity	Measures sympathetic response to sensory stimulation - reactivity and habituation	Magnitude of response significantly greater, and slower habituation in SMD children compared to typical children
Cardiac vagal tone	ECG	Reflects parasympathetic activity - recovery from stress, restoring calm alert state, regulation	Lower vagal nerve activity in the SMD children compared to typical and ASD children
Salivary cortisol	Analysis of saliva sample	Reflects body's stress response, both reaction and recovery	Raised cortisol levels in SOR children compared to typical children

Sensory over-responsivity described

Sensory over-responsivity is defined as an over-responsive behavioural reaction to sensory stimulation which is of a nature that would not be considered harmful or threatening to

typically developing adults or children, and is out of proportion to the stimulus. This is more intense, quicker in onset, and/or more long lasting than for the typically responsive individual (Interdisciplinary Council on Developmental and Learning Disorders, 2005). This response may be in reaction to stimuli in only one sensory system, or multiple sensory systems (Ben-Sasson, Carter, & Briggs-Gowan, 2010; Miller, Anzalone, et al., 2007). Associated behaviours may include fearfulness, anxiety, avoidance of sensory experiences, stubbornness and obstinacy, irritability, fussiness, inattention, hyperactivity, poor socialization, and difficulty with transitions (Interdisciplinary Council on Developmental and Learning Disorders, 2005; Reynolds & Lane, 2009; SPD Scientific Work Group, 2008). Individuals with SOR have defensive "fight, flight, fright or freeze" reactions to sensory stimuli in the environment that would be considered to be normal and non-threatening. These reactions are due to sympathetic nervous system activation (Miller, Anzalone, et al., 2007; Schaaf et al., 2015). SOR can occur as the sole diagnosis, or may be present with other conditions, and is frequently a co-morbid condition with ADHD, ASD, epilepsy and Generalized Anxiety Disorder (GAD), amongst others (Ben-Sasson & Podoly, 2017; Conelea et al., 2014; Koziol & Budding, 2012; Reynolds & Lane, 2008; van Campen, Jansen, Kleinrensink, Joëls, & Braun, 2015). A survey by the SPM Foundation which was completed by 716 parents, found that in the subset of children with SOR, the highest prevalence per sensory system was 77% showing auditory sensitivity, 52% touch sensitivity, and 50% taste sensitivity (SPD Scientific Work Group, 2008). The research findings into the prevalence of sensory over-responsivity will now be discussed.

Prevalence of sensory over-responsivity

Studies on the prevalence of sensory modulation disorder have mostly been conducted in America, and have found varying rates, although the trends are similar. A large study in one American school district by Ahn et al (2004) found a rate of SMD of between 5% and 14% in the kindergarten population (equivalent to grade R in the South African education system). These two rates resulted from two different calculations that were used. The higher prevalence was calculated from the number of participants who returned the SSP questionnaire used in the study. However, the response rate of 39% was considered by the authors to be very low, and therefore they did an additional calculation based on the

assumption that all non-respondents would have typical scores. This gave a conservative estimate for prevalence of 5%. A further nationwide American study found a SMD prevalence rate of 11% in a sample of 788 typically developing children (Little, Dean, Tomchek, & Dunn, 2016). A limited number of studies have been done in other countries, some reporting lower or higher prevalence rates. The prevalence rate in Saudi Arabia was reported to be 34% (Al-Heizan, Al-Abdulwahab, Kachanathu, & Natho, 2015). Israeli children demonstrated a lower rate, although the exact rate was not specified (Caron, Schaaf, Benevides, & Gal, 2012). Chemel (2015), in a South African study, found a high rate of 39% on the teacher questionnaire and 41% on the caregiver questionnaire of the Sensory Profile using 100 grade R children attending a private school, and therefore likely to be of high socio-economic status. Cultural and language factors may have influenced these results (Al-Heizan et al., 2015, Caron et al., 2012). When considering SOR, slightly higher prevalence has been found.

Three SOR studies, all sampling American children from one state, have looked at prevalence of SOR in the past ten years (Ben-Sasson, Carter, & Briggs-Gowan, 2009; Ben-Sasson et al., 2010; Van Hulle, Schmidt, & Goldsmith, 2011). The sample size for two of the studies was in the region of 1 000 (Ben-Sasson et al., 2009; Van Hulle et al., 2011), and Carter et al. (2011) had a sample size of 338. Van Hulle et al. (2011) found a SOR prevalence of 21% in children of 7 and 8 years. Carter et al. (2011) also found a prevalence of 21% in the smaller sample, however the sample was weighted, with approximately three-quarters having reported social-emotional-behavioural or language difficulties. Prevalence of 17% was found by Ben-Sasson et al. (2009). SOR has consistently been found to be the most common sub-section of sensory modulation disorders identified. McIntosh et al (1999) used EDRs in a small study using 19 typical and 19 SMD children, and found the largest SMD category identified was SOR, although the percentage was not reported in the article. A systematic review that synthesised the findings of 45 articles on SPD in preterm children of 0-3 years by Mitchell et al. (2015) found that 82% of children diagnosed with SMD fell into the SOR category.

SOR is frequently found in conjunction with other conditions, with co-morbidity most commonly occurring with ADHD, ASD and GAD (Bar-Shalita & Cermak, 2016; Conelea et al., 2014; Critz, Blake, & Nogueira, 2015; Koziol & Budding, 2012; Philpott-Robinson, Lane, &

Harpster, 2016; Shimizu, Bueno, & Miranda, 2014). In these studies, the findings suggest that the prevalence rate is much higher than in typical children presenting with SOR. Higher prevalence has also been found in Fetal Alcohol Syndrome, which is common in South Africa. The only South African study that could be found exploring this topic was by du Plooy (2017), who examined both sensory processing and sensory modulation in a small sample of 20 children diagnosed with Fetal Alcohol Syndrome. She compared this group with a control group of 20 from the same low socio-economic area. In the Fetal Alcohol Syndrome group, the prevalence of SOR was 90%. In the total sample, the prevalence of SOR was 63%. All other categories of SMD had greater prevalence than that cited in the literature.

A number of studies have investigated gender, with almost all studies finding no relationship between gender and prevalence of SOR (Conelea et al., 2014; Schoen, Miller, & Sullivan, 2014; Van Hulle et al., 2015). However, one study exploring SMD using the Short Sensory Profile (SSP) 1st edition translated into Hebrew, found gender differences in the areas of under-responsiveness and sensory seeking behaviours. Boys showed a greater prevalence rate in these areas (Engel-Yeger, 2010) but no gender differences were noted in sensory over-responsiveness. The sample size in this study was small, therefore the results cannot necessarily be generalized to the whole population.

A small number of studies have looked at prevalence rates in low socio-economic areas. Ben-Sasson et al. (2009) found that belonging to a minority ethnic group, being unemployed, of low educational level, single and receiving poverty assistance were all risk factors for SOR, however no prevalence rate for low socio-economic areas was reported. In du Plooy's (2017) study, the prevalence rate of SOR in the control group of children, who were drawn from low socio-economic areas in the Cape Winelands, was 35%. These figures suggest that in low socio-economic groups, there is a significantly higher prevalence of SOR.

Onset of SOR symptoms would appear to be early, with the majority of parents recalling that they noted associated behaviours before 5 years of age (Conelea et al., 2014). The developmental trajectory of SOR and SMD from childhood into adulthood remains unclear (Baranek, David, Poe, Stone, & Watson, 2006; Ben-Sasson et al., 2010). In the first study to look at the trajectory of SOR from infancy (1 year) to school age (7 years), with 521

participants, the researchers found stability in the scores, and established that early childhood sensitivity patterns significantly predicted SOR at 7 years of age (Ben-Sasson et al., 2010). The studies reported earlier which found a prevalence rate for SOR of 8 – 15% in young children of 7 - 10 years (Carter, Ben-Sasson, & Briggs-Gowan, 2011; Van Hulle et al., 2011) showed a decrease in rate to 2.5% in older children (Van Hulle, 2015). No information could be found on the progression of SOR into adulthood, although the disorder has been identified in adults (Bar-Shalita & Cermak, 2016). No literature could be found on whether there has been an increase in incidence of SOR in recent years, although an expert in the field suggests an increase (T. A. May-Benson, personal communication, January 26, 2017). However, this apparent increase in SOR may also relate to increased awareness of the problem, better diagnosis, peri-natal factors, environmental factors, and other factors. As with prevalence rate, there is little literature about the causes of SOR.

Causes of sensory over-responsivity

The causes of SOR are largely unknown (Van Hulle et al., 2015). However, pre-and peri-natal complications have been implicated as risk factors (Keuler et al., 2011; May-Benson et al., 2009). Two studies identified shorter gestational age and prematurity (prior to 37 weeks gestation) to be associated with SOR (Case-Smith, Butcher, & Reed, 1998; Goldsmith, Van Hulle, Arneson, Schreiber, & Gernsbacher, 2006), and three more identified a link to all areas of SMD, not only SOR (Bröring, Oostrom, Lafeber, Jansma, & Oosterlaan, 2017; Rahkonen et al., 2015; Wickremasinghe et al., 2013). Another study compared preterm (GA ≤ 37 weeks), with ages corrected to allow for the early delivery, to term infants at 4 and 6 months, and found increased tactile and vestibular sensitivities (Cabral, da Silva, Martinez, & Tudella, 2016). May-Benson (2009) found a very high incidence of jaundice in children with SPD (26%) compared to the national average (7%). The study was however limited to children already diagnosed with SPD, with no investigation of typical children. In addition, there were very few cases falling in the category of the severe scores, thus not providing a normal spread of scores. Three studies found that NICU stays linked with SMD, and this relationship was hypothesised to be linked to sensory overstimulation, repetitive painful medical procedures, parental separation and tactile, vestibular and kinaesthetic understimulation apparent in

these settings (Bröring et al., 2017; Case-Smith et al., 1998; Rahkonen et al., 2015). The study by van Hulle et al. (2015) found a significant association between gestational age and tactile sensitivity, and to a lesser extent auditory sensitivity. The shorter the gestational age, the more severe were the symptoms of sensitivity. A study by Keuler (2011) showed that prenatal complications (such as maternal stress, maternal illness) were strong predictors of tactile sensitivity; that both auditory and tactile sensitivity were heritable; and that females with a male co-twin were more likely to have SOR symptoms at 2 years. Most studies have identified no gender differences in SOR (Conelea et al., 2014; Schoen et al., 2009, 2014; Schoen, Miller, & Sullivan, 2017; Van Hulle et al., 2015).

A study examining specifically the auditory and tactile sensitivity aspects of SOR used a large (n=1394) sample of toddler-aged twins. This was the first study to explore the influence of genetic structure in SOR (Goldsmith et al., 2006). The researchers found a moderate genetic influence, with tactile sensitivity being more heritable than auditory sensitivity.

A South African study by Langkilde (2015) compared birthing method (VB, elective CS and emergency CS) with SPD, of which SMD and SOR are subsections, finding worse scores in all areas of SPD in the elective CS group (Langkilde, 2015). She reviewed a sample of 35 cases of children who were attending occupational therapy private practices, and were already diagnosed with SPD. While there were differences between the three birthing method groups, they were not statistically significant. The elective CS group showed greater difficulties as identified on the Sensory Profile 1st edition (SP) in all the sub-sections. The VB group had a 43% prevalence rate of SOR, whereas the CS group had a 70% SOR rate. When considering the four sensory modulation categories in the elective CS group, the category with the highest percentage, was SOR. Maternal age was not reported in the study, nor was socio-economic status, although it is likely that the participants were from the middle to high socio-economic groups, as they were attending private practices. Langkilde postulated a number of reasons for these findings. Firstly, the babies born by VB and emergency CS were likely to have had a greater gestational age, and therefore would have spent more time in the flexed, inverted position in utero. Those born by elective CS were more likely to have had a shorter gestational age, as planned deliveries tend to be scheduled earlier. They may therefore have missed this sensory-motor experience of flexion and inversion. Secondly, the

fetus would experience some of the effects of labour in a VB and an emergency CS. Thirdly, activation of the dorsal column medial lemniscal pathway may be stimulated by the deep pressure experienced during labour by the fetus, impacting on sensory modulation (Langkilde, 2015). Langkilde identified the small sample size, the use of a parent questionnaire as the only assessment tool and lack of information on other variables as limitations of the study. Langkilde recommended further research using a larger sample, and obtaining information on additional variables of gestational age (GA), spontaneous onset of labour versus induced labour, and other aspects of birth history.

The effect of socio-economic status on the development of SOR has not been widely studied. However, a number of studies have investigated the influences of low socio-economic status on brain development, and have linked low socio-economic status with abnormalities in brain structure and function (Ursache & Noble, 2016a, 2016b), alterations in stress physiology and cortisol levels (Raffington et al., 2018; Ursache, Noble, & Blair, 2015), executive functioning, particularly memory (Raffington et al., 2018; Ursache et al., 2015), growth retardation, poor child development and school achievement (Davies et al., 2011; Grantham-Mcgregor et al., 2007; Wehby & McCarthy, 2013) and the development of visual-motor integration skills (Dunn, Loxton, & Naidoo, 2006b; Ercan, Ahmetoglu, & Aral, 2011). These findings point to the impact of socio-economic factors on a variety of developmental domains (Davies et al., 2011), with a likelihood that SMD and SOR may be similarly affected. A limited number of studies have explored the SOR domain specifically.

Ben-Sasson et al. (2009) linked socio-economic factors, in particular single parenting and low socio-economic status, to an increased risk of SOR. A study investigating the sensory modulation patterns in institutionalized children showed an increased risk of all four categories of SMD, but particularly SOR (Lin, Cermak, Coster, & Miller, 2005). A review by Roman-Oyola (2011) found low socio-economic status to be a predisposing factor linking it to increased risk of SMD, and specifically SOR.

Only two South African studies could be found on this subject (Du Plooy, 2017; Van Jaarsveld, Venter, & Joubert, 2001). Van Jaarsveld et al. (2001) found a higher prevalence of sensory integration problems (of which SMD is a category) in the low socio-economic communities of

Bloemfontein, where 100 three to five-year-old children were tested. However, the test used in her study does not measure SMD specifically, so no figures were reported for this aspect of sensory integration. Du Plooy (2017) found the prevalence rate of SOR in a control group of 30 children aged five to nine years from low socio-economic rural areas of the Western Cape to be 35%. All other categories of SMD also showed a higher prevalence than the prevalence cited in the literature. These figures suggest that in low socio-economic communities, there is a significantly higher prevalence of SMD, and in particular SOR.

Assessment of sensory over-responsivity

There is no gold standard for the assessment of SOR or SMD, nor is there consensus on the best measuring tool (Conelea et al., 2014; Tavassoli et al., 2016). In addition, there is no assessment available at present which looks at all the elements of SMD (SOR, SUR and SS/C) over all seven sensory domains (tactile, visual, auditory, smell, taste, vestibular and proprioceptive). Most assessments are based on questionnaires (Carter et al., 2011; Tavassoli et al., 2016; Van Hulle et al., 2015), which have advantages and disadvantages. Advantages are that they provide a longitudinal and daily occurrence view, which may be missed in a single-session evaluation (Ben-Sasson et al., 2009). They also show responses in multiple environments (Eeles et al., 2013; Schoen, Miller, & Green, 2008; Schoen et al., 2017), and are low cost and easy to administer (Tavassoli et al., 2016). A disadvantage is that results from questionnaires are subjective to the clinician, parent and/or teacher, and are strongly influenced by the perceptions of the person filling in the questionnaire (for example their sensory regulating styles and expectations, their culture, altered memory of past events) (Ben-Sasson et al., 2009; Perez-Robles et al., 2013; Schoen et al., 2008; Tavassoli et al., 2016). Results from different contexts can also vary considerably. A questionnaire completed by a teacher may indicate normal functioning, as the child attempts to hold themselves together at school. Once arriving home, their behaviour may deteriorate and they become dysregulated (Miller et al., 2012), resulting in the report from the caregiver looking quite different to that of the educator.

It can be seen from the literature reviewed pertaining to sensory modulation and over-responsivity, that most of the research is based in America. Due to the context of this

research study, which involved different cultures, language groups and educational levels, the influence of these factors as reported in the literature was explored further.

Language and cultural factors

Research into the development and prevalence of sensory modulation patterns in cross-cultural contexts in very limited (Chow, 2005). However, the problem of using questionnaires to assess sensory modulation in different cultural and linguistic settings has been experienced by a number of researchers, where the challenge is to ensure validity of the tool (Kayihan et al., 2015; Neuman, Greenberg, Labovitz, & Suzuki, 2004; Su & Parham, 2002). The two relevant issues identified are cultural relevance and linguistic meaning (Caron, Schaaf, Benevides, & Gal, 2012; Kayihan et al., 2015; Neuman et al., 2004; Su & Parham, 2002). Cultural factors will be explored first.

Al-Heizan et al. (2015) found the prevalence rate of SMD to be 34% among Saudi Arabian children, considerably higher than in the American normative data. The researchers suggested that this was due to cultural factors related to social experiences and child-rearing styles in this country. The parenting style was more protective and nurturing than the American style, resulting in fewer opportunities for children to experience vestibular and proprioceptive stimulation, which contributed to the greater prevalence of SMD.

In a Hong Kong study, Lai et al. (2011) reported low correlation between the scores on the Home and the Classroom SMD questionnaires. This was thought to be due to the very structured Hong Kong school routine, and expectations for children's behaviour to be very controlled, whereas at home a lot more freedom was allowed.

A large study done in Hong Kong (Chow, 2005) found significant differences in prevalence of SMD between American and Hong Kong children. None of the possible child behaviours associated with SMD described in the statements on the questionnaire were considered to be sufficiently problematic by the parents to warrant a definite or probable difference score. The test was therefore not able to detect sensory modulation impairments.

Neuman et al. (2004) found significant differences in caregiver responses between Jewish caregivers completing a SMD questionnaire in both English and Hebrew. They highlighted two possible reasons for this ambiguity. The first was that a word or phrase can have slightly

different connotations in different cultures, with the example given of “fidgeting”, which in English has a restless or nervous connotation, which may not be present in other cultures. They also point to unconscious cultural influences resulting in different responses in two languages to the same item.

A study by Caron et al. (2012) compared caregiver responses in Israel on the Hebrew translation of the SSP 1st edition with caregiver responses in America using the original version. All the Israeli caregivers reported fewer atypical responses to sensory stimuli. The authors postulated two possible reasons for this – either Israeli children do not respond as intensely to sensory stimuli as their American counterparts, or that the Israeli caregivers are less likely to record a response as being behaviourally different to the norm.

Cultural differences in caregiver responses in a Turkish study (Kayihan et al., 2015) were thought to be linked to Turkish parenting styles. These do not encourage independence in young children, tending towards over-protectiveness (for example “Leaves clothes twisted on body”, caregivers frequently commented that children that age can’t notice that).

These findings suggest that cultural differences are real, often not conscious, yet significant, and need to be a factor considered in the assessment process, particularly when a subjective assessment tool is used (Caron et al., 2012). These studies indicate the complexity of attempting to transfer a subjective questionnaire into another culture. When a questionnaire also needs translation into a different language, this adds to the complexity.

When translations are used, the applicability of the measuring tool and the generazibility of the results can be negatively affected if the translation procedures are not stringent (Chow, 2005; Su & Parham, 2002). Sensory modulation questionnaires have been translated into a number of other languages, and the findings of these studies are reflected in Table 2-3.

TABLE 2-3 SMD QUESTIONNAIRE TRANSLATION STUDIES

Country	Test	Language	Reference	Pitfalls, comments, adaptations required	Findings
Puerto Rico	SSP	Spanish	(Román-Oyola & Reynolds, 2013)	Cognitive debriefing identified potential language and comprehension difficulties. A language clarification	Significantly higher SMD prevalence rate compared to American studies

Country	Test	Language	Reference	Pitfalls, comments, adaptations required	Findings
				guide was developed and given to caregivers when completing the questionnaire	
Brazil	SP	Portuguese	(Shimizu et al., 2014)	Issues round translation and adaptation to a different culture were not addressed in the article	SMD compared between ADHD and typical children found similar patterns to those in America
India	SSP	Tamil	(Sankar & Priyadarshini, 2014)	No adaptations. Caregivers had highly developed English and Tamil, and read the questionnaire in both languages, but completed it in Tamil	Internal consistency .84-.95 Discriminant validity <.001
Japan	SP	Japanese	(Nakagawa, Sukigara, Miyachi, & Nakai, 2016)	Likert scale adapted	Validity and prevalence not reported
Hong Kong	Sensory Processing Measure	Chinese	(Lai, Chung, Chan, & Li-Tsang, 2011)	Extensive back-translation process with 28 panel members Several items added or removed to increase cultural relevance	Test-retest reliability .70-.98 Internal consistency .64-.95 Discriminant validity p≤.001
Taiwan	Evaluation of Sensory Processing	Mandarin	(Su & Parham, 2002)	Stringent back-translation process and a pilot study with target population, with 46 revisions.	Importance of rigorous cultural and language translation in cross-cultural work
Israel	SSP	Hebrew	(Engel-Yeger, 2010; Neuman et al., 2004)	Rigorous back-translation process	Test-retest reliability .89 Internal consistency .72-.92 Appropriate tool for SMD screening
Turkey	SP	Turkish	(Kayihan et al., 2015)	Pilot study with target population	Test-retest reliability >.94 Internal consistency

Country	Test	Language	Reference	Pitfalls, comments, adaptations required	Findings
					.66-.97, except 1 subsection .39 A valid measuring tool for identifying SMD in children above 5 years only

SP: Sensory Profile; SSP: Short Sensory Profile

Neuman et al. (2004) emphasise the enormous complexity of both translating an assessment tool into another language, as well as the challenges linked to cross-cultural work. Roman-Oyola & Reynolds (2013) highlight the effect of culture on parents' perceptions of desired behaviours, parenting styles and societal expectations, and the influence this has on completion of a sensory questionnaire. Su & Parham (2002) call for norms to be developed for each particular culture. As they state, "We cannot rely on American data to interpret Taiwanese parents' ratings of their children" (Su & Parham, 2002, p. 584). Cultural and language factors can also impact on the caregiver's use and understanding of the Likert scale.

Use of the Likert scale

The Likert scale is used in most SMD questionnaires to enable the tester to convert the behavioural characteristics being measured into a numerical value. Cultural factors, educational level and language can affect the caregiver's use of the Likert scale, thus affecting the reliability of the measuring tool. Two research studies highlight the difficulties of using the Likert scale in SMD questionnaires cross-culturally (Chachamovich, Fleck, & Power, 2009; Lee, Jones, Mineyama, & Zhang, 2002).

Lee et al. (2002) found that Japanese caregivers reported greater difficulties with the use of the scale than American users, and that Chinese caregivers tended to skip questions more frequently than Americans. They found that seemingly minor details in the format of the scale – the particular words used to describe each numeric value on the scale; using words at only the end points or throughout the scale; the number of alternative choices in the scale – could affect the results. Construct validity was better for the Chinese users when four alternative choices were provided in the scale, and for the Japanese it was better when seven

were provided. Lee et al. (2002) also mentioned problems associated with the concept of measurement on a continuum which is completely foreign in some cultures.

The second study looked at the validity of using a 5-point Likert scale with caregivers who were non-readers (Chachamovich et al., 2009). Their findings were that the psychometric properties deteriorated significantly when completed by non-readers or poor readers. The Likert scale in addition requires some numeracy skills, as well as an ability to think conceptually, which the study by Chachamovich et al. (2009) found linked to poor reading ability and the resultant changes to brain structure and functioning. Their conclusion was that a 5-point or multi-point scale was not suitable for use with non-readers. Their recommendation was that for this group of caregivers, a simpler, three-point scale should be used, and that this would increase the psychometric properties. This however only applied to non-readers. If graduate caregivers completed a three-point scale, this also had a negative impact on the test's psychometric properties.

These findings provide a glimpse into the complexities of using a Likert scale in different cultures and with varying educational caregiver levels.

This review highlights the complexity of using caregiver questionnaires as a form of assessment, particularly when these are used cross-culturally and with different language groups and education levels. Although there are some advantages to this form of assessment, the disadvantages make reliability and validity low, and the results need to be interpreted with caution (Schoen et al., 2009). Table 2-4 below reflects the assessments currently used to evaluate SMD in children. The assessment tools which are relevant to use in this study are highlighted in bold in the table, and will be discussed further.

TABLE 2-4 ASSESSMENTS THAT EVALUATE SENSORY MODULATION DISORDERS IN CHILDREN (MILLER ET AL., 2004), UPDATED (BARANEK ET AL., 2006; DUNN, 2014; SCHAAF & LANE, 2015)

Name	Age	Components measured	Format	Source	Year
Brazelton Neonatal Behavioural Rating Scale	**0-1 month**	**Social skills, motor reflexes, tactile and vestibular processing**	**Therapist observation**	**Brazelton, T.B.**	**1984**

Name	Age	Components measured	Format	Source	Year
Child Sensory Profile 2	**3-14 years**	**Sensory modulation, behavioural and emotional responses**	**Parent questionnaire**	**Dunn, W.**	**2014**
DeGangi Berk Test of Sensory Integration	**3-5 years**	**Vestibular-based sensory integrative functions**	**Therapist observation**	**Berk, R.A., DeGangi, G.A.**	**1983**
Early Coping Inventory: A Measure of Adaptive Behaviour	4-36 months	Sensorimotor organization and reactivity	Therapist observation	Zeitlin, S. Williamson, G.G., Szczepanski, M.A.	1988
Infant Sensory Profile 2	0-6 months	Sensory modulation	Parent questionnaire	Dunn, W.	2014
Infant Toddler Symptom Checklist	7-30 months	Prickliness test	Parent questionnaire	DeGangi, G.A., Poisson, S.	1995
School Companion Sensory Profile 2	**3-14 years**	**Sensory modulation, behavioural and emotional responses**	**Teacher questionnaire**	**Dunn, W.**	**2014**
Sensorimotor History Questionnaire for Preschoolers	**3-4 years**	**Sensory integration and self-regulation**	**Parent questionnaire**	**DeGangi, G.A., Balzer-Martin, L.**	**1999**
Short Sensory Profile 2	**3-14 years**	**Sensory modulation, behavioural and emotional responses**	**Parent questionnaire**	**Dunn, W.**	**2014**
Test of Sensory Functions in Infants	4-18 months	Regulatory disorders, developmental delay	Therapist observation	DeGangi, G.A., Greenspan, S.I.	1989
Toddler Sensory Profile 2	7-35 months	Sensory modulation	Parent questionnaire	Dunn, W.	2014
Touch Inventory for Elementary School-aged Children	**Elementary school-aged children**	**Tactile defensiveness**	**Child self-report**	**Royeen, C.B., Fortune, J.C.**	**1990**

Name	Age	Components measured	Format	Source	Year
Touch Inventory for Pre-schoolers	Preschool-age children	Tactile defensiveness	Parent/teacher questionnaire	Royeen, C.B.	1987
Sensory Processing Measure	5-12 years	Sensory modulation, socialisation, praxis	Parent and teacher questionnaires	Parham, L.D., Ecker, C., Kuhaneck, H.M., Henry, D.A., Glennon, T.J.	2007
Sensory Experiences Questionnaire	**5 months-6 years**	**Sensory modulation**	**Parent questionnaire**	**Baranek, G.T., David, F.J., Poe, M.D., Watson, L.R.**	**2006**

The suite of SP2 questionnaires, particularly the Short Sensory Profile 2 (SSP2), are the most commonly used in research studies (Van Hulle et al., 2015). The other tests in this suite which were relevant to this study were the Child Sensory Profile 2 and the School Companion Sensory Profile 2. The Child SP2 is an expanded version of the SSP2, with 86 statements for the caregiver to respond to, as opposed to the 34 in the SSP2. The School Companion SP2 is a questionnaire for teachers to complete on the child's sensory processing. The psychometric properties of the SP2 suite of tests are good. The test-retest reliability of the SSP2 is very high, ranging from .83 to .97 for the different sections (Dunn, 2014). The interrater reliability (comparison with results of the questionnaire completed by another family member) is high, in the range of .73 to .89 for most sections. Construct validity was generally in the moderate to high range (Dunn, 2014), and was also established in relation to EDRs (Whitcomb et al., 2015). Discriminant validity was above 95% (Dunn, 2014). Content validity was not documented for the SSP2, but was for the SP2, on which the SSP2 is based, so is likely to be very similar. This found that the SP2 measured what it said it measured, and that there were sufficient items which reflected the distinct categories (Dunn, 2014). In addition, the SSP2 has a high correlation with the Behaviour Assessment System for Children and the Social Skills Improvement System Rating Scales which is significant, as SMD impacts both behaviour and social skills (Dunn, 2014).

The DeGangi Berk Test of Sensory Integration is one of the few therapist-administered tests. However, most of the test items relate to motor control (postural control and bilateral motor control) and reflex activity, with only a few items evaluating SMD. It takes approximately 30 minutes to administer. It is an outdated test, having been published in 1983.

The Sensorimotor History Questionnaire for Preschoolers is a parent questionnaire with a yes/no response to statements covering five of the seven sensory systems. Other areas are also assessed such as muscle tone, motor co-ordination and concentration. The researcher has no knowledge or experience with this assessment, thus it was not considered for use in this study.

The Sensory Experiences Questionnaire is a caregiver questionnaire specifically for assessing SMD in autistic children. It categorises the findings of SMD into hyper- or hyper-responsiveness. It reports some good psychometric properties, with internal consistency of .80. It was however only standardized on a small sample of 258 children. The sample population in this study were not autistic children, therefore the researcher did not consider using it.

In order to counter some of these disadvantages of questionnaires described above, a number of researchers have motivated that behaviour rating scales need to be supplemented by a more objective clinician assessment of the individual in order to achieve diagnostic accuracy (Baranek et al., 2006; Ben-Sasson et al., 2010; Chien et al., 2016; Carter et al., 2011; Eeles et al., 2013; Matsushima et al, 2016; Miller et al., 2012; Nakagawa, Sukigara, et al., 2016; Schaaf, Burke, et al., 2014; Schaaf & Lane, 2015; Schoen et al., 2009; Tavassoli et al., 2016). There are however currently no standardized, observable clinician assessments for SMD that can be used in conjunction with the caregiver questionnaires (Schoen et al., 2008). There are however some developments in this regard. The SensOR Scales was developed by researchers at the SPD Foundation in an attempt to fill this gap (Miller et al., 2012; Schoen et al., 2008, 2014, 2017). It is the first study to develop and evaluate a performance measure which uses direct observation of the client by the clinician to evaluate SOR, without the use of complex laboratory equipment (Schoen et al., 2008). It is still in the development stage. The SensOR Scales are applicable to children from 3 years to adults, and consist of the SensOR

Assessment which is done by the clinician, and the SensOR Inventory which is a questionnaire to be completed by the caregiver or the client (if over 16 years). Both look at all seven sensory domains (Schoen et al., 2008). The SensOR Scales has high internal consistency within each domain, strong discriminant validity (discriminating well between those with SOR and those without), strong concurrent validity with the SOR sections of the SSP, interclass correlation coefficients ranging from 0.824 to 1.00, test-retest reliability of 0.691 to 1.00 (Lane, Reynolds, & Thacker, 2010; Schoen et al., 2008, 2017) and moderate to high interrater reliability for the SensOR Assessment (Schoen et al., 2008). Further research and development of the test then resulted some changes to include the other two subtypes of SMD, namely sensory under-responsivity and sensory seeking/craving, with the expanded version referred to by the interim titles Sensory Processing Scale/Sensory Processing 3 Dimensions Assessment and Inventory (Schoen et al., 2014). The psychometric properties are similar to those reported above for the SensOR Scales (Schoen et al., 2014). Further research, as well as standardization of this test is required before it can be widely disseminated (Schoen et al., 2014).

Other forms of assessment to diagnose SMD and specifically SOR in the form of recent neurophysiological studies also show exciting possibilities, although they have only been used experimentally (Schaaf, Burke, et al., 2014) and require specialised laboratory equipment and expertise which is not readily available to occupational therapists. The study by Davies and Gavin cited above had one of their research questions “Can EEG techniques be useful in the diagnosis of SPD?” (although in their study all the children were diagnosed with the SMD component) (Davies & Gavin, 2007). They found that 86% of children with SMD could be accurately diagnosed by their ERP responses. Another study in 2010 was able to successfully identify 64.7% children with and without SOR using measures of EDR (Lane et al., 2010).

Intervention for sensory over-responsivity

Children with SOR benefit from a sensory-based treatment approach. Inhibitory stimuli are used for the over-stimulated nervous system, the most common being deep pressure and proprioceptive input, which are hypothesised to stimulate the inhibitory DCML system (Ayres, 1974; Dunn, 2014; Fisher et al., 1991; Knickerbocker, 1980; Roley et al., 2001). Patricia

Wilbarger developed a deep touch pressure and proprioceptive programme which is claimed to significantly reduce SOR (Bhopti & Brown, 2013; Kimball et al., 2007; Wilbarger & Wilbarger, 1991). Fisher (1991) and others also include slow, linear and rhythmical vestibular input (Dunn, 2014; Murray-Slutsky & Paris, 2000; Roley et al., 2001). Occupational therapy/sensory integration incorporates all these types of input. Ayres hypothesised that the gating mechanism was faulty in children with SOR, and that stimuli such as deep pressure and proprioception carried by the DCML caused the DCML to close the gating mechanism. In contrast, light touch stimuli would cause the anterolateral system to trigger opening the gates, prompting the defensive response (Ayres, 1974; Baranek & Berkson, 1994; Murray-Slutsky & Paris, 2000). The calming effect is thought to result from either the DCML system's inhibitory effect via the reticular formation on the release of inhibitory neurotransmitters, or through cortical inhibition (Baranek & Berkson, 1994; Murray-Slutsky & Paris, 2000).

However, the efficacy of treatment for SMD has been disputed (Pollock, 2007), with many of the studies not being rigorous enough (Miller, Schoen, James, & Schaaf, 2007; Pollock, 2007). An attempt has been made to correct this, with Miller and a team doing first a pilot study and then a randomized control study on the effectiveness of Ayres sensory integration (SI) with SMD children (Miller, Coll, & Schoen, 2007; Miller, Schoen, et al., 2007). In the initial pilot study (Miller, Schoen, et al., 2007), the main focus was to refine the methodology and establish which outcome measures were best able to indicate changes as a result of therapy, rather than to study the effectiveness of therapy. The larger study used 24 participants aged 3 – 11 years who had been diagnosed with SMD (Miller, Coll, et al., 2007). They were divided into 3 groups of 8 each – one who received occupational therapy/SI, a second group who did desk-top activities with individualized attention from an adult, and a placebo group. The occupational therapy/SI treatment group showed improvements in 3 of 7 of the behavioural outcome measures – the Goal Attainment Scale (GAS), attention, and cognitive/social scales. The GAS provides a standardized score of individualized goals important to the individual and their family (play, behaviour, self-care, etc.), and is highly sensitive for measuring improvements (Schaaf, Benevides, et al., 2014). Gains in the hypothesised direction, although not statistically significant, were shown in a further 2 behaviour scales, as well as in the amplitude of the EDR (ie. less hyper-reactive), compared to both the control and the

activity groups (Miller, Coll et al., 2007). A limiting factor of this study was the small number of participants. However, on other domains, the study was rigorous – a homogeneous sample, methodologically sound, standardized treatment, outcomes which were functional and sensitive and could be measured accurately. The findings of this study showed that occupational therapy/SI may be effective in treating children with SMD (Miller, Coll, et al., 2007). A larger study is being planned to further investigate this research question (Miller, Coll, et al., 2007; Miller, Schoen, et al., 2007). Another study (Schaaf, Benevides, et al., 2014) using occupational therapy/SI with children aged 4-8 years with autism, used a randomized control trial with a total sample size of 32. They found significantly higher scores on GAS in the treatment group, with these children needing significantly less caregiver assistance. These children displayed various types of SPD, not solely SMD, although many did show deficits in SMD, which were then targeted in therapy. The authors hypothesised that the improvements in GAS were to a certain extent due to changes effected by the therapy on sensory reactivity levels (Schaaf, Benevides, et al., 2014). It has been hypothesised that the changes in functioning post-treatment, reflect the brain's neuroplasticity – the ability of the brain to be shaped and to adapt to environmental input, in this case, the sensory experiences provided by occupational therapy/SI (Schaaf, Benevides, et al., 2014). The ability to process and integrate sensory input from the environment was thus improved, and this appeared to be borne out by some limited results showing changes in neural activity, specifically in more organized EEG activity and decreased EDR. A systematic review on the efficacy of treatment has recently been published (Schaaf, Dumont, Arbesman, & May-Benson, 2018). Of the 104 studies identified within the review period of 2007 and 2015, only five met the inclusion criteria of diagnosis with SMD, treatment with Ayres SI, and use of reliable outcome measures. Outcome measures used concerned mainly sensory regulation, socialisation, self esteem and skill performance, with three of the five studies used the GAS to assess outcomes. The review found that there had been a considerable improvement in the quality of research into the efficacy of treatment since previous reviews dating from 1986 – 2006. The research findings showed that there was strong evidence showing the efficacy of Ayres SI in children with sensory modulation disorders (Schaaf, et al., 2018).

A number of studies have specifically examined the effect of deep pressure on sensory modulation. Two studies examined the effect of weighted products, a form of deep pressure (one a weighted vest and the other a weighted blanket), on emotion and behaviour, but without specifying the deficit in sensory processing (Champagne, Mullen, Dickson, & Krishnamurty, 2015; Lin, Lee, Chang, & Hong, 2014). The study using the weighted blanket with adults, found a significant decrease in anxiety (Champagne et al., 2015). The study using the weighted vest involved 110 children with diagnosed ADHD, and showed improved on-task behaviour and reduced inattention (Lin et al., 2014). A study using 50 typical adults examined the physiological effects of deep pressure, measuring heart rate, respiration and EDRs as a function of both sympathetic and parasympathetic activity (Reynolds et al., 2015). It found that even a short period of 3 minutes deep pressure to the thorax resulted in a reduction of sympathetic activity, and increased parasympathetic activity. A similar result was obtained in a study by Bestbier and Williams (2017). It is theorised that the deep pressure input travels via the medulla and thalamus to the somatosensory cortex, where it reduces neuronal excitability and arousal, then providing top-down inhibition from the higher levels of the brain to the reticular formation, which is known to be involved with attention, concentration and alertness (Lin et al., 2014). The inhibitory influence of the descending reticular pathways is thought to have a direct effect on the autonomic nervous system, both the parasympathetic system (increased vagal tone) and the sympathetic system (reduced stress response) (Kimball et al., 2007; Reynolds et al., 2015). It is also thought that the deep pressure input travels to the Purkinje cells in the cerebellum, causing inhibition of the reticular formation (Champagne et al., 2015). The deep touch stimulation is thought to affect vagus nerve activity, improving self-regulation (Matsushima et al., 2016). Given the evidence cited above, deep touch pressure appears to be a significant treatment modality for SOR.

CONCLUSION

In this literature review, the two birthing methods, vaginal birth and elective caesarean section have been described. An important component of the vaginal birth is pressure, and the sequelae resulting from this pressure during a vaginal birth have been explored, both the effects on the neurophysiology of the birthing process and the functional implications. There

is a high incidence of CS births in private sector health care in South Africa. Findings from studies comparing CS and VB births detailing some negative sequelae of CS on breastfeeding, neurophysiology, brain function and development were described.

The disorder of sensory modulation, while widely understood by occupational therapists, is not generally accepted as a disorder in the medical and psychology professions, and is not included in the latest DSM-V (Miller et al., 2012; Schoen et al., 2017; Tavassoli et al., 2016). This chapter described the disorder, as well as two of the models which are relevant to this research study – Dunn's model of sensory processing and the Ecological Model of Sensory Modulation. The findings related to the neurophysiology of SMD have been explored, to aid in motivating that this is a distinct disorder, based on neurophysiological differences in these children. Sensory over-responsivity, one of the components of sensory modulation disorder, is an exaggerated behavioural reaction to sensory stimulation which is out of proportion to the stimulus. The prevalence ranges from 5 to 13% in America, with prevalence however varying considerably, being lower in some cultures, and higher other cultures, and higher in the presence of co-morbid conditions, and low socio-economic status. Possible causes of SOR include maternal factors, peri-natal factors, genetic influences and low socio-economic status. The assessment tools available were described, as well as their positive and negative characteristics. The Sensory Processing Scale presently being developed should greatly enhance the accurate assessment of SOR. Occupational therapists use sensory-based treatment techniques, principle of which is deep pressure, to treat SOR, and recent rigorous studies on the efficacy of this treatment have shown positive results (Miller, Coll et al., 2007; Schaaf et al., 2014; Schaaf et al., 2018).

The component of pressure is a feature of both a vaginal birth, as outlined above, as well as featuring as an important aspect of the treatment used by occupational therapists in the treatment of SOR. The review highlighted that none of the articles compared the prevalence rates of sensory over-responsivity between the two birthing methods, nor did any studies look at birthing methods as a possible cause of either SMD or SOR. The one research study which was the most closely linked to this researcher's study was an unpublished masters' thesis by Langkilde (2015). She examined the link between birth method and sensory

processing disorders, of which SOR is a category. When comparing birthing methods, the elective CS group showed greater levels of SPD (Langkilde, 2015). Langkilde recommended further research between the two groups with a larger sample, and that any association with other variables, such as gestational age (GA) and other aspects of birth history, should also be explored.

The following chapter describes the study methodology, including details of the research process, the data collection tools, and how the data obtained would be analysed.

CHAPTER THREE RESEARCH METHODOLOGY

INTRODUCTION

In this chapter, the description and motivation for the study approach and design used, is presented. The three levels of recruitment will be described – the first level relates to the geographical areas, the second level involves the selection of the specific ECD sites, and the third level outlines the recruitment of the child and caregiver dyads. The data collection tools, data collection process and subsequent analysis will be outlined. The chapter concludes with a consideration of the ethical principles that were pertinent to this research study.

RESEARCH APPROACH

The study adopted a quantitative approach as it aimed to gain information about a number of variables from a large sample of participants (Kielhofner, 2006). Quantitative studies focus on quantifying, or measuring the defined characteristics to be studied (Kielhofner, 2006). In this study, the presence or absence of sensory over-responsivity was the main characteristic to be measured, along with some demographic data. Inferences can be drawn from the statistical analysis of the sample data and generalized to a larger section of the population (Kielhofner, 2006). This fulfils the primary purpose of quantitative research, which is to estimate population parameters (Kielhofner, 2006).

STUDY DESIGN

This study made use of a cross-sectional descriptive, analytical design. It was descriptive, as it aimed to describe and measure some phenomena, using a validated sensory questionnaire to measure these phenomena (Kielhofner, 2006; Sandelowski, 2000). It was analytical, in that the data collected were analysed statistically. This enabled the researcher to determine and quantify the relationships between variables (Kielhofner, 2006). This study design was the most appropriate for this research, as the objectives of the study were to examine the

relationship between variables (Hoffmann et al., 2013) and test a hypothesis (Kielhofner, 2006).

POPULATION AND SAMPLING

The sample was drawn from a population of caregiver-child dyads living in different geographical sites.

Sample size

Power analysis was used to determine the required sample size for the study. The manual sample size calculation (Israel, 2003) was performed with the following data inputs:

- The total known population of children aged 3 to 4 years old in the Western Cape: 22 441 (Department of Social Development, personal communication, 2017).
- For the estimated SOR, a midpoint between the higher prevalence of 15% and the lower prevalence of 8% for SOR in the general population was taken, that is 11.5% (Carter et al., 2011; Van Hulle et al., 2012).
- Acceptable margin of error: 5%
- An 85% confidence level was selected in light of the fact that minimal research has been done in this particular field.

The final calculation resulted in a sample size of 84, being 42 in each of the VB and CS groups. The full calculation is presented in Appendix L.

Sampling strategy

The sampling strategy involved firstly selecting the geographical sites, secondly identifying the ECDs, and thirdly recruiting the child and caregiver dyads.

Selection of geographical sites

The non-probability sampling strategy of convenience was employed to minimise transport costs and time, but yet include a spread of cultural and ethnic groups, languages, educational and socio-economic levels, thus ensuring heterogeneity in the sample.

Three geographical areas in close proximity to each other, within a ten minute drive from the researcher's residence, and representing diverse income levels, were selected:

- Langa, which is two kilometres from Pinelands, termed the low income level area, with 72% of households having a monthly income of R3 200 or less (City of Cape Town, 2011).
- Kensington and Maitland, which are one to three kilometres from Pinelands, termed the middle income level area, with 33% of households having a monthly income of R3 200 or less (City of Cape Town, 2011).
- Pinelands and Thornton termed the high income level area, with 10% of households having an income of R3 200 or less (City of Cape Town, 2011).

Selection of ECD sites

The researcher obtained the City of Cape Town list of all ECDs in the above areas, both registered and non-registered, attended by children of the target ages (3 years 0 months to 4 years 11 months). The researcher allocated each ECD an ascending number from 1 to 86, which was the total number of eligible ECDs in these areas. To eliminate the possibility of selection bias, 12 numbers were randomly selected by the primary supervisor, using the random selection function in Microsoft Excel. These numbers were communicated to the researcher, who then identified the ECD linked to each number.

Selection of child and caregiver dyads

The inclusion and exclusion criteria for child participants are presented in Table 3-1 and Table 3-2.

TABLE 3-1 INCLUSION CRITERIA FOR CHILD PARTICIPANTS

Criteria	Rationale
Child between the ages of 3 years 0 months and 4 years 11 months	• three years was chosen as the lowest age, as at this age children usually start some form of schooling outside the home, and problems tend to become more evident. In a school, there are also more children and therefore more environmental stimuli, than in the home, making the symptoms of SOR easier to identify (Interdisciplinary Council on Developmental and Learning Disorders, 2005). • in infants and toddlers, SOR is harder to distinguish from other regulatory disorders, for example eating and sleeping disorders (Interdisciplinary Council on Developmental and Learning Disorders, 2005; Miller et al., 2004; Pérez-Robles et al., 2013). They tend

Criteria	Rationale
	to have outgrown these by three years (P. Barnard, personal communication January 16, 2017; C. Homewood, personal communication, December 9, 2016)
Child from a singleton pregnancy	• multiple births have been implicated as a possible factor in the aetiology of SOR (May-Benson et al, 2009)
For vaginal births, the baby may be born by any type of cephalic presentation (occiput anterior or posterior)	• very similar birthing processes (S. Clow, personal communication, March, 14, 2017)

TABLE 3-2 EXCLUSION CRITERIA FOR CHILD PARTICIPANTS

Criteria	Rationale
Child with cerebral palsy, orthopaedic conditions, Downs syndrome, low IQ (below 85), global developmental delays (Schoen et al., 2017)	• these conditions are likely to have different neuronal and psychophysiological processes underpinning them • sensory processing presupposes intact sensory receptors, normal neuromotor function, an intact nervous system and normal intellectual functioning (Ayres, 2004; Fisher et al., 1991)
Child from multiple pregnancies (S. Clow, personal communication, March 14, 2017)	• has been linked to complications in delivery, and a possible contributor to the aetiology of SOR (May-Benson et al., 2009), and it would be difficult to differentiate this from birth method.
Child from breech presentation (S. Clow, personal communication, March 14, 2017)	• has been linked to complications in delivery, and a possible contributor to the aetiology of SOR (May-Benson et al., 2009), and it would be difficult to differentiate this from birth method
Child born by emergency CS	• frequently indicative of possible medical complications, for example, fetal distress, which may then be a cause of SOR (Keuler et al., 2011; May-Benson et al., 2009), and it would not be possible to isolate these factors from the birthing method • the baby will have experienced some of the effects of a VB and some of the pressure component, and could therefore not be defined as either a true VB or a true CS delivery
Child has had previous occupational therapy	• occupational therapy could alter the child's symptoms (Schoen et al., 2017)
Serious confounding life events, such as death of a parent (Miller, Coll, et al., 2007)	• the definition of sensory processing presupposes the absence of primary emotional problems (Ayres, 2004; Fisher et al., 1991)

The inclusion criteria for caregiver participants are presented in Table 3-3.

TABLE 3-3 INCLUSION CRITERIA FOR CAREGIVER PARTICIPANTS

Criteria	Rationale
Caregiver of a child between the ages of 3 years 0 months and 4 years 11 months at the time of recruitment	• links to the child inclusion criteria (see Table 3-1)
Proficient in English, Afrikaans or isiXhosa to a grade 5 reading level	• this is the reading level recommended by the author of the SSP2 (Dunn, 2014)
Should have had regular contact with the child over the past 12 months, and be one of the present carers of the child.	• enables the caregiver to complete the sensory history questionnaire accurately (Dunn, 2014).

DATA COLLECTION TOOLS

Two data collection tools were used – the Short Sensory Profile 2nd edition (SSP2) (Dunn, 2014) and a demographic questionnaire.

The Short Sensory Profile 2nd edition

The Short Sensory Profile 2 (SSP2) was designed for diagnostic use by giving information on sensory processing patterns in children aged three to 14 years (Dunn, 2014). The SSP2 is composed of the 34 most discriminating items from the SP2, and is therefore shorter and quicker to complete (Dunn, 2014). It has been used in the vast majority of research studies investigating SOR (Ahn, Miller, Milberger, & McIntosh, 2004; Chien et al., 2016; Davies, 2010; Matsushima et al., 2016; Nakagawa et al., 2016; Schaaf et al., 2010; Schoen et al., 2009; Whitcomb et al., 2015), and is widely used by occupational therapists (Schaaf et al., 2010; Schoen et al., 2009). The SP2 suite of tests has published norms and has established cut-off points between typical and atypical performance (Van Hulle et al., 2015). The psychometric properties of the SSP2 are good (Dunn, 2014), and have been detailed on p. 37, under Assessment of SOR. The test is a recent edition. These were the motivations for selecting this questionnaire for use in this study.

A disadvantage is that the test has only been standardized on American children (Dunn, 2014) – 1791 children of various ages, an equal number of males and females, from all areas of USA, various race and ethnic groups, and various parental educational levels. These results can therefore not be generalised to other countries, cultures and languages. However, the test

has undergone an international review for cultural appropriateness (Dunn, 2014), although no details of this process could be found in the literature.

An extensive search did not yield any other tests that were suitable for this study. As far as the researcher could ascertain, the only other caregiver questionnaires besides the SP2 suite of tests which have been standardized and are currently available, are the Sensory Processing Measure (Parham, Ecker, Kuhaneck, Henry & Glennon, 2010) and the Sensory Processing Measure Preschool (Ecker, Parham, Kuhaneck, Henry & Glennon, 2010). The Sensory Processing Measure is only applicable for older children (5-12 years). Although the Sensory Processing Measure Preschool was relevant for this study, the researcher decided not to use it for a number of reasons. Very few researchers have used this measuring tool; it is a more recently developed tool and therefore has not been as extensively researched; and the SSP2 is quicker to administer, having 34 statements (as opposed to 75 statements), making it a more efficient tool for research. A new measure, the Sensory Processing Scale/ Sensory Processing 3 Dimensions Assessment and Inventory, is currently being developed by the SPD Foundation. The advantage of this measure is that it comprises both a caregiver questionnaire and a therapist-administered assessment. The test underwent a standardization process in 2017. The researcher requested to use it for her study, but permission was not granted (S. A. Schoen, personal communication, October 10, 2016).

The SSP2 is completed by the caregiver, who may be a parent, or another adult with whom the child lives. The test stipulates that the caregiver needs to have had regular contact with the child over the past 12 months, so that they would know how the child reacts in various situations in the home and community settings (Dunn, 2014). The caregiver would therefore be the adult who is the most permanent and present carer of the child. This is important, as the questions relate to the child's activities and behaviours in the home and community settings which would be familiar to the caregiver (Dunn, 2014). Table 3-4 presents examples of questionnaire statements in each of the four sensory domains. The vocabulary and grammar are such that it can be read by a caregiver with a grade 5 reading level (Dunn, 2014).

TABLE 3-4 SHORT SENSORY PROFILE 2 EXAMPLES OF ITEMS IN EACH SENSORY DOMAIN (DUNN, 2014)

Domain	Sample Items
Sensory sensitivity	Item 4 My child shows distress during grooming (for example, fights or cries during haircutting, face washing, fingernail cutting) Item 5 My child becomes anxious when standing close to others (for example, in a line)
Sensory avoiding	Item 18 My child resists eye contact from me or others Item 26 My child interacts or participates in groups less than same-aged children
Sensory seeking	Item 6 My child touches people and objects more that same-aged children Item 8 My child rocks in chair, on floor, or while standing
Low registration	Item 10 My child bumps into things, fails to notice objects or people in the way Item 30 My child seems oblivious within an active environment (for example, unaware of activity)

The SSP2 contains 34 statements to which the caregiver responds by marking one option on a scale of 1 to 5 (the Likert scale), with 5 representing almost always, and 1 representing almost never. There is also a 0 option, representing "Does not apply". The form takes approximately 15 minutes to complete (Dunn, 2014). In the scoring process, the statements are grouped and totalled in a way that produces six sub-section scores. Four of the scores represent the four modulation patterns identified by Dunn (2014), namely sensory seeking/craving, sensory sensitivity (or over-responsivity), low registration or avoiding. The fifth score provides a summary score of the sensory items in all the sensory systems, and the sixth score relates to the modulation output functions of behaviour and attention. These six sub-section scores each have five possible scoring categories – 'Just like the majority of others' (representing 0SD); 'More than others" (representing +1SD); "Much more than others" (representing +2SD); "Less than others" (representing -1SD) and "Much less than others" (representing -2SD) (Dunn, 2014). There would be a possibility of obtaining a "Less than others" and "Much less than others" score if the column "Does not apply" with a 0 value attached, was used, but respondents in this study were encouraged not to use this unless absolutely necessary.

Demographic information

A short questionnaire was developed by the researcher for this study, covering aspects of maternal health, labour, birth and infant health (see Appendix A). Guidelines for determining

the questions to be included were based on two considerations: firstly, the demographic data outlined in the SP2 manual (Dunn, 2014), and secondly, research studies into causal factors for SOR which indicated the importance of obtaining information on birth weight, gestational age, jaundice, any family history of SOR and birth injuries (Bentley et al., 2016; May-Benson et al., 2009).

Validation of the SSP2 for the study

Face validity indicates if the test appears to measure the underlying construct that it says it measures (Kielhofner, 2006). In order to achieve face validity for this study, six people were selected, two representing each of the three income level areas used in the study, and reflecting the languages, races, cultures and educational levels.

TABLE 3-5 CHARACTERISTICS OF VALIDATION PANEL MEMBERS

	Person 1	**Person 2**	**Person 3**	**Person 4**	**Person 5**	**Person 6**
Income level	High	High	Middle	Middle	Low	Low
Home Language	English	English	Afrikaans	Afrikaans	isiXhosa	isiXhosa
Race	White	White	Coloured	Coloured	Black	Black
Educational level	PhD	PhD	Grade 12	Grade 10	Grade 12	Grade 11

Participants for this part of the study were required to sign a consent form, binding them to confidentiality (see Appendix J). They then undertook a cognitive debriefing process to ascertain the face validity of the SSP2 ("Cognitive debriefing explained," 2016). This involved reading and completing the questionnaire in order to assess it for readability, vocabulary and appropriateness of the 34 statements for the study sample culture and context. Areas of concern they highlighted regarding readability and vocabulary were discussed, and consensus reached on changes and alternative words and phrases. The aim of changing or adding individual words or short phrases was to ensure that the statements were interpreted in the way they were intended in the original tool. Thus face validity would not be affected. In a number of instances, the statement when read as a whole, with the examples contained in the questionnaire, clarified the meaning. In addition to face validity, the panel evaluated the

readability and understanding of the Likert scale definitions. These definitions were clear to all panel members. The final agreed changes were included on a cue card (see Table 3-5) which was used when the caregivers required clarification. This ensured that the modifications were standardized.

TABLE 3-6 CUE CARD INDICATING RESULTS OF THE COGNITIVE BRIEFING PROCESS

Statement no.	SSP2 word/phrase	Clarifying word/phrase present in SSP2	Agreed alternative
3	Tunes me out	Seems to ignore me	NA
4	Distress	Fights or cries	Gets upset
4	Grooming	Hair cutting, face washing, fingernail cutting	NA
5	In a line	NA	In a crowd
7	Pursues movement	Can't sit still, fidgets	Wants to move
7	Routines	NA	Tasks
11	Strong preference	NA	Strong liking
14	Drapes	NA	Hangs
15	Accident-prone	NA	Often has accidents, eg. trips, knocks things over
16	Stubborn and unco-operative	NA	Difficult and unhelpful
19	Positive support	NA	Encouragement
20	Strong emotional outbursts	NA	Frustrated, angry
21	Interpret	NA	Recognise
23	Routines	NA	Tasks
25	Needs more protection	NA	Fragile
28	Pay attention	NA	Concentrate
30	Oblivious	NA	Unaware
33	Gets lost easily	NA	Eg. in shops, park

RESEARCH PROCESS

Selection of Research Assistant

The criteria for selecting the research assistant were an undergraduate degree and strong computer skills, particularly in the use of Microsoft Excel. A non-working occupational therapist was approached and she agreed to perform this function. The research assistant was provided with background information on the research, the rationale, research question,

aim and objectives of the study. Her role in the study and the processes she would be involved in were explained and contextualised. The importance of ethical behaviour such as confidentiality was discussed, and she was then required to sign a confidentiality agreement (see Appendix I).

Gaining Access to Sites

It was not necessary to obtain permission from any government departments to access the sites, as the ECDs were not owned or managed by them (Department of Social Development, personal communication, April 28, 2017). The necessary permissions to conduct research therefore needed to be obtained from the principal or head of each ECD. To this end, an appointment was made with the principal to explain the aims of the study and obtain written consent (see Appendix D and E). Permission was granted by all the principals approached.

Participant recruitment and obtaining informed consent

Once permission had been obtained from the ECD principals to approach caregivers, child and caregiver recruitment began. The researcher gave an introductory letter to the teachers, to be handed to the parents of all children who fell into the selected age band, with a reply slip enquiring whether they would be interested in participating in the study (see Appendix F). The researcher returned a week later to collect the reply slips, which were then given to the research assistant. The research assistant made telephonic contact with those who responded positively, to ensure the caregiver and the child met the selection criteria. If they did, she then discussed the aims of the study and what participation would involve, following a guideline drawn up by the researcher, to ensure that all the necessary information was communicated (see Appendix G). She then requested telephonic consent, and determined the child's birthing method.

The caregivers were enrolled by the research assistant on a consecutive enrolment process. A dummy value of either 0 or 1 was assigned to each caregiver on the basis of the child's birth method. The value of 0 was allocated to the VB group, and 1 to the CS group. In addition, a number, starting from 01, was randomly allocated to each child. From this point on, only the child's number was used, so that the researcher was blinded both to the birth method and the identity of the child.

The research assistant entered the data obtained onto an Excel spreadsheet (name of caregiver, contact details, language preference, whether the child met the selection criteria, and birth method). The information on birth method was then hidden, so that when the spreadsheet was emailed to the researcher, this column was not visible to her, and could not be accessed.

The researcher then made an appointment to meet each caregiver individually to sign the informed consent form (see Appendix H), and proceed with data collection. In some cases, the caregiver was not one of the parents, frequently being the maternal grandmother of the child. However, consent was still required from one of the parents (Human Research Ethics Committee - Faculty of Health Sciences, 2013; Human Science Research Council - Research Ethics Committee, 2012). There were some instances where, after repeated attempts, the research assistant was unable to make contact with the parent, even though the parent had indicated their interest on the study reply slip. In these cases, the researcher visited the child's ECD and communicated with the parent when they dropped or collected their child, checked selection criteria, and completed the process to obtain consent for those who met the inclusion criteria. The researcher did not however enquire about birth method, and this information was only obtained after the sensory history questionnaire had been completed, to prevent any bias on the part of the researcher during the completion of the questionnaire.

The recruitment process aimed to obtain the required sample size for both the vaginal and the CS birth groups, with equal numbers for the two birth method groups. An attempt was also made to obtain similar numbers in each of the three income level groups within each of the birth method groups to ensure representivity within each birth method group.

Once written consent has been obtained, the researcher began the data collection process.

Data collection process

In order to respect the copyright, original SSP2 questionnaire forms were used rather than photocopies. The researcher approached the publishers of the SSP2 for permission to include a copy of the questionnaire as an appendix to this dissertation. Permission was not granted (see Appendix K) (W. H. Schryver, personal communication, November 15, 2016).

Three isiXhosa-speaking caregivers did not have the required grade 5 level English reading ability to complete the questionnaire, therefore options for translation were explored with the publisher. It was not feasible to formally translate the SSP2 into isiXhosa as this was costly, and there were budgetary constraints. Permission was requested from the publishers, Pearson, to do an informal translation for use as a guide for the assistant, who would read the translated version to the caregiver, in order to ensure accuracy. This was granted (see Appendix K) (W. H. Schryver, personal communication, November 15, 2016). Further details on the translation are provided in Chapter Four.

The SSP2 questionnaire was completed first and then the demographic questionnaire. The SSP2 was introduced to the caregivers individually, in a private room at the ECD where this was available, but if not, in a secluded section of the ECD. Prior to administration, the blocks in the bottom half of page two and three of the SSP2 (providing definitions of the four sensory modulation types and the key for the sensory modulation type to which each statement belonged) were covered with cardboard, so as not to influence the caregiver's responses. The purpose and method of completion of the SSP2 was explained to the caregivers. Respondents were discouraged from using the "Does Not Apply" option unless absolutely essential (Dunn, 2014). As stipulated in Dunn's standardized administration procedure, caregivers completed the questionnaire independently (Dunn, 2016) wherever possible. Occasionally the caregiver accidentally omitted responding to an item, or indicated two responses for one statement. To identify these errors, the researcher checked the questionnaires immediately upon completion, and prompted the caregiver to complete any omitted items or provide clarification where there was duplication of responses.

The demographic questionnaire was completed after the SSP2, so that the researcher was not aware of the birthing method, thus eliminating the possibility of bias. To reduce the amount of missing data, in cases where the data collection was done in the caregiver's home and the caregiver was not able to remember certain information regarding the birth, the researcher requested the child's clinic card, which contained some of the unknown information (such as Apgar scores, gestational age and birth weight). In all cases where the data collection was done in the home, the caregivers were able to produce the clinic card. However, where data

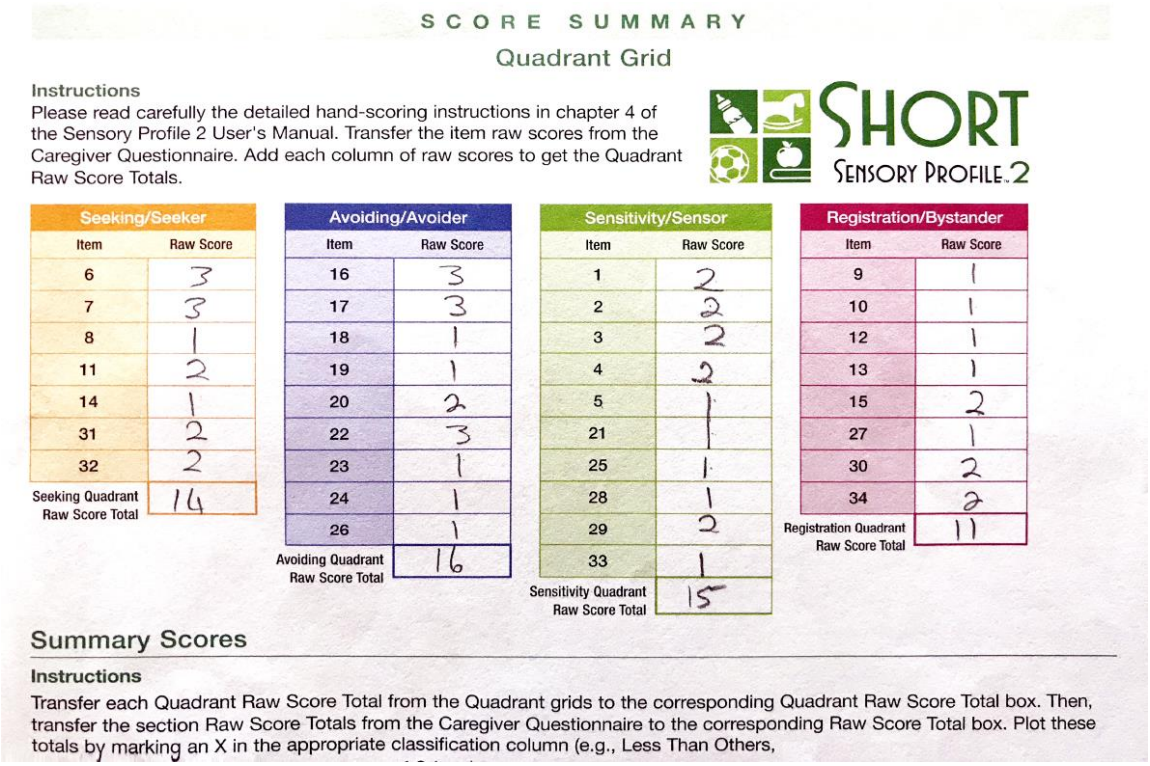
collection took place at the ECD, the clinic card could not be accessed, which may have affected the accuracy and completeness of the data.

Both questionnaires were numbered according to the allocations made by the research assistant, as described above.

Once data collection was completed, sufficient numbers of participants had not been obtained and the study was thus underpowered. Furthermore, there was unequal representation of participants across the income level areas, with acceptable numbers in the low and middle income level areas, but too few respondents in the high income area. This was due to greater numbers of children attending the selected ECDs in the low and middle income level areas than those in the high income level area. Therefore, an additional random selection was done by the primary supervisor, and additional ECDs in the high income level area were approached for participation. In this way, similar numbers of participants were recruited across the three income level areas.

DATA MANAGEMENT

The completed, numbered questionnaires and demographic information sheets for each caregiver were stapled together and placed in a locked box file for transportation to the researcher's home, where they were stored in a locked filing cabinet. The researcher scored the SSP2 on the original scoring sheets, and calculated raw score totals (refer to Figure 3-1) and SDs for the six sub-sections (refer to Figure 3-2). A standard deviation of +1 ("More than others") and +2 ("Much more than others") indicated atypical performance, and 0 indicated typical performance (Dunn, 2014). In this way, the researcher was able to use the SD scores to identify children with SOR, as well as identify difficulties in the other sensory modulation categories identified on the SSP2, namely sensory seeking, avoiding and low registration. A reproduction of the completed scoring sections of the SSP2 for one child who obtained typical performance scores is shown in Figures 3-1 and 3-2.



SCORE SUMMARY

Quadrant Grid

Instructions

Please read carefully the detailed hand-scoring instructions in chapter 4 of the Sensory Profile 2 User's Manual. Transfer the item raw scores from the Caregiver Questionnaire. Add each column of raw scores to get the Quadrant Raw Score Totals.

SHORT SENSORY PROFILE 2

Seeking/Seeker	
Item	Raw Score
6	3
7	3
8	1
11	2
14	1
31	2
32	2
Seeking Quadrant Raw Score Total	14

Avoiding/Avoider	
Item	Raw Score
16	3
17	3
18	1
19	1
20	2
22	3
23	1
24	1
26	1
Avoiding Quadrant Raw Score Total	16

Sensitivity/Sensor	
Item	Raw Score
1	2
2	2
3	2
4	2
5	1
21	1
25	1
28	1
29	2
33	1
Sensitivity Quadrant Raw Score Total	15

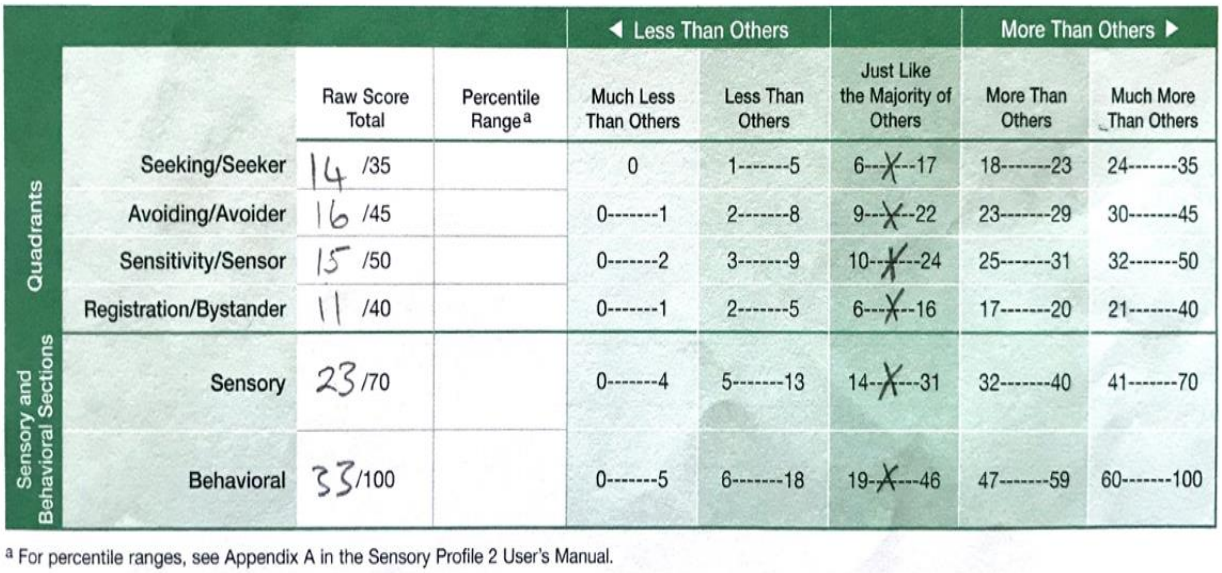
Registration/Bystander	
Item	Raw Score
9	1
10	1
12	1
13	1
15	2
27	1
30	2
34	2
Registration Quadrant Raw Score Total	11

Summary Scores

Instructions

Transfer each Quadrant Raw Score Total from the Quadrant grids to the corresponding Quadrant Raw Score Total box. Then, transfer the section Raw Score Totals from the Caregiver Questionnaire to the corresponding Raw Score Total box. Plot these totals by marking an X in the appropriate classification column (e.g., Less Than Others,

FIGURE 3-1 SSP2 RAW SCORE ITEMS ACCORDING TO SENSORY MODULATION CATEGORY FOR A TYPICAL CHILD PARTICIPANT



		Raw Score Total	Percentile Range[a]	◀ Less Than Others: Much Less Than Others	Less Than Others	Just Like the Majority of Others	More Than Others ▶: More Than Others	Much More Than Others
Quadrants	Seeking/Seeker	14 /35		0	1-------5	6---X---17	18-------23	24-------35
	Avoiding/Avoider	16 /45		0-------1	2-------8	9---X---22	23-------29	30-------45
	Sensitivity/Sensor	15 /50		0-------2	3-------9	10---X---24	25-------31	32-------50
	Registration/Bystander	11 /40		0-------1	2-------5	6---X---16	17-------20	21-------40
Sensory and Behavioral Sections	Sensory	23 /70		0-------4	5-------13	14---X---31	32-------40	41-------70
	Behavioral	33 /100		0-------5	6-------18	19---X---46	47-------59	60-------100

[a] For percentile ranges, see Appendix A in the Sensory Profile 2 User's Manual.

FIGURE 3-2 SSP2 TOTAL RAW SCORE CONVERSION TO SD ACCORDING TO SENSORY MODULATION CATEGORY FOR A TYPICAL CHILD

Once the scoring was completed for each score sheet, the researcher entered the individual item scores, as well as the total category scores and the category SDs onto a password-

protected Microsoft Excel spreadsheet. The data was stored on a password-protected computer, and was accessible only to the researcher and research assistant. Checks were performed and corrections made where necessary at all three steps - transposition of scores from individual items to the categories on the questionnaire, scoring calculations, and entering scores onto the spreadsheet. Data for all demographic characteristics were entered onto the Excel spreadsheet and checked for accuracy.

Once the study has been completed, the SSP2 test sheets and demographic questionnaires generated during this research will be stored securely in the UCT Occupational Therapy Division for five years.

DATA ANALYSIS

The Statistical Consulting Service at the University of Cape Town was initially consulted for assistance with the analyses. The final analyses were conducted using Statistica (StatSoft 2018) and EpiCalc2000 with guidance from the research supervisors.

The Shapiro-Wilk test was used on the SOR raw score data to verify the distribution of scores. This showed that the scores were not normally distributed ($W = 0.951$, $p = 0.002$), therefore non-parametric tests were used throughout. Medians and ranges were determined for numerical variables and frequencies and percentages for categorical variables. Associations between demographic variables and birth method group (objective one), prevalence of SOR by birth method group (objectives two and three), and demographic variables and SOR (objective four) were determined with the Fisher's exact test (two-tailed) or Chi-squared test of association for categorical data, and the Mann-Whitney U test for numerical data. The confidence interval was set at 85% and the level of significance at $p<.05$ throughout.

ETHICAL CONSIDERATIONS

This research adhered to the principles contained in the Declaration of Helsinki: Ethical principles for medical research involving human subjects (World Medical Association, 2013). Ethical approval was applied for, and obtained from the University of Cape Town (UCT) Faculty of Health Sciences Human Research Ethics Committee (HREC) (REF: 583/2017) (see Appendix L).

The following ethical principles were pertinent to this particular research:

Informed consent was obtained from a parent or caregiver legally responsible for the child. While it was possible that another caregiver fulfilled the role of caregiver and would be completing the questionnaire, where the parent had legal responsibility, the parent was required to provide consent (Human Research Ethics Committee - Faculty of Health Sciences, 2013; Human Science Research Council - Research Ethics Committee, 2012). The research assistant initially made contact with the potential caregivers, using a letter with a reply slip, thus limiting possible undue influence in the consent process which may have applied in a face-to-face interaction. An information sheet ensured that the parent/caregiver was provided with all the necessary information to make an informed decision (see Appendix G). Written informed consent was provided by all caregivers prior to data collection (see Appendix H).

Privacy was protected by discussing the consent information and completing the questionnaires in a private room where available, or in a quiet and secluded section of a room, or outside the ECD, if the weather was suitable.

Confidentiality was maintained by the research assistant assigning a number to each participant according to birth method and the parent's name as outlined in above. This process ensured blinding of the researcher to the birth method of each child, thus eliminating possible bias in attempting to influence the caregivers' responses to support the hypothesis. No personal, identifiable information about the parents/caregivers or the child was recorded during the study, thus ensuring **anonymity**.

As data collection was being done via a questionnaire, the principle of **non-maleficence** was less likely to be violated. There was no physical harm done, and no evidence of emotional harm. The researcher was aware that the potential existed for emotional harm to the caregiver, particularly if this was the mother of a child where SOR was identified. This was likely to take the form of negative emotions such as stigma, guilt or anxiety if she thought that the SOR was caused by decisions or omissions on her part regarding the birth process, or anxiety that a problem had been identified in her child, no matter what the cause. In the light of this possibility, the researcher had arranged for one free counselling session by a

masters' clinical or counselling psychology student. When SOR was identified and the caregivers wanted to explore their child receiving treatment, treatment options appropriate to their financial status would be offered. If the parents were on a medical aid or were financially able to cover the fees, they would be provided with a referral letter and the details of three private occupational therapists they could contact, with the number of sessions to be determined by the therapist. The researcher's details would not be provided, to ensure that she did not benefit financially by taking these children for therapy. If they were unable to cover the cost of therapy, they would be provided with a referral letter to Red Cross Children's Hospital, which has occupational therapists able to provide this treatment, with the charge levied on a sliding scale according to income. If the results obtained from this study indicated a high prevalence rate of SOR in children from low socio-economic groups, then the South African Institute of Sensory Integration would be approached to assist in the provision of therapy, as part of their role in facilitating accessibility of sensory integration in poorer communities.

Once the scoring of the SSP2 had been completed, the researcher was able to identify typical and atypical scores in all four SMD categories, and caregivers could be contacted to inform them of the results for their child. All caregivers were sent feedback via sms. This method of communication had been identified as the most reliable and effective method of contacting the caregivers during the data collection phase. Where there were atypical scores, the caregivers were provided with an option to meet the researcher to discuss the results, implications and recommendations. Seven of the total sms's sent to caregivers (N=91) could not be delivered, as the cell phone number which had been provided by the caregiver no longer existed. Of the remaining 84, four caregivers of children with atypical results identifying very mild SMD, requested a follow-up phone call to discuss the results. The researcher made an appointment time to call each of them for further discussion and to offer a face-to-face feedback appointment. During the telephonic conversation, no caregivers expressed negative emotions or wanted to pursue the discussions further with a face-to-face appointment. Counselling was offered, but not accepted. Occupational therapy services which were appropriate to their socio-economic status were offered, but not accepted. One

caregiver was a foster mother, and she requested a report on the findings to send to the case social worker. This was done.

The principle of **beneficence** was adhered to by providing information to caregivers on strategies which could be used to prevent SOR, as well as information on how to access treatment where SOR was identified, no matter which of the two groups the child belonged to.

Justice required that if any renumeration was provided to the participants, that this only covered the costs which may be involved in taking part in the study. In this study, the costs were however negligible to the participants, as the questionnaire was given to the caregivers at the ECD, where the caregiver was dropping and collecting the child daily. The time required to complete the sensory and the demographic questionnaires was only 20 to 40 minutes. For the above reasons, the researcher did not provide any reimbursement, financial or otherwise to the participants.

The **power relationship** was unequal, making the possibility of exploitation real. The inequality stemmed from the fact that the researcher was a professional and a specialist in the field of child development and more specifically SMDs. The difficulties some caregivers had with using the questionnaire as well as it's cultural inappropriateness increased the inequality of the relationship. To flatten this inequality, the researcher emphasised the valuable contribution that the caregiver would provide, and that this was information that only he/she could provide, as he/she knew the child best. Other modifications to the SSP2 to flatten the inequality are outlined in Chapter Four.

CONCLUSION

In this chapter the method of conducting this research study was outlined. This study used a quantitative research approach and a descriptive, analytical design, as these were best suited to the research question being posed. The sample size calculation determined that 84 participants were required, being 42 in each of the birth method groups. Three levels of recruitment were done, firstly a convenience sample of geographical areas which ensured a spread of income levels and other demographic characteristics. Secondly, a random selection process was used to select the ECDs in each area, based on a complete list of all

ECDs obtained from the City of Cape Town. The third level of recruitment was the selection of the caregiver child dyads, according to determined inclusion and exclusion criteria for the child and caregiver participants. An introductory letter with a reply slip was given to caregivers, and the process of obtaining consent was followed with those who replied in the affirmative. A sensory questionnaire, the SSP2, and a demographic questionnaire developed by the researcher were the two data collection tools used. The SSP2 needed to be validated before data collection commenced, and some minor adjustments were made to the language so that it was appropriate for use in all three diverse communities. The chapter concluded with the ethical considerations relevant to this study.

The next chapter will highlight the challenges involved in data collection in this particular research study, and will include further adaptations made, and procedures used for translation of the questionnaires into isiXhosa.

CHAPTER FOUR MODIFICATIONS TO THE DATA COLLECTION PROCESS

INTRODUCTION

This chapter describes the modifications that were made in response to the challenges experienced during data collection at the ECDs. Firstly, observations made by the researcher of the contextual features of the study sites are presented, as these formed the basis for a number of the challenges experienced in the data collection process. Secondly, difficulties experienced by caregivers in completing the sensory and the demographic questionnaires are discussed, as well as the subsequent adaptations made. These modifications were necessary to ensure ease of use and greater accuracy of caregiver responses.

CONTEXTUAL FEATURES OF THE STUDY SITES

The classification of the three areas where data collection occurred is described in the Methodology chapter. During data collection, the researcher observed unique contextual features in each of these areas, which resulted in a number of challenges to the research process. These were documented during data collection and are summarised according to income level area in Table 4-1. There were three ECDs in the low and middle income level areas, but six ECDs were used in the high income level area, as most ECDs in this category had smaller numbers of children registered. The greater number of research sites in the high income level area was necessary in order to have similar numbers of children in each of the three income level areas to enable comparisons. The ECDs in the low- and middle-income level area shared many of the same characteristics. These included greater numbers of children in a class, wider age ranges being catered for in the ECD, poor general conditions inside the ECDs as well as the outside conditions of buildings, limited educational and technical resources for the teachers, minimal play equipment, toys and activities for the children, minimal contact between teachers and parents, minimal parental involvement in the ECDs, poor nutrition and poor security. The ECDs in the high income level areas showed none of these characteristics. One area where the low and middle income area ECDs differed

was in the presence of the principal: the principal was rarely present in the low income level area ECDs, but was always present in the middle income level area ECDs, as well as the high income level ECDs.

TABLE 4-1 CONTEXTUAL FEATURES OF THE STUDY SITES PER INCOME LEVEL AREA

	Low income **Langa** **(n = 3)**	**Middle income** **Kensington, Facreton, Maitland** **(n = 3)**	**High income** **Pinelands, Thornton** **(n = 6)**
Number of children at ECD	40	25	8
Ages of children	2-5 years	3-5 years	3-4 years
Principal present	No	Yes	Yes
Transport to and from site	On foot, accompanied by a family member	On foot, accompanied by a family member or by taxi	On foot or in private vehicle, accompanied by parent
Condition of buildings	Poor – broken windows, doors unable to shut, peeling paintwork	Poor – exposed foundations, sagging ceilings, cramped	Buildings in good state of repair
Location	In community buildings	In principal's house	4 ECDs located in principals house, 1 in a community facility, 1 at a workplace
General conditions	Electricity, lights, running water	Electricity, lights, running water	Electricity, lights, running water
	1 ECD had spacious outdoor area, but children only allowed there for a short period in the day, 1 had limited outdoor area, which was mostly not used, 1 had none	1 ECD had no outdoor play area, 2 had small areas which were hardly ever used	Well-equipped, spacious outdoor areas
	Cramped indoor areas	Cramped indoor areas	Adequate to spacious indoor areas
	Fairly hygienic kitchen facilities	Unhygienic kitchen facilities at 2 ECDs	Hygienic kitchen facilities
Toilet facilities – children	Plastic potties, unhygienic facilities	Plastic potties, unhygienic facilities	4 ECDs had children's toilets, the others used adult toilets, all hygienic
Toilet facilities – staff	None at 2 schools – used facilities at neighbouring community hostel with communal toilets	None in school – used the toilet in the principal's house on the property	2 had staff toilets, the remaining used the principal's house toilet on the property

	Low income Langa (n = 3)	Middle income Kensington, Facreton, Maitland (n = 3)	High income Pinelands, Thornton (n = 6)
Security	Poor – open access. 2 ECDs had a gate which was bolted, not locked, for part of the day Frequent theft of equipment	Poor – front gates not locked, some doors to ECDs unlocked Theft not a problem	Locked, electronic access Theft not a problem
Nutrition	Breakfast and lunch expected, although at times this was not provided. Chips and lollipops common food eaten by children, many parents drank fizzy drinks	No food provided by ECD. Chips and lollipops a common food eaten by teachers & children. Some encouragement for parents to send yoghurts and fruit to school in lunch boxes	Only allowed to bring healthy snacks 2 ECDs provide breakfast and lunch
Teacher resources	No computer, printer, photocopier, telephone	No computer, printer, one ECD had a photocopier and telephone	Computer, printer, photocopier, CD player, telephone
Educational resources	2 ECDs – no educational resources 1 ECD – dressing up corner, a variety of educational resources	2 ECDs – no educational resources 1 ECD – dressing up corner, a variety of educational resources	Well resourced, sandpit, dress-up corner, books
Outdoor play equipment	Functional equipment at one ECD	Functional equipment at one ECD	Various outdoor equipment at all ECDs – trampoline, tree house, swings, jungle gym
Medium of instruction	isiXhosa	Officially English, but in practice Afrikaans spoken almost exclusively	English
Educational input	No educational programme at 2 ECDs	No educational programme at 2 ECDs	Educational programme in place
Parent involvement	Brief contact when parents drop child. Child usually collected by a sibling. One ECD had one group parent meeting a year, others had none	Brief contact when parents drop or collect child, unless done by a sibling. Group parent meetings twice a year	Contact on dropping and collecting child. Individual parent-teacher meetings twice a year

	Low income Langa (n = 3)	Middle income Kensington, Facreton, Maitland (n = 3)	High income Pinelands, Thornton (n = 6)
Observations of the surrounding area	Schools were located very close to children's homes.	Schools were located very close to children's homes.	Schools either located in the same suburb as children's homes, or parents came into the suburb for their work
	Many young children walking around the neighbourhood unsupervised	Children walking round neighbourhood with an adult or older sibling	Children walking round neighbourhood with a parent or nanny

THE SENSORY QUESTIONNAIRE

When data collection commenced, the cue card which the researcher developed based on the validation process for the SSP2 was used (see Table 3-6). However, it became apparent that the caregivers' ease of reading the SSP2 questionnaire and understanding of the Likert scale varied in the different income level areas. In the high income area, the caregivers easily understood and completed the questionnaire. This appeared to be due to English being the home language of all the caregivers, and the majority having a high educational level. The instructions for completion of the SSP2 and use of the Likert scale were quickly grasped, and caregivers were easily able to determine where the child's particular behaviours fell on the Likert scale. In the middle income area, the questionnaires were completed with some assistance from the researcher. This took the form of replying to caregivers' questions requesting clarification, as well as some explanations to aid understanding of the meaning of the five scaled divisions in the Likert scale. In the low income area, similar difficulties were noted but occurred more frequently. The caregivers were generally less proficient in English, even though they met the selection criteria in this regard. They asked for more help and required more explanations and clarification. In some instances their queries could not be resolved, with caregivers still evidencing confusion after repeated explanations. The Likert scale was poorly understood, necessitating use of the terms "a lot" and "never" by the researcher, which in effect converted the scale to a 2-point scale. Another challenge

experienced was that some of the statements were either not relevant, or fell outside the caregivers' experience. For example, statement 1 "My child struggles to complete tasks when music or TV is on" presupposes that caregivers have the option of a quiet room for the child to work in. This was however usually not an option due to overcrowding and limited space. This raised concerns about the accuracy of the data obtained, specifically content and face validity. As a result of these challenges, data collection was halted after four caregivers in the low income level area had completed the questionnaire in order to review its suitability for the study, and to consider how best to elicit valid data.

After consulting with the supervisors, the following adaptations were made to the method of administering the questionnaire:

1. The Likert rating scale: In response to the researcher's observation that some caregivers struggled with the rating scale concept, a cardboard "speedometer" (see Figure 4-1) was developed. The researcher had found that, as a clinician, this concept was a helpful aid to therapy, and it was decided to attempt an adaptation of this in the context of this research. The semi-circle was coloured with appropriate colours from the colour wheel to represent increasing frequency of behaviours. The Likert scale numbers were written over the colours. This was found to be an effective aid to achieve understanding and, in the researcher's observation, it improved the accuracy of the caregivers' responses on the rating scale.

FIGURE 4-1 "SPEEDOMETER"

2. Understanding the concept of body language/facial expressions: Statement 21, "My child struggles to interpret body language or facial expressions" was difficult for some caregivers to conceptualise, with caregivers frequently asking for clarification. A facial

expressions chart developed by Kritzas (2011) was adapted by removing facial expressions which were not easily identifiable or were more obscure (see Figure 4-2). Permission was requested to use and adapt the chart, and was granted (C. Kritzas, personal communication, November 20, 2018). The adapted chart was used when caregivers appeared not to understand Statement 21, and was successful in enabling caregivers to understand the statement.

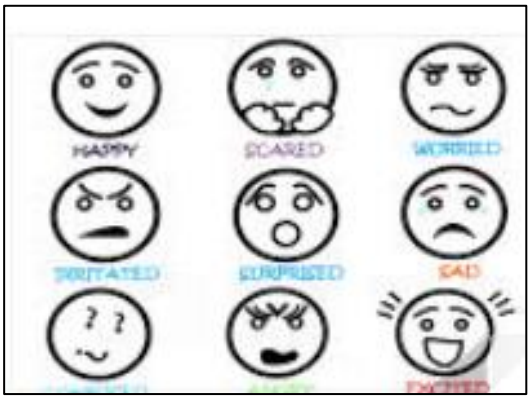


FIGURE 4-2 EMOTIONS/FACIAL EXPRESSIONS CHART (adapted from Kritzas, 2011)

The speedometer and facial expressions chart were subsequently used with caregivers when necessary. However, even with these aids, the SSP2 questionnaire took longer to complete with caregivers from the middle and low income level areas. This was attributed to the caregivers' lower educational levels, with resultant poor reading comprehension skills and difficulty with some of the statements. This resulted in the questionnaire taking approximately half an hour to complete as opposed to the 15 minutes estimated in the SP manual (Dunn, 2014).

THE DEMOGRAPHIC QUESTIONNAIRE

There were a number of challenges in reporting accurately the demographic information. This took the form of some missing information, which occurred more frequently where the caregiver was not one of the parents. Some items may have been under-reported, either due to societal pressure or an unequal power relationship between the caregiver and the researcher (for example alcohol and recreational drug use during pregnancy), or due to a lack of understanding of the question being asked (for example family history of SOR). In some instances these challenges reflected the difficulties caregivers experienced with the public

health care system, low maternal educational levels and the stresses associated with low socio-economic status. Attempts were made to address these challenges by requesting the caregiver to ask other family members who may be able to provide the necessary information, or requesting the clinic card when this was practical, and/or by providing further explanations or examples to aid understanding. Further details will be provided in Chapter Five.

High blood pressure was not measured, as the researcher did not have the necessary resources to do this. A mother was judged to have experienced high blood pressure during her pregnancy in cases where the mother used medication for hypertension.

TRANSLATION OF THE DATA COLLECTION TOOLS

As all caregivers in the high and middle-income groups were proficient in English, even those whose home language was Afrikaans, translation of the data collection tools into Afrikaans was not necessary. Three caregivers in the low-income area did not have the required reading skills to complete the questionnaires in English. As their home language was isiXhosa, the questionnaires were translated into isiXhosa so that an isiXhosa-speaking assistant could communicate accurately with them. This was in line with the permission from the publishers, Pearsons, which is reproduced in Appendix K (W. H. Schryver, personal communication, July 10, 2017). This permission allowed for an isiXhosa speaker who was a therapist, or someone who administered the test under the supervision of a therapist, to verbally administer the Sensory Profile questions and record the responses. The researcher gave an undertaking to Pearsons that the translated version would only be used for this research study with the three identified caregivers, and would not be circulated or used for any other purpose (W. H. Schryver, personal communication, July 10, 2017). Two isiXhosa-speaking adults who resided in the community, were competent in speaking and reading English and had at least a grade 11 school certificate, were selected to assist with the translation, and were required to complete a confidentiality agreement (see Appendix I). One of them translated the demographic and the SSP2 questionnaire into isiXhosa. The second person did the back-translation. The researcher then identified discrepancies in the back-translation process. An isiXhosa-speaking consultant at the UCT Writing Centre assisted

in finalizing and resolving these discrepancies and making the necessary modifications (Lee, Jones, Mineyama, & Zhang, 2002; Su & Parham, 2002). At this stage the translated versions of the questionnaires were ready to be used with the isiXhosa caregivers in the manner outlined above and in line with the conditions specified by the publishers (W. H. Schryver, personal communication, July 10, 2017).

There were some challenges in translating the demographic questionnaire into isiXhosa. For most of the medical terms, such as Apgar, gestational age, there was no isiXhosa equivalent. This required the English medical term to be used, which may have been a barrier to understanding. There was also no isiXhosa equivalent for the term "stress" used in the maternal history section, and a description had to be used instead. This problem has been addressed by two research studies. Su et al. (2002) translated a SMD questionnaire into Mandarin and found a frequent difficulty with words that did not have equivalent words in the translated language. The authors advised that the meaning behind the word which was being expressed in the original language should be translated. Kayihan et al. (2015) found no Turkish equivalent for a number of English words (for example "sedentary"), and they used other words that conveyed the closest meaning.

During data collection with the isiXhosa-speaking caregivers, one of the translators explained the consent form to the caregiver before he/she signed consent, so that the caregivers were fully informed. The translator then read the translated version of the SSP2 and the demographic questionnaire to the caregivers, in order to comply with the terms of permission granted by the publishers (WH Schryver, personal communication, July 10, 2017), clarifying any difficulties the caregivers may have had with the questions. The translator marked the appropriate rating on the Likert scale on the SSP2 form. With the demographic questionnaire, the translator translated the caregivers' responses back into English and recorded them in English for the researcher to be able to understand them. These additional steps required by the indirect method of translation in the completion of the questionnaires may also have compromised accuracy.

ADDITIONAL ISSUES

Making contact with caregivers

Making contact with the caregivers in the middle and low income level areas was difficult. Twenty-six (29%) of the caregivers could not be contacted to make an appointment, or failed to keep an appointment made and subsequently could not be contacted, despite repeated attempts. This was a fairly high percentage, given that these caregivers had already signed the reply slip indicating their willingness to take part in the study. This reflected a common problem in low socio-economic areas where there are unlikely to be landline telephones available, and cell phone usage is unreliable for a number of reasons. Limited access to electricity makes it difficult to charge cell phones; the high incidence of theft means that cell phones are frequently stolen; some caregivers did not own a cell phone, and were reliant on communicating via verbal messages through a family member, friend or work colleague; sim cards were frequently swopped between cell phones, so that the number originally provided was no longer used. In addition, the unpredictable schedules of low socio-economic communities (Ursache & Noble, 2016b) resulted in irregular attendance of children at the ECDs and inconsistent times of dropping and collecting children. This meant that the researcher could not plan to make contact with a caregiver at the ECD, as these times were not predictable.

Features of low socio-economic environments impacting sensory modulation

Heightened sensory stimulation, especially in the tactile, olfactory and auditory senses, was observed by the researcher in the low and middle income level environments. Tactile overstimulation resulted from the overcrowding in the ECDs, on public transport and in the homes. It was characterised by there being minimal personal space, with people constantly brushing against each other, or sitting or lying tightly packed in small spaces. Olfactory overstimulation resulted from overcrowding, poor personal hygiene (inadequate bathroom facilities in homes), cooking smells (no separate, designated cooking area), smells from fires (required for cooking and hygiene if no electricity) and sewerage smells (due to lack of toilet facilities and water-borne sewerage). Auditory overstimulation had a number of causes. Poverty results in not having money to spend on non-essentials such as carpets and curtaining. This lack of soft furnishing in the ECDs and homes did not allow for noise absorption, resulting in high noise levels of a strident, harsh quality. The ceilings were

usually low, which also added to the noise volume. Overcrowding resulted in high noise levels, frequently requiring shouting in order to be heard. Although no studies could be found on sensory overstimulation in low socio-economic environments, some research studies have explored the overstimulation in the neonatal intensive care units and the impact this has on the development of sensory modulation (Bröring et al., 2017; Rahkonen et al., 2015).

Chaotic schedules, lack of routine and resultant high levels of unpredictability which were described by Ursache and Noble (2016a, 2016b), were noted by the researcher. A number of people of varying ages may be sleeping in the same small space, which was not conducive to good sleeping routines. One home visited by the researcher to complete the questionnaires had five people, adults and children, sharing one single bed, with another three adults on mattresses on the floor in the same room. Cramped living facilities, where one small room is used as a bedroom, living room and kitchen for a number of people results in disorganization, chaotic structures and routines. This sense of disorganization can impact on the development of sensory modulation.

One high income level ECD

The principal of one ECD in the high income level area of Pinelands did not grant permission for the researcher to make direct contact with parents. Permission was instead given to put a notice requesting participation in the research on the ECD noticeboard. This was challenging, as less positive responses to the initial request for participation were considered likely as the researcher did not have direct access to the parents, which required more effort and initiative by the parents.

CONCLUSION

In this chapter, the observations in the three income level areas and associated ECDs, and the resultant challenges associated with the data collection stage of the research have been presented. Challenges included the great diversity of cultures, languages and the impact of low socio-economic circumstances of a number of participants. These resulted in some conceptual difficulties and cultural and contextual inappropriateness, which impacted on the validity of the data collected. They required adaptations to the administration of the SSP2 by

the researcher in order to enhance accuracy of the information provided by the caregivers. These took the form of a visual aid to assist in understanding the Likert scale, and a chart of facial expressions to assist the caregivers in their understanding of one of the statements in the SSP2. Both questionnaires were translated into isiXhosa for three participants who did not meet the reading level criteria, and were assisted in the completion by an isiXhosa community member.

In the following chapter, the participant flow is described, and the results of the data analysis are presented, as they pertain to the four objectives of this study.

CHAPTER FIVE RESULTS

INTRODUCTION

In this chapter, the participant flow is described and presented in a flow diagram. The results are then presented with reference to each of the four objectives of the research study.

The demographics of the mothers and the child participants in each of the two birth method groups are described, in line with the first study objective. Secondly, the prevalence of SOR for the entire group and by sub-group (VB and CS) is presented, as relating to objectives two and three. A description of all four sensory modulation patterns (including sensory avoiding, sensory seeking and low registration) for both birthing groups is also presented. The final section relates to objective four, detailing the other maternal and child variables reported on in the study, and their relationship to SOR.

PARTICIPANT FLOW

Of the 152 caregivers invited to participate in the study, five caregivers (4.5%) declined to participate. Most caregivers indicated considerable interest in the aim of the study and were motivated to participate.

At the one high income level ECD where the researcher was not granted direct access to the parents, a much lower response rate of parents to the initial request for participation was recorded. Of the over 100 children at this ECD, only two parents made contact with the researcher. Data collection was completed by these two caregivers.

Twenty-six caregivers who completed the reply slip on the initial recruitment letter (Appendix F) were excluded as they either could not be contacted to obtain consent and set up an appointment to complete the questionnaire, or an appointment was made but the caregiver failed to attend and could not be contacted subsequently. See Figure 5-1 for details of the participant flow.

The resultant sample size for this study was 91. All caregiver participants completed the SSP2 and demographic questionnaire. There was no missing data in the SSP2 caregiver responses.

There was some missing demographic data, either because the caregiver did not know, as s/he was not one of the parents, or because they could not remember the information.

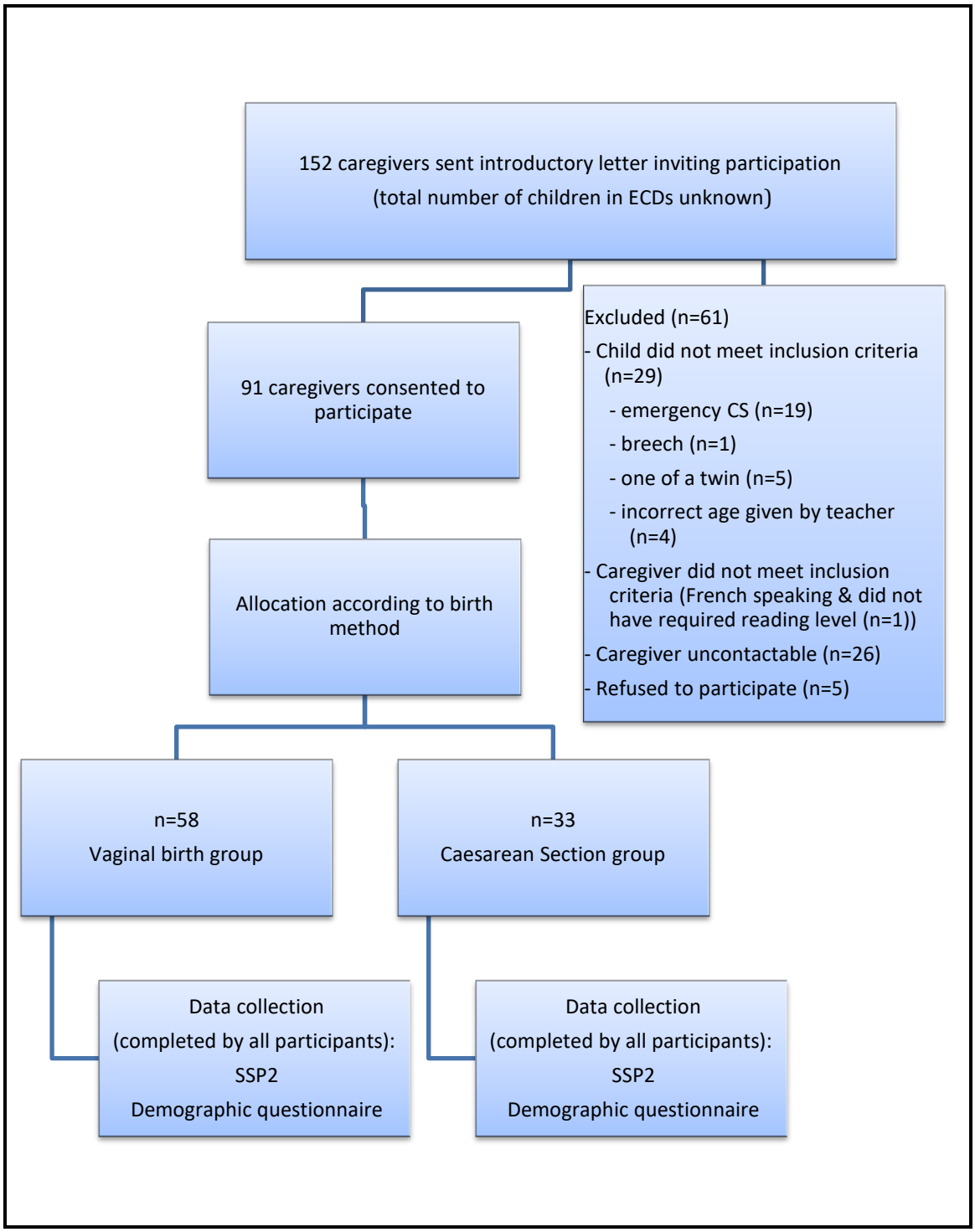


FIGURE 5-1 PARTICIPANT FLOW CHART

PARTICIPANT PROFILE

This section reflects the first objective of the study, to establish a profile of the mother-child dyads according to birth method (half born by CS, and half born by VB). It presents the profiles for the mother and the child participants by method of delivery (CS and VB) as captured on the demographic questionnaire.

Profile of the mothers

Eighty-six caregivers were the biological mother or father of the child participant. The remaining five caregivers were not the biological parents, but the child was living with them at the time of the data collection. The breakdown of these was as follows:

- two maternal aunts, one in the high income group and one in the low income group
- two maternal grandmothers, both in the low income group
- one foster mother, in the high income group

In all these five cases the child had minimal or no contact with the biological parents, or the parents had died. The demographic information was therefore provided by the caregivers.

Missing information was noted on a frequent basis for the variables of family history of SOR, birth weight and Apgar scores. Eight caregivers recorded “don’t know” for family history of SOR, and 15 caregivers did not know the child’s birth weight, with an additional six estimating it. As caregivers found it easier to remember the length of the pregnancy, the gestational age was hypothesised to be a more accurate indicator than birth weight. Apgar scores had the lowest response rate, with only 19 caregivers knowing this information, or being able to provide the child’s clinic card which reported these scores (72 reported “don’t know”).

Three items were judged by the researcher to have elicited inaccurate data from a number of caregivers, namely Family history of SOR, Alcohol use during pregnancy and Recreational drug use during pregnancy. Family history of SOR was not easily understood by many caregivers, and required further explanation. This may have reflected a lack of awareness of the concept and characteristics of SOR, and may have resulted in inaccurate responses or under-reporting, Alcohol and recreational drug use may also have been under-reported, with very few caregivers recording maternal use (only two caregivers (2%) reported recreational drug during pregnancy, and 11 (12%) reported alcohol use).

The characteristics of the mothers according to birth method group are presented in Table 5-1.

Table 5-1 Demographic Characteristics of The Mothers Per Birth Method Group (N = 91)

Variable	Vaginal birth group (n=58)		Caesarean Section group (n=33)				
	Median (range)	Missing data No. (%)	Median (range)	Missing data No. (%)	Mann-Whitney U		p-value
Maternal age	26.0 (17.0-43.0)	0(0)	32.0 (17.0-44.0)	2(6)	499.0		<.001*
	No. (%)		**No. (%)**		**Chi-squared**	**df**	**p-value**
Income level		0(0)		0(0)	11.49	2	.003*
Low	24(41)		8(24)				
Middle	25(43)		9(27)				
High	9(16)		16(48)				
Marital status		0(0)		0(0)			.037*#
Widow	0(0)		2(6)				
Single	21(36)		7(21)				
Divorced	1(2)		0(0)				
Co-habiting	12(21)		3(9)				
Married	24(41)		21(64)				
Education level		0(0)		2(6)	7.68	7	.362
Grade 0-11	25(43)		9(27)				
Grade 12 & Technical	23(40)		10(30)				
Tertiary	10(17)		12(36)				
Stress		0(0)		0(0)			1.000#
Yes	9(16)		5(15)				
No	49 (84)		28(85)				
Illness		0(0)		0(0)			
Yes	6(10)		4(12)				1.000#
No	52 (90)		29(88)				
Smoking		0(0)		0(0)	2.52	1	.113
Yes	8(14)		9(27)				
No	50 (86)		24 (73)				
Alcohol		0(0)		0(0)			.487#
Yes	5(9)		5(15)				
No	53 (91)		28 (85)				
Recreational drugs		0(0)		0(0)			1.000#
	1(2)		1(13)				
Yes	57 (98)		32(97)				
No							
High blood pressure		1(2)		1(3)	0.067	1	.795
	12(21)		6(18)				
Yes	45(78)		26(79)				
No							

*This refers to results which have a statistically significant difference of $p \leq .05$

#Fisher's exact test, two-tailed

Three of the maternal demographic variables showed a statistically significant difference when comparing the two birth method groups – those of maternal age, marital status and income level.

There was a statistically significant difference in maternal age between birth method groups (p = <.001), with the median age in the VB group being significantly younger (26.0 years) compared to the CS group (32.0 years).

There was a statistically significant difference in income level by birth group (p = .003), with a higher percentage of mothers in the VB group being from the low and middle income levels, while the CS mothers were predominantly from the high income level group.

There was a statistically significant difference in marital status by birth method (p = .037), with more married mothers in the CS group. Fifty-seven percent of mothers in the VB group were either single or co-habiting, compared to 30% in the CS group.

The variable of education level showed some differences between the two birth method groups, but was not statistically significant (p = .362). The VB group had 43% who did not complete schooling, whereas the CS group had 27%. Similarly, the percentage of mothers with tertiary education in the VB group was 17%, whereas in the CS group this was 36%. However, when considering maternal education levels in relation to income level areas, without separating the sample into birth method groups, this showed that 0% of mothers in the low income area had any tertiary qualifications, whereas 87% of mothers in the high income area had some form of tertiary education (see Table 5-2 below).

TABLE 5-2 RELATIONSHIP BETWEEN INCOME LEVEL AND EDUCATION LEVEL

	Low income level (n =32)	**Middle income level (n = 34)**	**High income level (n = 25)**
	No. (%)	**No. (%)**	**No. (%)**
Grade 0 – 11	19 (59)	15 (44)	0 (0)
Grade 12 & Technical	12 (38)	16 (47)	5 (20)

	Low income level (n =32)	Middle income level (n = 34)	High income level (n = 25)
Tertiary	0 (0)	3 (9)	19 (76)
Missing data	1(3)	0 (0)	1 (4)

Maternal stress, illness and recreational drug use during pregnancy were almost identical between the two birth method groups (p = 1.000). There were some maternal illnesses and stresses identified. Two of the mothers had AIDS and were on medication for this, one had TB which was linked to the AIDS diagnosis, and was also on TB medication. Eighteen reported suffering from hypertension during pregnancy. Two had gestational diabetes, and one suffered abuse from her partner during her pregnancy. Alcohol use during pregnancy was higher in the CS group, at 15%, compared to 9% in the VB group (p = .487).

Profile of the children

Three child variables demonstrated statistically significant differences between the birth method groups. These were gestational age, minutes to first breastfeed and sleeping difficulties. The demographic characteristics of the children are presented in Table 5-3.

TABLE 5-3 DEMOGRAPHIC CHARACTERISTICS OF THE CHILDREN PER BIRTH METHOD GROUP (N=91)

Variable	Vaginal birth Group (n=58)		Caesarean Section group (n=33)		Mann-Whitney U	p-value
	Median (range)	Missing Data	Median (range)	Missing data		
Birth weight	3.4 (1.8-4.7)	11(19)	3.2 (1.3-4.5)	4(12)	596.0	.366
Gestational age	40 (29-42)	3(5)	39 (32-42)	4(12)	472.5	.001*
Minutes to first contact	1 (1-38880)	3(5)	1 (1-360)	4(12)	765.5	.765
Minutes to first breastfeed	1 (1-38880)	6(10)	12 (1-360)	4(12)	478.0	.006*
Age to first solids	6 (1-12)	7(12)	6 (1-8)	2(6)	758.5	.761
Pressure in months	12 (0-54)	4(7)	18 (1-43)	6(18)	645.5	.405

		No. (%)		No. (%)		Chi-squared	df	p-value
Gender			0(0)		0(0)	0.29	1	.590
	Female	30 (52)		19 (58)				
	Male	28 (48)		14 (42)				
Birth order			1(2)		1(3)			.830#
	First	23(40)		9(27)				
	Second	18(31)		13(39)				
	Third	12(21)		8(24)				
	Fourth & Fifth	4(6)		2(6)				
Colic			0(0)		0(0)	0.16	1	.693
	Yes	12(21)		8(24)				
	No	46(79)		25(76)				
Illness			0(0)		0(0)			.133#
	Yes	3(5)		5(15)				
	No	55(95)		28(85)				
Ear infections			0(0)		1(3)			.780#
	Yes	11(19)		5(15)				
	No	47(81)		27(82)				
Allergies			0(0)		1(3)			1.000#
	Yes	7(12)		3(9)				
	No	51(88)		29(88)				
Eczema			0(0)		0(0)	1.01	1	.314
	Yes	16(28)		6(18)				
	No	42(72)		27(82)				
Asthma			0(0)		0(0)			.718#
	Yes	5(9)		4(12)				
	No	53(91)		29(88)				
Injuries			0(0)		0(0)			.129#
	Yes	0(0)		2(6)				
	No	58(100)		31(94)				
Eating problems			0(0)		0(0)			.349#
	Yes	2(3)		3(9)				
	No	56(97)		30(91)				

Crying		**0(0)**	**0(0)**	**0.51**	**1**	**.474**
Yes	**12(21)**	**9(27)**				
No	**46(79)**	**24(73)**				
Sleeping problems		0(0)	0(0)			.003*
Yes	12(21)	9(27)				#
No	46(79)	24(73)				
	No. (%)	**No. (%)**		**Chi-squared**	**df**	**p-value**

* This refers to results which have a statistically significant difference of p<.05

Fisher's exact test, two-tailed

There was a statistically significant difference in gestational age between birth method groups (p = .001), with a median GA of 40 weeks in the VB group, compared to 39 weeks in the CS group. Gestational age is frequently linked to birth weight, with the lower the GA, the lower the birth weight. However, in this study, the variable of birth weight did not show a significant difference between the two birth method groups (p = .366).

Most mothers in both birth method groups had immediate contact with their baby after birth, with no significant difference between groups (p = .765). However, there was a statistically significant difference (p = .006) in the amount of time (measured in minutes) before the first breastfeed, with a median of 1 minute for the VB group, compared to a median of 12 minutes for the CS group.

There was a statistically significant difference (p = .003) in the history of sleeping difficulties between the two birth method groups, with a frequency of 27% in the CS group compared to 21% of children in the VB group.

There was no significant difference in the number of months the children received some form of pressure (baby massage, swaddling, being carried in a baby sling or on the back). The median was higher in the CS group (18 months), whereas in the VB group the median was 12 months. This difference was not statistically significant (p = .405).

Birth complications were analysed in more detail (see Table 5-4 below), as they were frequently cited in the literature as being present in the birth history of children with SOR

(Keuler et al., 2011; May-Benson et al., 2009). None of the variables investigated in this study showed statistical significance between the two birth method groups.

There were no significant differences between the two birth method groups regarding admission to NICU (p = .454), with 7% of the VB group requiring admission to NICU, compared to 12% of the CS group. The reasons given by the caregivers for admission to NICU for the VB group were: growth retardation, breathing difficulties, prematurity and one baby with a cardiac condition (transposition of the great arteries). The reasons for admission to NICU in the CS group were: abnormal blood levels, breathing difficulties, low birth weight and severe jaundice.

TABLE 5-4 BIRTH COMPLICATIONS

Variable	Vaginal birth group (n=58)		Caesarean Section group (n=33)		p-value
	Frequency (%)	Missing Data	Frequency (%)	Missing data	
Assisted birth delivery (vacuum or forceps)	5 (9)	1 (2)	NA	NA	NA
Meconium present	2 (3)	0 (0)	NA	NA	NA
Birth injuries		2(3)		0(0)	.528#
Yes	2(3)		0(0)		
No	54(90)		33(100)		
Jaundice		0 (0)		0 (0)	1.000#
Yes	8(14)		5(15)		
No	50(86)		28(85)		
NICU		0 (0)		0 (0)	.454#
Yes	4(7)		4(12)		
No	54(93)		29(88)		
NICU Feeding (4 VB, 4 CS)		0 (0)		1 (3)	1.000#
Yes	1 (2)		0 (0)		
No	3 (5)		3 (9)		
NICU Breathing (4 VB, 4 CS)		0 (0)		1 (3)	.486#
Yes	3 (5)		1 (3)		
No	1 (2)		2 (6)		

Fisher's exact test, two-tailed

The reasons provided by the caregivers for having a CS are reflected in Table 5-5 below. It must be emphasised that these represent their understanding of the medical decisions made regarding the reason for the CS. A total of 14 mothers (42%) had a CS as they had had previous CSs. In an additional six cases, a CS was performed due to medical problems related to the mother. One case was described by the mother as an elective CS, and seven cases were due to complications related to the fetus.

TABLE 5-5 REASONS GIVEN BY CAREGIVERS FOR CAESAREAN SECTION (N=33)*

Reason for Caesarean Section (according to caregiver) N (known data) = 32*	No. (%)
Unsuccessful induction of labour	1 (3)
Mother hemiplegic	1 (3)
Mother AIDS and TB	1 (3)
Previous CSs	14 (42)
Overdue	2 (6)
No labour	1 (3)
Bridge presentation	1 (3)
High BP	3 (9)
Big baby	1 (3)
Fetal distress	1 (3)
Fetal heart beat too fast	1 (3)
Mother osteo-arthritis in right hip	1 (3)
Large head circumference	1 (3)
Cord wrapped round neck	1 (3)
Placenta Praevia	1 (3)
Elective	1 (3)

* Missing data for 1 participant

SENSORY OVER-RESPONSIVITY AND BIRTH METHOD

This section reflects the second and third objectives of the study, which were to determine the prevalence of SOR across the entire group, and then by birth method. Fisher's exact test

was employed to determine whether any statistically significant differences existed between the groups. In order to provide a complete picture of sensory modulation, the scores for all four sensory modulation patterns (including sensory avoiding, sensory seeking and low registration) for both birthing groups are presented. In this study, the presence of sensory over-responsivity is represented by adding the scores of +1 and +2 SD, unless otherwise specified.

The four sensory modulation categories according to birth method are represented in Table 5-6, indicating that the results contrasted to the hypothesised difference. There was a greater prevalence of SOR in the VB group, with 17 of the 58 (29%), presenting with SOR, compared to 3 of the 33 (9%) in the CS group presenting with SOR. The other three categories of SMD all showed similar figures to those for SOR, with a higher prevalence for all categories in the VB group. The highest prevalence was in the sensory seeking category, with 28 (48%) identified as sensory seeking. This was followed by sensory avoiding at 36%, sensory sensitivity at 29% and the lowest being low registration with a prevalence in the VB group of 24%. The prevalence for all sensory modulation categories was low in the CS group, with the highest percentage being for the sensory seeking group, which was 15%.

TABLE 5-6 LEVELS OF SEVERITY OF SENSORY MODULATION DISORDERS BY BIRTH METHOD GROUP (N=91)

Sensory modulation pattern	Vaginal birth group (n=58)			Caesarean Section Group (n=33)		
	SD 0[1]	SD +1[2]	SD +2[3]	SD 0	SD +1	SD +2
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Sensory over-responsivity	41(71)	14 (24)	3 (5)	30 (91)	3 (9)	0 (0)
Sensory seeking	30 (52)	18 (31)	10 (17)	28 (85)	3 (9)	2(6)
Sensory avoiding	37 (64)	14 (24)	7 (12)	30 (91)	2 (6)	1 (3)
Low registration	44 (76)	8 (14)	6 (10)	31 (94)	2 (6)	0(0)

[1] SD 0 = typical performance
[2] SD +1 = "More than others", having more symptoms of dysfunction than typically performing children
[3] SD +2 = "Much more than others", with the child having "much more" in terms of symptoms of dysfunction than typically performing children

Details on the four sensory modulation categories, with SD scores, are presented for each child participant in Appendix O.

Fisher's exact test was used to determine whether there were any significant differences in SOR between the birth method groups. The frequencies and percentages for the four SMD categories (SD +1 and +2 combined) and the p-values are presented in Table 5-7. As shown, there were statistically significant differences in SOR between the birth method groups, with a greater prevalence in the VB group (Fisher's exact p (two-tailed) = .034). This pattern was repeated in the remaining SMD categories. Birth by vaginal delivery was therefore significantly associated with sensory modulation disorders in all four categories.

When considering the prevalence of SOR in the total sample, with the two birth method groups combined, this was 22%.

TABLE 5-7 PATTERNS OF SENSORY MODULATION DISORDERS (N=91)

SMD Categories	Vaginal birth group (n=58)	Caesarean Section group (n=33)	Total group (N=91)	p-value (Fisher's exact test)
	No. (%)	No. (%)	No. (%)	
Sensory over-responsitivity				
Yes[1]	17(29%)	3(9%)	20(22%)	.034*
No[2]				
Sensory avoiding				
Yes[1]	21(36%)	3(9%)	24(26%)	.006*
No[2]				
Sensory seeking				
Yes[1]	28(48%)	15(45%)	43(47%)	.002*
No[2]				
Low registration				
Yes[1]	14(24%)	2(6%)	16(17%)	.043*
No[2]				

1 Yes= the child scored 1 (more than) or 2 (much more than) standard deviations above the mean

2 No = the child scored 0 SD (typical performance)

* This refers to results which have a statistically significant difference p<0.05

Table 5-8 below reports the results examining the influence of income level on birthing method. This indicated that 74% of mothers in the low and middle income level groups had a VB. In the high income level group, 64% of mothers had a CS.

TABLE 5-8 METHOD OF BIRTH BY INCOME LEVEL (N = 91)

	Low & middle income level (n=66)	High income level (n=25)
	No. (%)	**No. (%)**
Vaginal birth group	49 (74%)	9 (36%)
Caesarean Section group	17 (26%)	16 (64%)

Next, the prevalence of SOR according to income level was examined, and is reported in Table 5-9 below. In the high income level group, the total percentage of SOR was 16%. The total SOR for the middle and low income groups combined was 24%.

TABLE 5-9 SOR SD PER INCOME LEVEL GROUP

Income level	**SD 0**[1]	**SOR SD +1**[2]	**SOR SD +2**[3]
	No. (%)	**No. (%)**	**No. (%)**
High ((n = 25)	21 (84)	4 (16)	0 (0)
Middle and Low (n = 66)	50 (76)	13 (20)*	3 (5)*

[1] SD 0 = typical performance
[2] SD +1 = "More than others", having more symptoms of dysfunction than typically performing children
[3] SD +2 = "Much more than others", with the child having "much more" in terms of symptoms of dysfunction than typically performing children

* When SOR +1 and +2 were calculated individually, the percentages were 20% and 5% respectively. When calculating the sum of SOR +1 and +2, the statistician advised to total the raw data (13+3 = 16), and then calculate the percentage from this total, which is 24%. This discrepancy occurs due to the rounding off of the percentages.

SENSORY OVER-RESPONSIVITY AND OTHER VARIABLES

This section reflects the fourth and final objective of the study, which was to establish which other variables besides birth method were linked to the prevalence of SOR. The Mann-Whitney, Pearson's Chi-square and Fisher's exact tests were used where appropriate.

Of the maternal variables, maternal age (U = 380.5, p = .004) and marital status (p = .003) showed a statistically significant association with SOR. One child variable demonstrated a

statistically significant association with SOR - minutes after birth to the first breastfeed (U = 394.5, p = .049). Refer to Table 5-10.

Table 5-10 ASSOCIATION OF VARIABLES (OTHER THAN BIRTH METHOD) TO SOR

Variables/Factor	Test used	U statistic	Df	p-value
Maternal age	Mann-Whitney	380.5		.004*
Gestational age	Mann-Whitney	575.0		.840
Birth weight	Mann-Whitney	368.0		.098
Minutes to first contact	Mann-Whitney	460.5		.147
Minutes to first breastfeed	Mann-Whitney	394.5		.049*
Age of first solids	Mann-Whitney	565.0		.907
Pressure in mths	Mann-Whitney	566.5		.804
Income level	Pearson's Chi-square	3.41	2	.182
Marital status	Fisher's exact			.003*
Educational level	Pearson's Chi-square	7.81	7	.350
Stress	Fisher's exact			1.000
Illness	Fisher's exact			1.000
Smoking	Fisher's exact			.516
Alcohol	Fisher's exact			.487
Recreational drugs	Fisher's exact			1.000
High blood pressure	Pearson's Chi-squared	1.93	1	.165
Gender	Pearson's Chi-squared	0.01	1	.907
Birth order	Fisher's exact			.734
Birth injuries	Fisher's exact			1.000
Jaundice	Fisher's exact			.472
NICU	Fisher's exact			.680
Breathing NICU	Fisher's exact			1.000
Feeding NICU	Fisher's exact			1.000
Pressure	Fisher's exact			.302
Colic	Fisher's exact			1.000
Illness	Fisher's exact			.680
Ear infections	Fisher's exact			.508
Allergies	Fisher's exact			1.000
Eczema	Fisher's exact			1.000
Asthma	Fisher's exact			.678
Injuries	Fisher's exact			1.000

Eating problems	Fisher's exact			.582
Crying	Pearson's Chi-square	0.69	1	.405
Sleeping problems	Fisher's exact			.192

*This refers to results which have a statistically significant difference p<.05

CONCLUSION

Chapter Five presented the results of this study. A description of the participant flow was provided, represented by a flow chart. The results in relation to the four research objectives were then outlined.

Objective one was reflected in the demographic profiles for participants, both caregivers and children. These were tabulated in tables 5-1 to 5-5. The p-values for variables were calculated to identify significant differences between the groups for these variables. This showed statistically significant differences between the two birth method groups in relation to the three maternal variables of maternal age (p = <.001), younger in the VB group; income level (p = .003), lower in the VB group and marital status (p = .037), greater numbers of single mothers in the VB group. Three child variables showed statistically significant differences between the birth method groups, those of gestational age (p = .001), shorter in the CS group; number of minutes to the first breastfeed (p = .006), greater in the CS group and presence of sleeping problems (p = .003), more common in the CS group. Birth complications were also analysed in further detail, given that a number of studies had linked this factor to aetiology of SOR. The most common reasons the caregivers gave for having a CS was that the mother had had a previous CS.

Objective two then presented the prevalence of SOR, as well as for the other sensory modulation categories. In the total sample the SOR prevalence rate was 22%. When dividing the sample into income level groups, the prevalence of SOR in the high income group was 16%, and in the combined middle and low income level groups was 24%. When dividing the sample into the two birth method groups, the prevalence of SOR was 29% in the VB group and 9% in the CS group.

Objective three represented in tabular form the p-values for SOR and for the other three SMD categories between the two birth method groups, showing statistically significant differences for all categories, with higher prevalence in the VB group. The p-value for SOR was .034, with greater prevalence in the VB group. This therefore resulted in supporting the null hypothesis, which states that the prevalence of SOR will not be higher in the group of children born by CS.

Objective four presented a table to show the variables identified on the demographic questionnaire, with the p-value calculated, in order to investigate whether any of these variables linked to SOR. Of the variables examined, maternal age ($p = .004$), marital status ($p = .003$) and minutes to first breastfeed ($p = .049$) showed a statistically significant association with SOR.

Chapter Six will interpret these results, and put forward suggestions as to why the research findings showed a null hypothesis. The conclusions drawn will be supported by relevant literature which was reviewed in Chapter Two.

CHAPTER SIX DISCUSSION

INTRODUCTION

In this chapter the results presented in Chapter Five will be discussed as they relate to the objectives for the study. In the first section, objective one which is to establish a profile of participants by birth method group, will be discussed. The three maternal characteristics (age, marital status and income level) and three child characteristics (GA, minutes to first breastfeed and sleeping difficulties) showing statistically significant differences between the birth method groups are discussed and interpreted, making links to the literature review. Section two covers objective two, which sought to determine the prevalence of SOR by birth method, and objective three, which aimed to establish if there was a statistically significant difference in SOR and birth method. There were statistically significant differences in SOR between the birth method groups, with a greater prevalence in the VB group. The possible reasons for these results are discussed. Section three discusses the results related to objective four which sought to establish which variables were associated with SOR. The three maternal and child variables of maternal age, marital status and minutes to the first breastfeed showed statistically significant associations with SOR. These associations are discussed in the light of literature investigating possible aetiological factors linked to SOR. The hypothesis of this research study that there would be a higher prevalence of SOR in the CS group was not proven. The factors which were suggested to have contributed to the prevalence of SOR in this sample are discussed in the final section of this chapter.

Considering the similarities in ECD and participant characteristics in the middle and low income level groups outlined in Chapter Four and reflected in Table 4-1, these two groups have been merged for the purpose of the discussion, unless otherwise specified. This combined group is termed the low-middle income level group.

DEMOGRAPHIC PROFILES AND BIRTHING METHOD

In this section, the results pertaining to objective one will be discussed. This objective sought to establish a demographic profile of two groups of participants (mother-child dyads)

according to birth method (CS and VB) in terms of variables linked to SOR. Those maternal and child characteristics which were statistically different will be discussed further below, as these variables may have contributed to the aetiology of SOR.

Maternal demographic characteristics

The maternal demographic characteristics which showed a statistically significant difference between the two birth method groups were maternal age (p = <.001), income level (p = .003) and marital status (p = .037).

The mothers in the VB group were significantly younger at the time of giving birth (p = < .001) than the mothers in the CS group. This aligns with international literature reporting a higher rate of CS among older mothers (Bentley et al., 2016; Swain et al., 2008). Older mothers may tend to choose this method of birth, or the doctor may recommend a CS as they may feel it is medically indicated in older women (Bentley et al., 2016; Swain et al., 2008). Statistics South Africa provided a breakdown for maternal age in live births in South Africa for 2016, but it did not specify public or private facilities, nor socio-economic status or birth method, and therefore could not inform this subject (Statistics South Africa, 2017). No other references to maternal age could be found in the South African literature reviewed.

In the present study the mothers giving birth through vaginal delivery were of low and middle income status. This result is confirmed by the finding of a study by Matshidze et al., (1998) which revealed that the majority of mothers in low socio-economic areas in South Africa give birth through vaginal delivery. In low-middle income level groups, much of the apartheid infra-structure remains and as a result many medical facilities in these poorer geographical areas are public health care facilities characterised by low staffing numbers, poor quality care, and budgetary constraints (Chopra et al., 2009; Davies et al., 2011). A VB requires less sophisticated facilities and staffing, costs less, and is therefore the more frequent birth method in these facilities (Matshidze et al., 1998). When receiving care at these facilities the expectant mother is also unlikely to have the option of a CS discussed with her, or to be provided with a choice in this regard, due to its increased cost. Additionally, CS births for non-medical reasons are not considered by the Department of Health to be acceptable practice in the public sector (Department of Health, 2015; Massyn et al., 2017). In contrast,

few mothers in the high income level group (36%) had a VB and most mothers in this group used private medical facilities, and were more likely to be members of a medical aid scheme which pays the bulk of the medical costs associated with a CS, or else the families carry the cost themselves. These mothers would in all likelihood have had a private specialist caring for them during the pregnancy and birth, who would provide the choice of birthing options, and the mothers would have the financial means to afford a CS. The CS rate in this study in the high income level area of 64% is similar to that quoted by the Council for Medical Schemes of 67% for those families on Medical Aid (Council for Medical Schemes, 2016a, 2016b). In this study, the mothers who had a CS were requested to provide the reasons therefore. The data indicated that the caregivers understanding was that the CS was done for medical reasons in all cases except one case, which the caregiver stated was elective. The literature review illustrated that for many doctors, a CS is the preferred choice, for both medical and non-medical reasons (Bentley et al., 2016; Broomberg & Price, 1990; Habiba et al., 2006; Hildingsson et al., 2002; Kapellou, 2011; Swain et al., 2008; Thomopoulos et al., 2015). The doctor's opinion would be likely to have played a part in the mother's decision.

Many studies, both nationally and internationally, have linked maternal age with income level, with younger mothers being associated with low socio-economic status (Davies et al., 2011; Wehby & McCarthy, 2013). This is particularly relevant in South Africa, where mothers having a VB tend to be of a lower socio-economic status. This statement is supported by a study of a low socio-economic community in South Africa which found that 45% of mothers of children younger than one year, were 24 years of age or younger (Davies et al., 2011). The District Health Barometer's latest figures indicate that more than half of women who gave birth in 2016/2017 in public health facilities had their first child before their 21st birthday (Massyn et al., 2017). Poorer socio-economic areas are reported to have the highest delivery rates for women under 18 years of age (Massyn et al., 2017). The statistics in both of these studies refer to mothers using public health facilities, with the birth method not specified (Davies et al., 2011; Massyn et al., 2017). However, these mothers are likely to be of low socio-economic status and to have had a VB. The findings linking VB and younger mothers were borne out in this study, through the association with socio-economic status.

Marital status showed a statistically significant difference between the birth method groups ($p = .037$). Single and co-habiting mothers predominated in the VB group, and married mothers predominated in the CS group. A review of international and national literature showed marital status to be linked to socio-economic status, with single and unmarried mothers being associated with low socio-economic status (Davies et al., 2011; Román-Oyola, 2011; Ursache & Noble, 2016a). This leads to a probable conclusion that the middle to low income level composition of the VB group had associations with the marital status of the mother. This probable conclusion is further confirmed later in this chapter.

Maternal education level was used in this study, rather than paternal educational level, in line with most other international and national studies (Davies et al., 2011; Raffington et al., 2018; Wehby & McCarthy, 2013). Differences between birth method groups were noted in the maternal education levels in this study, however they were not statistically significant. The majority of mothers in the VB group did not have tertiary education, whereas the majority of those in the CS group did have tertiary education. In the low income level group taken on its own, 59% of the mothers had not completed their schooling, whereas this did not apply to any mothers in the high income level. A possibility is that, due to the link between low maternal age and low socio-economic status, some mothers may have been attending school when they fell pregnant, and dropped out of school as a result. No mothers in the low income level group had tertiary education, whereas 76% of mothers in the high income level group had completed tertiary education. These are similar figures to those reported by Davies et al. (2011) on a low socio-economic community in South Africa, which showed 62% of mothers had not completed high school, while only 0.5% had tertiary education. Educational level has been consistently found to have one of the strongest associations with income level (Davies et al., 2011; Dunn, Loxton, & Naidoo, 2006; Grantham-Mcgregor et al., 2007; Ursache & Noble, 2016; Ursache et al., 2015), and is one of the traditional indicators used to determine socio-economic status (Davies et al., 2011; Ursache & Noble, 2016a).

Three other maternal variables cited in the literature - maternal stress, illness and alcohol use during pregnancy - warrant discussion. Maternal stress and illness, and accompanying use of medications during pregnancy have been shown to be factors in the aetiology of SMD and SPD, although SOR was not specifically examined (May-Benson et al., 2009). However, no

significant differences were found in this study between the birth method groups when considering maternal stress and/or illness during pregnancy. Alcohol use in the VB group was less frequently reported then in the CS group. It has been shown above that the majority of VB mothers were from low-middle income level areas. Alcohol abuse is a major problem in low socio-economic areas, leading to a high incidence in South Africa of fetal alcohol syndrome (Davies et al., 2011). Pre-natal alcohol exposure of the infant is likely to highly compromise brain development, both pre- and post-natally, causing a variety of developmental sequelae (Davies et al., 2011; Roman-Oyola, 2011), including SMD and SOR (du Plooy, 2017; Roman-Oyola, 2011). Due to the risk of potential stigma, alcohol use during pregnancy may therefore have been under-reported.

Child demographic characteristics

The three child demographic variables showing statistically significant differences between the two birth method groups were gestational age, minutes to first breastfeed and sleeping difficulties. Two of these, GA and minutes to first breastfeed relate to the peri-natal period, whereas sleeping difficulties refer to difficulties at any age up to the time of the research.

Gestational age in the CS group was shorter than the VB group by one week ($p = .001$). This was an expected finding, as most CSs are planned to take place before labour begins, frequently at 37 or 38 weeks gestation (Bentley et al., 2016). Gestational age and birth weight are linked, with lower GA associated with lower birth weight. However, in this study, the birth weight variable was not statistically significant ($p = .366$). This was thought by the researcher to be due to the difficulty many caregivers had remembering the child's birth weight. In many instances, the caregiver could only state that the baby was "small" or "normal". Caregivers were in the main certain of the gestational age of the child. In this study GA responses were therefore considered more accurate than the birth weight.

Mothers in both birth method groups had almost immediate contact with their babies after birth. However, there was a statistically significant difference in the minutes to the first breastfeed ($p = .006$), with a median of 1 minute for the VB group and 12 minutes for the CS group. This finding correlated with the only other study that could be found which reported on this variable (Nissen et al., 1996), where the first breastfeed in the CS group was

significantly later than in the VB group. This period was even longer when the mother received a general anaesthetic rather than an epidural or spinal block, although general anaesthesia was not a common occurrence. This later first breastfeed is likely to be due to the protocols in place at many hospitals for the management of a CS baby, where the baby is presented to the mother for the first contact, and then immediately thereafter taken for medical review. The increased length of time to the first breastfeed has been linked to reduced frequency of oxytocin pulses in the CS group (Nissen et al., 1996).

Sleeping difficulties showed a statistically significant difference between the two birth method groups ($p = .003$), with greater frequency of difficulties reported in the CS group (27%) than in the VB group (21%). While no reasons could be found for this in the literature, it may be linked to two factors - the lower GA and the delayed first breastfeed in the CS group. Babies of lower GA are less able to regulate their physiological states such as sleeping, due to less mature brain development (Bigelow et al., 2010), resulting in greater dysregulation and irritability (Bigelow et al., 2010; Bystrova et al., 2009). Shorter GA has also been shown to be associated with more frequent respiratory and gastro-intestinal problems, with these children generally described by their parents as having poor health (Boyle, 2013). These health factors are likely to negatively affect sleep. The influence of the delayed first breastfeed may be linked to separation during the sensitive period of the first two hours immediately after birth (Bystrova et al., 2009), when close contact between the mother and infant appears to facilitate mother-infant interactions. Separation during this time was found to result in infants being less regulated and more irritable at one year (Bystrova et al., 2009), possibly linking to sleeping difficulties.

The remaining child demographic variables did not show any significant differences between the two birth method groups. Due to the importance of pressure in the treatment of SOR, this variable was included in the study. Pressure referred to a variety of ways that caregivers may provide deep pressure as a part of their handling of the baby and young child. These included baby massage, swaddling the baby, carrying of the baby in a baby sling, or on the caregiver's back. Carrying the child on the caregiver's back, usually strapped on tightly with a blanket or towel is a frequently used and traditional way for black South African women to carry their young children, often till the child is three or four years old. Due to the large

number of isiXhosa-speakers who resided in the low income level area of the study who were in the VB group, the median was expected to be higher in this group. However, this was not found, with the median being higher in the CS group, where caregivers reported using pressure till 18 months of age, whereas in the VB group, caregivers reported using pressure till 12 months of age. This was an unexpected result, for which the researcher was not able to find a reason.

SENSORY OVER-RESPONSIVITY IN THE SAMPLE

In this section the researcher will discuss the second and third objectives of this study, which set out to explore the relationship between birthing method and SOR. Firstly the prevalence of SOR in the total sample will be discussed within the context of current and relevant literature. The prevalence of SOR in each of the birth method groups, and the statistically significant differences in SOR prevalence between the two birth method groups, as well as suggested reasons for these differences will be discussed, drawing on literature to support the arguments presented.

Prevalence of SOR in the total sample

The prevalence of SOR in the total study sample was 22%. This was marginally higher than the American prevalence studies, which have variously reported SOR prevalence at 17% (Ben-Sasson et al., 2009) and 21% (Carter et al., 2011; Van Hulle et al., 2011). Studies done in countries outside of America have shown varying prevalence. A study comparing the SSP scores of Israeli and American children showed lower rates in all areas of SMD, including SOR, in the Israeli sample compared to the American sample, although the prevalence figure was not reported in the article (Caron et al., 2012). The SOR prevalence in a Saudi Arabian study was reported to be 31% (Al-Heizan et al., 2015). A South African based study conducted by Van Jaarsveld et al. (2001) investigated sensory integration (not only SOR) in both high and low socio-economic groups. The study reported a greater prevalence of sensory integration problems (of which SOR is one sub-category) in the South African population across all socio-economic groups. The low socio-economic group had 58 children and the high socio-economic group had 42 children, with both groups from the same ethnic and cultural group. Results were reported in the article for the two of the sub-categories tested, namely postural

control and bilateral integration, showing a prevalence of 34% and 69% respectively in the low socio-economic group. In the high socio-economic group, the prevalence was 7% and 29%, showing an overall lower prevalence. A disadvantage of the study was that only the percentages were provided, not the frequencies, therefore it was not possible to calculate totals for the total test scores, nor for the high and low socio-economic groups combined. The significance of these findings is that, although SOR specifically wasn't tested, but rather other aspects of sensory integration, it does demonstrate significantly higher prevalence of sensory integration difficulties in low socio-economic groups, which comprised a significant portion of this study sample. Du Plooy (2017) specifically investigated the prevalence of SOR, however only in low socio-economic areas in South Africa. She found a 35% prevalence of SOR in low socio-economic rural areas in the Western Cape, South Africa which is even higher than that found in this study.

An additional factor possibly influencing the prevalence cited in this study, was that although the sample comprised 91 caregivers, which was greater than the sample size required, the number in the CS group was 33 as opposed to the required sample size of 42. The results can therefore not be generalized to the total population of South Africa.

A number of challenges have been described in Chapter Four which affected data collection. Adaptations were developed by the researcher to address these, however the accuracy of the results may have been compromised, therefore prevalence may be lower or higher than reported. Some of these challenges were linked to cultural issues as a result of the questionnaire having been developed in America, and have been highlighted by other researchers (Caron et al., 2012; Chow. 2005; Kayihan et al., 2015; Lai et al., 2011). This is particularly applicable to the South African context, which is multi-cultural and very diverse, thus also making assessment of sensory modulation complex. Many statements in the questionnaire were inappropriate or irrelevant to the study participants. Linguistic factors also created challenges linked to differing meanings, or terms which were not understood or understood differently in a different culture. These factors have also been reported on by Neuman et al. (2004). Where translation into isiXhosa was necessary for three participants to be able to complete the questionnaire, the translation process as well as the process of

completing the questionnaire with an isiXhosa translator brought in additional possibilities for inaccuracies in understanding, as mentioned in the study by Chow (2005).

In addition, the accuracy of the Likert scale has previously been shown to be affected by the level of the participants' reading ability and culture (Chachamovich et al., 2009; Lee et al., 2002). For those with poor or no reading abilities, it has been shown that a 3-point scale would allow for greater accuracy than the 5-point scale used in this study (Chachamovich et al., 2009). In addition, for certain cultures, a 4- or a 7-point scale results in greater accuracy (Lee et al., 2002). These finding reveal the inaccuracies in measurement which can occur when the number of points on the Likert scale do not correlate with the respondent's educational or reading level or culture.

The researcher was aware of the possible cultural, language and educational factors which could impact the accuracy of the questionnaires, and went to lengths to make adjustments to the data collection process to increase the accuracy of the caregiver responses, although these were unlikely to deal with all the challenges presented. The prevalence reported is within the range of SOR prevalence cited in other studies (Ben-Sasson et al., 2009; Carter et al., 2011; Al-Heizan et al., 2015), and is thought to be a fair reflection of the prevalence of SOR in the area where the study was conducted.

Prevalence of SOR in the two birth method groups

The results of the study showed that there was a statistically significant difference in SOR between the two birth method groups ($p = .034$), with the greater prevalence of SOR in the VB group therefore supporting the null hypothesis. Findings presented in the literature review demonstrate the considerable influence of socio-economic factors on brain development (Grantham-McGregor et al., 2007; Raffington et al., 2018; Ursache & Noble, 2016) and the development of SMD and SOR (Ben-Sasson et al., 2009; Du Plooy 2017; Roman-Oyola 2011). In order to understand possible reasons for the null hypothesis, further data analysis was done to consider the influence of socio-economic factors on SOR, which may have contributed to the higher SOR prevalence in the VB group, which has already been shown to contain a high percentage of low-middle income level group participants. This is

additionally pertinent in South Africa, where the many of the population are of low socio-economic status.

A comparison in SOR prevalence between the high and low-middle income level groups (see Table 5-8) showed a difference of 8%, with the high income group having a prevalence of 16%, and the low-middle income level group having a prevalence of 24%. This suggests higher rates of SOR in low socio-economic areas when compared to higher socio-economic areas in South Africa. This conclusion is supported by international studies which have reported low socio-economic indicators as risk factors for the development of SMD and SOR (Ben-Sasson et al., 2009; Roman-Oyola, 2011). This result supports the findings of the only other study that included investigation of the prevalence of SOR in low socio-economic areas in South Africa (Du Plooy, 2017). She conducted her study in rural areas of the Western Cape, South Africa, and found a 35% prevalence of SOR.

There was a higher prevalence for the other three categories of SMD according to birth method group (sensory seeking, sensory avoiding and low registration) in the VB group, with statistically significant p-values of between .002 and .043. The majority of VBs in this study were in mothers of lower socio-economic status, reinforcing the finding discussed above which showed higher SOR prevalence in the low-middle income level group. Previous studies have similarly found a higher prevalence for all categories of SMD in low socio-economic rural areas in the Western Cape of South Africa (Du Plooy, 2017) and internationally (Ben-Sasson et al., 2009; Roman-Oyola, 2011).

Other environmental factors in the low-middle income level areas noted by the researcher during data collection were also likely to impact on the development of sensory modulation, and hence also SOR. These took the form of higher volumes and greater intensity of sensory input, as described in Chapter Four. The researcher could not find any studies examining the impact of high levels of sensory input in low socio-economic areas on sensory modulation. However, the high levels and intensity of sensory input associated with the neonatal intensive care environment and its effect on sensory modulation has been studied (Bröring et al., 2017; Rahkonen et al., 2015). Extrapolating the results of these studies to the present study suggests that the high levels and intensity of sensory input associated with low socio-

economic environments may also affect sensory modulation. In addition, unpredictable schedules, inconsistent sleeping and mealtime routines, which have been shown to be more commonly associated with low socio-economic home environments, may affect sensory regulation (Ursache & Noble, 2016b, 2016a).

In summary, low socio-economic status and associated environmental factors (high levels and intensity of sensory inputs and inconsistent routines prevalent in low socio-economic environments) appear to have played a role in the higher prevalence of SOR in the low-middle income level groups in this study. Literature has established that these factors affect brain development and function, and in turn SMD and SOR which supports the relatively high prevalence of SOR in the present study.

SENSORY OVER-RESPONSIVITY AND ASSOCIATIONS WITH OTHER FACTORS

In this section, the fourth objective will be discussed, which sought to establish which mother and child variables, other than birth method, showed a statistical link to SOR. The information on these variables was obtained via the demographic questionnaire. Maternal age, marital status and minutes to first breastfeed showed a statistically significant association with SOR.

Maternal age and SOR

Maternal age was associated with SOR ($p = .004$), with younger maternal age linking to SOR. No reference to the role of maternal age in the aetiology of SOR could be found to substantiate this finding, however a lower maternal age has been associated with greater risk of neurodevelopmental problems (Wehby & McCarthy, 2013). Wehby and McCarthy (2013) examined wealth gradients and child neurodevelopment in four South American countries, and found that in Brazil, lower maternal age was linked to a greater risk of the child developing neurodevelopmental problems. In the current study, mothers in the VB group were younger than those in the CS group ($p = <.001$) and were from a lower socio-economic group. The VB group also had a statistically higher prevalence of SOR compared to the CS group. These links, both to an international study (Wehby & McCarthy, 2013), and to supporting findings in this study linking maternal age to socio-economic status, therefore support the finding of a statistically significant association between SOR and younger

maternal age. This is however a finding particular to this study, and may not be generalizable to other studies, due to the small sample size and the cultural, linguistic and educational factors impacting on the participants' use of the questionnaires.

Marital status and SOR

The study finding of a statistically significant association between marital status and SOR (p = .003) is supported by a study of four South American countries that showed an increased risk of neurodevelopmental problems in children of unmarried mothers (Wehby & McCarthy, 2013). Ben-Sasson et al. (2009) similarly found that children with SOR were more likely to be living with a single mother.

Birth weight, GA and SOR

Due to the correlation between birth weight and GA, these variables will be discussed together. Gestational age has been linked in a number of studies to possible aetiology of SOR (Cabral et al., 2016; Case-Smith et al., 1998; Goldsmith et al., 2006; Keuler et al., 2011; Van Hulle et al., 2015). In particular, sensitivities in the tactile, vestibular and auditory sensory systems have been linked to shorter gestational age (Cabral et al., 2016; Van Hulle et al., 2015). Van Hulle et al. (2015) also found that the lower the gestational age, the greater were these symptoms of sensitivity. When intra-uterine development is interrupted prematurely, sequelae such as neurodevelopmental and respiratory problems and endocrine disorders may occur (Bentley et al., 2016; Boyle, 2013; De Weerth & Buitelaar, 2007; Kapellou, 2011). However, Keuler et al. (2011) did not find that gestational age and birth weight were predictors of SOR. May-Benson et al. (2009) reported a similar finding in their retrospective chart review at one clinical practice in an American city, aimed at identifying factors associated with SPD. They found that 12.4% of the children with SPD (n=1 000), had been born prematurely (defined as before 37 weeks), which is similar to the national American average of 12.7%. Babies of very low birth weight (less than 3lbs. 5oz) accounted for 1.5% of the SPD group, which was identical to the national average. Babies of low birth weight (less than 5lbs. 8oz) comprised 4.8% of the SPD group, lower than the national average of 8.2% (May-Benson et al., 2009).

The current study did not show a significant relationship between GA and SOR (p = .840),

despite a statistically significant difference in GA between the two birth method groups due to planned CS usually being scheduled before the due date. The association between birth weight and SOR was stronger than for GA (p = .098), but was also not significant. This is probably due to difficulties recalling birth weight figures, with caregivers frequently giving an approximate figure. The GA value is likely to be more reliable as it was easier for caregivers to recall, however there was no association between GA and SOR. This is in line with the findings of the two international studies cited above, which did not show an association between GA or birth weight and SOR (Keuler et al. ,2011; May-Benson et al., 2009).

Maternal educational level and SOR

Most researchers agree that maternal educational level is one of the strongest predictors of child development (Davies et al., 2011). In a study comparing early developmental outcomes according to socio-economic gradients, non-completion of maternal formal education was linked to greater risks of neurodevelopmental problems (Wehby & McCarthy, 2013). A study of SMD in Puerto Rican children from varying socio-economic levels found that the differences in SMD were related to maternal education level. They found that children of mothers who had only completed formal schooling had greater problems in the two specific aspects of movement sensitivity and under-responsivity, as identified on the SSP, than those with tertiary education (Román-Oyola & Reynolds, 2013). Bigelow et al. (2010) found that maternal educational level was one of three significant predictors of maternal sensitivity towards her baby, the other two being gestational age and the amount of skin-to-skin contact in the first 24 hours of the infant's life. Higher maternal education level was associated with increased maternal sensitivity to the infant's needs, greater stimulation, more language exposure, greater playfulness and a better ability to cope with stress (Bigelow et al., 2010). Greater maternal sensitivity to the infant's needs allows for improved maternal regulation of the infant, which is the basis for the development of self regulation by the child (Bystrova et al., 2009; Hofer, 2005), and the development of normal sensory modulation. Although a number of studies have found a link between low educational level and increased risk of various neurodevelopmental problems including SMD, this was not borne out in this study, which found limited association between educational level and SOR (p = .350).

Income level and SOR

The difference in prevalence of SOR in this study between the high and low-middle income level groups suggests the influence of socio-economic and associated environmental factors in the aetiology of SOR. This is linked to the effects of poverty on nutrition, regular child routines, language, developmental and educational stimulation which may all impact on the development of sensory modulation (Ben-Sasson et al., 2009; Grantham-Mcgregor et al., 2007; Ursache & Noble, 2016a; Wehby & McCarthy, 2013). The possible effects of sensory over- and understimulation experienced in the NICU on the development of sensory modulation described by Roman-Oyola (2011) may be similar to the environments of poor communities as discussed in more detail above in Chapter Four (Features of low socio-economic environments impacting sensory modulation). The Puerto Rican study found higher prevalence of SMD in the low socio-economic groups (Román-Oyola & Reynolds, 2013). More specifically related to this study, Ben-Sasson et al. (2009) found children living in low socio-economic communities to have a greater likelihood of having SOR. However, unlike previous studies which consistently showed children from low socio-economic households to be at greater risk for SOR (Ben-Sasson et al., 2009; Du Plooy, 2017), the association between income level and SOR in the current study was not significant ($p = .182$).

Maternal health and SOR

In this section, the maternal health issues of stress during pregnancy, illness during pregnancy (including hypertension), smoking, alcohol and recreational drug use will be discussed.

None of these factors were significantly associated with SOR, however, as mentioned in Chapter Five, smoking, alcohol use and drug use, may have been under-reported due to societal pressure not to admit to use of these substances during pregnancy.

No literature could be found examining an association between smoking and SOR. However, two studies indicated a link between alcohol use and SMD, although not necessarily SOR (Keuler et al., 2011; Roman-Oyola, 2011). The link between alcohol use and brain development has been widely described in the literature, and frequently results in Fetal Alcohol Syndrome (FAS) (Davies et al., 2011). Many of these children in turn are shown to have developmental delays and problems with sensory modulation. A South African study

found that problems in sensory modulation occurred in over 70% of the FAS population (Du Plooy, 2017). In addition, sensory modulation difficulties were identified across all the sensory systems, and all categories of sensory modulation. The categories of sensory over-responsivity (90%) and sensory seeking (90%) showed the highest prevalence for the FAS population (SD +1 and +2 combined). The breakdown regarding SOR was 80% scoring at or above SD +2, reflecting the severity of the SOR symptoms. The prevalence for low registration was 65% and for sensory avoidance 45% (Du Plooy, 2017). Roman-Oyola (2011) cited a prevalence of 88% for SMD amongst children with fetal alcohol spectrum disorders, which is similar to du Plooy's findings. Roman-Oyola (2011) and Keuler et al. (2011) both referred to studies by Schneider et al. (2007) done on primates showing a similar higher prevalence of sensory over-responsivity compared to the other categories of SMD after prenatal alcohol exposure.

Concurring with May-Benson et al. (2009) who found that in the SPD group one of the common maternal illnesses was hypertension, this was the most common maternal illness cited in this research study. Other illnesses in this study were gestational diabetes (one caregiver), diabetes, and severe flu. 45% of mothers of children with SPD in the retrospective chart review reported at least one type of maternal health issue during pregnancy (May-Benson et al., 2009). However, there was no association between maternal illness and SOR in the current study.

Birth complications and SOR

In this section, the aspects of birth complications, specifically birth injuries, jaundice and admission to a NICU will be discussed.

The finding in this study of no association between birth injuries and SOR, is supported by Keuler et al. (2011) who similarly did not find complications around the birth to be predictors of SOR. In contrast, two studies found that birth complications were factors in the aetiology of SOR (May-Benson et al., 2009; Roman-Oyola, 2011). May-Benson et al. (2009) found no raised prevalence of birth injuries or meconium staining. However, umbilical cord insults were 5% as opposed to the 1% in the normative sample. No umbilical cord insults were reported in this researcher's study. May-Benson et al. (2009) found the number of babies

admitted to NICU was 11%, but the comparative percentage for the normative sample was not provided in the article. Roman-Oyola's (2011) findings regarding sensory deprivation and over-stimulation in NICUs and the possible effects on sensory modulation that have been discussed above, are also relevant here. The association between SOR and admittance to NICU in this researcher's sample was however not strong (p = .680).

May-Benson et al. (2009) highlighted a higher prevalence of jaundice (26%) in the SPD cohort, compared to the American population norm of 7%. Roman-Oyola (2011) did not find a strong association, but recommended that a link between jaundice and SMD be explored further. This study also did not find a strong association between jaundice and SOR (p = .472).

Gender and SOR

In line with previous research, the current study found no association between the prevalence of SOR and gender (Schoen et al., 2009; Schoen, Miller, & Sullivan, 2017; Schoen et al., 2014; Van Hulle et al., 2015). A large study by Keuler et al. (2011) explored if the presence of a male co-twin may be a risk factor in the development of SOR in a female co-twin due to effect of prenatal exposure to testosterone. They found that an opposite sex twin was a predictor for SOR in the female co-twin. However, twins were excluded in this researcher's study, so this aspect of gender was not relevant.

Pressure and SOR

The factor of pressure was explored in the demographic questionnaire, as pressure has been shown to be an effective means of treating SOR (Ayres, 1974; Bhopti & Brown, 2013; Dunn, 2014; Kimball et al., 2007; Murray-Slutsky & Paris, 2000; Reynolds et al., 2015). Pressure applied by the caregivers was therefore thought to be an important variable to consider, as the researcher postulated that pressure may have reduced any SOR present, thereby altering the findings on SOR. However, no association was found between these two variables (p = .804).

Minutes to first contact, Minutes to first breastfeed and SOR

Clinical procedures associated with CS in many health care facilities require the baby to be removed immediately after birth to be suctioned, washed, weighed, etc. If there is no

medical emergency, the mother is usually given the baby to hold briefly before this is done, reflected in the minutes to first contact between the two birth method groups being equal, at one minute. This resulted in no association between minutes to first contact and SOR (p = .147). Minutes to first breastfeed however showed a statistically significant association with SOR (p = .049). The two hour period immediately after birth is critical for mother infant contact, and is known as the sensitive period. It is necessary for successful bonding, breastfeeding and maternal regulation of the infant (Bergman, 2014; Bigelow et al., 2010; Bystrova et al., 2009; Olza-Fernández et al., 2014). Separation during this time, reflected in the delayed first breastfeed, may hamper successful breastfeeding and therefore maternal regulation of the infant. In turn, this may adversely affect the development of the infant's self-regulation, which could in turn influence sensory over-responsivity (Hofer, 2005). These links could explain the significant association between SOR and minutes to the first breastfeed.

In the statistical analysis, the other variables did not show any association with SOR, nor did they have any relevance in the literature read by this researcher, and will therefore not be discussed here.

Factors influencing the study results

Chapter Four described the differences observed with caregivers according to income level group in completing the SSP2 questionnaire. These difficulties were related to four areas – educational and reading level; cultural factors; language; and socio-economic and related environmental factors. In this section, the effects of these difficulties and their impact on the accuracy of the responses obtained will be discussed in relation to relevant literature.

Caregivers from the high income level group, who had higher educational levels, completed the SSP2 with ease and in the standardized manner, but this was more difficult for those from the low-middle income level group. Completion of the questionnaire was hampered by the low educational level of many of the caregivers which impacted their reading ability, in particular reading with meaning, which was essential for completing this questionnaire and using the Likert scale. Ninety-one% of the middle income level group and 97% of the low income level group having no post-school qualification. This impacted their reading ability,

ability to read with understanding and to grasp the conceptual aspects of the questions. This may be a problem unique to South Africa, where the public education in the low socio-economic areas tends to be of a very poor quality. The Progress in International Reading Literacy Study 2016 (2017) confirmed this, finding grade four literacy levels in South Africa to be the lowest of all the countries studied in Africa, and the lowest in the world, with 78% of learners unable to read with meaning. In developing countries where the questionnaire has been used, this particular aspect was not noted as a problem in the literature. These factors linked to reading ability may have affected accuracy of the results obtained. To compensate for these challenges, the researcher provided additional assistance and explanations, and used the modifications described in Chapters Three and Four when necessary, to assist caregivers to complete the questionnaire as accurately as possible. As the questionnaire was developed to be completed independently and according to a standardized procedure (Dunn, 2016), the necessity of providing such assistance may have impacted the reliability of the standardized norms and accuracy of the responses. In the low-middle income level groups, the questionnaire took an average of 30 minutes to complete which is longer than the time specified in the manual (Dunn, 2014), indicating the greater difficulty these caregivers had, and the amount of assistance they required.

Difficulties understanding and using the Likert scale is another factor which could have influenced the results of the sensory questionnaire. Chachamovich et al. (2009) looked at the validity of using a 5-point Likert scale (used in the SSP2) with caregivers who were non-readers, and found that the psychometric properties deteriorated significantly when completed by non-readers or poor readers. Many of the low-middle income level caregivers would have received poor quality public school education, and many would have not completed their schooling (44% in the middle income level group, and 59% in the low income level group). Their ability to read with meaning and comprehension, skills which are required to complete a questionnaire, would therefore be compromised. In addition the Likert scale requires some numeracy skills, as well as an ability to think conceptually, which the study by Chachamovich et al. (2009) found linked to poor reading ability and the changes to brain structure and functioning that result from lack of reading ability. Their conclusion was that a 5-point or multi-point scale was not suitable for use with non-readers. Du Plooy (2017)

found similar difficulties with the understanding of the Likert scale in low socio-economic communities. These findings concur with this researcher's experience in completing the SSP2 in the low-middle income level areas. Even with the modifications that were employed, many caregivers appeared confused by the 5-point scale of the SSP2, and for these caregivers, the scale was simplified to a 3-point scale to improve understanding. At times this needed to be simplified even further to a 2-point scale of "yes/always" and "no/never". The researcher's experience corroborated the finding of Chachamovich et al., 2009, that reducing the number of values in the Likert scale would increase the reliability for the non-reading caregivers.

As the Likert scale is rooted in numerical concepts and the use of language to denote concepts of frequency, it comes as no surprise that participants who struggled with literacy and numeracy and conceptual thinking would find it difficult to complete, with attendant impact on the validity and reliability of what was being assessed. As most assessments of SMD are based on questionnaires using a Likert scale, the extent of the challenges in using these tools in other cultures and with caregivers of low educational levels is vast and not fully appreciated by occupational therapists.

Cultural factors were identified in the literature as having an influence on the accuracy of results on SMD questionnaires (Caron et al., 2012; Su & Parham, 2002). The Short Sensory Profile 2 was developed and standardized in America, and cultural validation studies have only been conducted in first world countries such as the United Kingdom, Germany and Australia. The use of the SSP2 in developing countries, and in different cultures is more complex and challenging (Al-Heizan et al., 2015; Caron et al., 2012; Chow, 2005; Lai et al., 2011). For example, the considerably higher SMD prevalence rate in Saudi Arabia (34%) compared to America has been attributed to cultural factors, different child-rearing practices and parental expectations (Al-Heizan et al., 2015). Contrasting parenting styles and expectations were found to affect results obtained with the SSP2 in studies conducted in Israel, Turkey and China (Caron et al., 2012; Chow, 2005; Kayihan et al, 2015). In addition, differing classroom expectations with a regimented structure impacted the results in China (Lai et al., 2011). In the current study, the questionnaire appeared to be culturally relevant for the high income level group of caregivers. However in the low income level group, some

of the statements (see examples in Chapter Four) were either not relevant to participants' lives or fell outside their experience. They were therefore being required to respond to situations that they could not relate to or had never experienced with their child, again impacting the results (Chow, 2005; Lai et al., 2011).

Language factors have been highlighted in the literature and may also come into play, affecting the results in this study. American English words may have a different meaning in another culture (Neuman et al., 2004). Chapters Three and Four explained the difficulties some caregivers in the low-middle income level areas experienced with the language used in the SSP2, and the need for additional or alternative words or phrases to aid understanding.

Translation of the SSP2 into isiXhosa for the three isiXhosa-speaking caregivers had challenges highlighted in the literature. SMD questionnaires have been translated and used in countries such as Brazil, Turkey and India (Kayihan et al., 2015; Sankar & Priyadarshini, 2014; Shimizu et al., 2014), with varying success. The studies by Neuman (2014), Engel-Yeger (2010) and Lai (2011) used a rigorous back-translation process, often involving a large panel of members, and many revisions. Neuman (2014) highlighted the work required and the complexity of ensuring a culturally appropriate translation where the results can be considered accurate. In this study, the cost and legality of using an official translation made this an unreasonable option. The informal translation used meant that the process was indirect, with a translator as an intermediary between the researcher and the caregiver. This complicated the data collection process, and may have introduced some undetected errors or inaccuracies, which would have also affected the results. Many medical terms had no isiXhosa equivalent, necessitating the use of English words, which may have presented a barrier to understanding. There is no word for "stress" in isiXhosa, so other words were used to explain the meaning, as suggested by researchers who translated SMD questionnaires into Mandarin and Turkish (Kayihan et al., 2015; Su & Parham, 2002). This may have resulted in the English term being misunderstood.

Socio-economic factors are shown above to have influenced educational and reading levels. In addition, they impact the environments in which the mother-child dyads function on a daily basis. These present challenges linked to overcrowding and increased sensory stimulation,

which have been outlined in Chapter Four. These additional environmental challenges may have altered the development of sensory modulation in the low-middle income level group and skewed the results obtained on prevalence. Although this aspect has not specifically been commented on in the literature, overstimulation in the neonatal intensive care unit has been linked to the aetiology of SMD (Bröring et al., 2017; Rahkonen et al., 2015). In addition to these complexities, the effects of socio-economic factors on brain development and its consequences for neuromotor development, cognitive and executive functioning and the development of sensory modulation have been described in both the international and South African literature (Davies et al., 2011; Grantham-McGregor et al., 2007; Raffington et al., 2018; Ursache & Noble 2016). In this study, these low-middle income level children tended to be located in the VB group. All these factors were likely to contribute to the high prevalence of not only SOR, but also all the other categories of SMD in this birth method group.

It can be seen that the educational and reading levels, cultural and language factors and socio-economic and environmental factors described above are highly complex, affecting caregivers' responses when completing a subjective questionnaire, as well as using the Likert scale. These factors may have compromised the accuracy of the information received from many of the caregivers in the low and middle income level groups via the questionnaires. The Ecological Model of Sensory Modulation (EMSM) developed by Miller et al. (2004) premises that the child does not function in isolation, but that their behaviour is a product of many external and internal dimensions which impact the development of sensory modulation, and this was borne out by the results of this study. The external dimensions of the EMSM, involving culture and environmental factors, are relevant to this study. The cultural factors have been explored above. The environmental factors relevant to this study relate to the high levels of auditory and tactile stimulation present in the ECDs, the homes and on the public transport. Other environmental factors noted in the observations of the geographical areas and sites (Table 4-1), namely poor nutrition, limited opportunities for obtaining a quality education, and lack of exposure to toys, educational games and gross motor play, may have influenced the development of the child participants' sensory modulation.

CONCLUSION

The main aim of this study was to determine whether the birth mode of delivery was associated with sensory over-responsivity, as measured by the Short Sensory Profile 2 Questionnaire. In this chapter, the results were discussed in the light of relevant literature, and were presented according to the objectives of the study. The demographics of the participants (objective one), showed that the statistically significant differences between the two birth method groups for the maternal variables of age ($p < .001$), income level ($p = .003$) and marital status ($p = .037$) and the child variables of gestational age ($p = .001$), minutes to first breastfeed ($p = .006$) and sleeping difficulties ($p = .003$) were supported by the literature.

Objectives two and three sought to investigate the prevalence and comparison of SOR in the two birth method groups. The SOR prevalence for the total sample was reported at 22%. This was compared to prevalence cited in other studies, both in America and in other cultures, showing a wide range of prevalence. The researcher's hypothesis of a higher prevalence in the VB group was disproved, and possible reasons for this included issues related to completing the SSP2 and the impact of socio-economic factors on neurodevelopment. Mothers in the VB group were characteristically from low socio-economic areas, single, young and had low levels of education. This was in line with international and South African studies reviewed showing the strong association between income level, maternal educational level, maternal age at giving birth and marital status (Davies et al., 2011; Grantham-Mcgregor et al., 2007; Ursache & Noble, 2016b). The children of these mothers grow up in poverty, with all that is associated with this, such as impoverished surroundings, poor nutrition, sanitation and hygiene and inadequate stimulation, and the resultant effects on sensory modulation and SOR. Sensory modulation also appears to be affected by the high intensity sensory inputs and inconsistent routines prevalent in low socio-economic environments. Socio-economic factors therefore appear to play a role in the higher prevalence of SOR in poor communities and in the VB group in this study. These factors also impact the other three categories of SMD which is thought to be due to all categories of SMD having similar underlying neurological structures and functions.

The fourth objective sought to identify which other demographic variables had an association with SOR. Maternal age ($p = .004$), marital status ($p = .003$) and minutes to first breastfeed ($p = .049$) showed statistical significance and were supported by the literature. These variables, along with some others which the literature had identified as linking to aetiology of SOR, were discussed. This study found a mild association between birth weight and SOR, and none between GA and SOR, with conflicting findings in the literature on these two factors. A variable examining pressure provided by caregivers after birth was included due to the importance of the component of pressure in a VB and as an occupational therapy treatment principle for SOR. No association was found between pressure and SOR. Gender, in line with the literature, was not linked to SOR.

The final chapter will draw conclusions from the study, discuss the limitations, and present possible ways forward for occupational therapy practice and for future research.

CHAPTER SEVEN CONCLUSION

INTRODUCTION

In this final chapter of the dissertation, the conclusion to the study is presented. This is followed by a discussion on the strengths and then the limitations of the study. Recommendations pertaining to occupational therapy practice and then suggestions for future research are outlined.

CONCLUSION TO THE STUDY

The hypothesis for this research developed out of a number of factors – the anecdotal increase in sensory over-responsivity noted by a number of occupational therapists; the published increase in the CS rate both in South Africa and worldwide; the use of pressure as an effective tool for treating SOR by occupational therapists; and the absence of the pressure component in an elective CS birth. The importance of pressure in the birthing process and the links with olfactory learning and maternal and self-regulation were detailed in the literature review. This provided support for the exploration of a link between pressure in the birthing process and SOR. It was hypothesised that the prevalence of SOR would be greater in children born by elective CS due to the missing sensory stimulation component of pressure during the birthing process.

This research study was designed so that SOR could be evaluated in children aged 3 years 0 months to 4 years 11 months who were allocated according to their birthing method, to either the VB or elective CS groups. The prevalence of SOR in the two birth method groups was then compared. In order to achieve heterogenicity in the sample, a variety of socio-economic, language and cultural groups were included in the sample population. The results support the null hypothesis, and showed that the VB group had a higher prevalence of SOR. It was motivated that the validity of the results was questionable due to a variety of factors. Low socio-economic status has a major impact on brain and sensory modulation development. The differences in culture and language of the study participants compared to

those for whom the questionnaire was developed and validated affected the contextual relevance and appropriateness of the questionnaire.

Due to the unique health care challenges and continuing effects of apartheid in South Africa, the division of participants according to birth method resulted in some consequences which had not been foreseen during the design of the study. Participants in each of the two birth method groups shared many additional characteristics besides the presence or absence of pressure during the birth process. The majority of the VB group caregivers were of lower socio-economic status (the middle and low income level areas), with the associated features of low maternal education, low maternal age, being single, poor nutrition, lack of developmental stimulation described. In addition, factors in low socio-economic environments which impact negatively on the development of sensory modulation, such as high noise levels, were identified. These factors were all likely to have contributed in the higher prevalence of SOR, as well as a high prevalence of all the other sensory modulation subtypes, in the VB group. Vaginal birth, in this study, could therefore be seen as a proxy for low socio-economic status, with all its associated characteristics. In considering the prevalence of SOR in this study, it is proposed that socio-economic status was in fact the criteria being measured, rather than birth method.

STRENGTHS OF THE STUDY

This is the first study to explore birthing methods as a possible factor in the aetiology of SOR. No other studies could be found internationally exploring this association.

This study also contributes to the very small number of South African studies exploring sensory modulation, providing valuable additional understanding on the prevalence of SOR, and SMD. Of particular importance was the participation of a large number of participants from low socio-economic areas where the majority of the South African population reside.

This study added to the limited research on sensory modulation in low socio-economic areas, both in South Africa and internationally.

The study also highlighted the researcher's experience of the high intensity and volumes of sensory stimuli associated with low socio-economic environments, which may influence the development of SOR. This characteristic has not been commented on in the literature previously.

LIMITATIONS OF THE STUDY

The limitations noted in this study were related to the inability of the study design to identify causation, the possibility of missing variables linked to the aetiology of SOR, the small sample size, and the predominance of low socio-economic caregivers.

1. This study found a number of statistically significant associations between various demographic factors and SOR. However, it was an observational study, therefore these associations do not identify causation, and causation therefore remains unknown (Kielhofner, 2006; Wehby & McCarthy, 2013).

2. Although the demographic characteristics that were investigated were informed by the literature review, there may have been other variables which were unknown to the researcher which were not investigated and may impact on the aetiology of SOR. These variables included characteristics of the low-middle income level environments which may have impacted on sensory modulation.
3. The sample size was relatively small (N = 91), and the range of scores obtained was limited and did not cover the full range. The consequence is that the results of the study cannot be generalized to the population as a whole. In addition, the numbers in the two birth method groups were not equally weighted (CS group: n = 33; VB group: n = 58), making comparisons less reliable.
4. The use of a subjective caregiver questionnaire to evaluate SOR had numerous limitations. The results would have been strengthened if additional clinical observations or physiological measures had been used (Baranek et al., 2006), however neither of these were possible within the boundaries of the current study.

5. There was a large proportion of participants from low socio-economic areas (the middle and low income level areas), comprising 73% of the total sample. The characteristics of

low maternal age, education level, and other associated issues discussed in the preceding chapter were applicable to these low socio-economic participants. In addition, there were factors linked to different languages and cultures which pertained to this group but not to the high income level group. These factors affected the validity of the results, making it difficult to test the hypothesis accurately.

RECOMMENDATIONS

Numerous challenges were experienced during the data collection process in this study. These related to issues around the cultural appropriateness of the SSP2 for a large number of the participants, as well as difficulties many caregivers experienced completing the questionnaire due to low educational and reading levels and linguistic issues. In addition, environmental factors in low socio-economic environments documented by the researcher may have impacted sensory modulation in the child participants. It is hoped that the information generated by this study will inform a number of areas related to occupational therapy practice and future research. These will be discussed below.

Recommendations for occupational therapy practice

Occupational therapists in South Africa are faced with many challenges particular to their context. These include very disparate socio-economic communities, as well as many different cultural, racial and language groupings. The Ecological Model of Sensory Modulation (Miller et al., 2004) emphasises that a child does not function in isolation, but that sensory modulation is related to a number of contextual factors, two of which are the environmental and cultural factors. This study confirms the statements of Caron et al. (2012) and Miller et al. (2004), illustrating how the influences of socio-economic status, culture and language, among other factors, impact on the development of a child, in particular the facet of SMD which has been considered in this research. In addition, there are very limited South African resources for therapists to use, with a heavy reliance on SOR assessment tools which have been developed in America. In line with Chemel's (2015) findings, this study has shown that these tools may not be appropriate for use in South Africa. They are also not standardized on the South African population, and therefore the results are currently interpreted based on American norms, which may be invalid for this population.

It is essential that occupational therapists are responsive to the needs of the communities where they work. We need to be culturally informed (Caron et al., 2012), and the work we do must be both culturally contextual and socially relevant.

Occupational therapists working in this field must bear in mind the effect of culture (Caron et al., 2012; Kayihan et al., 2015; Román-Oyola & Reynolds, 2013) and low socio-economic status (Ben-Sasson et al., 2009; Ursache & Noble, 2016b) on sensory processing, be aware of the dangers and limitations of administering and interpreting SMD questionnaires developed and normed in other countries, and consciously develop cultural humility with clients from cultures other than their own (Hook, Davis, Owen, Worthington, & Utsey, 2013; Tervalon & Murray-Garcia, 1998). Qualified occupational therapists can be conscientised regarding these issues in the form of input in post-graduate occupational therapy courses, through lectures and journal articles and Continuing Professional Development events offered by the Occupational Therapy Association of South Africa and the South African Institute for Sensory Integration. These issues should also be included in undergraduate training, so that students are made aware of them before beginning to practice.

The higher prevalence of SMD and SOR found in low socio-economic communities in this research, supports the findings of Du Plooy (2017), Roman-Oyola (2011) and Ben Sasson et al. (2009). This highlights the need for the South African Institute for Sensory Integration to facilitate access to general sensory integration stimulation in poor communities in South Africa, as well as accessibility of assessment and treatment for those in poor communities who are unable to afford this.

Recommendations for future research

This section will cover suggestions for research into the use and standardization of the SP suite of tests for South Africa, research into how sensory modulation develops in low socio-economic communities, the development of a South African test of sensory modulation, and the repeat of this study once an appropriate measuring tool has been developed.

1. Further research into the use of the SP suite of tests in the South Africa context.

The literature reviewed in this study revealed the various challenges associated with using the SP suite of tests across a diverse group of different cultures and languages (Chow, 2005; Du

Plooy, 2017; Kayihan et al., 2015; Lee et al., 2002; Neuman et al., 2004; Su & Parham, 2002). These studies and the researcher's own experiences have shown the dangers of transplanting a subjective questionnaire into a different environment. The Ecological Model of Sensory Modulation by Miller et al. (2004) speaks to the importance of the external dimensions which shape sensory modulation development, and the need for these aspects to be considered when evaluating sensory modulation. A study by Caron et al. (2012) provides a model for considering a child's development which includes culture as a specific developmental niche. This comprises the physical and social settings; the customs and practices of child care and child rearing; and the psychology of caretakers. The writers motivate for these factors to be explored further in order to better understand how they impact on sensory processing (Caron et al., 2012). The caregivers' dignity as well as respect for their cultural and language differences are not upheld when the norms and standards of the dominant American culture of these and many other psychometric tests is imposed on different communities. This therefore presents an ethical challenge. In addition, the amount of assistance needed by the caregiver from the researcher in completing the questionnaire meant that the power relationship was distorted, with the caregivers possibly perceiving themselves as the ignorant ones, and the researcher seen as the knowledgeable professional. This presents further ethical challenges. The need for cultural humility discussed above is imperative (Tervalon & Murray-Garcia, 1998). The researcher is of the opinion that if American questionnaires are to be used to assess sensory modulation, they need to undergo translation into the major African language groups most common in SA, and be adjusted for cultural appropriateness using both a formal back-translation and cross-cultural validation process. Du Plooy (2017) and Chemel (2015) also called for the use of the SP suite of tests in the South African context to be explored and to be standardized on the South African population.

2. Further research into how sensory modulation develops in low socio-economic areas of South Africa.

Around 200 million of five year old children in developing countries do not fulfil their potential, however very limited research focusses on the developmental challenges of these children (Grantham-Mcgregor et al., 2007). Poverty is frequently characterised by poor

nutrition, poor sanitation and hygiene, poor maternal education, poor maternal health, chaotic home routines and lack of stimulation (Grantham-Mcgregor et al., 2007). These factors appear to impact child development and sensory modulation (Grantham-Mcgregor et al., 2007; Román-Oyola, 2011). In addition, the high levels of sensory input in low socio-economic environments described in this study may have an impact on sensory modulation. Although the researcher could not find any evidence for this in the literature, the high levels and intensity of sensory input associated with the neonatal intensive care environment and its effect on sensory modulation has been studied (Bröring et al., 2017; Rahkonen et al., 2015). The limited research available suggests that sensory modulation develops differently as a result of the challenges specific to low socio-economic areas. Given the scale of poverty, and it's currently know effects on children, research into the aspect of sensory modulation is recommended. This is in line with the recommendations of two other South African studies by Du Plooy (2017) and Van Jaarsveld (2014), who both recommended further research on sensory modulation in low socio-economic areas.

3. Further research into the development of a uniquely South African tool for measuring SMD.

The first research suggestion made was to conduct further research into the use of the SP suite of tests in the South Africa context. While this is necessary, in light of the fact that occupational therapist are frequently using these assessment tools, there is also an urgent need for an assessment tool to be developed for use with South African participants. This should be contextually relevant and culturally appropriate, and available in languages that would be accessible for the vast majority of the population. Clinical utility would need to be considered, so that the new tool is appropriate, accessible, practicable and acceptable to the target population ((Smart, 2006). The test needs to be analysed to ensure it has the necessary psychometric properties to be a valid assessment tool, and standardized on the South African population. This assessment tool needs to comprise an objective therapist-driven assessment tool, as well as a subjective caregiver questionnaire. Both these methods of assessing sensory modulation have their advantages, and used together, will provide a more accurate evaluation of SMD (Baranek et al, 2006; Ben-Sasson et al., 2009; Eeles et al., 2013; Miller et al., 2012; Schoen et al., 2009).

4. This study needs to be repeated with an appropriate measuring tool.

The theoretical reasoning for undertaking this study is still relevant, and there was some evidence in the literature to support the hypothesis related to the significance of pressure in birth method and to the aetiology of SOR (Alberts & Ronca, 2012; Olza-Fernandez et al., 2014). However, this needs to be done using an appropriate assessment tool which is standardized on the South African population. Birthing practises may then need to be informed by any findings regarding birth method choices.

CONCLUSION

The null hypothesis for this study is accepted as the CS group did not show a higher prevalence of sensory over-responsivity than the VB group. This was thought by the researcher to be linked to a number of factors which adversely affected the accuracy of the responses obtained to the sensory questionnaire. These included the inappropriateness of the measuring tool for the low-middle income level caregivers due to language, cultural and education level challenges. Arising out of these findings, ideas for further research, aligned with and building on other research in this area have been suggested (Chemel, 2015; Du Plooy, 2017; Van Jaarsveld et al., 2001). Recommendations have also been put forward for the ways in which occupational therapists in South Africa should approach testing and treatment in different cultural and socio-economic contexts.

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APPENDIX A

DEMOGRAPHIC INFORMATION

DEMOGRAPHIC INFORMATION	NO.
MOTHER	
How old were you when your child was born?	_____ years
Married/living together/divorced/single/widow	_____
Highest education level	_____
Pregnancy history	
Severe stress	_____
Serious illness	_____
Smoking (how many per day?)	_____
Medication (specify)	_____
Alcohol use (how much?)	_____
Recreational drugs (describe)	_____
High blood pressure	_____
Family history of sensitivity to touch, sound, movement, light	_____
CHILD	
Birth order (1st, 2nd child, etc)	_____
Sex	_____
Date of birth	_____
Birth weight	_____
Apgar 1min	_____
Apgar 5min	_____
Number of weeks of pregnancy	_____
Labour: Natural onset/Assisted	_____

Length of labour (hours) _____

Delivery: Did you have a vaginal delivery? Yes – Please go to question 1

No – Please go to question 2

1 – Vaginal delivery

Pain medication _____

Assisted (forceps, suction) _____

Bottom emerged first/face forwards or backwards _____

2 – Caeserean Section

Reason for Caeserean Section

_____

Birth injuries/umbilical cord problems/meconium (describe)

_____

Jaundice: light therapy, how long? _____

Was your baby admitted to intensive care? _____

What was the reason for admission? _____

How many days in ICU? _____

Did your baby receive any medical support to help breathing or feeding? _____

Minutes to first contact _____

Minutes to first breastfeed _____

Breast/bottle fed _____

Supplementary feeding _____

Length of time of exclusive breastfeeding _____

Any difficulties with weaning (describe) _____

Any out-of-the-ordinary illnesses (describe) _____

Ear infections (describe) _____

Allergies (describe) _____

Eczema (describe) _____

Asthma (describe) _____

Any serious injuries (describe)

_____

Any feeding problems (describe) _____

Any sleeping problems (describe) _____

Colic (describe) _____

Fussiness / difficulty settling (describe)

_____

Age of sitting _____

Age of crawling _____

Method of crawling _____

Age of walking _____

Age of speaking in sentences _____

Was he/she swaddled, have baby massage, _____

carried in a baby sling or on the back?

If yes, at what age, & for how long? _____

Any other relevant information? _____

Thank you for taking the time to complete this!

Ann Watkyns

APPENDIX B

LETTER TO PRINCIPALS REQUESTING PERMISSION TO CONDUCT RESEARCH AT AN EARLY CHILD DEVELOPMENT CENTRE

Department of Health and Rehabilitation Sciences

Faculty of Health Sciences

Divisions of Communications Sciences and Disorders, Nursing and Midwifery, Occupational Therapy, Physiotherapy

F45 Old Main Building Groote Schuur Hospital

Observatory 7925

10 October 2017

To Whom It May Concern:

PERMISSION TO CONDUCT RESEARCH AT AN EARLY CHILD DEVELOPMENT CENTRE

I am an occupational therapist doing research towards a Master's degree in occupational therapy. The title of my study is: Sensory overresponsivity in children of 3-5 years. I would like to request permission to approach parents/caregivers of children aged 3 and 4 years at this ECD to explain the study, and ask them for consent to participate in it.

Once consent has been obtained, the parents/ caregivers will then be given a questionnaire to complete. The questionnaire comprises 34 questions related to any sensory sensitivities (overresponsivity) the child may display during daily living activities (dressing, play, etc.). Some demographic information (for example birth weight, any illnesses) will also be included. The questionnaire takes about 15 minutes to complete, and will be completed at a time convenient to the parents/caregiver.

The proposed study aims to investigate whether there is a difference in the rate of sensory sensitivity between children born by elective caesarean section or vaginal birth. My hypothesis is that sensory sensitivity will be higher in the elective CS group of babies. Sensory sensitivity impacts on children and adults, frequently compromising their concentration, sleep, eating habits and social skills. These problems frequently result in anxiety, depression and other mental health issues in adults. A greater understanding of the causes of sensory sensitivity would therefore greatly assist in finding strategies to manage and counter it. This possible cause of sensory sensitivity has never been studied anywhere in the world, so will be ground-breaking research.

Ethical approval has been obtained from the Faculty of Health Sciences Human Research Ethics Committee of the University of Cape Town (HREC Reference number 583/2017). There will be no coercion of any form, of the parents/caregivers or the children in order to gain participation from the study population. Permission may be withdrawn from the study at any point in time, free of prejudice, should they so wish. No personal, identifiable information about the ECD, the parents/caregivers or the child will be recorded at any point during the study. There will be no renumeration to either the ECD or child for taking part in this study. The children will not be involved directly in the research, with information being collected from the parents/caregivers. The children's schooling will not be affected in any way. Results of the study may be published and used for presentations. It may be that through participating in the study, parents/caregivers become aware that their child has sensory sensitivity. One free counselling session will be provided should any negative emotions result. A referral letter and the names and contact details of occupational therapists and/or hospitals will be provided to any parents/caregivers if they would like to address any sensory sensitivity identified.

Please forward any questions or concerns you may have regarding this research to the contact details furnished below:

Primary Supervisor:

Mrs Pamela Gretschel

pam.gretschel@uct.ac.za

021- 406 6739

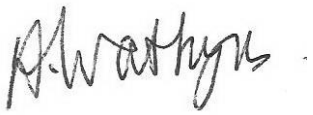
Chairperson of the UCT Faculty of Health Sciences Human Research Ethics Committee:

Professor Marc Blockman

021- 406 6338

Should you agree to give permission for all to parents/caregivers of children of the relevant ages attending the ECD to take part in the study, please read and sign the attached consent form. Thank you.

Yours sincerely,



Ann F Watkyns

Occupational therapist B.Sc.(OT)

0822554575

annwatkyns@gmail.com

APPENDIX C

CONSENT FORM FOR PRINCIPALS OF EARLY CHILD DEVELOPMENT CENTRES TO PARTICIPATE IN RESEARCH STUDY

Department of Health and Rehabilitation Sciences

Faculty of Health Sciences

Divisions of Communications Sciences and Disorders, Nursing and Midwifery, Occupational Therapy, Physiotherapy

F45 Old Main Building Groote Schuur Hospital

Observatory 7925

TITLE: SENSORY OVERRESPONSIVITY IN CHILDREN OF 3-5 YEARS

I, (Print name)……, representing ……, hereby give permission for parents/caregivers of children at this ECD to be approached for participation in this research study.

I understand that no identifiable information about the ECD, the parents/caregivers or the child will be collected at any point during the study. It is also understood that neither the ECD nor the child will receive any renumeration for taking part in this study.

I do / do not consent to this ECD participating in the study (circle appropriate response).

Signed:…… Date: ……..

Full Name:……..ECD:……

APPENDIX D

INTRODUCTION LETTER TO CAREGIVERS TO PARTICIPATE IN RESEARCH STUDY

Department of Health and Rehabilitation Sciences

Faculty of Health Sciences

Divisions of Communications Sciences and Disorders, Nursing and Midwifery, Occupational Therapy, Physiotherapy

F45 Old Main Building Groote Schuur Hospital

Observatory 7925

10 October 2017

Dear parent/caregiver,

My name is Ann Watkyns, and I am an occupational therapist doing research towards a Master's degree in occupational therapy. I am studying the sensory development of children of 3 and 4 years. This will involve the completion of a questionnaire by a parent/caregiver in order for me to receive the necessary information. This would take about 15 minutes. The questionnaire comprises 34 questions related to how your child performs in everyday activities such as washing their face, playing barefoot. The questionnaire will be completed at a time convenient to you. I will have no direct contact with your child.

Thank you for considering this request. If you are happy to find out more information about taking part in this study, please read and sign the reply slip attached, and return it to your child's class teacher at your earliest convenience. I would greatly appreciate your participation.

Kind regards,

Ann F Watkyns

Occupational therapist B.Sc.(OT)

I agree / do not agree to find out more information about taking part in this study (circle appropriate response).

Signed:…… Date: ……

Full Name:……

CONTACT DETAILS:

Home: ……

Work: ……

Cell: ……

Email: ……

APPENDIX E

INFORMATION ON RESEARCH STUDY FOR CAREGIVERS

PURPOSE OF THE STUDY:

It will be investigating whether there is a difference in the rate of sensory sensitivity (overresponsivity) between children born by elective caesarean section and those born by vaginal birth.

PROCEDURE TO BE FOLLOWED:

An important aspect of gathering the necessary information will be completion of a questionnaire by the parent/caregiver. If you agree to take part in this study, Ann will meet with you individually and privately, and you will be given the questionnaire to complete. The questionnaire comprises 34 questions related to everyday activities your child performs, such as washing their face, playing barefoot. This will take about 15 minutes to complete. Some information regarding the pregnancy, birth and early development will also be collected. The questionnaire will be completed at a time convenient to you, but is likely to be when you drop or collect your child. No additional transport costs or time will be required. However, if you are not able to come to the school, an alternative arrangement will be made which is convenient for you, and any costs involved will be covered. Ann will have no direct contact with your child.

IMPORTANCE OF THE STUDY:

Sensory sensitivity impacts on children and adults, frequently having a negative effect on concentration, sleep, eating habits and social skills. These problems may then result in anxiety, depression and other emotional problems in adults. This research will examine whether the method of birth contributes to sensory sensitivity. This possible cause of sensory sensitivity has never been studied anywhere in the world, so will be ground-breaking research. A greater understanding of the causes of sensory sensitivity would greatly assist in finding ways to manage and counter it.

Ethics approval has been obtained from the Faculty of Health Sciences Human Research Ethics Committee of the University of Cape Town (HREC Reference number 583/2017). You are under no pressure to participate in this study and you have the right to withdraw at any point without providing an explanation. There will be no consequences should you wish to withdraw. No identifiable information about you or your child will be collected at any point

during the study. Your child will not be involved directly in the research, and their schooling will not be affected in any way. Findings from the study will be reported in professional presentations, reports and research publications.

It may be that through participating in the study, you become aware that you child has sensory sensitivity. If necessary, one counselling session will be provided free of charge. Please indicate after the study if you would like to make use of this. If you would like your child to receive occupational therapy to address any sensory sensitivity identified, Ann will provide a referral letter and the names and contact details of therapists and/or hospitals for treatment.

Please forward any questions or concerns you may have regarding this research to the contact details furnished below:

Primary Supervisor:

Pamela Gretschel

pam.gretschel@uct.ac.za

021- 406 6739

Chairperson of the UCT faculty of Health Sciences Human Research Ethics Committee:

Professor Marc Blockman

021- 406 6338

If you give permission, please read and sign the consent form. Thank you

APPENDIX F

CONSENT FORM FOR CAREGIVERS TO PARTICIPATE IN RESEARCH STUDY

Department of Health and Rehabilitation Sciences

Faculty of Health Sciences

Divisions of Communications Sciences and Disorders, Nursing and Midwifery, Occupational Therapy, Physiotherapy

F45 Old Main Building Groote Schuur Hospital

Observatory 7925

TITLE: SENSORY OVERRESPONSIVITY IN CHILDREN OF 3-5 YEARS

I, (print name)…….have been given the information on this research study.

- I understand what is required of me.
- All my questions have been answered.
- I understand that neither I nor my child will receive any renumeration for taking part in this study, unless I am unable to come to my child's school and alternative arrangements need to be made, for which any travel costs involved will be covered.
- I do not feel that I am being forced to partake in this study.

- I am aware that I can withdraw from the study at any time should I wish to do so.
- I have been assured that if I refuse to participate in the study or choose to withdraw at a later stage, there will be no consequences for me or my child.
- I am aware that no identifiable information will be used.

I do / do not consent to my participation in the study, and to sharing my child's information. (Circle appropriate response).

Name of Caregiver……..

Signed:……. Date: …….

Place:…….

Name of Research Assistant:…….

Signed:…….Date:……..

APPENDIX G

CONFIDENTIALITY AGREEMENT FOR RESEARCH ASSISTANT TO PARTICIPATE IN RESEARCH STUDY

Department of Health and Rehabilitation Sciences

Faculty of Health Sciences

Divisions of Communications Sciences and Disorders, Nursing and Midwifery, Occupational Therapy, Physiotherapy

F45 Old Main Building Groote Schuur Hospital

Observatory 7925

TITLE: SENSORY OVERRESPONSIVITY IN CHILDREN OF 3-5 YEARS

Job description:

- Contact all parents (either telephonically or via email) at the selected ECDs who replied positively to the reply slip sent by the researcher. The aim of this communication is to determine if they meet the selection criteria, what their language preference would be (English, Afrikaans or isiXhosa), and find out the mode of delivery of the target child (vaginal or elective caesarean section). Arrange an appointment time to go through the information sheet, either telephonically or face-to-face, and obtain signed consent.
- This process will be continued until the required sample size has been reached, with 73 in both birth method groups.
- Groups to be allocated a value of 0 and 1.

- A number, starting from 01, will randomly be allocated to each participant. From this point on, the data collection process will be done by the researcher.

I, (print name)……..

- understand what is required of me, including the principle of confidentiality.
- All my questions have been answered.
- I understand and accept the terms of my renumeration for my role in the study.

I do / do not consent to maintaining confidentiality in all my work on this study (Circle appropriate response).

Name of Research Assistant……..

Signed:……. Date: …….

Place:…….

Name of Researcher:…….

Signed:…….Date:……

APPENDIX H

CONFIDENTIALITY AGREEMENT FOR VALIDATION PANEL MEMBERS TO PARTICIPATE IN RESEARCH STUDY

Department of Health and Rehabilitation Sciences

Faculty of Health Sciences

Divisions of Communications Sciences and Disorders, Nursing and Midwifery, Occupational Therapy, Physiotherapy

F45 Old Main Building Groote Schuur Hospital

Observatory 7925

TITLE: SENSORY OVERRESPONSIVITY IN CHILDREN OF 3-5 YEARS

I, (print name)……..

- understand the process required of me to validate the Short Sensory Profile 2
- I accept the principle of confidentiality.
- All my questions have been answered.
- I understand that I will not receive any renumeration for taking part in this study.

I do / do not consent to performing the function of validating the SSP2, and maintaining confidentiality while working on this study (Circle appropriate response).

Name of Assistant……..

Signed:……. Date: ……

Place:…….

Name of Researcher:…….

Signed:…….Date:……

APPENDIX I

CONFIDENTIALITY AGREEMENT FOR TRANSLATOR/BACKTRANSLATOR TO PARTICIPATE IN RESEARCH STUDY

Department of Health and Rehabilitation Sciences

Faculty of Health Sciences

Divisions of Communications Sciences and Disorders, Nursing and Midwifery, Occupational Therapy, Physiotherapy

F45 Old Main Building Groote Schuur Hospital

Observatory 7925

TITLE: SENSORY OVERRESPONSIVITY IN CHILDREN OF 3-5 YEARS

I, (print name)……..

- understand the process required of me to translate/backtranslate the Short Sensory Profile 2 and/or the demographic questionnaire.
- I accept the principle of confidentiality.
- All my questions have been answered.
- I understand that I will not receive any renumeration for taking part in this study.

I do / do not consent to performing the function of translating/backtranslating the SSP2 and/or the demographic questionnaire, and maintaining confidentiality while working on this study (Circle appropriate response).

Name of Assistant……..

Signed:…… Date: ……

Place:……..

Name of Researcher:……

Signed:……Date:……

APPENDIX J

HREC APPROVAL

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E52-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 404 7682
Email: nosi.isema@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

04 October 2017

HREC REF: 583/2017

Ms P Gretschel
Occupational Therapy
Health & Rehab Sciences
F-Floor, OMB

Dear Ms Gretschel

PROJECT TITLE: SENSORY OVERRESPONSIVITY IN CHILDREN OF 3-5 YEARS: A DESCRIPTIVE, ANALYTICAL STUDY: (M.Sc.-candidate-A Watkyns)

Thank you for submitting study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30th October 2018.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student A Watkins will be involved in this study.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval before the research may occur.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

HREC 583/2017

APPENDIX K

EMAIL CORRESPONDENCE WITH SSP2 PUBLISHERS, PEARSONS

PERMISSION TO REFER TO SSP2 TEST ITEMS IN THESIS; REFUSAL OF PERMISSION TO APPEND SSP2 QUESTIONNAIRE

Ann Watkyns <annwatkyns@gmail.com> Thu, 13 Apr 2017, 19:48

to bill.schryver, Pam, Helen

Dear William,

I am preparing my proposal for submission to the ethics committee for ethics approval prior to starting my research.

I re-read your reply to me from November, and have copied in the relevant section I need clarification on:

Finally, because of test security concerns, permission is not granted for appending tests to research reports of any kind. You may not include any actual assessment test items, discussion of any actual test items or inclusion of the actual assessment product in the body or appendix of your written research results. You are only permitted to describe the test, its function and how it is administered and discuss the fact that you used the Test; your analysis, summary statistics, and the results.

For my proposal, and for my final thesis write up, I am required to describe the measuring tool that I will be using, which is the SSP2. I would like to clarify whether I am allowed to do this in the proposal and thesis, or does it only apply to a published article or presentation that results from the research?

I was intending to include a short description of the assessment, with a table which I have copied below, which is from Miller, L. J., Robinson, J., & Moulton, D. (2004). Sensory modulation dysfunction: Identification in early childhood. In R. DelCarmen-Wiggins & A. Carter (Eds.), *Handbook of infant, toddler, and preschool mental health assessment* (pp. 247–270). New York: Oxford University Press.

Domain	Sample Items
Tactile sensitivity	1. Reacts emotionally or aggressively to touch 2. Has difficulty standing in line or close to other people
Taste/smell sensitivity	1. 1. Picky eater, especially regarding food textures 2. 2. Limits self to particular food textures/temperatures
Movement sensitivity	1. 1. Fears falling or heights 2. 2. Becomes anxious or distressed when feet leave the ground
Underresponsive/ seeks sensation	1. 1. Becomes overly excitable during movement activity 2. 2. Jumps from one activity to another so that it interferes with play
Auditory filtering	1. 1. Has difficulty paying attention 2. 2. Is distracted or has trouble functioning if there is a lot of noise around
Low energy/weak	1. 1. Poor endurance/tires easily 2. 2. Has a weak grasp
Visual/auditory sensitivity	1. 1. Responds negatively to unexpected or loud noises 2. 2. Covers eyes or squints to protect eyes from light

Please can you clarify is this is acceptable, and exactly where, and what, I may not use this information in my work.

Thanks you

Kind regards

On 13 Apr 2017 20:10, "Schryver, Bill" <pas.licensing@pearson.com> wrote:

Dear Ms Watkyns,

As the paragraph states you may describe the test.

You may also include the descriptive table you included.

That means you have Pearson permission to perform both of the above acts in your research.

Regards,

Bill Schryver

PERMISSION TO USE AN INFORMAL TRANSLATION

Dear Bill,

I am doing research towards a masters degree in occupational therapy in which I am assessing sensory modulation on 3 and 4 year old children in Cape Town, South Africa, using the Short Sensory Profile 2nd edition (2014) by Winnie Dunn. As per our previous communication on 15 November 2016, I have bought 150 original SSP2 questionnaires from Pearsons Assessment UK which I have used with the majority of the participants. To ensure a heterogeneous sample, I am including a spread of socio-economic groups. My data collection phase of the study is almost completed, and I have 3 caregiver participants from the low socio-economic group who are unable to speak or read English, and their language for communicating is Xhosa, which is one of South Africa's official languages.

I am requesting permission to translate the 34 statements on the questionnaire into Xhosa to enable these 3 caregivers to complete it. This will be done using the rigorous back-translation process, by experienced translators. This translation will only be used for these 3 participants, and will not be used for any other purposes. From my literature review, I see that this has already been done for India (Tamil language), Turkey (Turkish) and Puerto Rica (Spanish). I trust that this will be in order.

Thank you

Kind regards

Ann Watkyns

Licensing, - <pas.licensing@pearson.com> (sent by bill.schryver@pearson.com) 5 Jun

to me, Bill, Pam, Helen

Dear Ms Watkyns,

While a full translation license agreement cold be granted, thne minimum license fee is US$1,500.00.

That is a lot to pay for just 3 administrations.

A quicker and much less expensive option would be to just verbally administer the Sensory Profile questions and observations by an Xhosa speaker who happens to be a therepist or under sujpervision of a therapist.

That should accomplish your goals and not violate the copyright. In other words, Free instead of US$1,500.00.

Regards,

William H. Schryver

Senior Legal Licensing Specialist

Please respond only to pas.licensing@pearson.com

Ann Watkyns <annwatkyns@gmail.com> 6 Jun

to Bill, bill.schryver, Pam, Helen

Thank you for your prompt reply Bill and your advice.

Regards

Dear Bill,

I am sorry for the late reply, but I have been out of the country. It appears that I did not clearly explain the nature and purpose of the informal translation, for which I apologise.

The informal translation is only a guide for the Xhosa speaking person who will assist me with the verbal administration of the questionnaire. This seems to be in line with your suggestion, and thus not requiring authorisation.

However, I want to make sure that I have followed due process in this regard. Please confirm that this is acceptable.

I further undertake that the informal translation will be used for this purpose only, and I will not use it for any other purpose.

Kind regards

Licensing, - (sent by bill.schryver@pearson.com) 10 Jul (7 days ago)

to me, Helen, Pam

Dear Ms Watkyns,

Unfder the conditions you describe, Pearson has no objection to your use as an accommodation, and you have our permission to do so.

thanks,

Bill Schryver

Please respond only to pas.licensing@pearson.com

Ann Watkyns <annwatkyns@gmail.com> 11 Jul (6 days ago)

to Bill, Helen, Pam

Thank you Bill, much appreciated.

Kind regards

APPENDIX L

SAMPLE SIZE CALCULATION

The calculation is

$n = \frac{NX}{X+N-1}$ …where $X = \frac{\left(Z_{\frac{\alpha}{2}}\right)^2 p(1-p)}{m}$

n is the necessary sample size

N is the size of the population

α is the confidence level

$Z_{\frac{\alpha}{2}}$ is the $\left(1-\frac{\alpha}{2}\right) th$ quantile of the standard normal distribution.

p is the sample proportion that we expect

Code used to perform this calculation*:*

alpha <- 0.85

X <- (qnorm(1-((1-alpha)/2)))^2(0.115)*(1-0.115)/0.05^2*

N <- 22441

*round(N*X/(X+N-1))*

APPENDIX M

PARTICIPANT SMD PROFILES

ID no.	Participant no.	VB/CS	Seeking SD	Avoiding SD	Sensitivity SD	Registration SD
1	1	0	0	0	0	0
2	3	1	0	0	0	0
3	4	1	0	0	0	0
4	6	0	0	1	0	0
5	7	1	0	0	1	0
6	8	0	0	0	0	0
7	9	0	1	1	1	2
8	13	0	0	1	0	0
9	16	0	1	1	1	0
10	18	0	0	0	0	0
11	20	0	2	1	1	2
12	21	1	0	0	0	0
13	22	1	1	0	0	0
14	26	0	2	2	1	2
15	27	0	1	0	1	0
16	28	0	0	0	0	0
17	29	0	2	0	1	2
18	31	0	2	1	1	0
19	32	0	0	0	0	0
20	33	1	0	0	0	0
21	34	1	1	0	1	0
22	35	0	2	2	1	0
23	36	0	0	0	0	0
24	37	0	0	0	0	0
25	40	1	0	0	0	0
26	41	1	0	0	0	0
27	42	0	1	2	1	0

28	43	0	1	0	0	0
29	44	0	0	0	0	0
30	46	1	0	1	0	0
31	47	0	0	0	0	0
32	48	0	0	0	0	0
33	50	0	0	0	0	0
34	51	0	0	0	0	0
35	52	0	0	0	0	1
36	53	0	2	2	1	1
37	56	1	2	2	1	0
38	57	1	0	0	0	0
39	58	0	0	1	0	0
40	59	0	2	2	2	1
41	60	0	1	1	1	0
42	62	1	1	0	0	0
43	63	0	0	0	0	0
44	66	0	0	0	0	0
45	67	0	2	0	0	0
46	68	0	0	0	0	0
47	69	0	0	0	0	0
48	70	0	1	0	1	0
49	71	0	0	0	0	0
50	72	0	0	0	0	0
51	73	0	0	1	0	0
52	74	0	1	2	0	1
53	75	0	0	0	0	0
54	80	0	1	1	0	0
55	81	0	2	2	1	1
56	82	1	0	0	0	0
57	83	1	0	0	0	0
58	84	1	0	0	0	0
59	88	0	1	0	0	1

60	90	0	0	0	0	0
61	91	0	0	0	0	0
62	93	0	0	0	0	0
63	97	1	0	0	0	0
64	98	0	0	0	0	0
65	99	0	2	1	1	1
66	100	0	2	1	2	2
67	101	0	2	1	2	2
68	102	1	0	0	0	0
69	103	0	1	0	0	1
70	104	0	0	0	0	0
71	105	0	0	0	0	0
72	106	0	0	0	0	0
73	107	1	0	0	0	0
74	108	0	0	0	0	0
75	111	1	0	0	0	0
76	130	0	0	0	0	0
77	131	1	0	1	0	1
78	132	1	0	0	0	0
79	133	1	0	0	0	1
80	134	0	0	1	0	0
81	135	1	0	0	0	0
82	136	1	0	0	0	0
83	137	1	0	0	0	0
84	138	1	0	0	0	0
85	139	1	0	0	0	0
86	140	1	0	0	0	0
87	141	1	0	0	0	0
88	142	1	0	0	0	0
89	148	1	0	0	0	0
90	149	0	0	0	0	0
91	150	1	0	0	0	0