SENSORY INTEGRATION INTERVENTION AND THE DEVELOPMENT OF THE EXTREMELY LOW TO VERY LOW BIRTH WEIGHT PREMATURE INFANT

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Dedicated to:
All infants and their mothers
who have inspired this research,
My loving family
for endless love and support,
and
My Heavenly Father
for this beautiful journey

DECLARATION

I certify that the dissertation hereby submitted by me for the Master Occupational Therapy degree at the University of the Free State is my independent effort and had not previously been submitted for a degree at another university/faculty. I furthermore waive copyright of the dissertation in favour of the University of the Free State.

ELISE LECUONA

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ACRONYMS

AIDS	Acquired immunodeficiency syndrome
ASI	Ayers Sensory Integration
CA	Chronological age
CHR	Committee for Human Research
CNS	Central nervous system
ELBW	Extremely low birth weight
EMSM	The Ecological Model of Sensory Modulation
GA	Gestational age
HIV	Human immunodeficiency virus
HPCSA	Health Professions Council of South Africa
IVH	Intraventricular haemorrhage
KMC	Kangaroo mother care
LBW	Low birth weight
MRCSA	Medical Research Council of South Africa
MSA	Medial supplementary areas
NICU	Neonatal Intensive Care Unit
NRF	National Research Foundation
OT	Occupational therapist
OTASA	Occupational Therapy Association of South Africa
pH	Hydrogen ion concentration
PMNCH	Partnership for Maternal Newborn and Child Health
PVL	Periventricular leukomalacia
SAISI	South African Association of Sensory Integration
SDCP	Sensory Developmental Care Programme
SI	Sensory integration
SMD	Sensory Modulation Disorder
SPD	Sensory Processing Disorder
TSFI	Test of Sensory Function in Infants
VLBW	Very low birth weight
WHO	World Health Organization

CONCEPT CLARIFICATION

Clarification of concepts used in this study, listed alphabetically:

Ayers Sensory Integration (ASI) includes the theory, assessment methods, patterns of sensory integration and praxis dysfunctions, intervention concepts, principles and techniques developed by Jean Ayers (Parham & Mailloux, 2010:326).

Bayley III Scales of Infant and Toddler Development is an individually administered instrument that assesses the developmental functioning of infants and young children between one month and 42 months of age (Bayley, 2006a:1).

Components of the sensory integrative process (five sequential steps):

- **Sensory registration** is the initial awareness of a sensation. It is dependent upon recognizing the novelty of the stimulus e.g. "Something new has happened, I have been touched".
- **Orientation and attention** is when an infant pays selective attention to the stimulus e.g. "I have been touched here, on the hand".
- **Interpretation** is process of giving meaning to a stimulus e.g. "Mom is touching my hand".
- **Organization of a response**, determining a cognitive, affective and/or motor response e.g. the infant responds by looking at Mom, interacting and smiling or grasping her hand.
- **Execution of a response** is the final step of sensory integration and the only one that can be directly observed. If the execution involves a motor act e.g. grasping mom's finger, new sensory input is generated and the cycle begins again (Williamson & Anzalone, 2001:13,14).

Concepts related to the Model of Infant Behavior Based on Sensory Integration and Self-regulation:

- **Arousal** is the infant's ability to maintain alertness and make transitions between states,
- **Attention** is the ability to focus selectively on a desired stimulus or task,
- **Affect** is the emotional component of behavior,

- **Action** is the ability to engage in adaptive, goal-directed behavior,
- **Goodness-of-fit,** a concept that offers a useful way to reason about young children's sensory related behavior in their physical and social environments (Williamson & Anzalone, 2001:18-23).

Control group is the group of premature infants that have received the standard hospital care pre-discharge and follow-up visits post discharge from the Universitas Academic Hospital.

Corrected age refers to how old the infant would be if born at term rather than preterm (Hunter, 2010:652).

Chronological age (CA) refers to the infant's actual age since birth (Hunter, 2010:652).

Developmental Care refers to a method of care used on newly born premature infants with VLBW and ELBW in the NICU and focuses on the interaction between the infant's neuro-developmental needs and the environment (Nieder-Heitman, 2010:5).

Experimental group is the group of premature infants that will receive the 10 week sensory integration intervention programme in addition to the standard hospital care pre-discharge and follow-up visits post discharge from the Universitas Academic Hospital.

Extremely low birth weight (ELBW) a birth weight of less than 1000 grams (Hunter, 2010:653; Lubbe, 2008:7).

Fidelity refers to the extend to which the intervention provided in a research study is faithful to the key elements of the intervention approach (Hunter, 2010:367).

Gestational age (GA) refers to the total number of weeks the infant was in utero before birth (Hunter, 2010:653).

Infant is described as a very young child with age range of 0 – 12 months, before the child starts to walk (Collins, 2009).

Infant/Toddler Sensory Profile (Dunn) is a standardized, norm-referenced assessment tool. It is a judgment-based caregiver questionnaire designed to describe behavioural responses to various everyday sensory experiences in children from birth to 3 years of age (Stewart, 2010:213).

Kangaroo Care (KC) refers to the positioning of the infant chest-to-chest and skin-to-skin between the mother's breasts in an upright position. It is a component of Kangaroo Mother Care (KMC) (Nieder-Heitman, 2010:6).

Kangaroo Mother Care (KMC) is a method of caring for and nursing the preterm infant in a supportive environment. It consists of three components namely; skin-to-skin positioning, nutrition (breastfeeding) and early discharge and follow-up (Nieder-Heitman, 2010:6).

Neonatal Intensive Care Unit (NICU) is a complex and highly specialized hospital unit designed to care for infants who are born prematurely or are critically ill (Hunter, 2010:650).

Premature/preterm infant is an infant born before 37 weeks (Hunter, 2010:653).

Room density, also known as the occupancy rate is referred to as the number of persons in a house per unit habitable room (kitchens and bathrooms are excluded). It is a widely used index since it is an easily calculated and sensitive indication of housing provision, where any density of over one person per room indicates overcrowding (Oxford Dictionary of Geography, 2004).

Self-regulation is a process that involves the infant's capacity to modulate mood, self-calm, delay gratification and tolerate transitions in activity for example most babies self-calm by bringing a hand to the mouth to suck, touching their hands together, rocking and looking or listening to preferred visual or auditory stimuli e.g. mother or mother's voice (DeGangi, 2000:10).

Sensory Developmental Care Program (SDCP) in the NICU is a programme developed by Esther Nieder-Heitman based on sensory integration principles, Kangaroo Mother Care (KMC) and Developmental Care principles. The programme is designed to optimize the perception of sensation by the senses in a manner that is commensurate with the stages of neurological formation of the newborn premature infant in the NICU (Nieder-Heitman, 2010:6).

Sensory integration is the brain's organization of sensations from our body and the environment around us for use. This process enables a person to move, learn and behave in a productive manner (Ayers, 2008:5).

Sensory modulation is the ability to filter sensations and attend to those that are relevant, maintaining an optimal level of arousal and maintaining attention to a task, requires modulation. This process occurs on both a neuro-physiological and behavioural level. Modulation of sensory input is critical to our ability to engage in daily occupations (Lane 2002:104; Ayers, 2008:36).

Sensory processing is a term that refers to the way the nervous system receives sensory messages and turns them into responses (Miller, 2006:4).

Sensory Processing Disorder (SPD) exists when sensory input doesn't get organized into appropriate responses and an individual's daily routines and activities are disrupted as a result (Miller, 2006:5).

Sensory threshold, ideally this threshold is high enough that we can tolerate the complexity and stimulation inherent in the environment, yet low enough that we can perceive subtle changes and novelty in the environment. This threshold varies both between and within individuals (Williamson & Anzalone, 2001:28).

Somato-motor adaptive response, means that the child is adaptive with the whole body, moving and interacting with people and things in the three-dimensional space, an ASI intervention principal (Parham & Mailloux, 2010:327).

Test of sensory function in infants (TSFI) was developed as both a research and clinical tool, specifically to measure five sub domains of sensory processing and reactivity because these areas have a strong impact on the development of sensory integration in the infant (DeGangi & Greenspan, 1989:3).

Toddler is described as a child beginning to walk and with ages ranging between 8 and 12 months (Collins, 2001).

Very low birth weight (VLBW) is a birth weight between 1000 to 1499 grams (Hunter, 2010:653; Lubbe, 2008:7).

SUMMARY AND KEY WORDS

KEY WORDS

Ayers Sensory Integration (ASI) intervention, ELBW to VLBW premature infants, first year of development.

SUMMARY

This study aimed to investigate the effect of ASI intervention on the development of premature infants with ELBW to VLBW, within the first 12 months. ASI intervention approach is from the sensory integration theoretical and practice frame of reference used in occupational therapy. ASI provides playful meaningful activities aimed at enhancing sensory processing abilities of the brain and ultimately lead to appropriate adaptive functioning in daily life.

From the literature review it was evident that newborn premature infants are at risk for possible SI difficulties and developmental delays due to their immature CNS and possible times of medical instability, discomfort, pain and stress during the first weeks or months after birth. Research on effective developmental intervention strategies for premature infants is however limited and previous research related to ASI intervention on the development of the premature infant post discharge from the NICU could not be found by the researcher. Since SI forms the underlying foundation for learning and social behavior (Ayers, 2008:7), research in this field is essential for prevention of developmental delays and learning difficulties of premature infants.

The research proposal for this study was approved by the Ethics Committee, Faculty of Health Sciences of the University of the Free State (ECUFS no. 117/2011). Permission was obtained from appropriate authorities to conduct the study at the Occupational Therapy Department of Universitas Academic Hospital. A pilot study was done to determine the feasibility of the study.

A quantitative research approach was used to determine the effect of ASI intervention on the development of the ELBW to VLBW premature infant. Through a pre-test/post-test experimental design, the population of 24 premature infants was randomly divided into an experimental and

control group with 12 infants in each group respectively. Infants were matched according to their corrected ages and gender. Participants had corrected ages between four and 10 months, VLBW to ELBW, adhered to the inclusion criteria for the study and were referred from the High-Risk Infant Clinic at Universitas Academic Hospital.

The developmental status of participants was determined with the Bayley III Scales of Infant and Toddler Development (Bayley, 2006a), Test of Sensory Function in Infants (TSFI) (DeGangi & Greenspan, 1989) and Infant /Toddler Sensory Profile (Dunn, 2002) before and after a 10 week ASI intervention period with infants in the experimental group. The results of the Fidelity Measure indicated that the interventions sessions complied with the requirements for ASI intervention.

The pre- and post-test results were analyzed, interpreted and compared. The anthropometric and demographic profiles of the infants in both groups indicated that there was no statistical difference between the two groups except for the time hospitalized which was in favour of the control group and therefore the researcher was able to make reliable conclusions in terms of the study results.

This study has found that ASI intervention had a positive effect on the sensory processing and developmental progress of ELBW to VLBW premature infants especially in terms of cognitive-, language-, motor- and adaptive behaviour development within a short period of 10 weeks. Parents showed more interest and a better understanding of the developmental progress and sensory processing of their infants. This study has therefore provided sufficient evidence that early intervention in terms of ASI plays a critical role in the intervention approach of the sensory integration trained occupational therapists, working with premature infants and their parents.

The study results did not only indicate the importance of ASI intervention for better developmental outcomes for ELBW to VLBW premature infants, but also revealed that a lack of ASI intervention leads to a deterioration of developmental and behavioural outcomes.

OPSOMMING EN SLEUTELWOORDE

SLEUTELWOORDE

Ayers sensoriese integrasie (ASI) intervensie, ekstreme lae geboortegewig tot baie lae geboortegewig premature baba, eerste jaar van ontwikkeling.

OPSOMMING

Die doel van hierdie studie was om die effek van ASI intervensie op die ontwikkeling van premature babas met ekstreme lae geboortegewig tot baie lae geboortegewig, binne die eerste 12 maande te bepaal. Die ASI intervensie benadering is van die sensoriese integrasie teoretiese en praktiese verwysingsraamwerk gebruik in arbeidsterapie. ASI intervensie verskaf betekenisvolle spel aktiwiteite wat ten doel het om die sensoriese proseserings vermoë van die brein te bevorder en gevolglik te lei tot toepaslike aangepaste funsionering in alledaagse aktiwiteite.

Uit die literatuur oorsig was dit duidelik dat pasgebore premature babas 'n risiko loop vir moontlike sensoriese integrasie (SI) en ontwikkelings probleme, wat toe te skryf is aan hulle onvolgroeide sentrale senuwee sisteem en moontlike mediese onstabiliteit, ongemak, pyn en stress gedurende die eerste weke of maande na geboorte. Navorsing op effektiewe intervensie strategieë vir premature babas is egter beperk en vorige navorsing wat verband hou met ASI intervensie op die ontwikkeling van die premature baba na ontslag uit die neonatale intensiewe eenheid kon nie deur die navorser gevind word nie. Terwyl SI die onderliggende fondament vir leer en sosiale gedrag vorm (Ayers, 2008:7), is navorsing in die veld noodsaaklik vir die voorkoming van ontwikkelings en/of leerprobleme later.

Die navorsingsvoorstel vir hierdie studie is deur die Etiek Komitee van die Fakulteit van Gesondheidswetenskappe aan die Universiteit van die Vrystaat (EKOVS nr. 117/2011) goedgekeur. Toestemming is van toepaslike outoriteite verkry om die studie by die Arbeidsterapie Departement van die Universitas Akademiese Hospitaal uit te voer. 'n Loodstudie is gedoen om die uitvoerbaarheid van die studie te bepaal.

‘n Kwantitatiewe navorsingsbenadering is gebruik om die effek van ASI intervensie op die ontwikkeling van van die ekstreme lae geboortegewig tot baie lae geboortegewig premature baba vas te stel. Deur ‘n voor-toets/na-toets eksperimentele ontwerp, is 24 premature babas lukraak verdeel in ‘n eksperimentele- en kontrolegroep, met 12 babas in elke groep onderskeidelik. Die premature babas is in pare gegroepeer volgens hulle gekorrigeerde ouderdom en geslag. Deelnemers se gekorrigeerde ouderdomme was tussen vier en tien maande, ekstreme lae geboortegewig tot baie lae geboortegewig, volgens die beleid van die insluitingskriteria vir die studie en was verwys van die Hoë-Risiko Baba Kliniek by die Universitas Akademiese Hospitaal.

Die ontwikkelingstatus van deelnemers is bepaal deur die Bayley III Scales of Infant and Toddler Development (Bayley, 2006a), Tests of Sensory Function in Infants (TSFI - De Gangi & Greenspan, 1989) en Infant/Toddler Sensory Profile (Dunn, 2002) voor en na ‘n 10 weke ASI intervensie periode met babas in die eksperimentele groep. Die resultate van die Presiese (Fidelity) meetinstrument dui aan dat die intervensie sessies voldoen aan die vereistes vir ASI intervensie.

Die voor- en na-toets resultate is geanaliseer, geinterpreteer en vergelyk. Die antropometriese en demografiese profiele van die babas in albei groepe dui aan dat daar geen statistiese verskil tussen die twee groepe was nie, behalwe vir die tydperk van hospitalisasie, wat in die guns van die kontrolegroep was en die navorser was daarom in staat om betroubare gevolgtrekkings maak.

Die studie het gevind dat die ASI intervensie ‘n positiewe effek het op die sensoriese prossesering en ontwikkelings vordering van ekstreme lae geboortegewig tot baie lae geboortegewig babas, veral in terme van kognitiewe-, taal-, motoriese- en aanpassings gedrags ontwikkeling binne ‘n kort periode van 10 weke. Ouers het meer belangstelling getoon en het beter verstaan wat die ontwikkelings vordering en sensoriese prosessering van hul babas behels. Die studie het dus genoeg bewyse verskaf dat vroeë intervensie in terme van ASI intervensie ‘n kritieke rol speel in die intervensie benadering van die opgeleide sensoriese integrasie arbeidsterapeut wat met premature babas en hul ouers werk.

Die studie het nie net die belangrikheid van ASI intervensie vir beter ontwikkelings uitkomste vir ekstreme lae geboortegewig tot baie lae geboortegewig babas aangedui nie, maar het ook bewys dat ‘n gebrek van ASI intervensie lei tot ‘n agteruitgang van ontwikkelings en gedrags uitkomste.

CHAPTER 1

INTRODUCTION AND ORIENTATION

1.1 INTRODUCTION

An infant born premature is very small with a low (LBW) to extremely low birth weight (ELBW). The infant may experience specific challenges in his/her chances for survival and development since the support and protection of the womb is abruptly removed, while the immature organs especially the brain and lungs, still need to continue their development (Lubbe, 2008:27). Due to the immature, disorganized nervous system not being ready to process all the sensory information it is bombarded with, these infants are at risk for sensory integration problems. Ayers (2008:14) explains that the development of normal sensory integrative functions during infancy is important since most of the activity in the first seven years of life is part of the process of organizing sensations in the nervous system for adaptive responses. Each of these activities is used to develop building blocks for reaching appropriate developmental milestones. According to Biel (2010:4), although overstimulation of sensory information is minimized in most Neonatal Intensive Care Units (NICU's), the inevitable beeping and buzzing of equipment, lighting and busy atmosphere tend to agitate sensitive premature infants.

A recent study by Nieder-Heitmann (2010:2 of 3), indicated that a Sensory Developmental Care Programme (SDCP) in the neonatal intensive care unit (NICU) benefitted VLBW preterm infants' long term development concerning their sensory functions up to the age of 18 months corrected age. There is however a need for further studies in the field especially in terms of developmental intervention post-discharge.

A study done by Vohr *et al*. (2000:1216-1226) indicated that ELBW premature infants are at significant risk of neurologic abnormalities, developmental delays and functional delays at 18 to 22 months corrected ages; another study done by Powers, Ramamurthy, Schoolfield and Matula (2008:1258-1265) indicated a characteristic pattern of poor weight gain in the first 12 months which was followed by accelerated weight gain starting at 18 months. The mean of developmental scores also decreased in infancy, with improvements in motor development emerging at 18 months and cognitive skills at 30 months. In consideration of these results, the question was raised whether appropriate early intervention could improve the developmental progress of these infants within the first 12 months.

An earlier study done by Resnick *et al.* (1987:68-74) did indicate that a multidisciplinary Infant Development Programme (IDP) for low birth weight infants (LBW,<1800g) improved early developmental outcomes at 24 months adjusted age. Although this study was done in 1987, it supported the value of developmental intervention for premature infants.

DeMaio-Feldman's (1994:643) investigation into the relationship between somatosensory processing abilities of school aged children and their earlier experiences in the intensive care unit as VLBW infants suggested that these children's somatosensory processing abilities significantly differs from that of the typical population. The infants' birth weight, number of days supported by mechanical ventilation and number of days in the NICU were examined in relation to their somatosensory functions namely manual form perception, kinesthesia, finger identification, graphesthesia and localization of tactile stimuli. This study concluded that the restrictions imposed on position, movement and tactile exploration during hospitalization limited normal experiences necessary for the development of adequate body schema. These results highlighted the importance of early intervention with premature infants especially in the field of sensory integration; to provide a safe environment for these infants to experience normal positioning, movement and tactile exploration opportunities within each infant's unique sensory threshold and sensory processing abilities, to develop adequate body schema, motor planning and developmental progress and to prevent potential developmental and learning difficulties during the school age years.

Gorga (1989:731-735) explored occupational therapy intervention practices for infants from birth to 2 years. The author defined the role of the occupational therapist, as an interdisciplinary team member to facilitate independence in infants by enhancing motor control, sensory modulation, adaptive coping and sensorimotor development, social-emotional development, daily living skills and play. Sensory modulation is highlighted as essential for well-developed functioning in other areas such as motor control, social interaction and cognitive performance. In the specialized field of the NICU and follow-up of high risk infants after discharge the occupational therapist's involvement is essential in terms of monitoring the infant's development and to identify an appropriate early intervention approach. She already stated in 1989 that fundamental to a developmental assessment for high-risk infants, is an understanding of the particular course of neuro-motor and behavioural development of premature infants in the first year of life since, according to research, premature infants differ from full term infants in quality of movement, muscle tone and types of movement patterns. According to Eliot (2000:4) studies of adult learning indicated that the brain remains malleable throughout life, however it is significantly more so in infancy.

The researcher had the privilege to work with infants, including premature infants from June 2003 until March 2010. As an occupational therapist trained in sensory integration and neurodevelopmental therapy, the researcher were involved in developmental care programmes within neonatal intensive care units as well as providing further early intervention for premature infants between the ages of 40 weeks gestation to 3 years of age. The positive outcomes of the interventions with premature infants which consisted out of individual sessions as well as specific home programmes, involving parents in their babies' progress, ignited the special interest into the investigating of intervention approaches, optimizing the development of premature infants.

Because of the immature central nervous system as well as medical histories of the premature infants the researcher recognized the value of the sensory integration approach when addressing the development of the infants. The tactile sense together with encouraging the mother-infant-bond played a primary role in the early intervention after discharge from hospital. The researcher identified the challenge of gradually introducing sensory input, especially tactile and vestibular input, with the aim of encouraging optimal development within the delicate sensory processing abilities of these infants and the important role that self-calming plays in these infant's developmental progress. The researcher identified the need to investigate the impact of sensory integration intervention on the development of the premature infant.

1.2 PROBLEM STATEMENT

In consideration of previous studies and relevant literature, it is evident that early intervention within the first 18 months to 2 years benefits premature infants however research studies in this field are limited. There is a need for further research on effective developmental intervention for premature infants and specifically sensory integration intervention in terms of programs that include tactile, vestibular and proprioceptive input and allows for adaptive responses, to support premature infants' developmental progress as well as offer guidance to parents post-discharge from the NICU.

Since a large part of a child's capacity for learning is the ability to integrate sensory information, the question; if Ayers Sensory Integration (ASI) intervention specifically tactile, proprioceptive and vestibular input could have a positive effect on the developmental progress of premature infants as early as within the first 12 months of development, has inspired this research.

1.3 PURPOSE OF THE STUDY

The purpose of this research study will be discussed in terms of the aim and objectives.

1.3.1 Aim of the study

The aim of the study was to investigate the effect of Ayers' Sensory Integration (ASI) intervention on the developmental progress of the extremely low to very low birth weight premature infant of 12 months and younger.

1.3.2 Objectives

The objectives for this investigation were as follows:

1.3.2.1 To determine the developmental status of all premature infants participating in the study (experimental and control groups) through assessments with the Bayley III Scales of Infant and Toddler Development (Bayley, 2006a), Test of Sensory Function in Infants (TSFI – DeGangi & Greenspan, 1989) as well as Infant and Toddler Sensory Profile (Dunn, 2002).

1.3.2.2 To implement sensory integration intervention that complies with the requirements of the Fidelity Measure, specifically for each infant in the experimental group (that includes weekly individual sessions with a sensory integration therapist within an optimal and appropriate intervention environment, as well as a practical and realistic home activities for parents over a 10 week period).

1.3.2.3 To determine the developmental status of all premature infants participating in the study (experimental and control groups) after the 10 week intervention period with the experimental group through assessments with the Bayley III Scales of Infant and Toddler Development (Bayley, 2006a), Test of Sensory Function in Infants (TSFI - DeGangi & Greenspan, 1989) as well as Infant and Toddler Sensory Profile (Dunn, 2002).

1.4 SCOPE OF THE STUDY

This study was based on Jean Ayers' theory and practice of sensory integration. Ayers' Sensory Integration is described as part of the scope of practice of the occupational therapist in the Health Professional Council of South Africa's scope of practice documents (HPCSA, 2009:9). According to Ayers' theory, sensory integration is a process that already begins in the mother's womb. She defined sensory integration as the organization of sensations for use and explains that sensory integration is an unconscious process of the brain, in which information detected by a person's senses namely; movement, touch, gravity, position, sight, hearing and taste is processed and organized for use. Sensory integration gives meaning to what is experienced and allows a person to respond to situations in a purposeful manner known as an adaptive response (Ayers, 1983:1; Ayers, 2008:5-7).

According to this theory, sensory integration forms the underlying foundation for learning and for social behavior. Childhood play contributes to sensory integration as the child organizes the sensation of his body and gravity along with sight and sound. Genes provide every child with the baseline capacity for sensory integration, however he must develop sensory integration by interacting with the environment and many objects in his/her world and adapting his/her body and brain to many challenges during childhood (Ayers, 1983:5; Ayers, 2008:5-7).

In consideration of the above discussed literature it is evident that ASI intervention plays an important role in the approach of the pediatric occupational therapist with children from infancy to middle childhood who presents with sensory integration dysfunction.

Since a premature infant was abruptly removed from the ideal sensory environment of the mother's womb, the infant did not have the opportunity to fully develop primitive reflexes or build up muscle tone through pushing against resistance in a curled up position within a tight womb (Faure, 2011:86). A premature infant as a newborn presents with an immature central nervous system and most probably experiences times of medical instability, discomfort, pain and stress during the first weeks or months after birth and therefore is at risk for possible sensory integration difficulties and developmental delays.

During this study, sensory integration intervention was provided to premature infants with extremely low to very low birth weights between the corrected ages of four months and 12 months over a 10 week period. Through comparing the pre- and post-tests of the infants in the experimental and control groups in terms of sensory processing and developmental progress, the researcher evaluated the effect sensory integration intervention on the development of the premature infant within the time period of 10 weeks.

The Researcher has made recommendations in terms of clinical implementation of the findings as well as future research.

1.5 METHODOLOGY

The researcher has done a literature review to investigate the relevance of this study in terms of previous studies and relevant literature where after the study population was determined. For the purpose of this study a quantitative approach was used with an experimental research design to investigate the extent to which Ayers Sensory Integration (ASI) intervention influences the developmental progress of the premature infants. The study was experimental since the 24 participants were matched according to their corrected ages and genders and then divided randomly into two groups of 12 infants each. Infants in the control and experimental groups were evaluated in terms of their developmental status and sensory processing before and after the 10 week sensory integration intervention period of the experimental group. Through making use of random assignment, the chance that either group was not typical of the population was minimized (Hopkins, 2008:1 of 10; Leedy & Ormrod, 2010:219; Strydom, 2011:228).

The sensory integration intervention sessions with the infants in the experimental group consisted of meaningful play activities that provided mainly sensory input in terms of vestibular, proprioceptive and tactile input, however other sensory input namely visual, auditory and taste input was used in addition to these three main sensory input during sessions. These activities met the criteria for ASI intervention according to the Fidelity Measure as discussed in Chapter 4 (cf. 4.4). The approach were child-directed and intervention goals were determined according to the results of the pre-tests with the Bayley III scales of Infant and Toddler development, Test of Sensory Function in Infants (TSFI) as well as Infant/Toddler Sensory Profile in terms of each infant's sensory processing and developmental status. After the 10 week intervention period with the 12 infants in the experimental group, the results of both groups of the pre- and post-tests were compared to determine the effect of ASI intervention on the development of the premature infants.

The department of Biostatistics at the University of the Free State did a statistical analysis of the results as described in Chapter 3 (cf. 3.8). The researcher interpreted the results and has made conclusions and recommendations according to the findings.

1.6 THE IMPORTANCE OF THE STUDY

Research on effective intervention strategies to enhance premature infants' developmental progress and prevent developmental delays is limited. The researcher was unable to find any previous research on the effect of specifically ASI intervention on the development of the premature infant post-discharge from the Neonatal Intensive Care Unit (NICU). Since sensory integration plays such an important role in normal development of the child, the role of the sensory integration trained occupational therapist is therefore essential in terms of early intervention for premature infants post-discharge.

A large amount of sensory integration must occur and develop to enable a child to visually following an object with the eyes, to rolling, sitting, crawling, standing up and eventually walking, all within the first year of life (Ayers, 2008:5). Since premature infants with ELBW to VLBW are at risk for sensory processing difficulties and developmental delays, the researcher is of opinion that ASI intervention plays an important role in the follow-up intervention approach of these infants post discharge and in the first year of development.

This study has found that ASI intervention had a positive effect on the development of the premature infants within the short period of 10 weeks. Parents of these infants in the experimental group also became more involved in their participation during sessions and home activities and they showed more interest and a better understanding of the developmental progress and sensory processing of their infants. This study has therefore provided sufficient evidence that early intervention in terms of ASI intervention plays a critical role in the intervention approach of the occupational therapist working with premature infants and their parents.

1.7 ETHICAL CONSIDERATIONS

The research proposal for this study was approved by the Expert Committee of the Occupational Therapy Department and the Evaluation Committee of the School for Allied Health Professions (SAHP) of the University of the Free State. Permission for the execution of this study was also obtained from appropriate authorities; namely Dr. N. van Zyl, Head: Clinical Services of Universitas Academic Hospital, Prof. A. Venter: Head of Department and Dr. D.J Griessel: Senior lecturer/Principal Specialist, Pediatrics and Child Health, University of the Free State and Universitas Academic Hospital as well as Ms. M. Taljaard: Deputy Director, Occupational Therapy Department, Universitas Academic Hospital to conduct the study at the Occupational Therapy Department of Universitas Academic Hospital. The final research proposal was then approved by the Ethical Committee, Faculty of Health Sciences of the University of the Free State (ECUFS No. 117/2011, ADDENDUM M), for the implementation of the study with premature infants selected according to the inclusion and exclusion criteria.

Informed consent was obtained from the participating premature infants' parents (ADDENDUM L). The researcher provided the parents with accurate and complete information regarding all aspects of the study. Parents or guardians of the premature infants were legally and psychologically competent to give consent and were informed that they could withdraw their infants from participating in the study at any time without any negative consequences.

The study was implemented at the Occupational Therapy Department, Universitas Academic Hospital. The assessments took place in a small assessment room and the intervention sessions took place in a spacious therapy room with appropriate equipment necessary for ASI intervention (Parham *et al.*, 2010). Strict precautionary measures were taken to provide a safe environment for the infants at all times. The researcher made use of a translator when needed for parents who's language of preference was not English or Afrikaans. Participation in this study was voluntarily and except for a travel allowance, the parents of participating infants did not receive compensation for participating in the study. All information of participating infants and their parents were handled with confidentiality. The findings of this research will be submitted in an article format to an accredited journal for publication.

1.8 OUTLINE OF CHAPTERS

This dissertation consists of six chapters, arranged as follows:

Chapter 1 – The *introduction, problem statement and purpose of the study*. This chapter provides a brief introduction to the study. The problem statement is stated and the purpose of the study is discussed in terms of the aim and objectives. The scope and importance of the study, methodology and ethical implications are summarized.

Chapter 2 – The *literature review* reflects relevant literature related to the premature infant, sensory integration, the development of sensory integration, sensory integration intervention as well as a short discussion on the relevance of this study within a low sosio-economic South African context.

Chapter 3 – *Research approach and methodology.* The research approach and methodology are presented. This study follows a quantitative research approach. The study design; a randomized controlled clinical trial, methods used during the implementation of the study in terms of sampling of participants, measurement and intervention, analysis of data as well as ethical aspects are thoroughly discussed.

Chapter 4 – The *results* obtained in the pre- and post-tests are presented in the form of tables and figures with short summaries of the findings. These results also include the anthropometric and demographic information of participants as well as the results obtained from the ASI Fidelity measure used to ensure fidelity regarding the use of ASI intervention during the treatment sessions.

Chapter 5 – *Discussion of results.* The research results presented in Chapter 4 are discussed, interpreted and compared with relevant literature. The limitations of the study are also identified.

Chapter 6 – *Conclusions and recommendations.* Conclusions made by the researcher and the value of the study are presented, as well as recommendations for implementation of intervention with premature infants and future research.

1.9 SUMMARY

In this chapter the background and outline of the dissertation were presented. The following chapter presents a thorough literature review to describe relevant aspects of premature infants, Ayers Sensory Integration (ASI) as well as an investigation into the importance of sensory integration in the development of the premature infant.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 summarized the research study in terms of the problem statement, aim of the study, methodology as well as ethical considerations. The outline of the Chapters was also presented. The literature review that follows will discuss literature relevant to the research study. The premature infant is looked at in terms of reasons for premature birth, the Neonatal Intensive Care Unit (NICU), characteristics of as well as the development of the premature infant. Sensory integration; the sensory systems and their functions, the development of sensory integration, sensory integration intervention, The Fidelity Measure, as well as sensory integration intervention within a low socio-economic South African context are included in the literature review.

2.2 THE PREMATURE INFANT

A full term pregnancy range from 37 to 42 weeks and during this time the full term infant is provided with a safe, comforting environment inside the mother's womb to grow and develop optimally until birth. Infants born between 24 and 37 weeks are considered premature infants and are classified according to age and by birth weight. The premature infant's age are classified according to: Gestational age (GA - which refers to the total number of weeks the infant was in-utero before birth), chronological age (referring to the infant's actual age since birth), and corrected age (which refers to the age the infant would be if born at full term and is generally used in assessing developmental status until 12 months). Post-conceptional age (PCA) is commonly only used until 40 or 44 weeks and refers to the infant's age in relation to when conception occurred (PCA is obtained by adding the weeks since birth to the infant's gestational age). Classifications by birth weight ranges from average in size (above 2500g), low birth weight (LBW – between 1500g to 2500g), Very low birth weight (VLBW - 1000g to 1499g), Extremely low birth weight (ELBW - less than 1000g) and Ultra low birth weight (ULBW - less than 750g) (Bergman, 2010:21; Hunter, 2010:652; Faure, 2011:87; Lubbe, 2008:23,26).

For the purpose of this research study the term premature infant will refer to premature infants with very low (1000g to 1499g; VLBW) and extremely low (less than 1000g; ELBW) birth weights born between 24 and 37 weeks gestation.

2.2.1 Causes for premature birth

Premature birth can be caused by a variety of medical conditions during pregnancy as well as certain lifestyle conditions. Medical conditions that can cause an infant to be born prematurely include the following; expecting multiples, high blood pressure called pregnancy induced hypertension which may result in preeclampsia, intra-uterine growth retardation in the premature infant, premature rupture of membranes which causes leaking of the amniotic fluid, placenta preavia where the placenta implants low down in the womb and gradually tears loose as the uterus grows, placenta abruptio where the placenta suddenly tears loose from the wall of the uterus which mostly happens as a result of an injury, fetal abnormalities as well as high levels of stress hormones from the mother, that cross the placenta and that can result in prematurity and fussy, irritable babies (Lubbe, 2008:24; Nosarti, Murray & Hack, 2010:3-8).

Other risk factors for premature birth include; previous preterm birth, miscarriage, multiple abortions, urinary tract infections, vaginal or other infections, sexually transmitted diseases, history of kidney disease, uterus and cervical abnormalities such as cervical incompetence, diabetes, clotting disorders, pregnancy through in vitro fertilization, being underweight before the pregnancy and low weight gain during the pregnancy, obesity, short period between pregnancies, intra-uterine growth restriction. Lifestyle and environmental risks that may put mothers at greater risk for delivering premature infants include; late or no antenatal care, smoking during pregnancy, alcohol consumption during pregnancy, using illegal drugs, the physical environment for example exposure to lead paint or crowding and pollution, domestic violence, lack of social support, long working hours with long periods of standing and stress (Lubbe 2008:25; Nosarti *et al.*, 2010:3-8). There is no doubt that having a premature baby is an unexpected, stressful experience and that parents of a premature infant feel vulnerable, anxious and not in control especially during the first few weeks and months after birth.

2.2.2 The Neonatal Intensive Care Unit

Premature infants are admitted to Neonatal Intensive Care Units (NICU) immediately after birth. These are complex and highly specialized hospital units designed to care for premature and critical ill infants. An increased awareness among NICU staff of environmental, and care giving influences, on the vulnerable newborn infant have led to the development of the NICU care approach to include Developmental Care and the involvement of the infant's family in addition to primary medical concerns (Hunter, 2010:650; Lubbe, 2008:49). Stressors such as bright lights, loud noises, an intrusive environment, painful interventions as well as unintentional and repeated disruption of sleep and rest can be limited through correct handling and positioning techniques, however, it cannot be eliminated completely. Within this challenging environment and with their immature systems the premature infant's physiological- (heart rate, breathing, blood pressure, elimination and temperature regulation) and behavioural functions (sleep and awake states, calming techniques and environmental interaction), needs to be stabilized (Lubbe, 2008:27; Nosarti *et al.*, 2010:17).

Undoubtedly these early challenges have an effect on the infant's long term development and as the survival rate of premature infants increases, concerns emerge about their long-term developmental outcome (Bergman, 2010:123; Hunter, 2010:651).

According to Wiley-Blackwell (2011:1 of 2) on behalf of the American Neurological Association and Child Neurology Society, exposure to stressors in the NICU is associated with alteration in the brain structure and function of very preterm infants. The study found that infants who experienced early exposure to stress displayed decreased brain size, functional connectivity and abnormal motor behaviour. The study results further indicated that the average daily exposure to stressors was greatest in the first 14 days following birth. Further research in terms of stress exposure on the preterm brain, independent of illness severity, were recommended to improve outcomes for premature infants.

Hunter (2010:653) states that because the sick premature infant experiences significant stress such as agitation, autonomic instability and excessive use of calories when incoming sensory stimuli exceed the ability of the immature CNS to respond and adapt, it becomes a priority to help the infant remain calm and organized through reducing avoidable stressors. Developmental interventions within the NICU that support neonatal physiologic stability and brain development include light and sound modifications, therapeutic positioning, nurturing touch, non-nutritive sucking, alterations of caregiver timing and handling techniques, preservation of sleep and increased family involvement.

Kangaroo Care is used extensively in NICU's worldwide and is very beneficial for premature infants. The infant is placed on the mother's naked chest and the baby is wearing only a nappy and a soft hat to keep his/her head warm. The baby is then covered with a blanket or the mother can wear a Kangaroo Care top. The mother's body temperature will rise a degree or two to warm her baby and will then maintain a constant temperature for the baby. Mothers are encouraged in the NICU's to Kangaroo Care their infants as much as possible since it holds numerous benefits for the infant, amongst others; better weight gain, encourages earlier breast feeding and reduces incidence of hospital acquired infections (Faure, 2011:81).

Bergman (2010:78) explains through practicing skin-to-skin Kangaroo Care with premature infants, the mother's body helps the premature baby's body to find a physically healthy balance or stability. This skin-to-skin contact sets healthy set points for the baby's heart rate, blood pressure and oxygen saturation. The author further explains that if the baby is later stressed, he/she will be able to cope better and return to stability or self-regulate. Neuroscience has shown that the baby's brain translates all sensations into emotions. The safe feeling that a baby experiences during skin-to-skin Kangaroo Care, fires the basic brain pathway to approach. The baby will therefore open his/her eyes, even at a very early gestational age and make eye-to-eye contact with the mother which is very important for the bonding and attachment process.

According to Bergman (2010:44-46) every full term infant should be given skin-to-skin Kangaroo Care at birth and emphasizes that it is even more important for fragile premature infants to receive skin-to-skin contact to help them stabilize sooner. The many benefits of skin-to-skin contact through Kangaroo Care for premature infants and their parents are summarized; the infant experiences less stress, brain bleeds and crying, presents with better brain and emotional development, are more alert when awake and sleeps better, the heart rate stabilizes, the infant presents with more stable oxygen saturation, has fewer apnea attacks, feels less pain from injections and presents with better breathing, the infant's temperature is maintained most stable on the mother and breast feeding starts more easily, more gestation specific breast milk is produced by the mother, the infant presents with faster weight gain and can usually go home earlier. The parents; become central to the caring team, experiences better bonding, interaction with their fragile infant, less guilt and emotional healing, parents seems to be calmer, empowered and more confident, they are able to learn their infant's unique cues for hunger, can get more sleep, cope better in the NICU, are less depressed and perceives their baby less as abnormal.

2.2.3 The characteristics of a newly born premature infant

Parents of a full gestation, new born baby are overwhelmed by the wonderful experience of the birth of the new addition to the family. These parents, after nearly nine months of waiting, are usually well prepared and excited to see and hold their baby in their arms. A full term infant may weigh between 2,5 kg and 4,5 kg, have a pinkish colour, is able to cry and have some or a lot of movement activity in the arms and legs. Within just a few days, the newborn infant is able to lift his/her head briefly when lying on the tummy, focus on objects held within 20 to 25 cm from the eyes and is able to move his/her arms and legs on both sides of the body equally well (Eisenberg, Murkoff & Hathaway, 2009:45-47). In contrast, parents of premature infants, already traumatized by the premature birth for which they had not been prepared, may be shocked when they first see their tiny fragile infant and may most probably feel helpless and insecure in how to handle and approach their infant (Lubbe, 2008:1).

The new born, premature infant may look (Bergman, 2010:20,21):

- very tiny with a wrinkled face,
- the head may look too large, longer and thinner for his/her body size and the head bones are very soft,
- arms and legs may be skinny, look long and be stretched straight out,
- ribs may stick out, and most probably cave in with every breath,
- the skin is thin, fragile, shiny, wrinkled and may change colour depending on the amount of oxygen in the blood,
- eyes are sensitive to light and may be kept closed most of the time,
- hands and feet are long and thin, although perfectly formed,
- ears may be very soft and unformed,
- may have hair on the body, especially the shoulders,

- since the tiny body of a preterm may not be ready to cope on it's own, the infant may need lots of tubes and machines to help him/her survive,
- the body systems are still immature:
  - the heart may beat irregularly,
  - the lungs may struggle to breathe
  - the central nervous system is still immature and the infant may present with twitching actions,
  - the digestive system may take time to work properly,
  - the immune system is still immature and may need the mothers colostrum (first milk) to help protect her body.

Premature infants usually only get discharged from hospital when he/she reaches the date that would have been the birth date if born full term and if the baby is medically stable with no other complications. It is important that parents and infants must be ready to go home before discharge from the Neonatal Intensive Care Unit (NICU). The premature infant must have reached certain milestones in the NICU and the parents must feel comfortable and prepared to take care of him/her at home before he/she can leave the hospital (Lubbe, 2008:245). It could take several weeks and even months before a premature infant is ready to go home and this can be a very stressful and frightening time for parents.

2.2.4 The development of the premature Infant

Today it is common to see survivors of preterm births in normal nurseries and schools as a result of advancing neonatal technology and expertise. Ten years ago however it was rare that an infant born below 30 weeks gestation would survive or even achieve a normal developmental outcome. Premature infants now have a significant chance of leading a normal life (Bellman & Peile, 2006:19). It is therefore essential to investigate effective early intervention for premature infants to encourage and support normal development and help them to reach their full potential.

Through making the early identification and treatment of infants and young children with developmental disabilities a greater priority, the importance of minimizing potential developmental delays in infants at risk for handicapping conditions are being emphasized by pediatricians and other health professionals. As a result, attention is directed increasingly toward the identification and treatment of preventable disabilities such as emotional, learning, attention and sensory-motor disorders. This awareness leads to a growing population of children in need of special services, observed by professionals and include an increasing incidence of premature infants who are at high risk of developing long-term perceptual, learning and behavioural difficulties in the school-aged years (DeGangi, 1995:4,5).

According to Brazelton (1992:353) the pathways in the immature baby's nervous system are redundant, in other words, even if there are damaged areas, other areas can take over the functions of the damaged ones if early intervention is started in time. We cannot help an infant to regenerate damaged nerve cells; however there are ways now to help an infant make up for neurological impairment. These techniques must be started as early as possible and for this reason, all premature infants should be assessed before discharged to determine the need for early intervention. Lubbe (2008:269) identifies the following tests which have proven effective for early detection of developmental difficulties; a hearing test, a vision test, a brain scan to determine the possibility of developmental delays, blood tests and a full developmental assessment at 4, 8 and 12 months corrected age.

Brazelton (1992:353) continues that the premature infant is likely to develop at a slower rate because of the cost of organizing such a fragile nervous system. He states, electroencephalographic research has proven that while an infant is acutely ill or on intensive support systems, such as a respirator, his brain goes on hold and does not mature. All of his energy goes into his physical recovery. After he is well, his brain will begin to make progress and enable the infant to catch-up in terms of his development.

Hunter (2010:653) explains that many premature infants do surprisingly well after a long NICU stay, whereas others develop unanticipated problems. The results of a study by Feldman and Eidelman (2006:e869-e878) from the School of Medicine in Jerusalem, Israel indicated that small-for-gestational-age premature infants are at higher risk for developmental and cognitive delays as well as difficulties in the mother-infant relationship across infancy. According to the researchers, infants born with extremely low birth weights are at a double risk and therefore should receive special clinical attention and care.

DeGangi (1995:5) states that putting off the problem has its price. Children and families pay a high personal price in undue stress created by developmental difficulties. These children also place a financial burden on the educational system later on in life. Yet, she continues that with foresight, these difficulties are preventable in many cases. Lubbe (2008:273) emphasizes the importance of parents' responsibility to identify their baby's physical and developmental delays as early as possible to lessen the impact of serious disabilities, prevent pre-school delays and decrease future social and financial dependency. She encourages parents to stimulate their infants once home, to promote optimal development and states that they must play an active role in monitoring their infants' progress. Therefore it is also important for parents to understand that a premature infant's corrected age is generally used in assessing developmental status, at least until 12 months (Hunter, 2010:653; Lubbe, 2008:274)

Parents of premature babies however are most likely to be in desperate need of support since most parents do not anticipate the possibility of having a premature baby. Although parents are keen for knowledge, their understanding may be limited by the overwhelming amount of information they get in this very distressing and uncertain time (Bellman & Peile, 2006:27).

According to Vergara *et al.* (2006:659) occupational therapists working with infants in the NICU as well as their families is highly specialized and only appropriate for therapists with advanced knowledge and skills in neonatal care. Occupational therapy approaches such as sensory integration and neurodevelopmental therapy combined with specialized knowledge of neonatal medical conditions and developmental variability and abnormality are applicable with these premature infants within the NICU to ensure safe, effective practice. It is important to recognize the special needs of these families.

Therefore it is evident that the pediatric occupational therapist has an important role to play in supporting parents of premature infants as well as with regards to appropriate early intervention to support premature infants in their development post-discharge from the NICU.

2.3 SENSORY INTEGRATION

In normal developing children, sensory integration is an ongoing process that occurs on a subconscious level allowing for the development of body scheme or body image and of skills across many areas including cognitive, motor, social, and emotional realms (Ayers, 2008:13).

Paris and Murray-Slutsky (2000:87) supports the work of Jean Ayres by confirming that sensory integration is what allows us to take all of the continuous streams of information from within our bodies and the environment around us and use the information to learn, plan and organize our behaviour.

Sensory information is continuously received into the nervous system from two sources; the environment or from within our bodies. This sensory information includes not only the five senses most people are aware of namely auditory (hearing), visual (seeing), olfactory (smell), gustatory (taste), and tactile (touch), but also vestibular input (movement and balance), kinesthetic/proprioception input, pain, pressure receptors from the internal organs and chemical input (Bundy & Murray, 2002:13; Paris & Murray-Slutsky, 2000:83).

The sensory information that is received is converted by receptors into electrical or chemical energy which the body can decode, transport and use for function; for example within the eye, specialized receptors have specific decoding functions namely one type of receptor transmits light and another colour etc. The receptors are divided into different categories dependent on the type of receptors:

- Distance receivers – concerned with events at a distance, removed from the immediate vicinity of the body, making the person aware of the external, remote environment.
- Exteroceptors – concerned with the external but near environment and makes a person aware of the people and things in our immediate environment.
- Interoceptors – concerned with the internal environment of a person responsible for pain, temperature and light touch but also proprioceptors which provide information about the position of the body in space.

Information is received from each sense separately however, once the sensory information enters the nervous system it begins to be combined, compared and contrasted. The basic senses are closely connected to each other and form interconnections with other systems within the brain (Lane, 2002:42; Paris & Murray-Slutsky, 2000:83,84).

This process is a complex interplay between the various senses however to summarize, the impulses travel from the receptors up through the spinal cord, brain stem and midbrain. From the midbrain some impulses go to the cerebral cortex and others to the cerebellum where the information is decoded, synthesized and dealt with (Paris & Murray-Slutsky, 2000:84). Reeves

(2001:89) added that as the brain assimilates and organizes information from ongoing sensory experiences, the coordination and balance of CNS responses are essential for the sensory integration process.

Table 2.1 below summarizes the functions of the major components of the CNS that involves the processing of all the sensory input from the internal and external environments.

TABLE 2.1 Components of the Central Nervous System (CNS).

<table>
<tr><th>THE MAJOR COMPONENTS OF THE CENTRAL NERVOUS SYSTEM</th></tr>
<tr><th>BRAIN AND CEREBRAL CORTEX</th></tr>
<tr><td>

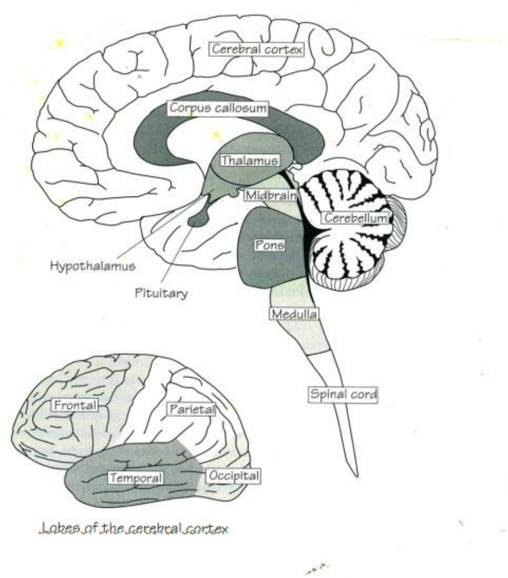


FIGURE 2.1 The Brain and Cerebral Cortex (Eliot, 2000:7)</td></tr>
<tr><th>SPINAL CORD LEVEL</th></tr>
<tr><td>

At this level, spinal cord reflexes are generated, e.g.:

- The muscle stretch reflex (simplest form of reflex); A stretch to the muscle serves as the stimulus that initiates this reflex which then leads to a reaction, a contraction of the muscle. This is a protective reflex, it prevents the muscle from injury when the muscle is stretched to the point of tearing (Lane, 2002:43; Paris & Murray-Slutsky, 2000:84,85).

</td></tr>
</table>

BRAINSTEM – MIDBRAIN (Thalamus and Hypothalamus), PONS and MEDULLA (see above in FIGURE 2.1)	
Reticular activating formation (RAS). Runs through the pons, hypothalamus and thalamus.	Activity in this system produces the conscious–alert state that makes perception possible. o It is a network of interconnections between ascending sensory tracts, and o forms interconnections from the trigeminal, auditory, visual and olfactory systems, o has the capability of heightening or dampening the information passing through it, o it is a non-specific system, can be activated by many types of sensory input, o believed to contribute to difficulties in modulation of sensory input and regulation of behavior, arousal and emotion (Lane, 2002:38; Paris & Murray-Slutsky, 2000:84,85).
Pons	Houses all the regulatory or vegetative functions of the brain and are recognized as measureable and observable indicators of neuronal regulation. o Respiration o Blood pressure o Heart rate, etc (Lane, 2002:43; Paris & Murray-Slutsky, 2000:85)
Hypothalamus	Functions include some fairly discrete visceral reflexes and other complex behavioural and emotional responses. Autonomic responses are triggered here: • including hormonal reactions involved in rage and other strong emotions, • possible chemical transmitters namely, epinephrine and norepinephrine are used by stimulated areas within the hypothalamus and contribute to arousal levels, sensory regulation and levels of stress and anxiety (Lane, 2002:43; Paris & Murray-Slutsky,

	2000:85).
Thalamus: The communication center for all sensory information.	o Serves as a way station for all types of sensory relays to the cerebral cortex and other structures. o Thought to aid in focusing attention to relevant stimuli by the processes of correlation and integration that occur within. o A small portion of the thalamus has a very large reciprocal relationship with the frontal lobe and is involved with emotion and behaviour. o It is a way station for outward-traveling information from the cortex to other areas within the brain. o It's messages may be facilitating or inhibiting to the system (Lane, 2002:43; Paris & Murray-Slutsky, 2000:85).

CEREBELLUM	CEREBRAL CORTEX
o Responsible for coordinating muscle groups in synergy throughout the body, o Responsible for timing and sequencing of muscles for synergies of actions so that movements are performed smoothly and accurately, while combining information with the proprioceptive system to ensure the movements are graded appropriately to the task. o Is constantly informed of commands being issued by the cerebral cortex and pyramidal systems via the thalamus, o All sensory modalities feed their impulses to the cerebellum, o After evaluation of these signals, the cerebellum is able to make automatic and appropriate corrections for mistakes	**LIMBIC SYSTEM**: an area of cortical tissue surrounding the hilum of the hemisphere and is comprised of the hippocampus, its central structure and the amygdala. o It is responsible for integrating cortical and hypothalamic functions. o Limbic system circuits have been noted to have a prolonged after-discharge following stimulation, e.g. emotional responses are generally prolonged and will outlast the stimuli that initiate them. o There are relatively few connections between it and the cortex and therefore relatively little opportunity for cortical influences. o Involved in the process of learning. o Evidence exists that avoidance and

or inaccuracies in muscle activities. o Is believed to be involved in the control of emotions, behaviour and learning of some motor skills (Lane, 2002:43; Paris & Murray-Slutsky, 2000:85).	defensive behaviours are orchestrated by mechanisms within this area of the brain (Lane, 2002:40; Paris & Murray-Slutsky, 2000:85). **Hippocampus:** communicates input from the cerebral cortex to the hypothalamus and thalamus and sends information back to the cerebral cortex. It is involved with learning, memory, cognition, motivation and emotion (Paris & Murray-Slutsky, 2000:85). **Amygdala:** involved with the ability of the system to psychologically prepare for action. Works with the hypothalamus to control biologic rhythms and sexual behaviour, and contributes to motivation (Paris & Murray-Slutsky, 2000:86).

Neuronal regulation or transmission occurs via chemicals called **neurotransmitters**, released at the cellular level within each area of the CNS. These neurotransmitters:

- determine whether excitation or inhibition will occur, each neuron within each area of the CNS is constantly bombarded by adjacent neurons sending both excitatory and inhibitory input at the same time,
- the combination of input is integrated by the neuron through neuronal integration, which determines whether a cell will fire (Lane, 2002:42; Paris & Murray-Slutsky, 2000:84).

The interconnection of all of these systems provides for inhibitory and excitatory mechanisms that regulate attention and arousal, generate adaptive responses to our environment, aid in regulation of emotional tone, and control our ability to function (Lane, 2002:42; Paris & Murray-Slutsky, 2000:84).

If neuronal excitability becomes too intense, the disintegration in interaction between multiple systems can occur. It can cause confusion, irritability, fluctuations in emotional tone, and disorganization within the system. A simple tactile stimulation may be perceived as aversive or threatening vestibular information may be disorienting auditory stimulation may become too intense and visual stimulation overwhelming. However, if the information is received and coordinated accurately with other sensory information, a person is able to interpret a situation accurately, control emotions and behaviour and make an appropriate organized response (Paris & Murray-Slutsky, 2000:84).

2.3.1 THE SENSORY SYSTEMS AND THEIR FUNCTIONS

According to the Ayers Sensory Integration (ASI) theory, the brain does not function in terms of isolated sensory modality development or function. Tactile/proprioceptive and vestibular/proprioceptive systems interact routinely with the auditory and visual systems to supply multimodal sensory information needed for an individual to make a meaningful motor response (Spitzer & Smith-Roley, 2001:7). Therefore for the purpose of this study, sensory systems and their functions will be discussed in terms of; The somatosensory system (tactile/proprioceptive system), the vestibular/proprioceptive system, the visual system and the auditory system.

2.3.1.1 The Somatosensory System: Tactile and Proprioception

The somatosensory system is responsible for sensations arising from both the tactile and proprioceptive input. Information received from the tactile system is compared with and contrasted to the information from the muscles and joints (proprioceptive system). The combination of these systems operating as a team enables us to develop spatial and temporal concepts and to perform movements automatically without depending upon other systems (Lane, 2002:43; Paris & Murray-Slutsky, 2000:89).

An infant’s ability to feel, lies within the two regions of the somatosensory cortex on each side of the brain because ascending sensory pathways cross the middle of the body. Sensations on the right side of an individual’s body trigger activity in the left region of the somatosensory cortex and vice versa, therefore each somatosensory region contains a map of the opposite half of the body as illustrated below in Figure 2.3 (Eliot, 2000:125).

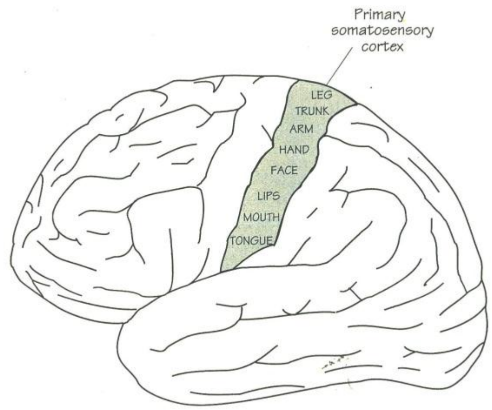


FIGURE 2.2 The somatosensory region of the cerebral cortex (Eliot, 2000:126).

According to Eliot (2000:130) premature babies as young as 25 weeks post-conception presents with electrical activity in the somatosensory cortex in response to touch stimuli. These responses, still extremely slow and immature speed up dramatically in the last few weeks of gestation. Brain imaging indicated that the primary touch and motor regions of the newborn infant's brain are the only areas of the cortex to show any significant activity, emphasizing the significance of an infant's tactile awareness. The infant's sense of touch however is far from mature at birth. Sensory axons entering the spinal cord aren't fully myelinated until 6 months of age, while thalamic axons entering the cortex begin the maturation process one month before birth and complete it after 12 months. Electrical responses to touch in the somatosensory cortex grow stronger and faster throughout the first year of life, parallel with this myelination.

The tactile system is the most pervasive system and is comprised of all the touch receptors of the body. The skin is the primary receptor; the sensory receptors within the mouth are also tactile receptors. They perceive texture through tactile input, separate from taste (Paris & Murray-Slutsky, 2000:89). According to Lane (2002:43-44) the tactile system receptors are mechanoreceptors, the process of neural transmission begins when a mechanical force for example light touch, deep pressure, stretch or vibration is applied to the receptors. Figure 2.3 below illustrates how a cold teething ring activates both touch and temperature receptors in the fingers, electrical excitation is then sent through the spinal cord, brain stem and thalamus and is then terminated in the somatosensory cortex where the teething ring is consciously perceived by the infant (Eliot, 2000:124).

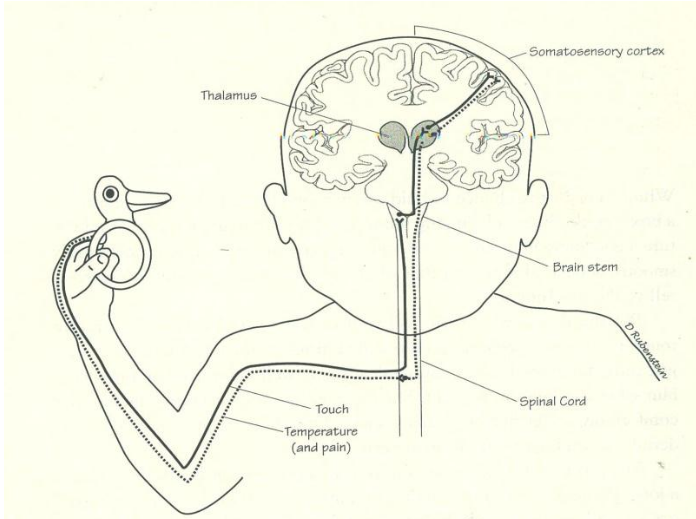


FIGURE 2.3 The Neural pathways of touch (Eliot, 2000:124).

The two major pathways of tactile sensation are the anterolateral system and the dorsal column medial-lemniscal tract (DCML). Tactile information is received from various sensors in the skin and relayed to the CNS via the anterolateral spinothalamic pathways and the DCML. The proprioceptive information is integrated with the tactile system via the DCML pathway and the information is carried to the somatosensory cortex for discrimination of touch and proprioception (Lane, 2002:43-44; Paris & Murray-Slutsky, 2000:87).

The anterolateral system consists of three tracts; the spinothalamic, spinoreticular and spinotectal tracts. They transmit the sensations of pain, temperature, crude and light touch. This system extends through the spinal cord and brain stem, supplying information to many areas. It is slow moving and poorly organized and provides less discriminate spatial or temporal information. It also passes through the reticular formation part of the brain stem, and thus influences levels of arousal and emotional tone. The information is relayed first to the hypothalamic structures and then to the limbic system and therefore is highly integrated with emotional behaviour that provide for emotionally charged responses to the sensations. Integration at this level enables fight or flight response to pain, high temperature and other potentially dangerous or threatening situations. This system also projects to the thalamus, the communication system for all sensory information (Lane, 2002:49; Paris & Murray-Slutsky, 2000:87).

The modalities associated with the DCML tract, include discriminative touch, two-point discrimination, stereognosis, awareness of shape, size, texture, awareness of passive movement, position sense, vibration sense and weight perception. It contributes to information that facilitates spatial perception of one's body and awareness of body image. It also contributes to object manipulation and motor planning. It is hypothesized that the DCML system modulates arousal and have strong inhibitory influences on the spinothalamic system. Greater tactile discrimination leads to decreased tactile defensiveness and results in better central nervous system organization. Deep touch pressure and proprioception also decreases the sensation of pain (Lane, 2002:45; Paris & Murray-Slutsky, 2000:88).

In addition to these two major somatosensory pathways, the trigeminothalamic tract is responsible for tactile discrimination in the face, lips, mouth and tongue (Lane, 2002:51). It is a very important component in oral praxis and plays an important role in terms of tactile discrimination for infants through the mouthing of objects.

The function of proprioception is described as the perception of joint and body movements as well as the position of the body or parts of the body in space. The system is comprised of a variety of receptors within our muscles, joints, ligaments and tendons. The receptors located in the muscles are the muscle spindles and Golgi tendon organs which sense elongation of muscle fibers and tension, or the force being exerted by the muscle. These receptors are responsible for the stretch reflex as a protection against injury, and the ability to cortically override the stretch. Impulses from the muscles reach the cerebellum without affecting consciousness and provide the body with the automatic background activity, which is postural tone and balance (Lane, 2002:45; Paris & Murray-Slutsky, 2000:88).

The information from these sources is conveyed through the dorsal root of the spinal cord via the DCML, lateral spinothalamic and spinocerebellar tracts yielding vital information essential for awareness of the position of the limbs and about their movements. Most proprioceptive impulses reach the CNS on an unconscious level. The information passes through the thalamus, where it is analyzed against all other incoming or outgoing sensations before being relayed to the cerebellum. The cerebellum uses all the information to predict, judge and correct the motor act to achieve the correct force, direction and rate of muscular contraction and relaxation. This allows for automatic, unconscious motor control. The pons which houses the reticular formation exerts either a facilitating or inhibiting influence on the information and the hypothalamus allows for emotional response to stimuli and is responsible for eliciting increase muscle power when needed. The parietal lobe is responsible for the motor response to the stimulus (Lane, 2002:47; Paris & Murray-Slutsky, 2000:88).

In conclusion; early tactile experiences according to Eliot (2000:123-138) are important for an infant's sensory-motor development, physical growth, motor skills, development of cognitive potential, the infant's understanding of the physical world, health and emotional well-being. According to the author, genes and experience interact to shape the brain (nature versus nurture). Touch sensitivity develops in a head-to-toe sequence with the mouth being the first region to become sensitive and is used by babies to explore objects.

Lane (2002:51) describes touch as the first 'language' and states that the tactile system plays a very important role in determining behaviour. The tactile sense is the first system to function in-utero and mediates an infant's first experiences in the world after birth through being nourished, calmed and forming attachments through bonding. Eliot (2000:123) adds that at 12 weeks gestation almost the entire surface of the body is responsive to touch, however an infant has a long way to go until he/she can discriminate all different types of tactile sensations and accurately pinpoint the location of a touch sensation on his/her skin. The somatosensory system does however enable an infant to, at birth feel a lot more than he/she can see, hear or taste. She continues that an infant's early experience of touch and being touched are very important for molding later tactile sensitivity, motor skills and the understanding of the physical world as well as for his/her health and emotional well-being.

2.3.1.2 The Vestibular and Proprioceptive systems

According to Lane (2002:58) vestibular and proprioceptive processing are hypothesized to jointly contribute to the perception of active movement, development of body scheme and the development and use of postural responses especially those involving extensor muscles. These two systems together with vision provide:

- subjective awareness and coordination of movement of the head in space,
- postural tone and equilibrium,
- coordination of the eyes, head and body, and stabilization of the eyes in space during head movements, for example compensatory eye movements.

The vestibular system is responsible to detect movement and the direction thereof as well as if the body is upright or not. This system also signals when balance is threatened. When this information is not delivered accurately by the vestibular system, the world becomes a very confusing and frightening place. Vestibular information is the reference point against which other sensory input for example tactile, proprioceptive, auditory and visual are measured and is what allows localization of a stimulus, concepts of spatial and temporal relationships and body orientation to the environment (Lane, 2002:58; Paris & Murray-Slutsky, 2000:90). Figure 2.4 below illustrates the vestibular system pathway.

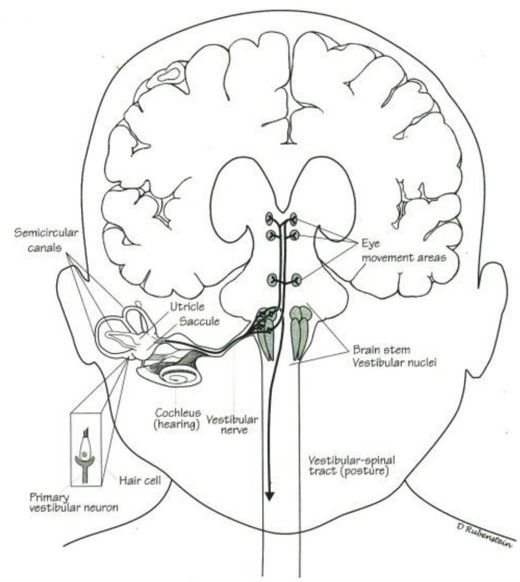


FIGURE 2.4 The Vestibular System - Balance and motion (Eliot, 2000:149).

According to Trott, Laurel and Windeck (1993:6), our Vestibular system is our sense of movement and gravity through which we develop a relationship with the earth and knowing what is right side up, upside down, left, right, horizontal and vertical. This information is the basic to everything we do, and paces the functioning of the entire CNS and prepares it for other sensory input. It also provides us with a sense of safety that can come only from knowing that one's feet are planted firmly on the ground.

The five components of the vestibular apparatus are the two otolith organs namely the utricle and the saccule, and the three semicircular canals. Receptors for the vestibular system are hair cells located within the apparatus in the inner ear very close to the receptors of the auditory system. The hair cells in the otolith organs (utricle and saccule) are attached to the macula, and the hair cells of the three semicircular canals are attached to the crista ampullaris (Lane, 2002: 53; Paris & Murray-Slutsky, 2000:90).

The otolith organs are primarily responsible for static functions and information processed by these receptors is used to detect the position of the head and body in space and control of posture. Together the utricle and saccule respond to head tilt in any direction and to linear slow movement, these structures are critical to the maintenance of upright posture and equilibrium (Lane, 2002:53; Paris & Murray-Slutsky, 2000:90).

The utricle are concerned with movement in relation to gravity (linear acceleration) and the position of the head in space where the saccule is believed to be a receptor of vibratory stimulation to the face and head and may influence eye movements. The response of the organs is tonic, for example placing and hold (Lane, 2002:54; Paris & Murray-Slutsky, 2000:90).

The three semi-circular canals respond to acceleration and deceleration as well as angular displacements of the head. Their responses are phasic, for example coordination of movements also gives us a sense of orientation, it is our internal compass. These vestibular sensations have a direct bearing on our sense of balance, head control, eye gaze, and on our postural and antigravity extensor muscle tone (Lane, 2002:55; Paris & Murray-Slutsky, 2000:90).

Vestibular information is transmitted to the CNS through various pathways which is very briefly summarized as follows in TABLE 2.2 below:

TABLE 2.2 Vestibular System Pathways (Lane, 2002:56-58).

DESCENDING VESTIBULOSPINAL PATHWAYS	
Lateral vestibulospinal tract (LVST)	• Originates from the lateral vestibular (Deiter's) nuclei, • conveys primarily otolith inputs, • descends ipsilaterally to limb, but also axial, alpha and gamma motor neurons (proprioception link), • motor responses are ipsilateral facilitation of extensor muscles and inhibition of flexor muscles (prone extension).
Medial vestibulospinal tract (MVST)	• originates from medial, descending and lateral vestibular nuclei, • conveys primarily semicircular canal inputs,

	• descends bilaterally to axial, muscle, alpha and gamma motor neurons of the neck and upper trunk, • motor responses is bilateral facilitation and inhibition of neck and upper trunk muscles (supine flexion).
Reticulospinal tract: (*arousal and attention*)	• vestibular afferents descend indirectly via the reticulospinal tract to both flexor and extensor alpha and gamma motor neurons, • has both excitatory and inhibitory influences, • projects to the autonomic nervous system (fight and flight reactions).
Functional implications of these descending pathways include head righting and equilibrium reactions, powerful autonomic effect and a proprioceptive link.	
BRAINSTEM LEVEL VESTIBULAR PATHWAYS	
Reticular formation	• Vestibular afferent influence alerting and arousal: - Slow, rhythmic motion tends to decrease arousal. - Fast, irregular motion tends to increase arousal.
Vestibulo-cerebellar pathways	• Extensive direct connections between the vestibular system and the cerebellum, • both are intimately involved in mediating proprioceptive inputs (muscle tone, smooth and coordinated movement), • the spinocerebellar system carries information from muscles, tendons and joints. It is concerned with postural reactions and processes governing standing and walking.
ASCENDING VESTIBULAR PATHWAYS	
Vestibulo-ocular pathway	• Vestibular inputs to the medial and superior vestibular nuclei ascend bilaterally in the medial longitudinal fasciculus (MLF) to cranial nerves III,IV & VI (3 nerves feeding the eye), • projections from the cranial nerve nuclei mediate compensatory eye movements, • responsible for vestibular nystagmus: vestibular-mediated eye movements in conjunction with angular acceleration, • influence of the visual system on the vestibular system (and vice versa).

	Functional implications of this pathway: - The vestibular system works in conjunction with the visual system to mediate eye movements. - The vestibular system does not control all types of eye movements (e.g. visual system mediated eye movements include smooth pursuits, saccades, convergence, divergence). - Postrotary nystagmus is a measure of interaction between optokinetic nystagmus and vestibular nystagmus (not a pure measure of vestibular function).
Reticular-limbic pathways	• Vestibular inputs to reticular system project to the limbic system, • probably related to emotional responses to vestibular input and strong drive of children to seek vestibular stimulation.
Vestibulo-cortical projections	• Vestibular, visual & proprioceptive signals converge at cortical levels to provide conscious awareness of body position in space, • when input from the visual, proprioceptive, and/or vestibular input are in conflict, the vestibular system provides a frame of reference for interpretation of conflict, • thalamus and parietal lobe, • somatosensory transition zone (Area 3A).

Descending impulses within this system reinforce the tone of the extensor muscles of the trunk and extremities, enabling us to be upright against the pull of gravity. Conjugate eye movements occur in response to head movements and to the position of the head in space, and are directly influenced by this system. Without a stable head, conjugate eye use is less than optimal. Vestibular reflexes combined with optic reflexes enable the eyes to remain fixed on a stationary object while the head and body are moving (Lane, 2002:58; Paris & Murray-Slutsky, 2000:90).

Kranowitz (1998:290) describes proprioception as the unconscious awareness of sensations coming from one's joints, muscles, tendons and ligaments, and is described as the position sense. Paris and Murray-Slutsky (2000:89) state that conscious awareness of various parts of the body depends upon impulses arising from the receptors around and in the joints themselves. Velocity receptors discharge during changes in joint angles, and position receptors give us information about joint angles that is not dependent upon movement at the joint (at rest). The information from these sources is conveyed through the dorsal root of the spinal cord via the DCML, lateral spinothalamic and spinocerebellar tracts yielding vital information essential for awareness of the position of our limbs and about their movements.

Most proprioceptive impulses reach the CNS on an unconscious level. The information passes through the thalamus, where it is analyzed against all other incoming or outgoing sensations before being relayed to the cerebellum. The cerebellum uses the full gamut of the information to predict, judge and correct the motor act to achieve the correct force, direction and rate of muscular contraction and relaxation. This allows for automatic, unconscious motor control. The pons (which houses the reticular formation exerts either a facilitating or inhibiting influence on the information and the hypothalamus allows the emotional response to stimuli and is responsible for eliciting increased muscle power when needed. The parietal lobe is responsible for the motor response to the stimulus (Paris & Murray-Slutsky, 2000:89).

Proprioceptive information is integrated with the vestibular and visual systems for the acquisition of postural control, oculomotor control and feed-forward required to anticipate action in time and space. It gives information about the force, speed and direction of movement (Lane, 2002:58). Proprioception, combined with vestibular information provides the CNS with a stable frame of reference against which other sensory input is interpreted (Paris & Murray-Slutsky, 2000:88).

Henderson, Pehoski and Murray (2002:129) state that the influence of vision on balance is secondary to the integration of the vestibular, proprioceptive and tactile signals responsible to orient our bodies to the direction of gravity and to the surface of support. The somatic senses are primarily in postural control but vision also exerts a powerful influence through the mechanism of optic flow.

Post rotary nystagmus illustrates the close connection between the vestibular and the extra ocular muscles. This relationship between the motion receptors and the extra ocular muscles is critical to perceiving the correct relationship between the body's motion and that of the visual fields. The combination of information from the extra ocular muscles, the vestibular apparatus and the visual field itself enables the individual to tell whether his/her eyes are moving, his/her head is moving, or the visual field itself is moving (The Southern California Postrotary Nystagmus test manual, 1976:5-8).

According to Eliot (2000:149), vestibular sensitivity as the sense of balance and motion is the next most precocious sensory skill after touch. The fetus becomes responsive to movement stimulation at just 10 weeks post conception and by 12 weeks the fetus has begun to reflexively moving its eyes in response to a change in head position. She continues that as one of the earliest senses to develop, the vestibular system provides a large share of the infant's earliest sensory experiences and plays a critical role in organizing other sensory and motor abilities as well as influence the development of higher emotional and cognitive abilities. At five months gestation the vestibular apparatus has reached its full size and shape and vestibular pathways to the eyes and spinal cord have begun to myelinate allowing the entire vestibular system to function in a mature way. Other vestibular pathways do however myelinate at a slower pace.

The vestibular system is over responsive during infancy and reaches peak sensitivity between six and 12 months, then declining rapidly until two and a half years and more gradually until puberty. This slow maturation explains why infants and toddlers are wobbly on their feet, but may be useful for other aspects of neurological development. This slow maturation is known to result from gradual modifications in the synaptic strength and dendritic growth of neurons in the brain stem and higher neural centers, as opposed to any changes in the inner ear. Maintaining balance depends on the vestibular-, visual-, proprioceptive systems and motor skills. Maturation of the vestibular system is therefore important for the development of postural abilities (Eliot, 2000:149).

2.3.1.3 The Visual system

Smith-Roley and Schneck (2001:313) emphasizes the importance and complexity of vision which is apparent from the amount of neural tissue that is involved in the processing of visual information with the optic nerve alone that contains more than one million fibers. According to the authors, functional vision develops through a complex variety of experiences that provide inter-sensory information and associations. A person can look at a rose and, in addition to seeing its colour, size and shape, remember how it smells, recall the softness of the petals, and bring to mind its weight and texture. This ability to associate other sensory data with qualities learned through vision alone is the product of sensory integration. According to Kranowitz (1998:294) vision is the process of identifying sights, understanding what you see and preparing for a response.

As a result of light perception, vision occurs. Vision requires the processes of extracting and organizing information from the environment;

- the visual-receptive component, primarily related to reflexive-protective functions and orienting, localizing and tracing functions, as well as the ability to interpret what the individual sees and then use that information,
- the visual-cognitive component, primarily related to voluntary exploration functions and abstract spatial relations.

These two components are essential to all aspects of functional vision (Smith-Roley & Schneck, 2002:313 – 315).

The individual relies most heavily on visual input for day-to-day function on visual input. The visual system functions primarily as an edge, contrast, and movement detector. Visual images are perceived best when they are stable; therefore our visual abilities depend in part on the vestibular-ocular reflex, which contributes to a stabilized visual field. The visual system itself can adjust to movement within the environment with the optokinetic reflex, which works with the vestibulo-ocular reflex to maintain a stable image on the retina. Visual processing is complex, with at least three parallel pathways carrying information that must be integrated (Smith-Roley & Schneck, 2002:313). Figure 2.6 below illustrates the visual pathways from the eyes to the midbrain and to the cerebral cortex.

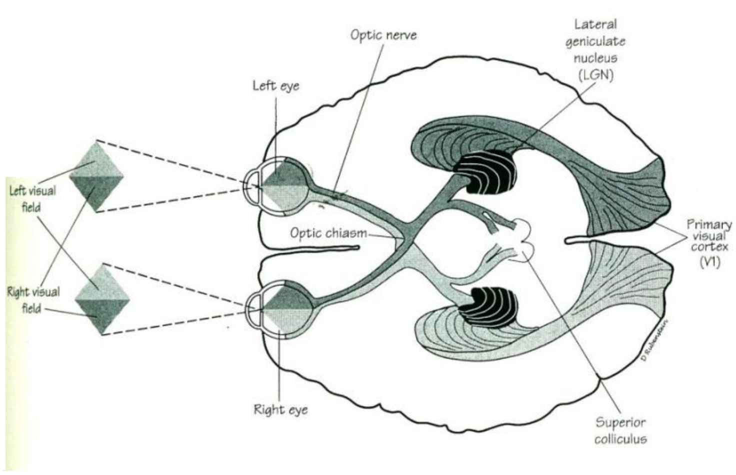


FIGURE 2.5 Visual pathways from the eyes to the midbrain and to the cerebral cortex (Eliot, 2000:201)

Vision receptors are specialized cells located in the neural retina at the back of the eye. These photoreceptors, the rods and cones, transduce light energy into electrical energy that can be transmitted to the CNS. Cones cells are responsible for day vision, mediate colour vision and provide higher acuity than rods do, they respond rapidly. Rods cells are responsible for night vision and are highly light sensitive and able to amplify light signals to enable vision in dim light, they respond slowly. The process of changing light energy into a neural signal begins with the rod and cone cells. These cells maintain tonic activity and transmit information to the CNS in an ongoing manner through neurotransmitter release. Because of the complexity of the retina, a great deal of processing occurs in this structure before the time when information is transmitted via the optic nerve to the CNS (Lane, 2002:61).

The retina has ten layers, receptor cells synapse onto bipolar cells found in the inner nuclear layer and from there connect with ganglion cells, the axons of which form the optic nerve and project to the thalamus. One class of ganglion cell is activated by light directed at the center of its receptor field and the other is turned off by light directed at the center of its receptor field, forming two parallel routes to the CNS that provides the ability to detect contrast in a visual image. Individuals are therefore not dependent on the absolute amount of light available in our visual world to detect shape, movement and colour but instead use light and dark contrast for most of this information. A great deal of information about contrast, colour, form and movement in the visual environment is processed before information reaches the CNS (Lane, 2002:61-62).

Visual processing has not received the same careful analysis in sensory integration theory that other sensory systems have. Yet children who experience difficulties with visual processing, especially the aspects of vision that process and interpret spatial information, are frequently referred to occupational therapy for evaluation and treatment.

Visual processing is commonly divided into two systems. One of these systems recognizes objects. It is attuned to the features of objects that enable us to identify and remember them. This system is referred to as object vision, or the 'what' system. The other system is the 'where' system, or spatial vision. This system determines the locations and positions of objects, relative both to the self and to other objects. It processes the features of objects that are needed for actions. The spatial processing that occurs in the where system is unconscious. It is the contribution of vision to our ability to move in our environment and interact with objects that makes understanding visual spatial abilities important to sensory integration (Henderson, Pehoski and Murray, 2002:124).

According to Eliot (2000:227) vision critically influences mental development such as emotion, language and intelligence. Vision develops at a very quick rate and dominates human sensory experience. Therefore this sense soon becomes the major means through which a child learns about the people and properties of his/her world. The author states that the type of visual experience and visual-motor activities a child engages in early in life are profoundly important in shaping his/her emerging mind.

2.3.1.4 The Auditory system

The ear is the receptor of the auditory system and consists of two functional units; the acoustic apparatus and the vestibular apparatus. Within the auditory system is the vestibulocochlear organ, which consists of three main parts: external, middle and internal. It has two functions, balance and hearing. The external and middle parts are mainly concerned with the transference of sound to the internal ear, which contains the vestibulocochlear organ that is essential for equilibrium and hearing (Moore, Dalley & Agur, 2010:963).

Figure 2.7 below illustrates the neural pathways of hearing through which auditory information is carried from the cochlea through several relays in the brain stem, midbrain and thalamus before reaching the cerebral cortex (Eliot, 2000:233).

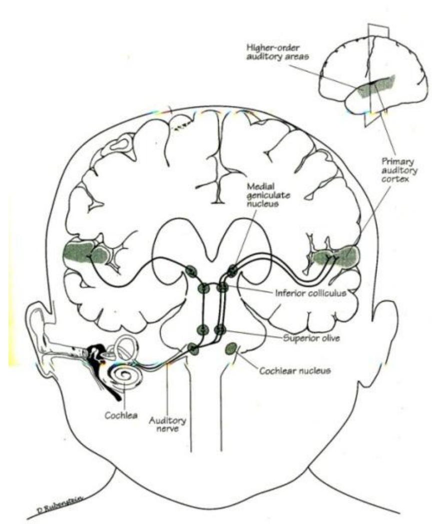


FIGURE 2.6 Neural pathways of hearing (Eliot, 2000:233).

According to Kranowitz (1998:279) audition is the ability to receive and apprehend sounds; hearing. Auditory perception is the ability to receive, identify, discriminate, understand and respond to sounds while auditory discrimination is the process of differentiating among sounds. Auditory figure-ground is the ability to discriminate between sounds in the foreground and background so that one can focus on a particular sound or voice without being distracted by other sounds and auditory sequencing is the ability to recall and repeat in logical order what has been heard. She also describes auditory-language processing skills as the abilities of listening and verbally communicating, acquired as one hears and perceives sounds and interacts with the environment.

According to Eliot (2000:228, 229) the development of hearing begins early but matures gradually. The author explains that although babies can hear well at birth, their auditory skills continue to improve over a very long period until school age. Like vision, a child's hearing has the ability to be modified by experience. The quality of auditory development is influenced by hearing itself. Listening, as early as from the third trimester onwards shapes the way infants' brains become wired to process and understand different sounds. Infants' early experience with speech and music are very important in shaping many higher aspects of brain function, including emotion, language and other cognitive abilities.

According to Reeves (2001:95) the following dysfunctions can occur:

- Deafness can occur due to poor conductance for example if the bone structures or eardrum has a problem or because of damage of the nerves, also spoken of nerve deafness.
- Hearing difficulties influence language development negatively.
- Fluctuating hearing loss can occur when a person has continuous middle-ear infections.

An auditory processing disorder exists when a child does not adequately use auditory information of sensation, resulting in learning difficulties in the following areas; auditory discrimination, auditory figure ground, auditory memory, symbol to sound association, auditory analysis, auditory synthesis, blending sounds e.g. bl as in black, sound closure and linguistics (understanding language, vocabulary etc.). The child may present with ineffective listening skills, poor attention span, inadequate following of instructions, slow processing speed of auditory information, inaccurate sound localization and inappropriate behaviour (Reeves, 2001:95).

2.3.2 SENSORY MODULATION

Sensory modulation according to Williamson and Anzalone (2001:27) is the ability to manage reaction to sensation and is best described in terms a threshold to sensory input. It is a process that occurs on both a neurophysiological level and a behavioural level and is related to the sensory registration step of the sensory integrative process. The authors identifies three important factors in understanding sensory modulation; sensory threshold, the rate of recovery from sensation and the amount of time a child can remain in an optimal zone of responsivity.

Lane (2002:106) explains that modulation of sensory input allows a person to respond to relevant input, not to respond to input that is irrelevant, and to do so in a manner that promotes adaptive environmental interaction. Modulation facilitates engagement in satisfying and meaningful occupations. Appropriate modulation of sensory input lays a foundation for occupation and allows us to engage successfully in self-care, play and work through the function of the CNS.

It is important to consider the sensory threshold, or point of initial responsivity to sensory input when thinking about sensory modulation. Sensory thresholds vary both between and within individuals. In most individuals these thresholds are high enough that one can tolerate the complexity and stimulation inherent in the environment, yet low enough that one can perceive subtle changes and novelty in the environment. When referring to sensory thresholds, one refers to the central process through which input from multiple sensory modalities is combined over time and space (Williamson & Anzalone, 2001:29).

It is hypothesized that modulation dysfunction may have its roots in regions of the limbic system and hypothalamus and is said that the purpose of the limbic function is to integrate and coordinate both our outer and inner world experiences into unity, making the limbic system a likely candidate for involvement in sensory modulation dysfunction. Involvement of the limbic system provides an explanation for the emotional or social difficulties often accompanying tactile and sensory defensiveness, it accounts for the presence of defensiveness or dormancy across sensory systems and allows for extreme shifts or inconsistencies in responsivity from defensiveness to dormancy, that may be observed in an individual either with regard to a single sensory system or more (Lane, 2002:110).

The term sensory defensiveness is used to describe a disorganized response to sensory input resulting from an imbalance between inhibition and excitation within the CNS. This imbalance leads to too little inhibition and a consequent flood of input reaching higher CNS structures. The result is defensive behaviours and can be observed in the olfactory, tactile, and auditory systems. Children with such defensiveness are characterized as overly active, hyper-verbal, distractible and disorganized (Lane, 2002:107).

Researchers assumed that when an individual overreacts (hyper responsive), under reacts (hypo-responsive) or fluctuates in his/her response to sensory stimuli, in a way that is irrelevant for the specific stimuli that is received, the person has a sensory modulation dysfunction. These hyper- or hypo-responsive reactions can be related to vestibular-, tactile-, visual-, auditory and taste or smell modalities. One or more modalities can be affected (Quadling *et al.*,1999:10).

Sensory dormancy is characterized by disorganized and immature behaviour but is described as the result from excessive inhibition of incoming sensory input and a lack of sensory arousal. Dormancy can also be observed in the olfactory, tactile and auditory systems (Lane, 2002:108).

It is also hypothesized that sensory defensiveness and sensory dormancy together formed a continuum with over responsiveness at one end and failure to respond at the other (Lane, 2002:108).

A theoretical model of sensory processing (used synonymously with sensory modulation), was proposed by Winnie Dunn based on a child's neurological thresholds and behavioral response patterns. She refers to a neurological threshold as the amount of stimuli required for a neuron or neuron system to respond. At the one end of this continuum, thresholds are very high and it takes a lot of stimuli to meet the threshold and fire the neurons, at the other end the thresholds are very low and it takes very little stimuli to meet the threshold and fire the neurons (Dunn 2002:15).

She described behavioural responses as the way people act in consideration of their thresholds, at the one end of the continuum children act in accordance with their thresholds and they would behave consistently to this neural activity. At the other end of this continuum children respond to counteract their thresholds (See an example of the Continuum of four Quadrants of Winnie Dunn,

Figure 2.7 below). Habituation according to her theory occurs when we recognize familiar input and no longer need to register or orient to it, it enables us to tune out background information in order to focus on relevant information, for example to hear the lawnmower outside while listening and paying attention to the teacher's lesson in front of the class (Dunn 2002:7).

Neurological Threshold Continuum	**Behavioral Response/Self-Regulation Continuum**	
	PASSIVE	ACTIVE
HIGH (habituation)	**Low Registration**	**Sensation Seeking**
LOW (Sensitization)	**Sensory Sensitivity**	**Sensation Avoiding**

FIGURE 2.7 Relationships between Behavioural Responses/Self-Regulation and Neurological Thresholds (Dunn, 2002:8).

The Ecological Model of Sensory Modulation (EMSM) elaborates both contextual factors and individual symptoms. The four contextual external dimensions (culture, environment, relationships and tasks influence the three personal internal dimensions (sensation, emotion and attention) (Miller, Reisman, McIntosh & Simon, 2001:59 – 60).

The EMSM highlights the external contextual factors interacting with internal characteristics to create SMD. Referrals for occupational therapy in regard to SMD come from a person's inability to interact appropriately with the environment (Miller *et al.*, 2001:59 – 60).

In the EMSM each external dimension interacts with each internal dimension, either to support or to challenge responses in a specific situation. A just-right match between internal and external dimensions occurs when there is a good fit between:

- o the support of demands of the task, relationships, environment and culture, and
- o the individual's capacity for processing sensation, emotion and attention.

A good fit results in adaptive performance (e.g. completed tasks or processes). When the external dimensions do not provide the appropriate framework or impede performance, problems occur (Miller *et al.*, 2001:59 – 60).

According to Kranowitz (1998:123) the hypo-sensitive child with increased tolerance for movement may:

- Need to keep moving, as much as possible, in order to function.
- Repeatedly and vigorously shake his head, rock back and forth, and jump up and down.
- Crave intense movement experiences, such as bouncing, rocking ,assuming upside-down positions.
- Be a thrill seeker, enjoying fast-moving or spinning playground equipment.
- Not get dizzy, even after twirling in circles or spinning rapidly for a lengthy amount of time.
- Enjoy swinging very high and/or for long periods of time.

According to Lane (2002:119) clinical evidence has suggested that in addition to classic examples of Sensory Modulation Disorder e.g. aversive responses to vestibular and proprioceptive inputs, gravitational insecurity and vestibular and proprioceptive under-responsiveness, over-responsiveness may be a factor in both the auditory and visual systems as well.

2.3.3 THE PROCESS OF LEARNING NEW MOTOR SKILLS

Eliot (2000:261) explains that motor milestones are the most obvious indication of neurological progress in the first year of life. Motor skills are divided into gross and fine motor skills according to the types of muscles involved in the motor actions. Gross motor skills require the coordination of large muscles of the trunk and limbs and include both postural and locomotor activities, while fine motor skills use the smaller muscles of the arms and hand and basically involve manipulative activities. Within the first year of life, important milestones can be summarized as follows;

- Gross motor scale: Infants begin with mastering control of the head, progress to rolling over, sitting, crawling, standing and finally walking.
- Fine motor scale: Infants start with hitting movements by the whole arm, then mastering first reaching and grasping an object with the whole hand, followed by grasping between the thumb and several fingers, followed by a true pincer grasp, holding an object between the

thumb and forefinger.

Elliot (2000:264) explains that voluntary movements are initiated in the motor cortex (Figure 2.8) below, electrical signals are then send down from the motor cortex, through the corticospinal tract to control the appropriate motor neurons, whose cell bodies are located in the spinal cord. As seen in Figure 2.9 below, the cortex excites a bicep motor neuron and at the same time represses a triceps motor neuron, causing the biceps muscle to contract and the triceps to relax.

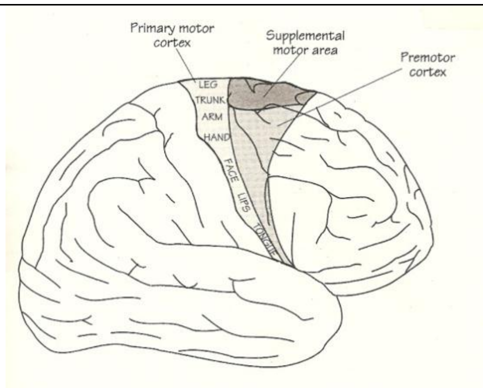


FIGURE 2.8 Major motor areas of the cerebral cortex (Eliot, 2000:265)

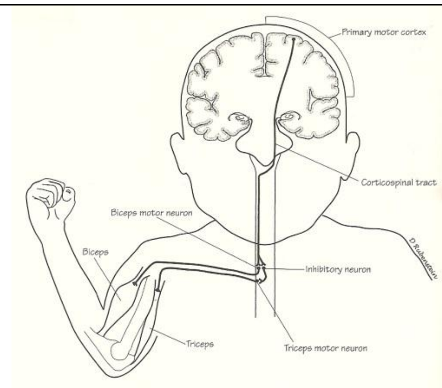


FIGURE 2.9 Anatomy of a simple motor action (Eliot, 2000:266)

2.3.3.1 POSTURAL CONTROL

According to Ayers (2008:88) the ability to change position and move from one place to another without losing balance is a very important aspect of coordination. Postural reactions help infants to lift up their heads, roll over and get up on hands and knees. The foundation for balancing and equilibrium responses that develop later on, are formed through these early postural reactions. These movements depend upon the integration of motor messages and sensory input from the muscles, joints, vestibular system, and to a lesser extent the skin. Posture is assumed to be the outward manifestation of vestibular and proprioceptive processing.

Jacobs and Schneider (2001:29-32) state that the ability to perform isolated movements, especially with the arms and legs requires postural control. Muscle tone, range of motion, weight bearing and weight shifting, proximal joint stability and postural adjustments together play a role in postural control. Movements should not be stereotyped, normal development are distinguished by a variety of sequenced movement patterns. A Variety of movement patterns are the ability to change movements according to the requirements of a task or the environment.

Postural reactions and extra ocular muscle control have been shown to be intimately related on a reflex level, each one affecting the other:

- The vestibular-ocular reflex: Each time the head moves, the semi-circular canals are stimulated, affecting extra ocular muscles and skeletal muscles. This muscle co-contraction elicits proprioceptive input through the semi-circular canals to the eye muscles.
- The optical righting reflex reverses the direction of posture-eye influence.
- Perception of verticality acts on the postural mechanisms to help keep the body upright.
- Ocular movements also have an effect on some of the postural reflexes, including the righting reactions (Cook *et al.*, 2003:12).

Proprioception gives us the unconscious awareness of our body that helps stabilize us when we sit, stand and move. The child with dysfunction lacks the stability to make fundamental postural adjustments for these everyday skills (Kranowitz, 1998:138-142). Muscle tone defined by Kranowitz (1989:287) is the degree of tension normally present when one's muscles are relaxed, or in a resting state. Low tone is the lack of supportive muscle tone, usually with increased mobility at the joints.

The influence of vision on balance is secondary to the integration of the vestibular, proprioceptive and tactile signals responsible to orient our bodies to the direction of gravity and to the surface of support. The somatic senses are primarily in postural control but vision also exerts a powerful influence through the mechanism of optic flow (Henderson, Pehoski & Murray, 2002:129).

2.3.3.2 PRAXIS

Praxis ability is in some ways the highest and most complex form of functioning in children. Praxis requires attention which enables the brain to plan the kind of messages to send to the muscles as well as the sequence in which to send them when new or novel motor actions need to be performed. An infant uses praxis abilities to pick up a rattle, put a spoon into his/her mouth as well as to crawl through a doorway until these actions becomes skills and no longer require planning (Ayers, 2008:89-90).

The word praxis refers to that ability of being able to formulate a concept or idea, organize pertinent information in order to formulate a plan, then sequence, time and execute the movement or motor plan. It involves the ability to know what to do and how to do it (Lane, 2002:71; Murray-Slutsky, 2000:237).

Ayers identified praxis as a fundamental organizational process that involves:

- ideation,
- motor planning, and
- the execution of purposeful actions.

According to this viewpoint, praxis is a process in which one mentally generates and idea of what to do and organizes a temporal sequence of actions within the spatial contexts of the physical world to participate in occupations. Through conceiving, planning and executing adaptive action, sensation is made meaningful and translated into a body percept (Blanche & Parham, 2001:184-185).

Although execution of movement is generally what we observe, praxis primarily entails ideation and planning:

Ideation: Also referred to as knowing what to do or conceptualizing an action, is likely a cortical function. Although ideation cannot be localized to any one area, it is clear that the prefrontal cortex is involved in the process. It plays a major role in setting goals and is active when we perform (or even imagine performing) complex goal-directed sequences of movements, particularly in novel situations. It is also thought to be, in part, the result of basal ganglia activity (Reeves and Cermak, 2002:83-85).

Planning: Both the lateral pre-motor and medial supplementary motor areas (SMA) play important roles in the planning of movement. These areas are described as being involved in the translation of a movement strategy into movement tactics (how to do it) or in selection of appropriate movements. The lateral pre-motor area is active when movement occurs in response to external events. The SMA depends primarily on proprioceptive input. It is activated when action is self-initiated. The SMA is associated with orientation of the eyes and the head and with planning of bimanual and sequential movements. Area 5 of the parietal cortex is another major site of convergence of bilateral proprioceptive input from muscle, cutaneous and joint receptors of the body with input from other sensory systems. Indirect vestibular signals may also project to this area. Area 5 has close connections with pre-central motor areas, including the SMA, further suggesting a role of proprioceptive input to motor planning (Reeves & Cermak, 2002:83-85).

Execution: The motor cortex provides a mechanism for the execution of the movement that is selected when performing a voluntary action. Neurons in the primary motor cortex receive and encode ongoing input about the speed, direction and velocity of movement. This feedback comes from muscles, joints and skin via the thalamus as well as intra-cortical projections from the somatic sensory cortex. Information from the primary motor cortex is transmitted to the muscles for execution of a motor command via the corticospinal and coricobulbar pathways. Movement depends on information traveling from various areas of the brain to alpha motor neurons in the spinal cord. The motor system relies on a continuous flow of sensory information before and during task performance. Information comes in over sensory pathways describing the environment, the position and orientation of the body and extremities, and mechanical information about muscle contraction. In addition for volitional movement to occur, integration between and among brain structures responsible for all levels of motor output is required. The cerebellum also has a major role in the execution of coordinated movements; it has a highly dynamic function with high levels of activity as movement is occurring. The cerebellum also regulates postural control, and guides movements of the eyes, head, body and limbs; it is also thought to play a role in motor learning because cerebellar circuits are modified through experience. It transfers motor tactics from the conscious to the unconscious. The basal ganglia receive significant input from the SMA via the thalamus, projected back to this region. This region of the brain participates in the initiation of movements; it may play its role when movements are complex enough to require sequencing. The basal ganglia are most important in the completion of movement sequences. The ventral system of the basal ganglia also receives information primarily from the limbic system. These connections may sub serve motivation and emotion (Reeves & Cermak, 2002:83-85).

Praxis pertain primarily to the planning of a motor act, is a process that requires knowledge of actions and of objects, motivation and intention on the part of the person. Although praxis may be observed when individuals interact with the physical environment, it entails more than the observed physical act (Reeves & Cermak, 2002:71).

To have praxis, a child must be able to conceptualize a plan, organize the information and carry out the sequence of motor acts. This is the result of sensory registration, integration, schema and engram formation (sensory integration) (Ayers, 2008:90).

Praxis ability is necessary for two broad categories of movement of which one is gross motor control. This is the smooth coordination of the large muscles, which allows a child to bend and stretch, to move his body from one place to another by creeping or running and to move his hands or feet to manipulate objects (Kranowitz, 1998:79).

This information is provided from the tactile, kinesthetic, proprioceptive and vestibular sensory systems. Sensory registration, orientation and ideation will never be formed unless the child carries out the sequence and accomplishes the task. Meaning must be attributed to the sensory information. Also, the ability to carry out the sequence will depend on the child’s knowledge of his body (body scheme) and his ability to integrate the information and process feedback and feed-forward information (Murray-Slutsky, 2000:245).

2.3.3.3 FINE AND EYE-HAND COORDINATION

Exner (2010:276) describes fine motor abilities as patterns dependent on tactile and proprioception as well as visual information for accuracy. As the process of maturation takes place within children, they start to combine visual abilities with fine motor abilities and later, eye-hand coordination with visual-perceptual abilities. Eye-hand coordination is the collaboration of a child’s vision with his hand to perform a movement accurately for example to draw a line from dot to dot.

Eye-hand coordination contributes to visual-motor integration, necessary for stringing pop beads or fitting a jigsaw puzzle piece into place. When a child picks up a jigsaw piece, it is his developing sensory integration that lets him see it, handle it, understand it, and fit it into a puzzle (Kranowitz, 1998:53).

Fine motor skills include a child's ability to perform the following tasks, manipulating buttons of clothes, zips, spin a top as well as controlling a pencil or crayon to make recognizable shapes and symbols. The child also constantly prefers to use one hand more than the other for tool use (Kranowitz, 1998:55).

Motor planning is necessary for fine motor control, which develops after establishing gross motor control. Fine motor activities require the precise use of small muscles in the fingers and hands, in the toes, tongue, lips and muscles of the mouth (Kranowitz, 1998:80).

According to Kranowitz (1998:15) a child with poor eye-hand coordination may have trouble using markers and crayons, creating art projects, building with blocks, doing puzzles, eating neatly or tying shoe laces. This child's handwriting may be sloppy and uneven.

2.3.4 FORM AND SPACE PERCEPTION

According to Smith-Roley and Schneck (2001:313), Jean Ayers originally described vision as being so important that the word perception typically meant visual perception. She discussed visual perception as an end product, contributing to the complex function of form and space perception. Four closely interrelated functions essential to survival were identified:

a) Perception of gravity and motion through space,
b) Extra-ocular muscle control,
c) Locomotion and postural responses, proprioception relative to them, and
d) Visual perception of space.

Visual-spatial processing skills are perceptions based on sensory information received through the eyes and body as one interacts with the environment and move one's body through space. The following are visual processing skills:

- Depth perception, the ability to see objects in three dimensions and to judge relative distances between objects or between oneself and objects,

- Directionality, the awareness of right/left, forward/back, and up/down and the ability to move oneself in those directions,
- Form constancy is the recognition of a shape regardless of its size, position or texture,
- Position-in-space is the awareness of the spatial orientation of letters, words, numbers or drawings on a page or of an object in the environment,
- Spatial awareness is the perception of one's proximity to or distance from an object as well as the perception of the relationship of one's body parts,
- Visual discrimination is the differentiation among symbols and forms such as matching or separating colours, shapes, numbers, letters and words,
- Visual figure-ground is the differentiation between objects in the foreground and in the background (Kranowitz 1998:295).

Ayers emphasized the importance of the learned ability to attribute meaning to the sight of the body-space environment as an end product of adaptive motor responses. She discussed form and space perception as an idea, a cognitive process based primarily on vision. She was the first to highlight the contributions of the vestibular/proprioceptive and tactile sensations to the development of the functional use of form and space perception (Smith-Roley & Schneck, 2001:324).

Unconscious visual-spatial processing does not only guide our movements but also contribute to the conscious processing referred to as spatial cognition. Visual spatial abilities are a component of many cognitive skills. These are skills we use when understanding relationships between lines, angles and curves that are needed in geometry or architecture or in visualizing potential chess moves as well as finding your way in a new place without getting lost (Henderson, Pehoski & Murray, 2002:131).

Movement through space requires coordination of vestibular, proprioceptive and visual systems primarily through the dorsal stream. Spatial cognition depends primarily on both the ventral and dorsal streams of the visual system as well as the prefrontal cortex for the discrimination of spatial properties such as the position, orientation and size of objects and their parts. The common link is the dorsal stream, which tells us where objects are relative to ourselves and to each other. Without this there is no spatial component (Henderson, Pehoski & Murray, 2002:131).

Constructional performance is a perceptual activity with a motor response that includes drawing and assembling, it has a strong spatial component. Construction requires not only spatial abilities processed by the dorsal system and elementary form perception as processed by the ventral system but also a wide range of cognitive abilities, which may include attention, concentration or verbal facility depending on the task. It is divided into two types, drawing and copying as well as assembly (assembly is the use of objects to construct a design) (Henderson, Pehoski & Murray, 2002:131).

2.4 The development of sensory integration

Ayers (2008:13) explains that from birth to the age of 7 years, a child learns to sense his body and the world around him. He learns how to move effectively in that world, how to interact with gravity as well as innumerable objects within this world namely pieces of furniture, clothes, shoes, eating utensils, toys pencils, books as well as other people. He learns what different sounds mean, how to make sounds and eventually how to speak. He receives sensory information from each of these and must develop sensory integration to use the sensory information and interact effectively. According to Ayers (2008:13), sensory integrative functions in all children develop in a natural order, with the same basic sequence although some children develop faster and some more slowly. She states that children who deviate a great deal from the normal sequence of sensory integrative development are most likely to have trouble later on with other aspects of life.

Jean Ayers in Spitzer and Smith-Roley (2001:6) described sensory integration as the organization of sensory input for use. The foundation that enables meaningful and purposeful participation in a variety of daily occupations is provided through normal sensory integrative abilities. The sensory integration theory considers the dynamic interactions between an individual's abilities or disabilities and how they act or interact with their environment (Spitzer & Smith-Roley, 2001:6).

According to this model the sensory integration to engagement in daily occupations resembles a rolling wheel and its parts represent the following aspects:

- THE HUB: Sensory integration
- THE SPOKES: Sensory modulation, supporting social engagement and emotional well being and sensory discrimination, supporting praxic skills and postural, ocular and oral control.
- These spokes link to a RIM of: Adaptation, motivation and organization.
- The wheel supports the TIER of: Occupations; work, play, leisure and rest. The wheel spins in an occupational context of the physical, social, and cultural environments. The wheel (in its entirety and in its parts) and the environment are in constant interaction, exerting forces on each other. The degree of flexibility and interaction with the occupational context can be much greater than that of a literal wheel rolling through physical space (Spitzer & Smith-Roley, 2001:6).

The core theoretical components of sensory integration are summarized by Spitzer and Smith-Roley (2001:6) as; the necessity of integrated sensation, the adaptive response and self-direction, the dynamic process of sensory integration, as well as the role of sensory integration in typical development.

2.4.1 Basic principles of child development according to Jean Ayers

Ayers (2008:13) identified basic principles of child development. According to Ayers, the most basic principle deals with organization. She states that most of the activity in the first 7 years of life is part of one process: the process of organizing the sensations in the nervous system.

2.4.1.1 Organization through adaptive responses: The greatest sensorimotor organization occurs during an adaptive response to sensation, a response in which the person deals with his body and the environment in a creative or useful way, e.g. a baby hears a sound and turns his head in the direction of the sound or a newborn infant is placed on his tummy and he lifts his head and turns it to the side to be able to breathe more easily (Ayers, 2008:14).

2.4.1.2 The inner drive: Every child has a great inner drive to develop sensory integration. A baby does not have to be told to crawl, stand up or climb, he is directed by nature from within. Without this inner drive toward sensory integration, none of us could have developed (Ayers, 2008:15).

2.4.1.3 Building blocks: In this sequence of development, the child uses each activity to develop building blocks that become the basis for more complex and mature development (Ayers, 2008:15).

TABLE 2.3 The major developmental steps in the path of sensory integration 0 – 12 months summarized (Ayers 2008:16-22).

The first month	**Touch**	• The sense of touch operates fairly well for several months in the womb. • Therefore a newborn is able to interpret some of his body sensations and respond with built-in reflex movements, e.g. if you gently touch an infant's cheek, he is likely to turn his/her head towards your hand or if you place a cloth over his/her face, he will try to get it of by moving his/her head and arms. • Although these reactions are automatic, the sensations must be integrated for the reflex to occur in a meaningful and purposeful way, e.g. sensations from a wet diaper makes the infant uncomfortable, while the touch of his/her mother's hand is comforting. • An infant is unable to discriminate where he/she is being touched because his/her brain cannot differentiate one spot from another. • Touch sensations at this age are more important as a source of emotional satisfaction. • The touching between an infant and his/her mother is essential for brain development and the development of the mother-child bond. • The infant will automatically grasp any object that

		touches the palm of his/her hand, a reflex designed to help the child hang on to something so that he/she doesn't fall. • The infant's hands often remains curled into loose fists for the first few months of life since he/she does not have the ability to open or extend his/her fingers. • The caregiver's nurturing touch and rhythmic movements are essential in early development.
	Gravity and Movement	• Shows responses to the sensations of gravity and movement that come from his inner ears. When held in your arms and suddenly lowered, a newborn baby would show alarm and his/her arms and legs may move outward as though to grasp something. It is the messages he/she receives from his/her inner ears that he/she is falling and that he better try to do something to protect himself/herself. • This clinging or flexion movement of the entire body is the first total body motor pattern. • When held up with his/her head resting on his/her parent's shoulders, the one month old infant would intermittently try to lift up his/her head. The pull of gravity stimulates the part of the brain that, in turn, activates the neck muscles that raise the head. • This adaptive response will develop over the next few weeks so that the baby can lift his/her head while lying on his/her stomach. At one month this neural mechanism is still immature, the infant's head wobbles and needs support. • The sensations of gentle body movement tend to organize the brain. In addition to calming the baby, carrying and rocking provide sensations that are essential building blocks for other sensations and for self-determined body movements.

	Muscle and joint sensations	• Senses how to adjust his/her body to fit nicely into the arms and body of the person holding him/her through his/her muscles and joints. • In the first few months the infant makes many movements that appear random and haphazard in an effort to practice and organize many, many movements to develop motor skills, later these movements become well organized. • Sensations from his/her muscles and joints and inner ears stimulate his/her nervous system to produce movements, e.g. when lying on his/her back he/she thrusts his/her arms and legs out playfully and when lying on his/her stomach, he/she makes alternating crawling motions. • The infant's inner drive helps him/her to organize these sensations and movements. • Muscle and joint sensations tell the brain when the head is turned to one side, activating the tonic neck reflex which makes the arm on that side tend to extend or straighten while the other arm tends to bend at the elbow. This is only a tendency, it does not always happen when the infant's head is turned. • The tonic neck reflex influences the muscle tone in our arms for our entire life, however it's influence should become negligible by the sixth year.
	Sight	• The 1 month old infant's sense of sight is not very well organized, although he/she recognizes his/her mother's face and other significant objects. • Focus is vague and cannot differentiate complex shapes or colour contrasts. • Can sense danger in movement or in touch, but not from sight. • First step in developing vision: to learn to follow a

		moving object or person with his/her eyes and then his/her head. An adaptive response that requires sensations from the muscles surrounding the eyes and in the neck, in conjunction with gravity and movement sensations from the inner ears. • An infant becomes alert and happy when he/she sees movement in people or animals or toys, practicing his/her ability to follow them with his/her eyes.
	Sound	• Will respond to the sound of a rattle, bell and to the human voice although he/she cannot understand what these sounds mean. • May turn his/her head and smile in response to sound. Simply responding to sounds is the first building block in the development of speech. • Makes small throaty sounds. The muscular contractions in the throat that cause these sounds also produce sensations that help to develop speech areas of the brain.
	Smell and Taste	• Together with the senses of gravity, movement and touch, the sense of smell is another sense that is well organized at birth and is not further developed and refined in the older child in the way that sight and hearing are. • The infant can taste well. • Sucking is an adaptive response that comes from taste and smell, and the infant usually has the reflex at birth.
• At 1 month the infant has already performed a considerable number of adaptive responses to sensations, particularly to the sensations from his own body and from gravity. • Many of these responses are built into his nervous system before birth and are turned on by the sensation of gravity, movement and touch. • Without the integration that occurs in this simple sensorimotor activity, adequate development would be impossible later in life.		

The second and third months	**The eyes and neck**	• Motor functions develop from head to toe. • The eyes and neck are the first body parts he learns to control. Keeping the head and eyes stable is a fundamental ability that has very important survival value. • Visual perception involves more than just looking at something; the eyes must hold a steady image of the object and the neck must keep the head steady for the object not to appear blury. The brain must therefore integrate three types of sensations: 1) Gravity and movement sensations from the inner ears, 2) Sensations from the eye muscles, and 3) Muscle sensations from the neck. The brain puts these three types of sensations together to know how to hold the eyes and neck steady. As the infant scans the room and looks at people and objects, his/her brain is busy working to integrate the sensations from his/her inner ears. Through this integrative process, he/she learns to "take a clear picture" of the environment even when his/her head or whole body is moving. • In the third month, the child is driven to raise her head and upper body n a way that helps him/her to see and explore her world. • This development will continue for several years and is a vital building block for learning to read, helps the child to learn balance and overall body movement.
	Rising up	• In prone, the infant (after he learns to hold his head up with his neck muscles) uses the muscles in his/her upper back and arms to lift his/her chest off the floor. The urge to lift his chest comes mainly from the sensations of gravity, which stimulate the brain to

		contract the muscles in the upper back. • Learns to sit upright with his/her head balanced if you support his lower back.
	Grasping	• The infant at three months' hands are open most of the time. • Reaches for objects and people but lacks the eye-hand coordination necessary to make his/her reach accurate. • As he/she integrates body sensations with what he/she sees, he/she finds out how to aim properly. • Grasping is still an automatic reaction to the touch sensations in the palm of his/her hand, and he/she cannot voluntarily release his/her hold on a rattle. When he/she grabs, he/she does not use his/her thumb and forefinger, instead he/she holds the objects with his/her three other fingers and the palm of his/her hand. His/her sense of touch sends messages to his/her brain that helps him/her to hold on to the object. • Over the next few months he/she will integrate these touch sensations with the sensations for the muscles and joints in his/her hands and gradually develop a more efficient pincer motion with his/her thumb and forefinger.
The fourth to sixth months	**The arms and hands**	• Makes big movements such as banging a spoon against a table and experiences the thrill of having an impact on the physical world. This very simple emotional satisfaction is a building block toward the more mature emotions that develop later on. • Begins to touch and look at his/her hands, and thereby develops an awareness of where his/her hands are in space. • Touch, muscle and joint sensations along with vision are needed to learn to use his/her hands accurately in conjunction with what he/she sees.

		• The infant needs to coordinate the parts of his/her brain that "see" with those parts that "feel" the hand and arm. • He/she begins to use the thumb and forefinger, but his/her grip lacks precision. • He/she is apt to reach with one hand more often than with both together since he/she can now control his/her urge to reach. • The beginning of coordination between the two sides of the body; one of the most important developments at this age occurs when the infant spontaneously brings his/her hands together in front of his/her body so that they touch each other. • Another step in this development occurs a few months later when he/she holds a toy in each hand and bangs them together. These actions require an important type of sensory integration that must develop long before the child can know his/her right and left. Infants who do not touch their hands together and bang toys are more likely to show signs of poor sensory integration when they are older. • By the sixth month, the child's wrist rotates so he/she can turn his/her hand and manipulate objects and play in many new ways. • Most of the movements in the first 6 months were automatic, but now the infant begins to do things that he/she must plan. Each new play activity involves more of this motor planning and more sensory integration. • He/she can sit alone for a short time without losing his/her balance. The automatic muscular reactions that keep him/her upright are guided by the sensations of gravity, movement, and sight.
	The airplane position	• At about 6 months, the infant's nervous system becomes particularly sensitive to the pull of gravity on his/her

		head while he is lying on his/her stomach. • This sensitivity produces a strong urge to raise the head, upper back, arms and legs all at the same time. • The baby balances his/her whole body on his stomach, and looks a little bit like an airplane. Referred to by therapists as the prone extension posture. • By 6 months, a baby automatically moves upward away from the pull of gravity, orienting his/her head and body in space. • This position is a vital step in developing the muscles that are used for rolling over, standing up and walking. Older children who cannot hold this position often have problems integrating gravity and movement sensations.
	The joy of being moved	• At 6 months the infant likes to be rocked, held up, swung in the air, turned over and moved about. These are among the most satisfying experiences of infancy. The joy comes from experiencing stronger gravity and movement sensations, which the child can now integrate. • If the movements are too rough or the child cannot integrate the sensation, they will disorganize the nervous system and cause him/her to cry.
The sixth to eighth months	**Locomotion**	• Movement from one place to another is one of the most important aspects of development during this period. • Locomotion greatly increases the number of things and places the infant can explore. • Crawling and creeping on hands and knees contribute many sensations to be integrated and also give the child a concept of himself/herself as an independent being. • First the infant must get himself/herself into the prone position, on his/her stomach. The neck righting reflex, which has been active since birth, helps him/her turn over from his/her back onto his stomach. The sensations

		that activate this reflex come from gravity and the muscles and joints of the neck. These sensations activate the neck righting reflex for much of the time at this age, and so the normal infant tends to spend a lot of time lying on his/her stomach.
	Spatial perception	• By 8 months, the child is learning about space and distances as he crawls from one pace to another in a way that helps him/her to navigate the world around him/her. • Locomotion gives the child knowledge about space and the distance between himself/herself and objects in the environment. It is not enough merely to see things to judge distance, the brain must also feel the nature of distance through the sensation of body movement. • As the infant crawl and creeps from one place to another, he/she learns the physical structure of space, and this helps him/her to understand what he sees. • Good distance judgment also helps the child to know how large things are.
	The fingers and eyes	• The infant can now use his/her thumb and forefinger in a scissors or pincer action to pick up small objects or pull a string. • He/she can poke his forefinger into a hole. • The sensation of touch, and those from his/her muscles and joints, provide the basic information and guide these movements. For fine hand motions, however, he/she needs precise information from his/her eyes. • He/she must have fine control over his/her eye muscles to direct his/her eyes precisely to the place he needs to see. To develop precise eye control, the child must already have the simple eye control that developed as he/she lay on his/her stomach and raise his/her head, crawled and crept about in his/her environment.

	Motor planning	• An infant begins to plan his/her hand movements well enough to ring a bell or put simple things together and take them apart. • Movements must be planned inside the brain to complete a series of actions in the proper sequence. • Sensations from the body provide the information necessary for planning movement. • The child begins to look for an object that has been covered up or dropped out of sight. • By touching and moving around objects, he/she learns that they still exist even when he/she cannot see them. This is the beginning of the mental ability to visualize objects.
	Babbling	• The 8 month old listens to sounds well enough to hear details. • He/she recognizes familiar words and knows that some sounds mean one thing and other mean something else. • He/she may repeat simple syllables such as "ma" and "da", although this is not really speech. • Babbling sends sensations from the jaw joint, muscles, and skin of the mouth to the brain. As the brain integrates more and more of these sensations, it learns how to form more complex sounds.
The ninth to twelfth months	**This is a time for major changes in the way the child relates to the earth and the space around his/her body.** • **He/she crawls for longer distances and explores more places in the environment.** • **This stimulates the nervous system with many sensations from the muscles that hold up his/her head and body and the bones that support his/her weight, and also from the pull of gravity.** • **These sensations help him/her to coordinate the two sides of his body, learn how to motor plan, and develop visual perception.** • **He/she spends a lot of time just looking at things and figuring out**	

	what they are. The greater the variety of things he experiences as he/she roams about, the more practice he/she gets in integrating sensations and forming adaptive responses to those sensations.	
	Play	• The infant bangs things together, pulls them off a table, throws them about etc. Very often one of his/her hands reaches across to the other side of his body. • The ability to cross the midline is developed by these motions. Every time an infant puts something together or takes it apart, the brain learns to plan and carry out a series of movements in proper sequence. Every time he/she makes a mess of his/her food with a spoon or scribbles with a crayon, he/she learns something about tools and how to use them.
	Standing up	• One of the biggest events in early childhood is standing up alone. It is the end product of all the integration of gravity, movement, and muscle and joint sensations of the months before. • It requires the integration of sensation from every part of the body, including the eye and neck muscles, which continue to be essential. • Standing up is quite a challenge, since a relatively tall body must balance itself on two small feet. • It is best to allow the child to practice standing up on his/her own, so that he/she masters that challenge by himself/herself.
	Words	• The infant can now understand a fair amount of what parents say but can speak only a few simple words, like "mama" or "dada". • It appears that the sensations arising from body movement help to stimulate the part of the brain that is involved in making these sounds.

2.5 Sensory integration intervention

Eliot (2000:2-9) describes an infant's brain as a learning machine; she explains that through the process of neural plasticity (the way the brain change with experience) infants brains access neural circuits as they're needed, wire them up and develop or sharpen them to the task at hand; for example to reach for a toy or to crawl. According to the author every touch, movement and emotion an infant experiences is translated into electrical and chemical activities, subtly modifying the way the infant's brain is wired together.

Eliot's explanation of neural plasticity as the key to an infant's development correlates with the theory of sensory integration of Jean Ayres. According to Parham and Mailloux (2010:326) and Ayres (2008:5); Ayres' basic theoretical assumption was that the integration of sensory systems within the brain is a critical factor in human behavior and that knowledge of sensory integration function and dysfunction would give insight into child development and help to better understand developmental problems of children. According to sensory integration theory; sensory input is necessary for optimal brain function and Ayres (2008:5) considered sensory input to be nourishment for the brain just as food is nourishment for the body. The brain is designed to constantly take in sensory information and it malfunctions if deprived of it.

Parham and Mailloux (2010:326) add that the mere provision of sensory stimulation is limited in value. Too much sensory stimulation can generate stress that is detrimental to brain development and may reduce the infant's subsequent ability to cope with stress. For sensory input to have an optimal effect on an infant's development, learning and behavior, sensory input must be actively organized and used by the infant to act on and respond to the environment through an adaptive response. This adaptive response is possible if the brain is able to efficiently organize incoming sensory information, which then provides a basis for action. This process indicates sensory integration (Ayers 2008:7).

There is little doubt that the quality of early experience does shape children's brain development in critical ways. Genes as well as the infant's environment are both important however we can do very little about our genes, and a great deal about the kind of environment we provide for our children (Eliot, 2000:2-9). The kind of environment we provide is where sensory integration

intervention plays a critical role in the developing brain of the premature infant through the process of neural plasticity.
Based on sensory integration theory and in consideration of the immature Central Nervous System (CNS) of premature infants which is not sufficiently developed to adjust to and organize the possible overwhelming sensory stimuli and demands of his/her environment, the researcher aims to focus her research specifically on Ayers Sensory Integration (ASI) intervention and how this can support and enhance optimal development.

Note: Miller (2006:4) introduced the term sensory processing to refer to the way the nervous system receives sensory messages and turn them into responses. This change of terminology has recently leaded to controversy amongst occupational therapists specializing in the field of sensory integration. According to the Sensory Processing Disorder Resource Centre (n.d.:1), sensory integration is still being used to describe the theory and treatment based on the original work of Ayres. However, the term Sensory Processing Disorder is used to define and describe the disorder/dysfunction symptoms in aim of making this a universally accepted medical diagnosis and therefore enabling medical insurance reimbursement for evaluation and treatment purposes. The researcher aims to ground the research study on the theory and treatment based on the original work of Ayres and therefore the term sensory integration will be used for the purposes of this study.

According to Ayers (2008:6), sensory integration is an important type of processing. Williamson and Anzalone (2001:15) explain that it involves organizing sensation from the body and the environment for adaptive use. This process occurs in five steps namely; sensory registration, orientation and attention, interpretation, organization of a response and execution of the response. An individual’s subjective perception of a stimulus depends on the intensity, duration and location of the stimulus and it is important to consider how sensation is perceived by an individual and the behavior that results from the processes of sensory integration. This proposed research study aims to encourage integration of sensory input in the premature infant. The researcher proposes that to promote sensory integration of the premature infants participating in this experimental group, their development will be influenced positively.

According to Williamson and Anzalone (2001:17) we must learn to recognize clues to the sensory basis for a child’s behavior. These clues will provide and suggest intervention approaches that are likely to promote a child’s learning and performance.

Williamson and Anzalone (2001:18-23) and Schaaf and Anzalone (2001:281-283) discusses a useful set of lenses for focusing on the observable behavior that results from infants' sensory integration which were provided by Lester, Freier and LaGasse in 1995. The four A's of infancy identified by them are as follows:

- **A**rousal which refers to the infant's ability to maintain alertness and make transitions between states,
- **A**ttention which refers to the infant's ability to focus selectively on a desired stimulus or task,
- **A**ffect which refers to the infant's emotional component of behaviour, and
- **A**ction which refers to the infant's ability to engage in adaptive, goal-directed behavior.

These four A's of infancy listed above describe the principal ways in which infants and toddlers perceive and modulate sensory information and form the core of behavioral regulation in infants. Balanced self-regulation is achieved when there is a good fit between an infant's sensory integrative capabilities and the demands of the physical and social environments, goodness-of-fit (Williamson & Anzalone, 2001:23).

Intrinsic factors consist of arousal, attention, affect and action, the four A's as discussed above as well as sensory responsivity and self-regulation. These intrinsic factors are interrelated and influence each other (Schaaf & Anzalone, 2001:292-293).

2.5.1 The Clinical Reasoning Process

Van Jaarsveld (2011:8) identified one of the golden keys to become a master clinician within the field of ASI as the ability to understand the different sensory integration (SI) difficulties and dysfunctions and then to be able to plan and implement intervention accordingly. The author states that to understand and have a comprehensive picture on the possible difficulties and dysfunctions based in SI functions is not an easy process. She presented a model for clinical reasoning on possible SI difficulties and dysfunctions, based on the work of Bodison (2010), Smith-Roley (2011), Smith-Roley, Schaaf, Koomar & Benson (2010), and adapted by van Jaarsveld (2011) as illustrated in Figure 2.10 below, which will be used to interpret and discuss the pre- and post-test results of this research study.

DEVELOPMENTALLY APPROPRIATE, ORGANIZED BEHAVIOR AND MOTOR ACTIONS RELATIVE TO TIME AND SPACE					
Praxis	***Visuo dyspraxia***		***Somato dyspraxia***		
	DIFFICULTIES WITH IDEATION				
Motor Skills		***BIS Dysfunction***			
	Postural-ocular control difficulties				
Discrimination & Perception (Spatial & temporal qualities of info)	Vestibular-Ocular difficulties				
	Poor discrim	1. Otolithic 2.Semicircular canals	Poor discrim	Poor discrim	Poor discrim
Under Responsive **Sensory Seeking** (High Threshold)	Under responsive	Hypo responsive	Hypo responsive	Hypo responsive	Hypo responsive
Arousal & Modulation (sustaining engagement despite variability)		***Gravitational Insecurity***	Excessive use as modulator		
Over Responsive (Low Threshold)	Sensitive	***Intolerance to movement***	Sensitive	***Tactile defensiveness***	Over responsive
Sensory Registration	Registration	Registration	Registration	Registration	Registration
Sensory Systems:	**Visual**	**Vestibular**	**Prop**	**Tactile**	**Auditory**

Refined use

Discriminative use

Modulation

Additional Dysfunctions:

- ***Generalized dysfunction***: Perform with below average scores on all major areas tested (tests involved in BIS and visuo- and somatodyspraxia)
- ***Praxis on verbal command*** (on its own not a dysfunction based in sensory integration functions)

Note: Dysfunctions identified by research and factor analytical studies are in *bold and italic* whilst other problems seen in children and also described in literature are referred to as difficulties and not dysfunctions.

FIGURE 2.10 Model for clinical reasoning on possible sensory integration difficulties and dysfunctions (van Jaarsveld 2011:7).

2.5.2 Intervention (The process of sensory integration: Four levels - ADDENDUM A)

The four levels of the sensory integration process that were used in the intervention planning for each premature infant in the experimental group will now be briefly discussed.

According to Ayers (2008:54-55) different types of sensory information come together to form the functions a child needs to be successful and happy in life. The brackets in ADDENDUM A represent four levels of the sensory integrative process. Unfortunately this diagram does not show the fluidity of the process in life, all aspects develop together however some functions lead up to others.

Every bracket on the diagram (ADDENDUM A) indicates numerous aspects coming together into one through the process of sensory integration. For example, the bracket following tactile (touch) in the first level indicates that touch sensations from every bit of skin of the infant come together for several types of use:

- to help the infant suck and eat,
- to form a mother-infant bond, and
- to comfort or console the infant.

The bracket that brings vestibular and proprioceptive input together in the infant leads to:

- well organized eye movements for tracking objects,
- posture for sitting or standing,
- physical balance important for standing and walking,
- muscle tone, and
- gravitational security.

The second level of the sensory integration process is reached when the three basic senses (tactile, vestibular and proprioceptive) are integrated into providing and supporting:

- body concept,
- coordination of the two sides of the body,
- motor planning skills,
- activity levels,
- attention span, and
- emotional stability.

At the third level of integration the child does things that are more purposeful for example eating with a spoon or fork, drawing, putting things together and taking them apart. All these skills at the fourth level are end products of every sensory process that took place in the first three levels. These include the ability to organize and concentrate as part of the academic learning capacity; self-esteem, self-control, and self-confidence that comes from feeling the body as a competent sensory-motor being, and from good neurological integration. Once the two sides of the body can work together in purposeful activity, there is a natural specialization of the two sides of the body and brain (Ayers, 2008:54-55).

Ayers (2008:45), explains that it is important to note that the child works at each level of sensory integration throughout childhood. The infant's nervous system at two months is contributing a great deal at the primary level of integration, a bit less at the secondary level and very little at the third. At the age of one year the primary and secondary levels are of utmost importance and the third level is also starting to contribute to development. At the age of three years, the toddler is still working on the primary, secondary and third levels and the fourth has begun to play a role in skills development. The primary level of sensory integration should be complete at the age of six years, the secondary level almost complete and the third level is still active with the fourth becoming important. This process illustrates that the child learns the same aspect over and over again, first in crawling, then in walking then in riding a bicycle.

For the population of premature infants participating in the experimental group of this study, the intervention followed the process of sensory integration in terms of the four levels described. The focus was mainly on the first and second levels but followed the flow towards the third level as needed/indicated for individual participants.

DeGangi and Greenspan (1998:3) states in the Test of Sensory Functions in Infants Manual that limited research has been done to describe the early development of sensory integration and the impact these behaviors have on later learning and emotional development although a few studies have found that infants with early sensory-motor deficits, particularly a hypersensitivity to stimuli, were later found to demonstrate emotional difficulties, regulating sleep/wake cycles, irritability, colic and lack of cuddliness during infancy. It is therefore, very important to identify infants who may display hyper or hypo sensitivities to sensory stimulation before they develop more serious developmental disabilities.

According to Ayers in DeGangi and Greenspan (1993:1,2), the normalization of tactile and vestibular functions has been described as essential for refinements in fine and gross motor skills as well as in motor planning abilities.

Sensory integrative intervention techniques are integrated within the context of parent guidance and child-centered activity to normalize the child's responses to sensory stimulation, modulate arousal and state control, and promote organized adaptive responses during play and everyday activities (DeGangi, 2000:114, 115).

2.5.3 The Fidelity Measure of Research on the effectiveness of Ayers Sensory Integration intervention

According to Parham and Mailloux (2010:368-369) research on the effectiveness of Ayers Sensory Integration (ASI) is particularly critical to evidence-based practice.

Fidelity refers to the extent to which the intervention provided in a research study is faithful to the key elements of the intervention approach, therefore the sensory integration intervention delivered in this research study needs to be consistent with the core elements and key therapeutic strategies of ASI (Parham & Mailloux, 2010:367).

Following a study on the effectiveness of occupational therapy using a sensory integration approach with children who had sensory modulation disorders, the researchers of the study, Miller, Coll and Schoen (2007:228) recommended that researchers should use a combination of physiological and behavioural measures to select criteria that will identify a homogeneous sample as well as a fidelity to treatment measure are needed.

Parham *et al.* (2007:216-227) aimed to assess validity of sensory integration outcomes research in relation to fidelity. The researchers identified core sensory integration elements through expert review and nominal group process. These core elements were classified by the researchers into structural (equipment used and therapist training) as well as therapeutic process categories. Following the analysis of 34 sensory integration intervention studies for consistency of intervention descriptions with the identified core elements, the researchers concluded that validity of sensory integration outcomes studies is threatened by weak fidelity in regard to therapeutic process. The researchers recommended fidelity to be adequately addressed in outcomes research before conclusions regarding sensory integration effectiveness can be drawn with confidence.

Parham and Mailloux (2010:368) explains the nature of ASI intervention as highly individualized, child centered and fluid, therefore a rigid treatment protocol is incompatible with the ASI intervention approach.

A fidelity instrument developed for use in research on Ayers Sensory Integration (ASI) intervention, developed by Parham, Smith-Roley, May-Benson, Koomar, Brett-Green, Burke, Cohn, Mailloux, Miller and Schaaf, was proven reliable and valid determining whether an observed intervention session represent occupational therapy using ASI. This study concluded that the Ayers sensory integration Fidelity Measure has strong content validity and that the process section is reliable and valid when scored by trained raters with expertise in ASI (Parham *et al.* 2011:133-142).

2.6 The proposed study within a low sosio-economic South African context

According Lawn and Kerber (2006:16) statistics indicate that babies in Africa are at high risk of being born prematurely due to infections, particularly sexually transmitted infections (STI's), malaria and HIV/AIDS. The regional estimate in Africa for premature birth is around 12%, which is almost double the frequency of premature birth in European countries. Lubbe (2008:23) indicates that in South Africa annually, approximately 15% of infants are born prematurely.

Statistics from the Universitas Academic Hospital in Bloemfontein for the period January 2010 until February 2011 indicated a number of 645 premature births at the hospital of which 245 infants (38% of total premature births) were born with very low birth weights (VLBW) or extremely low birth weights (ELBW) and 133 of these VLBW and ELBW infants (72,7%) survived during the year (PPIP v2.2:2011). This high survival rate of premature infants indicates a need for research in terms of appropriate stimulation to support the development of these infants.

Universitas Academic Hospital is a specialty hospital linked with the University of the Free State's Faculty of Health Sciences. The services offered at the hospital provide advanced health care to all patients as well as training of under- and post graduate doctors and other health care professionals. This tertiary referral hospital is subsidized by the provincial government and provides quality, accessible and comprehensive health services to the Free State community including rural and low-socio economic areas within the Free State. All citizens have equal access to services and a standard or no fee is charged for services provided, according to a patient's income. Patients admitted to Universitas Academic Hospital are referred from secondary hospitals for specialty care including neonatology for critical ill and premature infants (Department of Health, Free State Province n.d.:1 of 3)

Research done by the Department of Occupational Therapy, University of the Free State over a four year period indicated that toddlers from low socio-economic environments were more likely to experience difficulties with developmental components dependent on sufficient sensory integration namely postural control, bilateral motor coordination and reflex integration (Van Jaarsveld, 2010:13).

The results of this study indicate a greater risk for children from low socio-economic backgrounds to experience difficulties especially with the mentioned developmental components.

Information gained from the literature review highlights the necessity of investigating effective early intervention for premature infants to encourage and support their normal development and optimal growth, provide them with appropriate tools and a suitable environment to reach their full potential.

2.7 CONCLUSION

Chapter 2 presented an in depth literature review of aspects related to premature infants which formed the foundation for this research study namely; possible causes of premature birth, the NICU environment, characteristics of premature infants as well as the development of the premature infant was discussed. The literature review also looked at sensory integration in terms of the sensory functions, the development of sensory integration, sensory integration intervention, the clinical reasoning process, the importance and use of the ASI fidelity measure within research, as well as the relevance of the proposed study within a low socio-economic South African context. In Chapter 3 the research methodology used in this research study is presented.

CHAPTER 3
RESEARCH APPROACH AND METHODOLOGY

3.1 INTRODUCTION

From the literature review it was evident that premature infants' are at risk for possible SI difficulties and developmental delays. Research on effective developmental intervention strategies for premature infants is however limited and previous research related to ASI intervention on the development of the premature infant post discharge from the NICU could not be found by the researcher. This research investigates the effect of ASI intervention on the development of the ELBW to VLBW premature infant. In this chapter the research methodology used during this study will be discussed.

3.2 STUDY DESIGN

An experimental research design was used for this study. The aim of the quantitative research was to determine the extent to which sensory integration intervention (an independent variable) influences the developmental progress of the premature infants (a dependent/outcome variable). Through making use of a pretest-posttest design the participants in the control and experimental groups were measured before and after the 10 week intervention period of the experimental group (Hopkins, 2008:1 of 10; Leedy & Ormrod, 2010:228-231).

A Randomized controlled clinical trial is a study in which the study participants are allocated by chance alone (randomly) into groups, for example in this study; the experimental group that received the sensory integration intervention and the control group that did not receive the sensory integration intervention. The participants for this study were assigned randomly to an experimental and control group respectively and therefore classifies as a randomized controlled clinical trial. Through random assignment, the chance that either group was not typical of the population was minimized (Fouche, Delport & De Vos, 2011:152; Hopkins, 2008:3 of 10).

3.3 RESEARCH POPULATION

The term population of a research study according to Strydom (2011:223), sets boundaries on the study units. It refers to individuals within the universe (all potential participants of interest) who possess specific characteristics e.g. for the purpose of this study, premature infants with extremely low (ELBW) to very low birth weights (VLBW). The population of a research study is the totality of persons with which the research problem is concerned.

3.4 SAMPLING

Convenience sampling according to Leedy and Ormrod (2010:212) entails making use of people that are readily available as participants. In this study only premature infants referred from the High Risk Infant Clinic at Universitas Academic Hospital in Bloemfontein participated and was therefore considered as a convenience sample.

According to Strydom (2011:223) a sample of the research population comprises elements or criteria for inclusion in a study. It was critical for the researcher to develop these criteria for the implementation of this study and no premature infant was included or excluded for non-scientific reasons.

3.4.1 Inclusion criteria

The following inclusion criteria must have been met by the referred premature infants in order to have been able to participate in this clinical trial; The infants must:

- have had a gestational age between 26 and 36 weeks (prematurity),
- had a corrected age between 4 and 10 months (according to three-month developmental stages, 0-3 months, 4-6 months, 7-9 months and 10-12 months as well as the use of the TSFI assessment which starts at the age of 4 months),
- have had a birth weight of 750g – 1499g (ELBW to VLBW), and
- had to be medically stable for the whole duration of the study (for the exclusion of variables that might affect developmental progress).

3.4.2 Exclusion criteria

The following exclusion criteria were used to determine whether a premature infant referred from the Universitas Academic Hospital High Risk Infant Clinic may not have been allowed to participate in the clinical trial:

- infants who have received any previous occupational therapy or sensory integration intervention except for the standard follow-up clinic visits offered at Universitas Academic Hospital post-discharge,
- infants who have been diagnosed with any additional conditions or neurological abnormalities that may prevent an infant to reach developmental milestones within reasonable expectations for prematurity or prevent an infant to reach developmental milestones due to physical disability, e.g. cerebral palsy, down syndrome, fetal alcohol syndrome, spina bifida, arthrogryposis, osteogenesis imperfect and HIV/AIDS.

3.4.3 Determining the size of the research sample

Leedy and Ormrod (2010:214) explain that the size of an adequate sample depends on how alike or different the participants are with respect to the characteristics of interest for the research study. Formulae exist for calculating an appropriate sample size needed for a specific study and the researcher must provide specific information to a statistician to apply these formulae.

For the purpose of this study, referred premature infants had to be selected according to specific inclusion- and exclusion criteria. The selected infants were matched according to their corrected ages and genders before randomly divided into experimental and control groups. Infants in both groups were tested during pre- and post-tests and the infants in the experimental group had to participate in a 10 week intervention period. The results of each infant's pre- and post-tests had to be calculated and processed. It was necessary to consider the manpower and time available to administer the tests and implement the sensory integration intervention. The processing of assessment forms, results obtained and costs involved for the whole process had to be taken into consideration. The correct sample size was therefore very important because a too big sample would have been time consuming and probably impractical or impossible to administer and process, and a too small sample could have led to inconclusive results and therefore could have wasted a lot of time and money.

The sample size was determined by Dr. Jacques Raubenheimer, biostatistician from the University of the Free State, and the researcher, through consideration of the birth statistics of premature infants born with VLBW and ELBW at the Universitas Academic Hospital in Bloemfontein, number of premature infants referred from the High Risk Infant Clinic, inclusion and exclusion criteria as well as the available time and manpower to facilitate the assessments and to implement the ASI intervention. The pilot study played an important role in determining the final sample size for this study.

According to the Perinatal Problem Identification Programme (PPIP) statistics of the Universitas Academic Hospital in Bloemfontein, provided by Annelize Steinhöbel, matron of the hospital's NICU, 245 VLBW and ELBW premature infants were born between January 2010 and February 2011 of which 133 infants survived. A total of 63 infants were referred from the High Risk Infant Clinic however most infants could not be included into the study due to the inclusion and exclusion criteria (cf.3.3.1 & 3.3.2).

The researcher aimed to implement the intervention process of the infants with one therapist administrating the pre- and post-tests and with the researcher implementing the ASI intervention, within a 12 week period for each infant respectively. With consideration of this information, the sample size was determined.

Following the pilot study, it was determined that a convenience sample of 26 premature infants with corrected ages between 4 months and 10 months, gestational ages from 26 to 36 weeks and birth weights between 700g to 1499g, from the Universitas Academic Hospital in Bloemfontein would participate in the study, with 13 infants in the experimental group and 13 infants in the control group respectively. Two participants however dropped out of the study after the first week as a result of their parents being unable to attend the weekly sessions due to work responsibilities. With consultation of Dr. Jacques Raubenheimer the size of the study sample was altered to 24 participants with 12 infants in each group respectively.

3.4.4 Matching

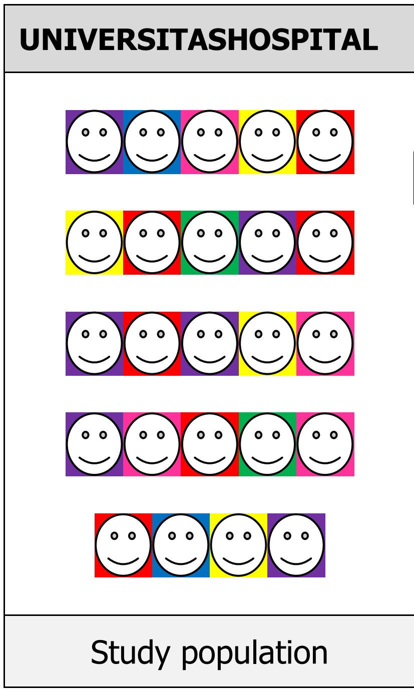
Infants that were selected according to inclusion and exclusion criteria were matched according to their corrected ages (how old the infant would be if born at term) and gender (boy/girl). Ayers

(2004:160) examined the developmental trends separately for older boys and girls and found significant gender differences on many of the variables for the Sensory Integration and Praxis Test (SIPT), therefore the researcher found it necessary to match the study participants according to their gender.

Each member of every infant pair was then randomly assigned into an experimental and a control group respectively through the process of drawing names. The selection process is illustrated in FIGURE 3.1 below.

The selection process

STEP 1: 24 Infants selected according to the inclusion and exclusion criteria.



STEP 2: The selected population of 24 infants were matched according to their corrected ages and genders.

	Age group	Total	Gender	
			Boys	Girls
	4 months	6	2	4
	5 months	2	0	2
	6 months	4	2	2
	7 months	2	2	0
	8 months	4	1	3
	10 months	6	3	3

Matched (ages and gender)

STEP 3: The infants were then randomly assigned into the experimental and control groups respectively from their matched pairs.

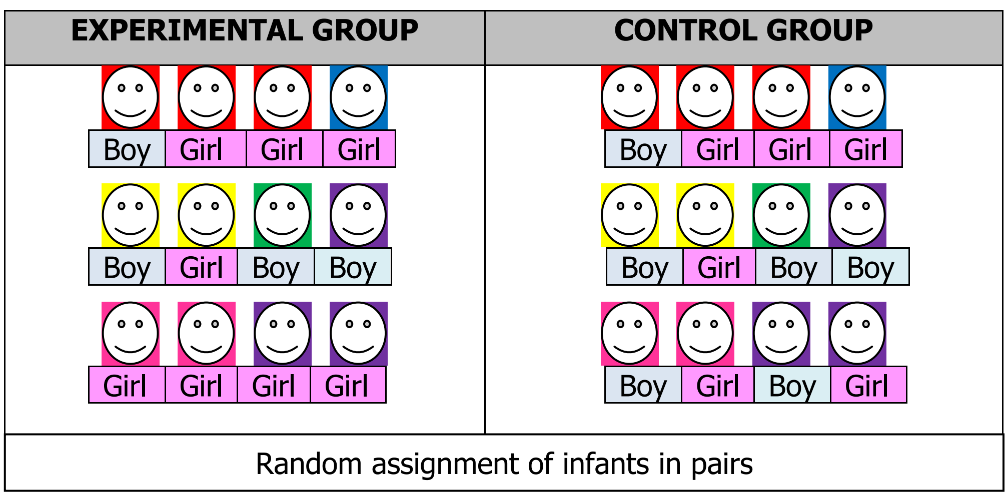


FIGURE 3.1 The selection process.

Unfortunately, two infant pairs could not be matched according to their genders. This was taken into consideration during the interpretation of results and will be discussed in Chapter 4.

3.5 THE COURSE OF THE STUDY OVER A 12 WEEK PERIOD

BEFORE THE STUDY

OT's 1 (Assessment OT) and 2(Researcher) Experimental and Control Groups	• Pilot study • Information from medical files/meditec • Sampling • Parent interviews and signing of consent forms

WEEK 1

OT 1 (Assessment OT) Experimental and Control Groups (population of 24 infants)	Pre-Tests: • TSFI • Sensory Profile • Bayley III Scales

WEEK 2 – 11

OT 2 (Researcher) Experimental Group (12 infants)	Intervention: • One Treatment session/week • Home programme

WEEK 12

OT 1 (Assessment OT) Experimental and Control Groups (Population of 24 infants)	Post-Tests: • TSFI • Sensory Profile • Bayley III Scales

FIGURE 3.2 The course of the study.

3.6 PILOT STUDY:

A pilot study was done to determine the feasibility of the research study in terms of the infrastructure, funding and availability of participants and was performed after the approval of the Ethics Committee of the Faculty of Health Sciences, University of the Free State and other relevant committees.

The pilot study served as a method to detect flaws in the protocol as well as the proposed intervention process and planning. This made it possible for the researcher to rectify possible flaws before the actual study started as well as to get an indication of possible results (Fouché & Delport, 2011:73).

Two VLBW to ELBW premature infants referred from the High Risk Infant Clinic at Universitas Academic Hospital were selected for the pilot study according to the in- and exclusion criteria. The pilot study took place over a period of two weeks.

The assessment occupational therapist, trained and experienced to conduct the Bayley III Scales of Development, Test of Sensory Functions in Infants (TSFI) and Infant/Toddler Sensory Profile conducted the pre-tests and the researcher was present during both assessments. The findings, note taking and assessments were evaluated and discussed afterwards.

Both pilot study participants were exposed to two sensory integration intervention sessions with the researcher over a two week period at the Occupational Therapy Department, Universitas Academic Hospital. Aspects that were tested in the pilot study included the practical feasibility of the study in terms of transport for the parents and infants, duration of assessments, treatment procedures, the appropriateness of the assessment and intervention areas, documentation of data and to evaluate if the record sheets covered all the necessary aspects. The two pilot study participants were referred to the Occupational Therapy Department of Universitas Academic Hospital for further follow-up intervention after the completion of the pilot study.

The pilot study brought valuable insights into the process of the research study and the researcher was able to take this into consideration during the final phase of planning and implementation of the study. Due to the use of three standardized assessments and a parent questionnaire, the duration of the assessments was longer than expected and this was considered in determining the sample size as well as allocating enough time for assessment appointments.

The participants in the pilot study were selected according to the same in- and exclusion criteria of the study population. This process indicated that many possible candidates in the population did not qualify to be included in the research study according to the in- and exclusion criteria. This had a huge impact on determining the sample size of the research population and with consultation of the biostatistician, Dr. J. Raubenheimer, the researcher adjusted the sample size (cf. 3.3.3).

The assessment and intervention rooms proved to be appropriate for the purpose of the study. The assessment room was small and clinical with no external aspects to distract infants from the task at hand during assessments. The room also had a one way mirror/window which could be used if necessary during assessments. The intervention room was spacious and allowed room for flow of physical activity. Equipment and materials could be arranged to allow for rapid change of the physical and spatial configuration of the intervention environment. The room consisted of adequate suspension facilities and a variety of equipment, mats, mattresses, crash mats, suitable sensory toys and textures could be stored and arranged within the room without constructing the flow of the intervention sessions. The intervention room complied with the requirements for ASI intervention as prescribed by the Fidelity Measure.

3.7 MEASUREMENT

Leedy and Ormrod (2010:88) explain that research is only a viable approach to a problem when there are data to support it. Researchers seek to discover underlying truths through analyzing relevant data. For the purpose of this study the process by which values were obtained for the participating premature infants, involved more than one method of collecting the desired data.

Measurement was done through:

- Information obtained from potential participating infants' medical files. The medical history of infants was used for the selection process according to the inclusion and exclusion criteria. Relevant information were gathered by the researcher from the medical files on Meditec and documented on a data form (ADDENDUM B).

- A parent questionnaire compiled and conducted by the researcher was completed in the initial parent interviews to obtain basic medical and demographic information as well as pregnancy-, birth- and developmental history of each participating infant. Trained translators were utilized for all interviews conducted with parents whose first language was not English or Afrikaans.
- The Infant/Toddler Sensory Profile (Dunn, 2002) a standardized caregiver questionnaire for infants from 0 to 12 months was used for the pre- and post-tests of all the infants in the experimental and control groups.
- The following standardized instruments were also used by the assessment occupational therapist during the pre- and post-tests of all the participating infants in experimental and control groups:
  - Test of Sensory Functions in Infants (4 – 18 months) (TSFI – DeGangi & Greenspan, 1993), and
  - Bayley III Scales of Infant and Toddler Development (1 - 42 months) (Bayley, 2006a).

3.7.1 The measurement tools

The Infant/Toddler Sensory Profile (Dunn, 2002:1-2) for infants from birth to 36 months, was designed to contribute to a comprehensive assessment of an infant's performance when combined with other evaluations and observations. It is a tool for linking an infant's performance strengths and barriers with his/her sensory processing patterns. The purpose of the test is to evaluate the possible contributions of sensory processing to the infant's daily performance patterns and to provide information about his or her tendencies to respond to stimuli and which sensory systems are likely to be contributing to or creating barriers to functional performance. The infant's parents or caregivers are involved through completing the caregiver questionnaire in which each item describes the infant's responses to various sensory experiences according to the perception of the parents/caregiver and therefore provides another perspective on the infant's strengths and challenges for diagnostic and intervention planning. The Infant/Toddler Sensory Profile Technical Report (2008:5) indicates that the test is reliable since the caregiver rating is stable over time and is acceptable for identifying target areas of intervention. The test was also compared with selected items on the Infant/Toddler Symptom Checklist, large and meaningful correlations between the two instruments were found which indicated validity of the test.

The TSFI was developed as both a research and clinical tool, specifically to measure five sub domains of sensory processing and reactivity in infants from 4 to 18 months, namely; reactivity to tactile deep pressure, adaptive motor functions, visual-tactile integration, ocular-motor control and reactivity to vestibular stimulation. All these areas have a strong impact on the development of sensory integration in the infant. It can be used in the assessment of infants with developmental delays, regulatory disorders and those at risk for learning and sensory processing disorders including high-risk premature infants. The TSFI can and should be used in conjunction with other developmental tests such as the Bayley Scales III of Infant and Toddler Development and other standardized assessments to provide an overall indicator of the infant's developmental functioning and in order to make decisions regarding the infant's developmental status (DeGangi & Greenspan, 1993:1-3).

The Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) is an individually administered instrument that assesses the developmental functioning of infants and toddlers between 1 month and 42 months of age. The primary purpose of this standardized assessment tool is to identify children with developmental delay and to provide information for intervention planning. The Bayley-III assesses infant and toddler development across five domains namely cognitive, language, motor (fine- and gross motor), social-emotional, and adaptive behaviour. Assessment of the cognitive, language and motor domains are conducted using items administered to the infants and toddlers. Assessments of the social-emotional and adaptive behaviour domains are conducted using the parents/primary caregivers' responses to a questionnaire. The additional behaviour observation inventory of the Bayley III, completed by both the assessment occupational therapist and the parent/caregiver assesses the infant's behavior during the testing situation and incorporates the child's behavior at home, aiding in the interpretation of the Bayley-III scales (Bayley, 2006a:1). According to Bayley (2006b:67) statistical data revealed that the Bayley-III is a reliable instrument and that one can have a high level of confidence in the scores a child obtains on this test.

The Fidelity Measure for ASI was utilized by a trained, independent occupational therapist to assess the intervention sessions implemented by the researcher. Video recordings of the intervention sessions were used for the purpose of the Fidelity Measure and the sessions were evaluated after the completion of the study.

3.7.2 The measurement process

The researcher obtained all the medical information and background information from the infant's medical files on Meditec and also conducted the initial parent interviews with the parent questionnaires. The assessment occupational therapist, trained and experienced to conduct the assessment procedures and data recording of the Infant/Toddler Sensory Profile, the Test of Sensory Functions in Infants and the Bayley Scales III Scales of Infant and Toddler Development assessed all 24 infants during the pre- and post-tests of the study. The assessment therapist was blind to which infants were in the experimental or control groups respectively.

Ten intervention sessions were randomly selected from the collective 120 sessions of the 12 infants in the experimental group after the completion of the study. These 10 sessions were then evaluated according to the ASI Fidelity Measure through observations of video recordings by an independent occupational therapist trained to conduct the ASI Fidelity Measure.

3.8 INTERVENTION

The infants in the experimental group received the ASI intervention implemented by the researcher over a period of 10 weeks. The developmental stages of infants within the first year of development were considered during intervention planning. Infants' development in terms of normal developmental milestones are divided into three-month periods namely 0-3 months, 4-6 months, 7-9 months and 10-12 months in most informal and standardized developmental scales. The researcher aimed to determine the effect of ASI within these three-month (12 weeks) periods with the pre- and post-tests being conducted during weeks one and 12, and the implementation of the ASI intervention during weeks two to 11 (10 weeks) (cf.3.4).

The ASI intervention received by the infants in the experimental group consisted of:

- one individual therapy session per week of 30 to 45 minutes, and

- recommended home activities and suggestions for the mothers. The home activities consisted of a maximum of two appropriate activities given and demonstrated to each parent following each weekly individual session.

All the infants in the experimental and control groups continued to receive the standard follow up clinic visits and services provided at Universitas Academic Hospital during the 10 week period. These visits involve developmental and medical screenings every three months by the pediatrician, occupational therapist, physiotherapist and dietician to monitor the infant's progress. Parents of infants in the control group were provided with information on development and guidance from the therapist after the completion of the study.

Schaaf and Anzalone (2001:277) state that the sensory integration theory, by definition, necessitates consideration of both intrinsic and extrinsic factors that influence infants' and young children's behavior during ASI intervention as discussed in Chapter 2 according to the Model of Infant Behaviour based on Sensory Integration and Self-Regulation.

3.8.1 Shaping outcomes: Organizing assessment data into an intervention plan

This was the final stage of the evaluation process, the researcher organized the information obtained through the measurement procedures for each infant in the experimental group into a meaningful description of how the child's sensory needs affected his or her occupational behavior and therefore also his/her development. The researcher then outlined an intervention plan to build on areas of strength and improve areas of need. The model of infant behavior illustrated in (ADDENDUM D) provided a framework within which the researcher was able to organize intervention on three different (but not mutually exclusive) levels:

1. helping parents to understand their premature infant and his/her developmental progress,
2. facilitating goodness-of-fit between the premature infant and his or her sensory environment, and
3. remediating the underlying sensory processing and self-regulation problems and/or their behavioural expression in terms of the four A's as necessary.

Through this approach to intervention the researcher were able to plan and follow a course of intervention that addressed specific individual needs and built on areas of strength in the context of naturally occurring events within the family. Integration of therapeutic activities and daily routines provides the repetition and reinforcement of learning necessary to bring about developmental change and establish a foundation for the formation of developmentally appropriate affective relationships (Schaaf & Anzalone, 2001:292-293). The involvement of the infants' mothers in the intervention process was therefore a necessity.

ADDENDUM D were used for each infant in the experimental group to organize their pre-test data into an intervention plan. This enabled the researcher to identify the key issues for each individual infant, related to sensory processing function/dysfunction:

- parents' ability to read cues,
- goodness-of-fit,
- responsivity/threshold,
- self-regulation,
- individual sensory systems, and
- the four A's (Arousal, Attention, Action and Affect).

The therapist interpreted each infant in the experimental group's profile (which consists of data collected from the infant's medical files, parent interviews and formal pre- and post-tests) and then used:

- appropriate developmental milestones according to the infant's corrected age and abilities (Bayley III Scales results), and
- the four levels of the sensory integration process (ADDENDUM A) was used to organize assessment data and plan appropriate intervention strategies for infants in the experimental group. The focus was mainly on the first and second levels but followed the flow towards the third level as needed/indicated for individual participants.

3.8.2 The intervention plan

The researcher aimed to determine the best focus of intervention for each individual infant. With infants and young children, the focus of intervention are frequently the parents in the home environment, however, each situation brings with it a unique combination of environment, social, and intrinsic strengths and areas of need (Schaaf & Anzalone, 2001: 292-293).

For the purpose of this study and the intervention used by the researcher, it was very important to distinguish *sensory integration* from *sensory stimulation*:

- *Sensory stimulation* refers to providing or imposing sensory input on the child who is not necessarily actively engaged.
- *Sensory integration* in its purest sense, involves active engagement of the child in self-directed, meaningful activities that produces adaptive responses to promote integration and organization of sensation for use (Schaaf & Anzalone, 2001:292-293).

Although infants might not be able to self-direct activity in the traditional sense, they are constantly telling the adults in their world about their needs and wants through nonverbal communicative cues and gestures. Learning to read and respond to the language of infants and young children is an essential aspect of the sensory integrative process. By learning to recognize, read and respond to those cues, therapists, parents and caregivers gain insight into the child's interest, wants and needs (Schaaf & Anzalone, 2001:292-293).

The researcher considered the following factors during the clinical reasoning process to provide the just-right challenge during the therapist directed sensory integrative intervention sessions:

- the infant's clinical profile (ADDENDUM D),
- the infant's motivation,
- the family and their priorities, and
- the sensory challenges and affordances available in the infant's physical environment e.g. how flexible is the environment? How can one change the sensory richness if needed? (Schaaf & Anzalone, 2001:292-293).

The following therapy goals were considered during the intervention planning:

1) To utilize the parent-and work to expand the parent's understanding, observation, relationship, and communication with the infant. It was essential to include the family in the intervention plan especially for the purpose of this study in which the parents of the participating infants most probably have been separated from the infant while the infant was hospitalized after being born prematurely and may have been medically fragile. An important aspect was the goodness-of-fit between the parent's style and routines and the infant's sensory needs.

2) To modify the physical environment within the intervention sessions and if possible at home, or manipulate the sensory input that the infant seek or received. This aspect required appreciation of multiple properties of that sensory input namely: type, intensity, duration, location, and frequency.

The infant's sensory threshold and whether he or she was acting in accordance with or compensated for this threshold were constantly considered by the researcher in terms of the following:

- How wide, narrow, or changeable was the infant's threshold range?
- What sensory modalities were arousing, calming, organizing or disorganizing for the infant?
- What properties of that sensory input (type, intensity, duration, location or frequency) influenced the infant's sensory threshold, self-regulation, and organization?
- What available toys, equipment, and other environmental factors (including social) had to be modified to influence the environmental affordances available to the infant (for example expand, limit, or clarify the possibilities for action in the physical environment)? (Schaaf & Anzalone, 2001:292-293).

3.8.3 Intervention activities

The variety of activities used during the ASI intervention sessions with the 12 infants in the experimental group focused on vestibular- (gravity and movement), proprioceptive- (muscles and joints) and tactile (touch) stimulation. A variety of visual and auditory toys e.g. sugar filled balloons, hanging objects, sensory balls, stuffed animals, dolls, musical toys, visual toys, rattles, coloured light sticks and puppets were used to support engagement in play.

Some examples of activities that were used in this study are presented and illustrated in ADDENDUM E. Please note that this was not the only activities used and that since sensory integration intervention is a child-centered approach, activities were chosen and adapted within each session as required. All activities used in the study were recorded in the progress notes of each session and video recorded. All parents of participating infants gave informed consent for the digital recording of sessions (for academic use) (cf. 1.7).

The intervention room that was utilized for this study complied with the necessary requirements recommended for an ASI intervention room according to the Fidelity Measure. These requirements included; adequate space within the room, adequate equipment was available and stored within the room for easy access and safety, the availability of adequate suspension equipment, the availability of a quiet space within the intervention area, the availability of mats, cushions, crash mats and pillows to be used for infants to crawl over as well as for safety requirements under suspended equipment. Equipment used was appropriate in terms of size and safety for infants, and safety of equipment was considered and monitored continually throughout sessions.

Progress notes for the therapy sessions were kept for each infant (see ADDENDUM F). The forms were specifically designed in terms of:

- the date, time and duration of the intervention,
- therapy goals and activities for each session,
- the infant's behaviour and reaction to stimulation,
- the subsystems of the synactive theory of development in terms of organized and disorganized signals were noted if observed e.g. stress cues for assessment of thresholds during applied stimuli:
    - extension of extremities,
    - arching,
    - fatigue,
    - finger splaying,
    - fussiness,
    - sitting on air,
    - frowning,
    - toe splaying,
    - yawning,
    - gaze aversion,
    - stop sign, and
    - crying.
- therapy progress for each session and whether therapy had to be terminated during a session and why, as well as
- other relevant observations.

3.8.4 Home activities for parents and caregivers

Home activities were selected weekly with careful consideration of each individual infant's and parents' needs as well as the infant's age and progress, as previously discussed. The aims of these selected activities included the following:

- to serve as appropriate complimentary stimulation to the weekly sensory integration intervention sessions and not as essential stimulation,
- to encourage parent/infant bonding and interaction,
- to improve parents' insight into the value of developmental stimulation, and
- to actively involve parents and caregivers in the infants' therapy and progress.

Examples of home activities utilized in this study are presented and illustrated in ADDENDUM G. The role of infant massage as part of the home activities is also discussed. A weekly feedback record sheet were completed by the researcher to monitor the implementation of recommended home activities of parents however as mentioned above, these activities were only complimentary to the ASI intervention and not a compulsory programme (ADDENDUM H).

3.8.5 The Fidelity Measure

Using the ASI Fidelity Measure to document the intervention of this research study made an important contribution to understanding the extent to which gains ASI intervention can be maintained long-term on the development of the ELBW to VLBW premature infant. The development of the fidelity measure and manual of procedures for sensory integration intervention were an important step in enhancing the strictness of sensory integration trials (Case-Smith, 2010:16). The results of the evaluated intervention sessions (cf. 3.6.2) according to the core principals of ASI intervention are presented in Chapter 4.

3.9 ANALYSIS OF THE DATA

For the demographic data, various descriptive statistics were reported, including frequencies and percentages for categorical data, means and standard deviations or medians and percentiles for continuous data. Where applicable; frequencies, means, and medians are also reported for the various scales and subscales.

Associations between categorical variables were examined using the Chi-square test, with the Fisher's exact statistic computed, because of the small sample size and the resultant small cell counts.

Differences between the experimental and control group mean scores (pre- and post-test) for the various scales and subscales were tested with the t-test for independent samples. Paired t-tests were also used to compare the difference in pre- and post-test means on the various scales and subscales for the children in both the experimental and control groups. The analysis was performed by the Department of Biostatistics, UFS.

3.9.1 Statistical values

The following statistical values of results will be presented in Chapter 4 however the results will be discussed and interpreted mainly in terms of the p-values.

p-value: The smaller the p-value the stronger the evidence against the null hypothesis. The evidence collected against the null hypothesis is summarized as a p-value. Before performing hypothesis tests, a significance level, commonly $\alpha = 0.05$, will be allocated. This implies that the tests are performed under 95% confidence intervals. The smallest significance level at which the null hypothesis will be rejected, is given by the p-value (Rice, 2007:335).

t – test-statistic: A numerical value which portrays information about the sample. The test statistic is calculated from the observations in order to obtain estimates to analyze the data (Kele, 2011:7). The test statistic follows a t-distribution which is divided into two regions; a rejection region and non-rejection region. Thus the value of t will determine whether the hypothesis will be rejected or not. If the test statistic obtained from the hypothesis test exceeds the critical value, given by t-distribution tables, the null hypothesis will be rejected (Rice, 2007:425).

Degrees of freedom: The amount of variables used from the sample to calculate the test-statistic, which are free to vary from the mean values of the data (Kele, 2011:7).

3.10 METHODOLOGICAL AND MEASUREMENT ERRORS

According to Delport and Roestenburg (2011:172) a researcher must ensure that the measurement procedures and the measurement instruments to be used have acceptable levels of reliability and validity before implementing the study to be able to obtain valid and reliable data. Validity of measurement instruments has two aspects namely, that the instrument actually measures the concept in question and that the concept is measured accurately. In general, reliability refers to the extent to which independent administration of the same or similar instruments consistently yields the same or similar results under comparable conditions (Delport & Roestenburg, 2011:172,178). For this research study the researcher was interested in the validity of the measurement tools, whether the standardized tests used measured what it was meant to measure.

Leedy and Ormrod (2010:275) explains that the internal validity of a research study is the extent to which it's design and the data it gives allow the researcher to draw accurate conclusions about cause-and effect, and other relationships. Internal validity is essential in experimental designs; without it, any results the researcher obtains are not interpretable.

The three components involved in the measuring process for this research study were:

a) the researcher and the assessment occupational therapist,

b) the participants (ELBW to VLBW premature infants), and

c) the measuring instruments; standardized assessments namely the Bayley III Infant and Toddler Developmental Scales, the Test of Sensory Functions in Infants (TSFI) and the Infant/Toddler Sensory Profile.

With each of these components measurements errors could occur which had to be eliminated since the errors could have influenced the results.

Possible random error (variables) associated with the observers:

- To prevent inter-observer variation, the researcher made use of only one assessment occupational therapist for the pre- and post-tests.
- Only the researcher were involved in the intervention process of all the infants in the experimental group.

- Both the researcher and the assessment occupational therapist involved in this study were qualified in the use of sensory integration assessment and treatment.
- To prevent intra-observer variation, standardized assessments were used and the assessments were only preformed once before the intervention and once after the intervention.
- Validity in terms of measurement was accomplished through using an occupational therapist trained and experienced in the use of sensory integration assessment procedures for the assessments of the participating infants.

Variables and bias were limited by:

- Using only one trained occupational therapist for the pre- and post-tests of all 24 study participants.
- The assessing therapist was blind as to which infants were in the experimental group and which infants were in the control group.
- Assessments were periodically monitored by the researcher to see if procedures were followed correctly.
- A pilot study was done to pre-test questionnaires, standardized assessments and the intervention process.
- Only the researcher was involved in the intervention process with the experimental group.

Bias in terms of analysis and interpretation was limited, through using standardized assessments:

i) The Bayley III Scales of Infant and Toddler Development: The creation of items for the Bayley III was based on developmental research and theory that identifies behaviours typifying normal development in young children. It is an individually administered instrument that assesses the developmental functioning of infants and young children 1 month to 42 months of age (Bayley, 2006b:1-3).

ii) The Test of Sensory Function in Infants (TSFI) provides objective criteria that allow the evaluator to determine whether, and to what extent, an infant has deficits in sensory functioning. The TSFI can be used to assess infants with difficult temperaments of developmental delays and is also an effective way to evaluate high-risk premature babies who may be at risk to develop learning problems (Western Psychological Services 2011:1 of 1).

iii) The Infant/Toddler Sensory Profile was developed to evaluate sensory processing patterns in infants and helps therapists to profile the effect of sensory processing on functional performance in the daily life of the infant. This test was standardized with 589 cases (100 per age range) and provides validated and reliable scores, as well as interpretation of results (PsychCorp n.d.:2 of 5).

The following bias may have occurred in the study:

- Membership bias: A sample of premature infants in Universitas Academic Hospital does not represent all premature infants. Samples for studies are often selected from such subgroups, to simplify the sampling. This has been clearly stated so that the interpretation of the results is meaningful.
- Drop-out: If more than 20% of the premature infants (24 participants) did not complete the full course of the study, results may have been influenced to such an extent that it did not reflect the truth in terms of the effect of the sensory integration intervention on the development of the infants. Drop-out could have occurred in the following phases of the research project:
    - sampling,
    - measurement process; pre- and post-tests, or
    - intervention period; all infants in the experimental group must have attended at least 8 out of 10 intervention sessions and must not have missed two consecutive sessions.

  Drop-outs could have occurred due to withdrawal from parents, absconding – parents not bringing their infants for intervention or assessment appointments, or death of a participant or parent. Accurate documentation of all drop-outs has been done.

  During this study two infants dropped out due to their parents not being able to bring them to the weekly therapy sessions. These infants however dropped out during the sampling stage of the study and the researcher was able to adjust the matching and sampling accordingly.

Methods used to reduce variation and bias:

- In- and exclusion criteria as well as measurement procedures were clearly defined in advance and applied consistently and precisely in the study. Information from the medical files was collected according to a specific data form.
- The assessment therapist was not aware which infants were in the control groups and which infants were in the experimental groups.
- As explained above, inter- and intra-observer variation were limited to a minimum through utilizing a trained and experienced assessment therapist in terms of the methodology and measurement instruments of the study. The researcher conducted regular checks of the data collection process.
- Parents of participating infants were fully informed of the value of the study and the researcher encouraged the parents to participate in intervention sessions throughout the study since the parents' involvement and participation is part of the integrated process of sensory integration.
- To prevent participant exhaustion, the participating infants in the experimental group only attended one session per week over the 10 week intervention period.
- The manpower available for this study, namely one assessment therapist and the researcher involved in the intervention process as well as available time was considered in the determining of the sample size to prevent researcher exhaustion.

Through randomization the researcher attempted to make the prevalence of possible confounders (race and socio-economic background) similar in the different groups. Matched sampling according to specific criteria namely the corrected ages of the infants and genders were used for the experimental and control groups.

3.11 ETHICAL ASPECTS

De Vos, Strydom, Schulze and Patel (2011:23) explain that research should be based on mutual trust, acceptance, cooperation, promise and well-accepted conventions and expectations between all parties involved in the research study. Ethical guidelines and committees may have supported the researcher in decision making; however the final responsibility for ethical conduct rested with the researcher. The researcher was accountable for the positive and negative consequences of every decision and committed to good ethical practice during the implementation of this research study.

Ethical Implications guided by the Ethical Code prescribed by the HPCSA and OTASA that were considered for this research study:

3.11.1 Approval

- The research proposal for this study was approved by an Ethical Committee, Faculty of Health Sciences at the University of the Free State (Committee for Human Research, CHR) (ECUFS No. 117/2011, ADDENDUM J).

- Permission for the execution of this study was also obtained from appropriate authorities; namely Dr. N. van Zyl, Head: Clinical Services of Universitas Academic Hospital, Prof. A. Venter: Head of Department and Dr. D.J Griessel: Senior lecturer/Principal Specialist, Pediatrics and Child Health, University of the Free State and Universitas Academic Hospital as well as Ms. M. Taljaard: Deputy Director, Occupational Therapy Department, Universitas Academic Hospital to conduct the study at the Occupational Therapy Department of Universitas Academic Hospital. (ADDENDUM K).

- The final responsibility rested with the researcher, to present a study that fulfilled all ethical requirements.

3.11.2 Informed Consent

- Informed consent was obtained from the participating premature infants' parents. The researcher provided the parents with accurate and complete information regarding the aim of the study, the sensory integration intervention that was to be conducted, advantages for the infants and parents participating in the study, the assessment procedures, length of the study and credibility of the researcher. Participating in this study held no disadvantages for the infants (ADDENDUM I).

- Parents or caregivers of the premature infants had to be legally and psychologically competent to give consent and have been made aware that they could withdraw their infants from participating in the study at any time without any negative consequences.

- Written consent (ADDENDUM I) was given for digital media to be used during the study for the purpose of implementing the Fidelity Measure to ensure credible study, to use the material for academic purposes as well as for publication of the study results and findings in academic journals and newsletters were obtained from the parents/caregiver of the participating infants however the infants' and parents' identity will not be published.

3.11.3 Protection against physical discomfort

- The researcher protected all participating premature infants against any form of physical discomfort within reasonable limits. Infants were assessed beforehand in terms of the excluding criteria and monitored throughout the duration of the study in terms of their medical stability. None of the participating infants however proved vulnerable during the investigation.

3.11.4 Confidentiality

- All information of participants and their parents were handled in a confidential manner. A written agreement between the parents and the researcher (ADDENDUM I) limited access to personal information of the infants and their parents to the researcher and co-researcher involved in the study. Confidentiality of personal information and results of the study were secured through keeping all information anonymous with only the involved researchers having full access to the names, details and assessment results of the participants and their infants. The parents of participants had the right to self-determination which implied that the parents of participants had the right and competence to evaluate information provided to them in regards to the research study, weigh alternatives against one another and make decisions on behalf of their infants.

3.11.5 Credibility of the researcher and assessment occupational therapist

- The researcher is a sensory integration, neuro-developmental and developmental care for premature infants trained therapist with 10 years' experience specializing in the field of pediatrics and early intervention with infants. Her interest and experience in the field of early intervention started in 2001 and led to her involvement in the intervention with premature infants in a Neonatal Intensive Care Unit in 2003. Through this daunting but exciting involvement the therapist were further trained in Developmental Care with premature infants and her interest to encourage the development of premature infants post-discharge. Considering the researcher's working experience and training in terms of the sensory integration theory and practice, premature infants and working with parents as part of an interdisciplinary team, the researcher was competent and skilled to undertake the proposed research study.

- To prevent measurement errors/bias with regards to the fidelity measure (cf.3.6.1) an independent occupational therapist, trained to conduct the fidelity measure, assessed randomly selected, video recorded intervention sessions with infants in the experimental group. The random selection of intervention sessions were done by the study leader and the percentage of sessions to be evaluated were determined by the biostatistician involved in the study. The researcher was not involved in selecting the independent occupational therapist who evaluated the sessions.

- The assessment therapist involved with the pre- and post-tests of the infants is a sensory integration and Developmental Care trained therapist with five years' experience in Pediatric Occupational Therapy, specializing in the field of neonatal and infant assessment and intervention. The assessment occupational therapist were presented with a contract (ADENDUM L) so that she was aware what was expected of her and what the role of the researcher entailed.

- The researcher strived to write an accurate, objective, clear and unambiguous report that contains all essential information, suitable for publication in relevant academic journals. Plagiarism was avoided through recognizing all sources consulted and people who collaborated. All involved parents of participating infants in the experimental and control groups were informed about the findings in an objective manner without too many details offered or impairing the principle of confidentiality.

3.12 SUMMARY

Chapter 3 discussed the research methodology used by the researcher for this clinical trial. An experimental, quantitative research design was used. The study population consisted of 24 ELBW and VLBW premature infants between four and 10 months corrected ages and were matched according to corrected ages and genders before being randomly assigned to the experimental and control groups respectively. Measurement was done through three standardized assessments during pre- and post-tests and the experimental group participated in ASI intervention over a period of 10 weeks. The intervention sessions were evaluated according to the Fidelity Measure for ASI intervention. The ethical considerations of the researcher were also discussed. Chapter 4 presents the anthropometric- and demographic profiles of the study population, as well as pre- and post-tests results through tables and figures as well as the results of the ASI fidelity measure in terms of the intervention sessions.

CHAPTER 4

RESULTS

Chapter 3 discussed the methodology used in this research study. Chapter 4 will present the results obtained in terms of the anthropometric and demographic profiles of the study participants as well as assessment results of the pre- and post-tests of the Infant/Toddler Sensory Profile, Test of Sensory Functions in Infants as well as Bayley III Scales of Infant and Toddler Development. The results of the ASI Fidelity Measure are also presented.

4.1 THE ANTHROPOMETRIC PROFILE OF THE STUDY SAMPLE

The anthropometric profile of the study population will be discussed in terms of the infants' gestational and corrected ages, genders, birth weights as well as other relevant post-natal information.

4.1.1 The study population

The study population consisted of 24 premature infants born with VLBW or ELBW and resided in or near Bloemfontein. The participating infants were referred from the Universitas Academic Hospital High Risk Infant Clinic and as discussed in Chapter 3, randomly divided into an experimental and control group respectively and matched according to their corrected ages and genders. For the purpose of this study it was important that the two groups of infants were similar as far as possible to be able to investigate the impact of ASI intervention on the experimental group. Various comparisons were thus done on the pre-test scores to compare the groups. A p-value of >0.05 indicated that there was not a statistically meaningful difference between the two groups.

4.1.1.1 Corrected ages of participants

The corrected ages of the study participants at the time of the pre-tests ranged from 3 months and 23 days to 10 months and 27 days. Figure 4.1 below illustrates the matching of the 24 participants' according to their corrected ages.

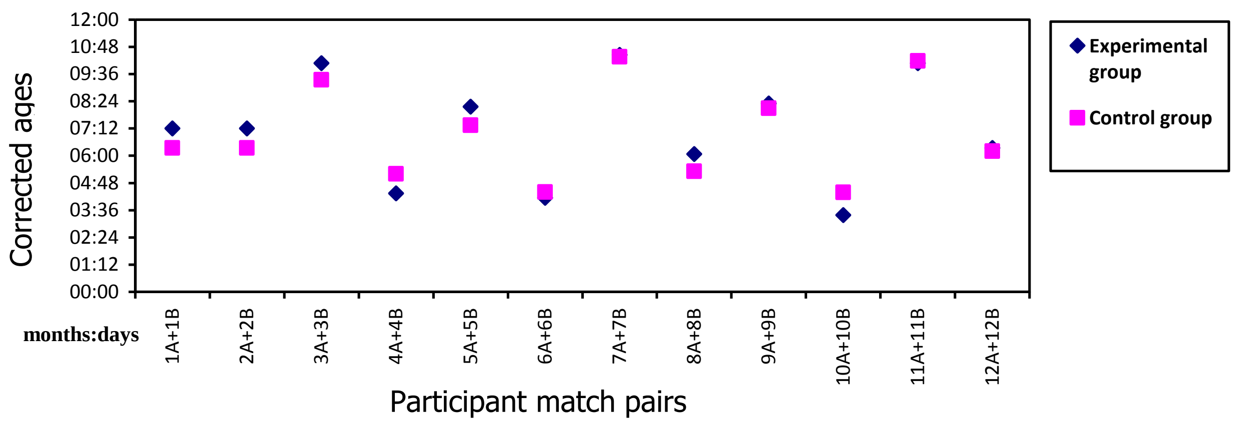


FIGURE 4.1 Summary of the matched study participants corrected ages (n=24).

No statistical difference was found (p=0.94) between the corrected ages of the infants in the experimental and control groups respectively. These results are a strong indication of the comparability of the two groups in terms corrected ages.

4.1.1.2 Gender of participants

The researcher was able to match 20 out of the 24 participating infants according to their gender as indicated below in Table 4.1. Since convenience sampling was used for this study with participants referred from the High Risk Infant Clinic at Universities Academic Hospital, the sample size was relatively small. Within this population and in consideration of the in- and exclusion criteria, it was not possible to match all 24 participants according to their genders however this was considered during the interpretation of results in Chapter 5.

TABLE 4.1 Summary of the study participants' genders (n=24)

	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	6A	6B	7A	7B	8A	8B	9A	9B	10A	10B	11A	11B	12A	12B
Boys	x	x				x				x	x	x	x	x	x	x								
Girls			x	x	x		x	x	x								x	x	x	x	x	x	x	x

The statistical analysis in terms of gender did however indicate that there was not a statistical difference found between the two groups, (p=0.68), these results strengthens the comparability of the two groups in terms of gender.

4.1.1.3 Gestational ages of participants

Since the corrected ages of premature infants is generally used to assess their developmental status (Hunter, 2010:653; Faure, 2011:87; Lubbe, 2008:58) the gestational ages of the participants were not considered as a matching criteria for participants in the two groups. The gestational ages of participants were however important for the purpose of selecting possible participants according to the inclusion criteria of the research study. Table 4.2 below presents the summary of the participants' gestational ages.

Table 4.2: Summary of participants' gestational ages (n=24)

GESTATIONAL AGES	EXPERIMENTAL GROUP n=12	CONTROL GROUP n=12	TOTAL		
			Df	t	p
Minimum	28 weeks	28 weeks	21.98	-0.41	0.69
Maximum	35 weeks	33 weeks			
Mean	30.33 weeks	30.67 weeks			

The gestational ages of all participants of the study ranged from 28 weeks to 35 weeks and no significant statistical difference was found (p=0.69) between the gestational ages of the two groups. The mean scores of the two groups are also a strong indication of the similarities of the groups in terms of gestational ages.

4.1.1.4 Birth weights of participants

The participants birth weights ranged from 750g (ELBW) to 1175g (VLBW). Table 4.3 below illustrates the birth weight distribution of the experimental and control groups indicating that the mean birth weight of the infants in the control group was slightly higher than the mean birth weight of the infants in the experimental group.

TABLE 4.3 Summary of the study participants' birth weights (n=24).

BIRTH WEIGHT	EXPERIMENTAL GROUP n=12	CONTROL GROUP n=12	Difference	TOTAL		
				Df	t	P
Minimum	750g	810g	60g	21.351	-1.13	0.27
Maximum	1450g	1490g	40g			
Median	1085g	1175g	90g			
Mean	1097g	1204g	107g			

A p-value of 0.27 indicated that there was not a significant statistical difference between the birth weights of the experimental and control groups.

4.1.2 Relevant post-natal information

For the purpose of this study; reasons for premature birth, self-soothing methods used by participants before the study, the implementation of Kangaroo Care in the NICU and the number of weeks hospitalized were identified as relevant post-natal information.

4.1.2.1 Reasons for premature birth

The most common reason for premature birth for the study population was preeclampsia (high blood pressure) with 66.67% (n=8) of infants in the experimental group and 75% (n=9) of infants in the control group respectively. Three infants in the experimental group were born prematurely due to multiple pregnancies (twins), one of the infants' twin brother did not survive. Two mothers in the control group unfortunately did not know why their infants were born premature. Figure 4.2 below illustrates the reasons for premature birth in the experimental and control groups.

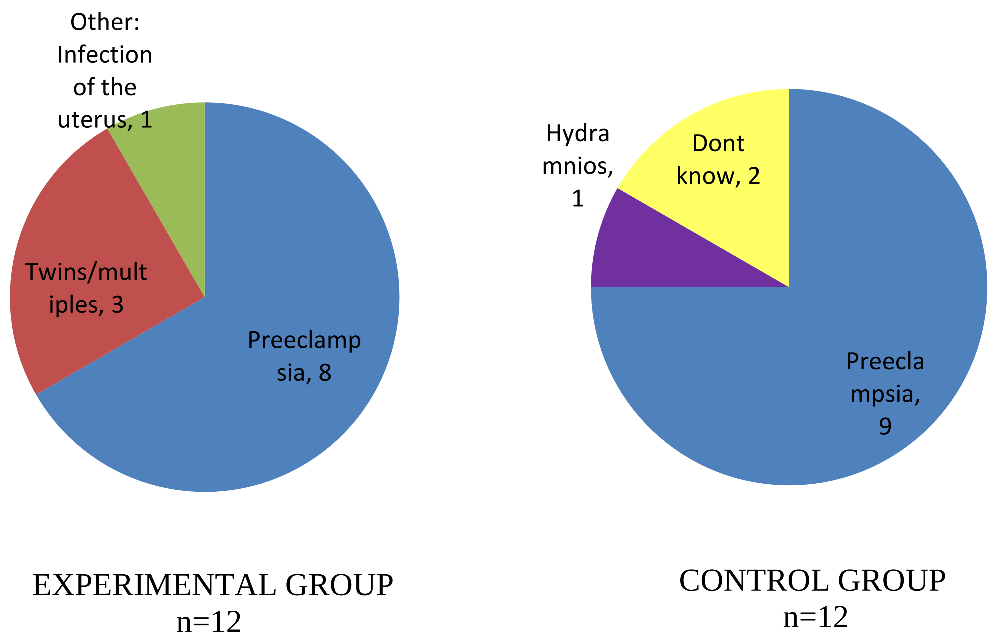


FIGURE 4.2 Reasons for premature birth (n-24).

The statistical analysis of reasons for premature birth for the study population indicated that there was not a statistical difference between the two groups (p=0.11).

4.1.2.2 Self-soothing methods used by participants

Sucking fingers is a self-soothing method that infants already develop in the mother's womb (Faure, 2011:34). Self-soothing methods are important skills for babies to learn to calm themselves and in the process enabling them not only to be calm and content infants or sleep well, but also allowing them to explore their world and develop optimally. For the purpose of this study, learning about the participants self-soothing methods was necessary since self-regulation is an important aspect of sensory integration in infants and their ability to interact with their environment. Infants self-soothing methods were analyzed according to the following variables: Sucking a dummy, finger sucking, both dummy and finger sucking, neither dummy or finger sucking and other methods that included breastfeeding or holding by the mother. Soothing taglets were provided to the infants in the experimental group and this was included in the post-tests of the infants' self-soothing methods and their ability to self-calm. Figure 4.3 below illustrates the self-soothing methods infants in both groups used at the time of the pre-tests dates.

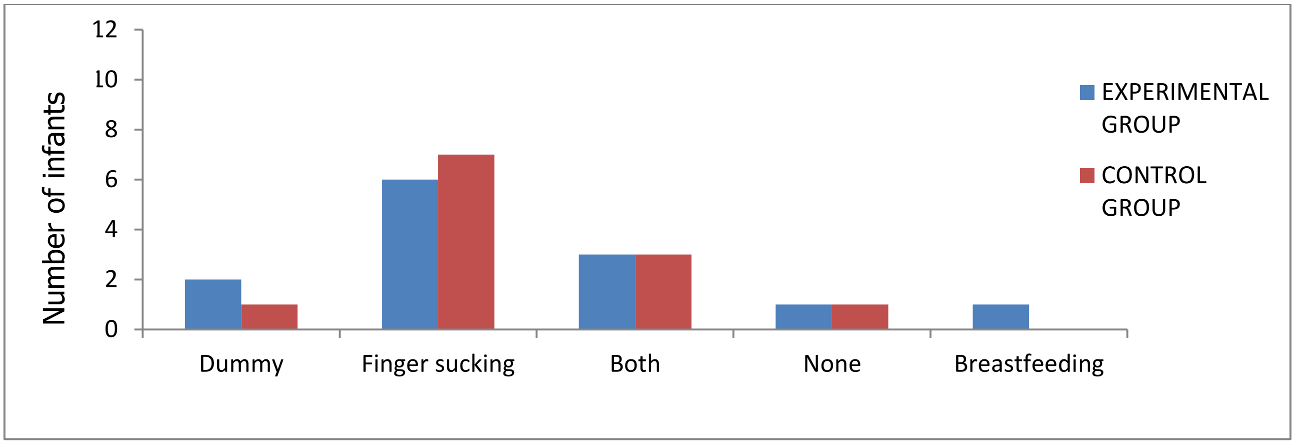
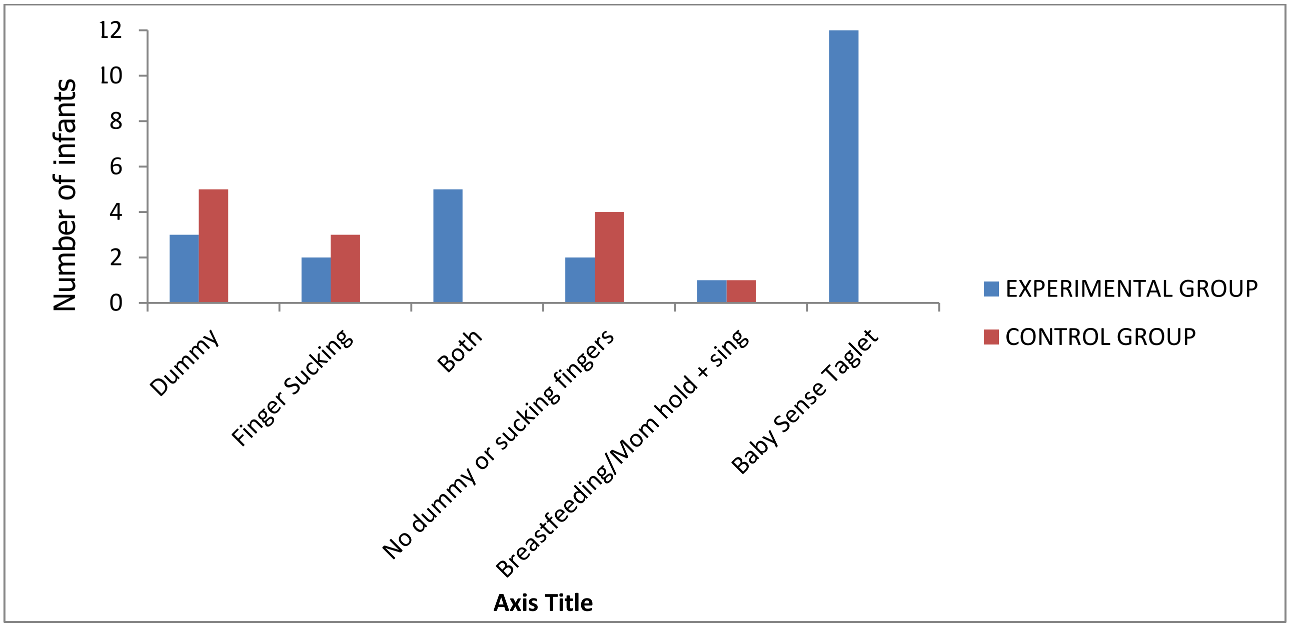


FIGURE 4.3 Pre-tests – Self-soothing methods (n=24).

The majority of infants used finger sucking for self-soothing with 58.33% (n=7), of infants in the experimental group and 50% (n=6), of infants in the control group. Both groups presented with 25% (n=3 in each group) of the infants that used both finger sucking and sucking a dummy to self-sooth. One infant in the experimental group (8.33%) was unable to self-sooth and the mother used breastfeeding as a method to calm her baby. There was no statistical difference (p=1.00) found of self-soothing methods used by infants in both groups at the time of the pre-tests which strengthens the comparability of the two groups in terms of self-regulation.

Figure 4.4 below illustrates the self-soothing techniques used by infants in both the experimental and control groups at the time of the post-tests. The results of the experimental group indicated finger and dummy sucking was used for self-calming by the majority of infants in this group with 41.67% (n=5) of infants that used finger- and dummy sucking, 25% (n=3) of infants sucking dummies and 16.67% (n=2) of infants sucking their fingers. Two infants in this group (16.67%) still did not use either finger- or dummy sucking for self-soothing techniques even though this was encouraged throughout the intervention period of ten weeks. One of these two infants only relied on being held by or being close to his mom to calm himself and one of the infants still relied on breastfeeding to be calmed which was a personal choice of the mother and a decision respected by the researcher. Only the infants in the experimental group received taglets, and their mothers were encouraged to use the taglets for an additional self-soothing technique as part of the intervention. All 12 infants (100%, n=12) in the experimental group used the taglet to self-sooth mostly after play activities or during bed time and sometimes during play activities. All 12 mothers provided positive feedback with regards to their infants using the soft taglet as a security object to self-calm.



Self-soothing methods

FIGURE 4.4 Post-tests – Self-soothing methods (n=24).

The post-tests results of the infants in the control group with regards to their self-soothing methods indicated that 41.67% (n=5) of infants used only a dummy to self-calm, 25% (n=3) of infants used only finger sucking to self-calm and 33.33% (n=4) of infants used neither finger- or dummy sucking for self-soothing techniques. One of these four infants (8.33%, n=1) relied on being breastfed by his mother to be calmed. Although a p-value of 0.09 did not indicate a significant statistical difference between the self-soothing methods used by the experimental and control groups at the time of the post-tests, compared to the pre-test results' p-value of 1.00, the two groups presented with a noticeable difference in terms of self-soothing methods used at the time of the post-tests.

4.1.2.3 Kangaroo Care

The implementation of Kangaroo Care in the NICU is important for the healthy development of sensory integration in premature infants as discussed in Chapter 2. Information with regards to whether mothers of the study participants practiced Kangaroo Care with their infants and for how long was valuable for the purpose of this study. Figure 4.5 below illustrates the time mothers in both the experimental and control groups spent on practicing kangaroo Care with their infants.

All 12 mothers in the experimental group practiced Kangaroo Care with their infants. The amount of weeks these mothers practiced Kangaroo Care ranged from 1 week (8.33%, n=1) up to as much as 36 weeks (8.33%, n=1). Four mothers (33.33%) practiced Kangaroo Care for 12 weeks and 3 mothers (25%) practiced Kangaroo Care for 4 weeks which seemed to be the average time frames for this group.

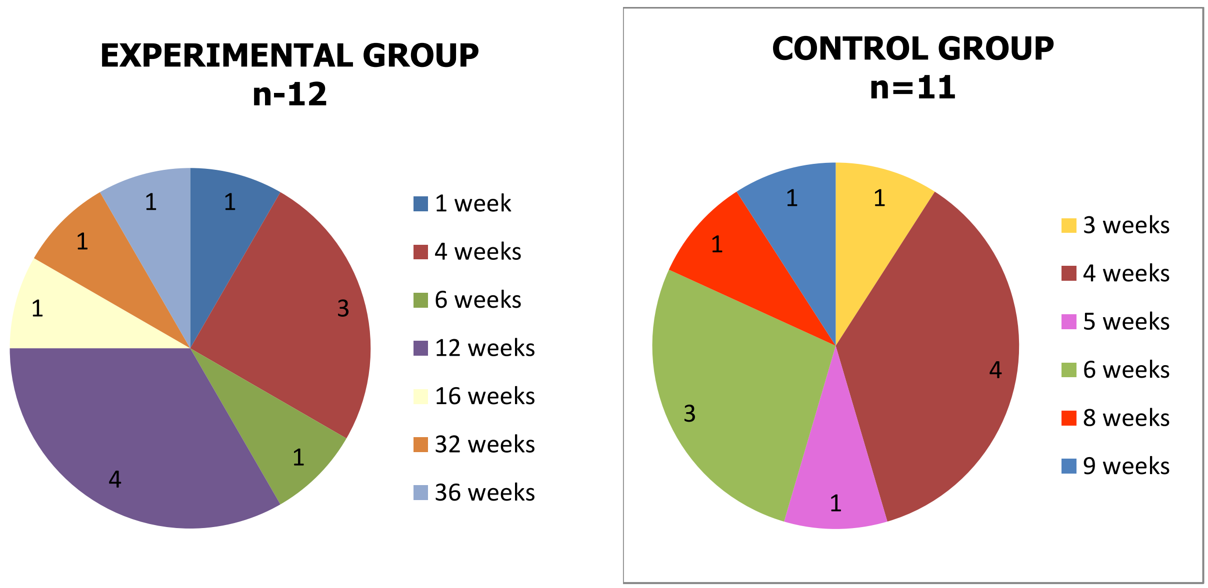


FIGURE 4.5 Summary of time spent on Kangaroo Care by mothers (n=23).

Only 11 mothers in the control group practiced Kangaroo Care with their infants. The amount of weeks these mothers practiced Kangaroo Care ranged from 3 weeks (8.33%, n=1) to 9 weeks (8.33%, n=1). Four mothers (33.33%) in this group practiced Kangaroo Care for 4 weeks and three mothers (25%) which seemed to be the average timeframe for this group. There was not a statistical difference (p=0.16) found when the amount of weeks mothers in the two groups practiced Kangaroo Care with their infants were compared.

4.1.2.4 Weeks in hospital

Premature infants are admitted to Neonatal Intensive Care Units (NICU) immediately after birth, these are complex and highly specialized hospital units designed to care for premature and critical ill infants. An increased awareness among NICU staff of environmental and care giving influences, on the vulnerable newborn infant have led to developing the approach of NICU care to include developmental care and the involvement of the infant's family in addition to primary medical concerns (Hunter, 2010:650; Lubbe, 2008:49). Stressors such as bright lights, loud noises, an intrusive environment, painful interventions as well as unintentional and repeated disruption of sleep and rest can be limited through correct handling and positioning techniques, however it cannot be eliminated completely. Within this challenging environment and with their immature systems the premature infant's physiological- (heart rate, breathing, blood pressure, elimination and temperature regulation) and behavioural functions (sleep and awake states, calming techniques and environmental interaction), needs to be stabilized (Lubbe, 2008:27).

Undoubtedly these early challenges have an effect on the infant's long term development and as the survival rate of premature infants increases, concerns emerge about their long-term developmental outcome (Hunter, 2010:651). Figure 4.6 below illustrates the number of weeks infants in both groups were admitted in hospital.

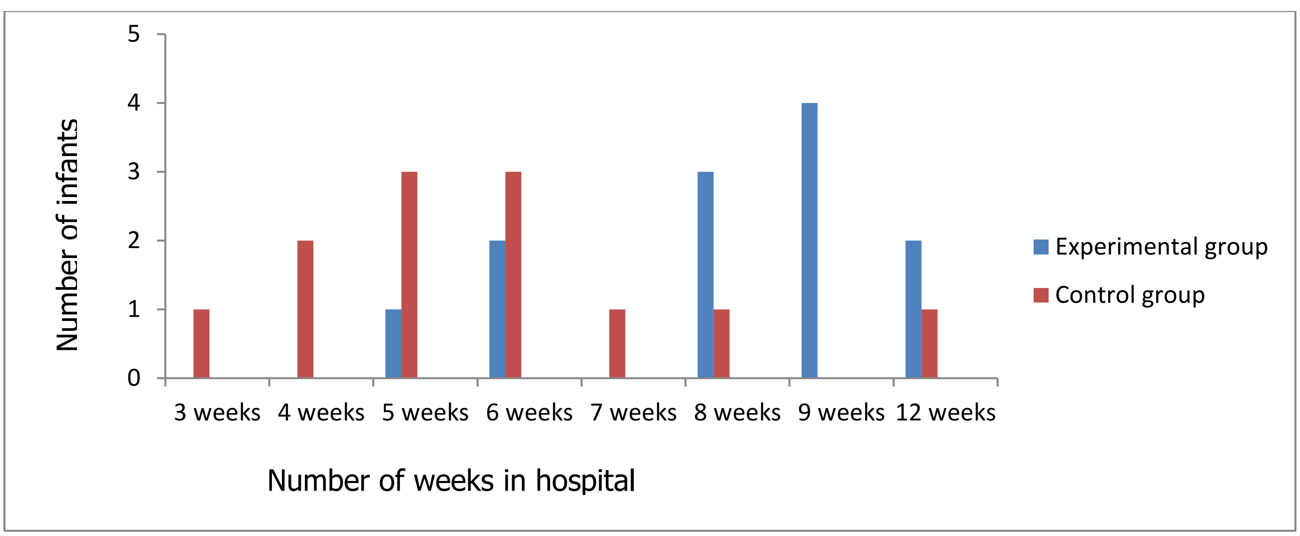


FIGURE 4.6 SUMMARY: Weeks in hospital (n=24).

There was a significant statistical difference (p=0.01) between the two groups with regards to the time of hospitalization of the infants. However, the children from the experimental group spent more weeks on average (8.4) in hospital than those from the control group (5.9), which will, if anything, not give the experimental group a head start on the control group.

4.2 THE DEMOGRAPHIC PROFILE OF THE STUDY SAMPLE

The demographic profile of the study participants will be discussed in terms of; the geographic and socio-economic information of infants; the ages, marital status, educational levels and occupations of parents as well as home languages. All 24 participants resided in or near Bloemfontein.

4.2.1 Profile of the parents of participating infants

Information related to the parents of the participating infants were analyzed in terms of the following variables; age, marital status, home language, educational level and occupations. This information contributed in the process of ascertaining the comparability of the experimental and control groups in terms of the socio-economic status and home environments of the participating infants.

4.2.1.1 The ages of the parents

Table 4.4 below provides a comparison of the ages of the mothers and fathers of the intervention and control groups respectively and illustrates that the mean age for the mothers of participating infants at the day of the pre-tests was 28.6 years. The ages of the mothers ranged from 21 years to 41 years.

TABLE 4.4 Summary: Age of parents (n=24).

	Experimental group n=12				**Control group n=12**				**Total group n=24**			
	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
Mothers	29.6	5.7	21	41	27.7	5.9	21	37	28.6	5.7	21	41
Fathers	34.0	5.8	27	49	32.5	6.4	25	42	33.5	6.12	25	49

The mean age for the fathers of the participating infants was 33.5 years and ranged from 25 years to 49 years. No significant statistical difference was found between the ages of mothers ($p=0.43$) or fathers ($p=0.45$) of the experimental and control groups respectively.

4.2.1.2 Marital status of parents

Figure 4.7 below illustrates that a higher percentage of infants parents in the intervention group were married or living together than the parents in the control group. The percentage of single parents was higher in the control group.

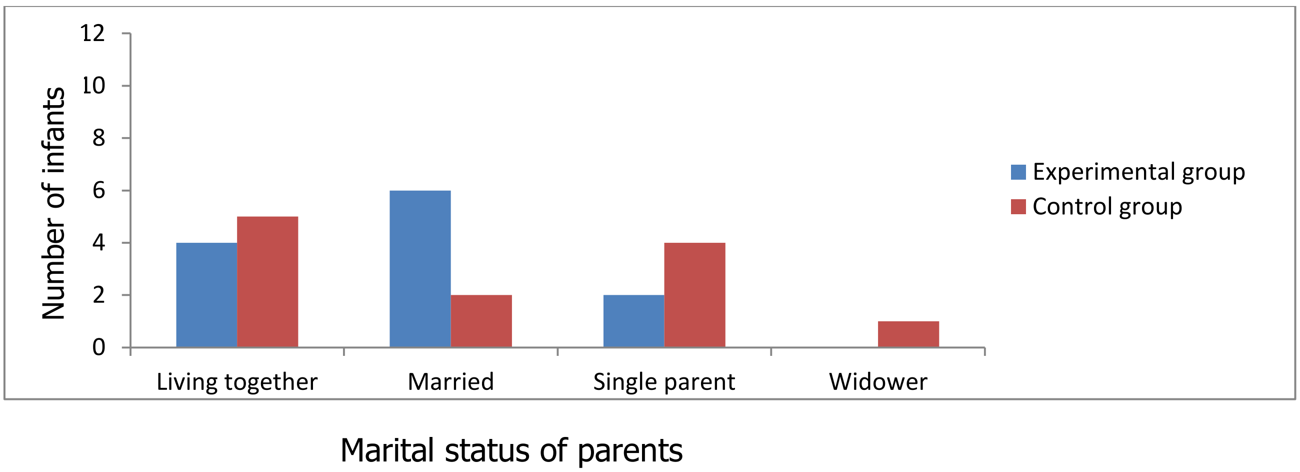


FIGURE 4.7 Marital status (n=24).

The statistical analysis in terms of the marital status of infants parents in both groups indicated no statistical difference ($p=0.32$) between the two groups.

4.2.1.3 Home languages

Figure 4.8 below illustrates that the majority of participants' home language were Sotho and that other languages included Xhosa, Tswana and Afrikaans.

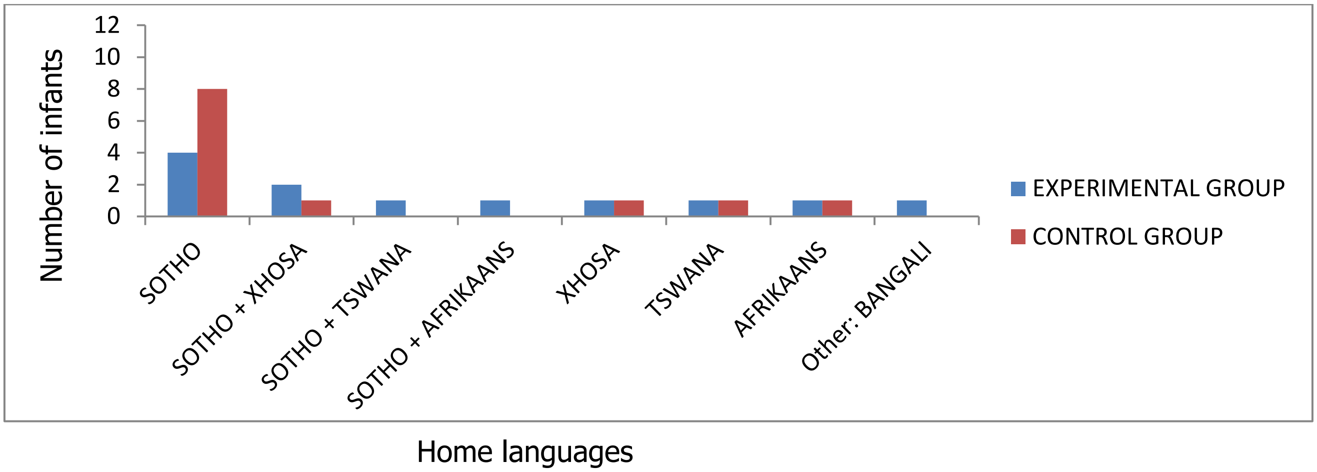


FIGURE 4.8 Summary: Home language of participants (n=24).

Bangali was the home language of only one infant in the experimental group. The infant's parents immigrated from India.

4.2.1.4 The educational level of participants' mothers

The educational level of the mothers of the study participants ranged between no schooling (4.16%, n=1) to post-matric qualification (8.33%, n=2) as illustrated in Figure 4.9 below. The majority of mothers obtained matric (54.17%, n=13).

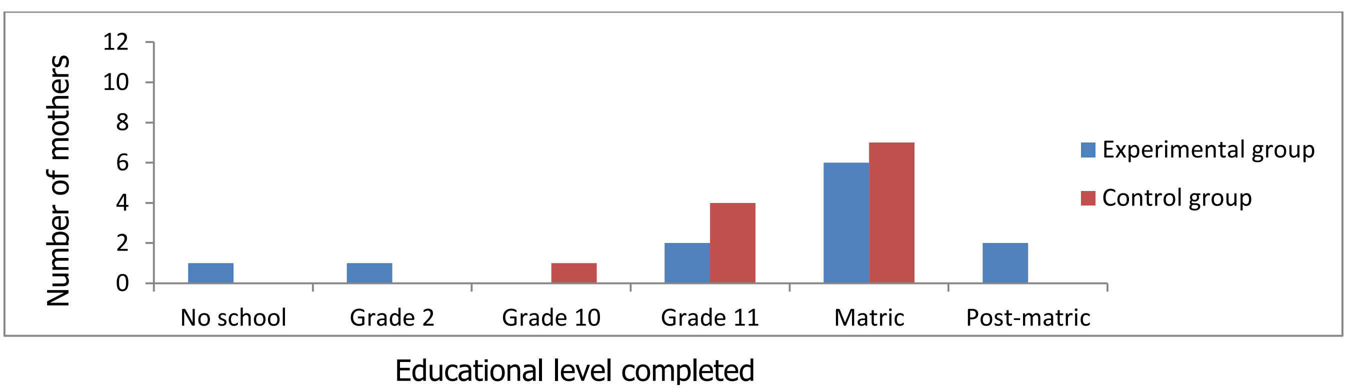
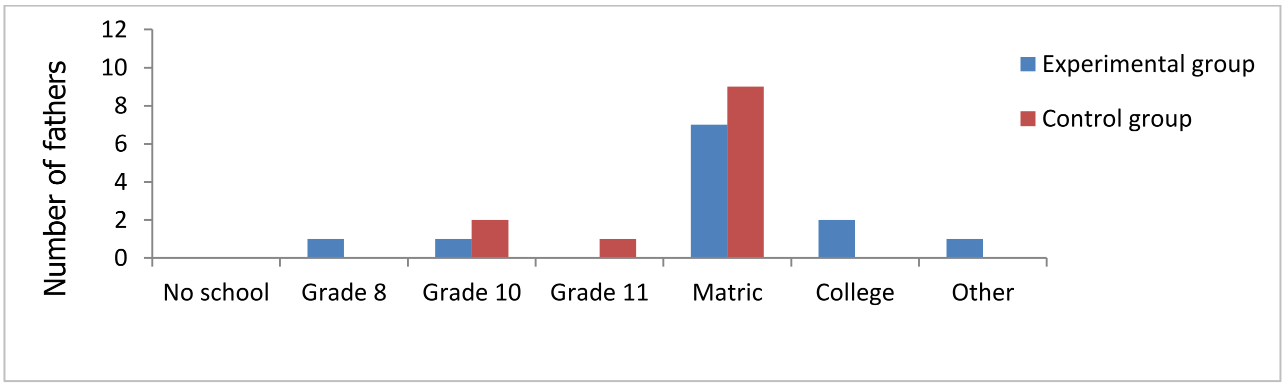


FIGURE 4.9 Educational levels completed of participants' mothers (n=24).

Although two mothers in the experimental group had post-matric qualifications, two mothers in the same group also had no schooling or only obtained grade two while the mothers in the control group's educational levels ranged from grade 10 to matric. There was no statistical difference (p=0.48) found between the educational levels of the mothers in the experimental group and the control group respectively.

4.2.1.5 The educational level of participants' fathers

The educational level of the participants' fathers ranged between grade eight (4.16%, n=1) to post-matric qualification (8.33%, n=2) as illustrated in Figure 4.10 below.



Educational level completed

FIGURE 4.10 Educational levels completed of participants' fathers (n=24).

The majority of fathers obtained matric (66.67%, n=16). There was no statistical difference (p=0.55) found between the educational levels of the fathers in the experimental group and the control group respectively.

4.2.1.6 Mothers' occupations

The majority of mothers in both groups were not working (70,83%, n=17), two mothers in the experimental group, and five mothers in the control group were working.

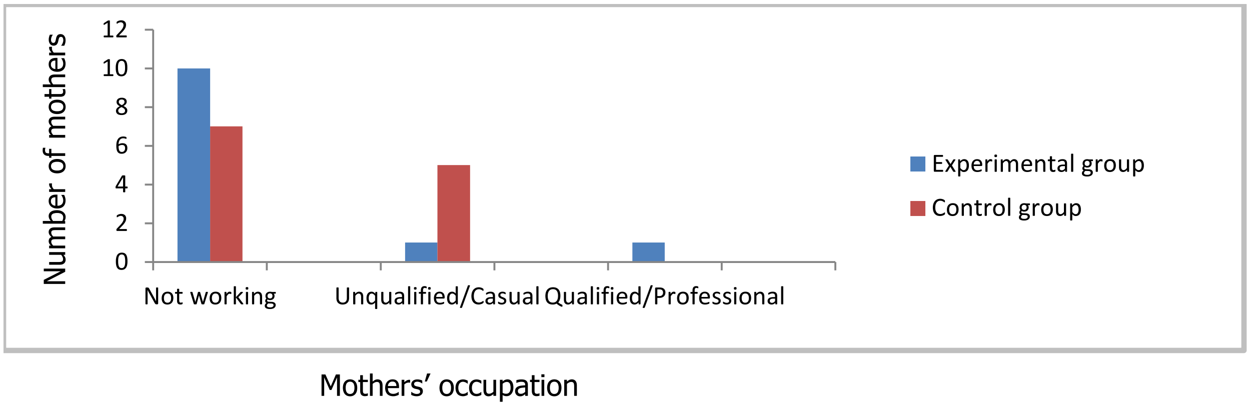


FIGURE 4.11 Mothers' occupations (n=24).

No statistical difference (p=0.16) was found between the occupations of mothers in the experimental and control group respectively.

4.2.1.7 Fathers' occupations

The majority of fathers in both the experimental and control groups were unqualified or casual workers (79.17%, n = 17) as illustrated in Figure 4.12 below.

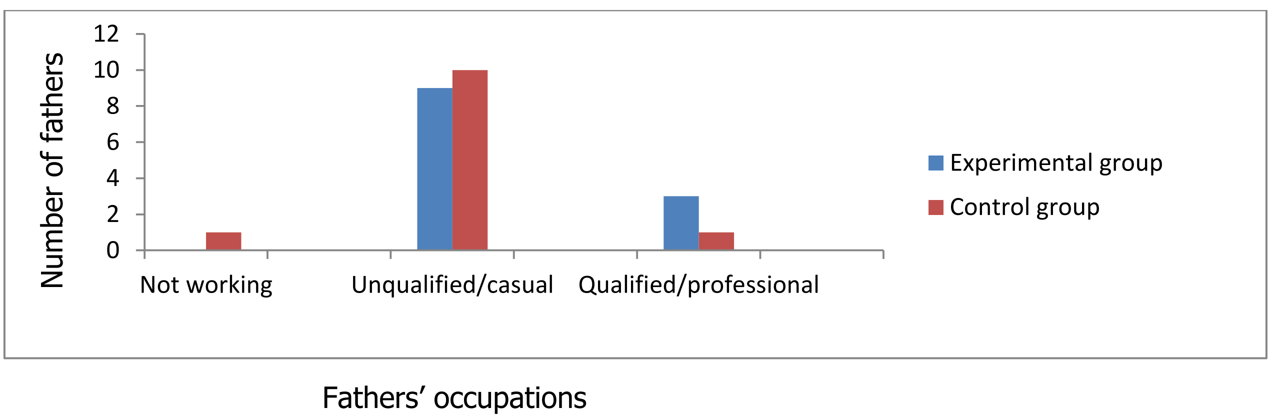


FIGURE 4.12 Fathers' occupations (n=24).

No statistical difference (p=0.59) was found between the occupations of fathers in the experimental and control group respectively.

RELEVANCE OF ANTHROPOMETRIC AND DEMOGRAPHIC DATA

The anthropometric and demographic profiles of the participating infants presented and discussed in this chapter indicated that the randomization of the experimental and control groups resulted in the comparability with regards to the variables listed below in Table 4.5:

TABLE 4.5 Anthropometric and demographic variables of participants.

	P=values	Tests used
Ages of mothers	0.43	t-test
Ages of fathers	0.45	t-test
Marital status of parents	0.32	Chi-square
Educational level of mothers	0.48	Chi-square
Educational level of fathers	0.55	Chi-square
Mothers occupations	0.16	Chi-square
Fathers occupations	0.59	Chi-square
Corrected ages	0.94	t-test
Genders	0.68	Chi-square
Gestational ages	0.69	t-test
Birth weights	0.27	t-test
Reasons for premature birth	0.11	Chi-square
Pre-tests self soothing	1.00	Chi-square
Number of weeks kangaroo care	0.57	Chi-square
Time hospitalized (In favour of control group)	0.01	t-test

These results indicated that there were no statistical difference between the anthropometric and demographic profiles of the infants and their parents in the experimental and control groups respectively with the single exception of weeks hospitalized, which were in the favour of the control group who was hospitalized for a shorter period than the experimental group. The two groups were similar in all the relevant factors. These comparisons enabled the researcher to make valuable conclusions regarding the effect of sensory integration intervention on the development of the premature infants through analyzing and interpreting the pre- and post-tests results of the Infant/Toddler Sensory Profile, Test of Sensory Functions in Infants and Bayley Scales III of Infant and Toddler Development.

4.3 TEST RESULTS

The pre-test results of all three assessments of the experimental and control groups will first be compared and the comparability of the two groups will be discussed with regards to the relevant subtests of all three assessments. The post-test results of all three assessments will then be interpreted and analyzed in terms of the progress of the experimental and control groups in comparison with one another.

4.3.1 The results of the Infant/Toddler Sensory Profile

The Infant/Toddler Sensory Profile was utilized in this research study as an assessment tool to enable the researcher to gather information about the participating infants' sensory processing abilities and learn how those patterns supported and/or interfered with the infants' functional performance and development. The researcher was able to use the pre-test results during the intervention planning process for each infant as described in Chapter 3, section 3.8.1 (ADDENDUM D).

The pre-test results of the Infant/Toddler Sensory Profile was combined with the pre-test results of the TSFI and Bayley III Scales of Infant and Toddler Development of each infant; for the purpose of intervention planning as well as for the purpose of comparing the pre- and post-test results to determine the effect of the 10 week Ayres Sensory Integration intervention on the development of the infants in the experimental group.

The results of the Infant/Toddler Sensory Profile will be discussed in terms of the following sub-sections; low registration, sensation seeking, sensory sensitivity, sensory avoiding and low threshold of all 24 infants participating in the study. The results of the sub-sections; auditory-, visual-, tactile-, vestibular- and oral sensory processing will be discussed for the 11 infants who fell in the relevant age group for these sections.

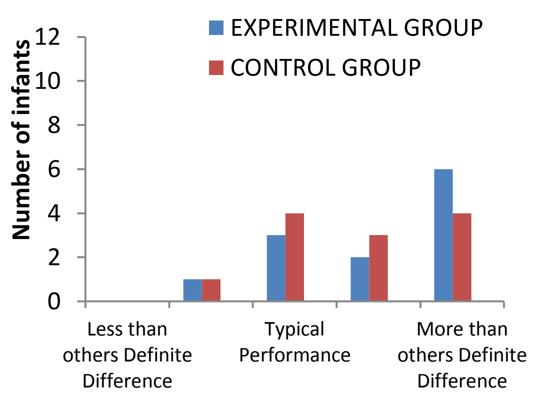
4.3.1.1 Low Registration

The items included in the Low Registration subtest measure the infant's behavioural responses to all types of sensation available in his/her environment e.g. the infant being unaware of dirty diapers or not noticing when people enter the room etc. (Dunn, 2002:15). It is hypothesized that children with low registration in the more- or much more than other ranges have inadequate neural activation to support performance and therefore may miss noticeable cues to support ongoing activity (Dunn, 2002:94).

The results of the pre-tests indicated that there was no significant statistical difference between the experimental and control groups in terms of the low registration component of the Infant/Toddler Sensory Profile (p=0.87). Figure 4.13 below (left) indicates that a majority of 50% (n=6) of the infants in the experimental group presented with a definite difference in terms of low registration compared to 33.33% (n=4) of infants in the control group. A slightly higher percentage of infants in the control group 33.33% (n=4) fell within the typical performance range compared to the 25% (n=3) of the infants in the experimental group.

With a p-value of 0.15 the post-test results indicated that although there was not a significant statistical difference between the low registration components of the two groups, the similarities however were much less between the experimental and control groups. Figure 4.13 below (right) indicates that a large majority of 66.67% (n=8) of the experimental group presented with a typical performance in terms of low registration compared to the 25% (n=3) of the control group.

Pre-Test (n=24)



Post-Test (n=24)

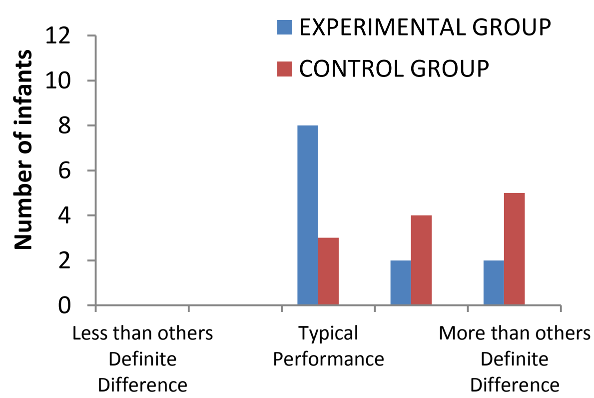


FIGURE 4.13 Low Registration pre- and post-tests results (Infant/Toddler Sensory Profile).

The experimental group showed an increase of 41.67% (n=5) of infants presenting within the typical performance range of the low registration component after the 10 week intervention period while the low registration typical performance results of the control group presented with a slight decrease of 8.33% (n=1).

4.3.1.2 Sensation Seeking

The infants' interest in and pleasure with all types of sensations are measured through the items included in the Sensation Seeking subtest (Dunn, 2002:15) e.g. the infant enjoys looking at his own reflection in the mirror or enjoys rhythmical activities. Infants whose behaviour are consistent with sensation seeking presents with high neurological thresholds. They have a tendency to actively work to meet these thresholds. These infants and toddlers are described as active and continuously engaged in their environments, in an attempt to add sensory input to every experience in daily life. As with infants who presents with low registration in the more- or much more than others ranges, it is hypothesized that sensation seekers also have inadequate neural activation however, in contrast to low registration infants; they are driven to meet their thresholds and creates opportunities to increase sensory input (Dunn, 2002:45).

Figure 4.14 (left) below illustrates the results of the pre- tests in terms of sensation seeking behaviour. The majority of infants in both the experimental (66.67%, n=8) and control groups (66.67%, n=8) presented within the typical performance range and a p-value of 0.39 indicated that there was not a significant statistical difference between the experimental and control groups.

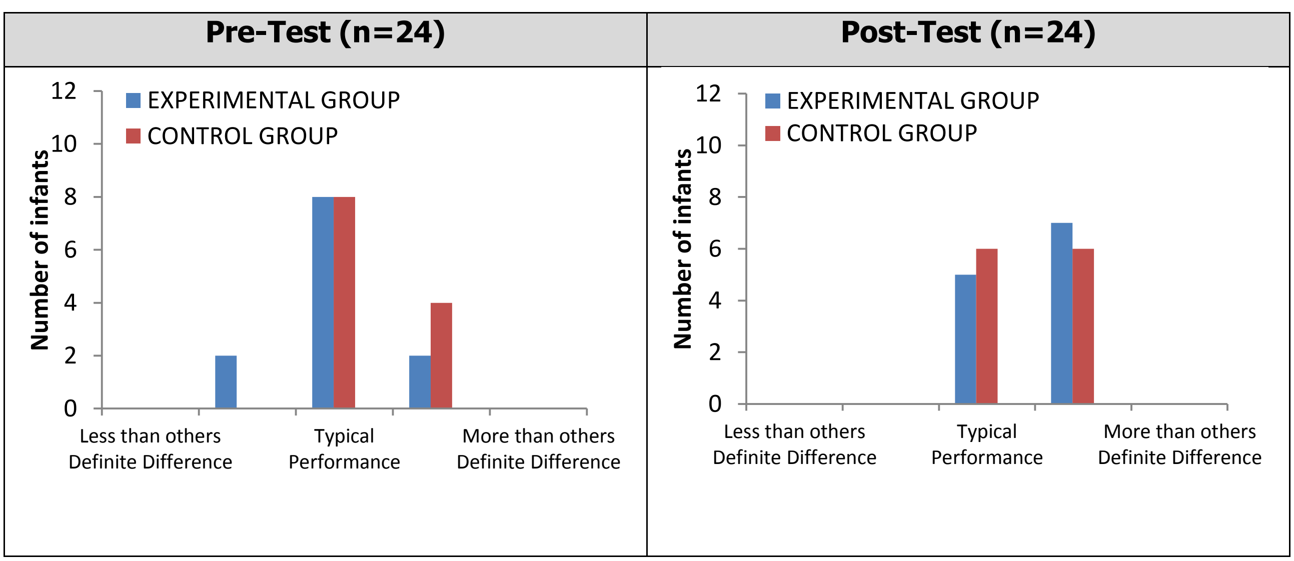


FIGURE 4.14 Sensation Seeking pre- and post-tests results (Infant/Toddler Sensory Profile).

The sensation seeking post-test results also did not indicate a significant statistical difference (p=1.00) between the two groups however, the percentage of infants in the control group that fell within the typical performance range decreased to 50% (n=6) while the percentage of infants in the experimental group presented with a larger decrease of infants falling within the typical performance range (41.67%, n=5) as illustrated in Figure 4.14 above (right).

4.3.1.3 Sensory Sensitivity

An infant's ability to notice and react on all types of sensation are measured through the items included in the Sensory Sensitivity subtest e.g. an infant is distracted and/or has difficulty eating in noisy environments or becomes agitated when having his/her hair washed (Dunn, 2002:15). Infants whose behaviour are consistent with sensory sensitivity have low neurological thresholds and a tendency to react to sensory stimuli according to these low thresholds (Dunn 2002:44).

There was no statistical difference between the experimental and control groups in terms of sensory sensitivity (p=1.00) during the pre-tests as illustrated in Figure 4.15 below (left). The majority of infants, 58.33% (n=7) in both the experimental and control groups respectively fell within the probable difference (more than others) range.

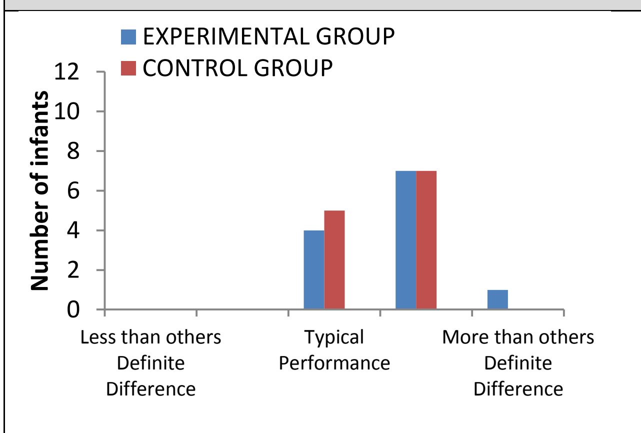
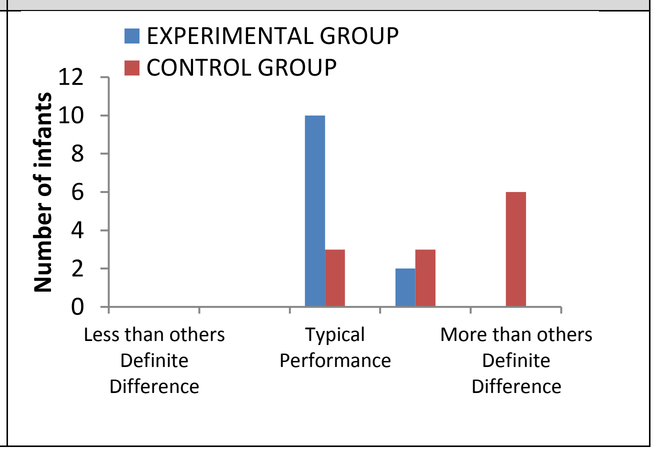
Pre-Test (n=24)	**Post-Test (n=24)**
	

FIGURE 4.15 Sensory Sensitivity pre-and post-tests results (Infant/Toddler Sensory Profile).

The sensory sensitivity post-test results however indicated a significant difference (p=0.004). Figure 4.15 above (right) illustrates that all 12 infants in the experimental group showed an improvement in their post-test results indicating less sensory sensitive behaviour while the infants in the control group showed a significant increase in sensory sensitive behavior. The majority of infants in the experimental group (83.33%, n=10) presented within the typical performance range with only two infants (16.67%, n=2) in this group falling within the probable difference (more than others) range while 50% (n=6) of infants in the control group fell within the definite difference (more than others) range and 25% (n=3) of infants in this group fell in the probable difference range (more than others).

4.3.1.4 Sensation Avoiding

An infant's need for controlling the amount and type of sensations available is measured through the items included in the Sensation Avoiding subtest e.g. the infant avoids getting his/her face/nose wiped or he/she tries to escape from noisy environments (Dunn, 2002:15). Behaviour of infants that is consistent with sensation avoiding represents low neurological thresholds with a tendency to actively work to keep these thresholds from being met. Sensation avoiders in the more- or much more than other ranges might engage in very disruptive behaviours. It is hypothesized that meeting thresholds is uncomfortable or frightening to the child. A child's coping strategy is to keep these events at bay. Infants do this by either withdrawing or engaging in an emotional outburst that enables them to get out of the threatening situation. Children who are sensation avoiders also might create rituals for their daily lives (hypothesized to be a strategy to allow only familiar patterns of input), and by their behaviour entice others to support these rituals. From a sensory processing perspective, the child is creating a situation to limit sensory input to those events that are familiar and therefore 'easy' for the nervous system to interpret. Children who avoid sensation are resistant to changes because change represents an opportunity to be bombarded with unfamiliar stimuli (Dunn, 2002:45,46).

The results of the sensory avoiding pre-tests indicated that the majority of infants in the control group (66.67%, n=8) presented with bahaviour within the typical performance range while the same percentage in the experimental group presented with behaviour that indicated a probable difference (more than others) as illustrated in Figure 4.15 below (left). The results of the two groups, indicated a statistical difference with a p-value of 0.04.

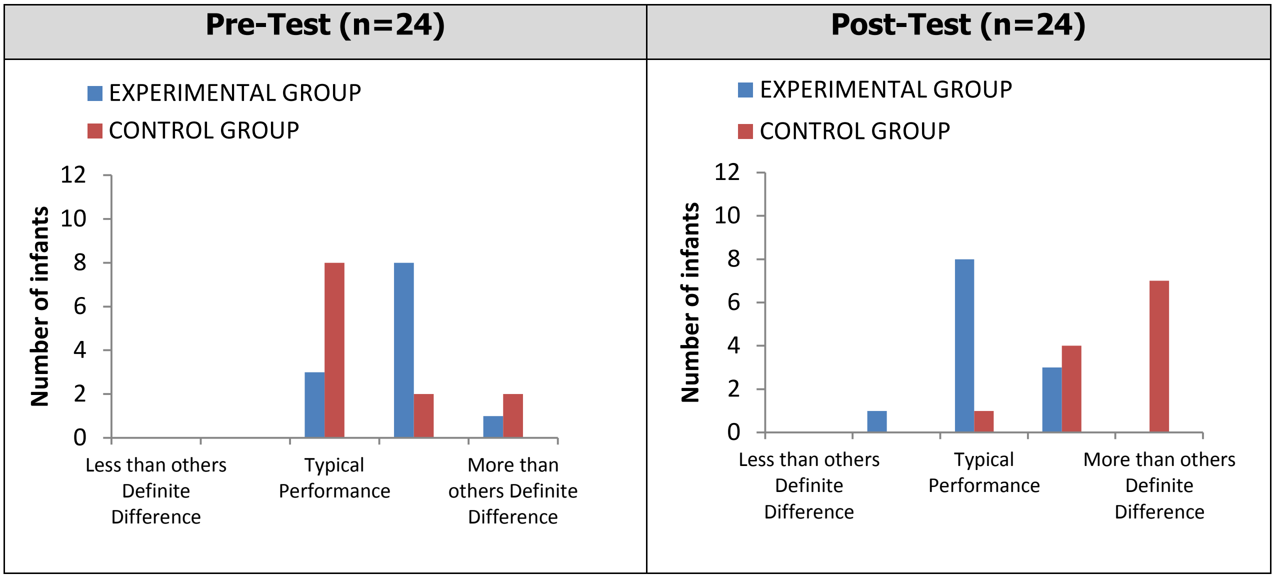


FIGURE 4.16 Sensory Avoiding pre-and post-tests results (Infant/Toddler Sensory Profile).

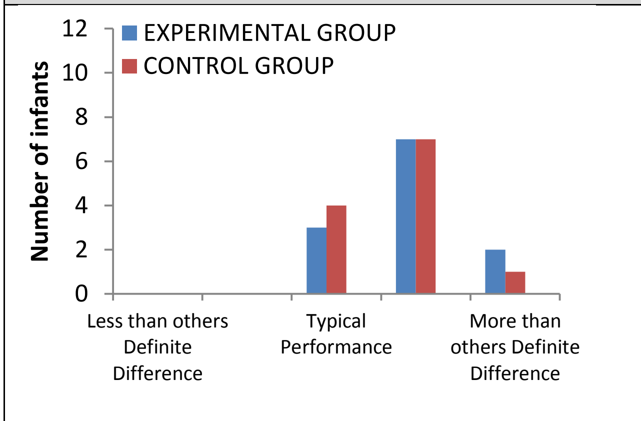
Figure 4.16 above (right) illustrates the results of the post-tests and indicates a significant statistical difference (p=0.0015) between the two groups. Infants in the experimental group presented with significantly less sensory avoidance behaviour with 66.67% (n=8) of the infants' results falling within the typical performance range compared to the 8.33% (n=1) of infants in the control group. A majority of infants in the control group 58.33% (n=7) presented with severe sensory avoidance behaviour 10 weeks after the initial pre-tests.

4.3.1.5 Low Threshold

The Low Threshold section serves as a combined quadrant of Sensory Sensitivity and Sensation Avoiding quadrants and is relevant in terms of some aspects of poor sensory processing, particularly for fussy infants or infants who require a great deal of structure (Dunn 2002:15). Behaviour consistent with low threshold represents low neurological thresholds with children using both active and passive self-regulation strategies. Infants with low thresholds tend to be fussy and require a great deal of structure. This apparent inconsistency reflects the nervous system's attempts to simultaneously respond to stimuli and protect itself by reducing input, therefore producing variable responses (Dunn, 2002:46,47).

Figure 4.17 below (left) indicates that there was no statistical difference between the low threshold results of infants in the experimental and control groups' pre-tests (p=1.00). The majority of infants in both groups' (58.33%, n=7 in each group) results fell within the probable difference range.

Pre-Test (n=24)



Post-Test (n=24)

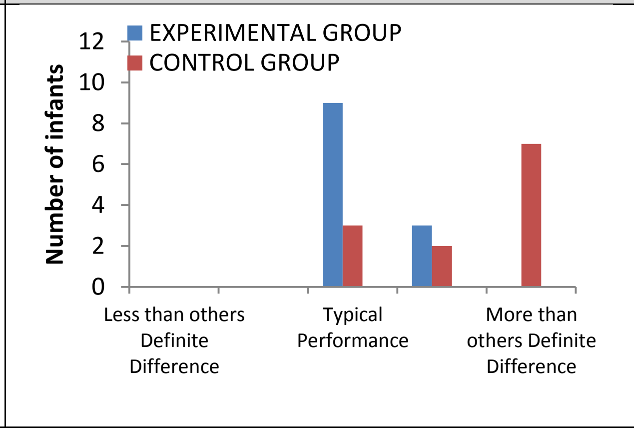


FIGURE 4.17 Low Threshold pre-and post-tests results (Infant/Toddler Sensory Profile).

The low threshold post-test results presented a significant difference between the infants in the experimental and control groups (p=0.0038) as seen in Figure 4.17 above (right). A large majority of 75% (n=9) of infants in the experimental group fell within the typical performance range showing an improvement of 50% (n=6) with only 25% (n=3) of infants in this group falling within the probable difference range compared with the 58.33% (n=7) of infants in the control group that presented with results falling in the definite difference range 10 weeks after the initial pre-tests.

The following five subtests are included in the Infant/Toddler Sensory Profile questionnaire for the 7 to 36 month old infants, namely auditory-, visual-, tactile-, vestibular- and oral processing and will be presented and discussed according to the results relevant to the infants who fell within this age group at the time of the pre and post-tests.

During the pre-tests, 12 infants; six infants in the experimental group and six infants in the control group fell within this age group, and during the post-tests, due to the increase in age during the course of the study, 10 infants in the experimental group and 11 infants in the control group fell within this age group.

4.3.1.6 Auditory Processing

The infants' responses to things heard are measured through items in the Auditory Processing subtest e.g. the mother needs to speak loudly to get her infant's attention or the infant is distracted and/or has difficulty eating in noisy environments (Dunn, 2002:14).

No statistical difference were found (p=0.55) between the auditory processing results of the infants in the experimental group and the infants in the control group as presented below in Figure 4.18 (left). The majority of infants in the control group (66.67%, n=4) presented with typical performance in terms of auditory processing compared to the 50% (n=3) of infants in the experimental group within this age group.

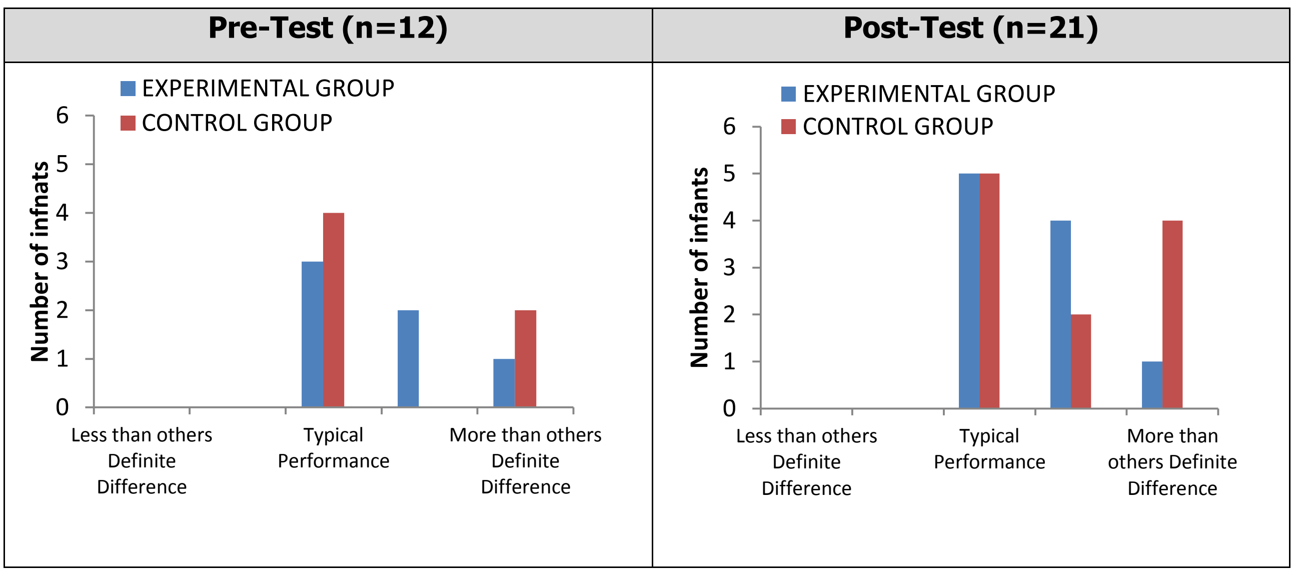


FIGURE 4.18 Auditory Processing pre-and post-tests results (Infant/Toddler Sensory Profile).

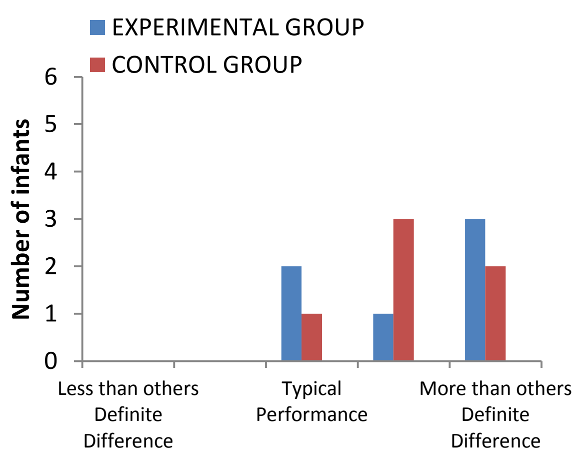
During the post-tests again no statistical difference (p=0.39) were found between infants in the two groups' auditory processing results, however 50% (n=5) of infants in the experimental group presented within the typical performance range compared to the 45.5% (n=5) of infants in the control group as illustrated in Figure 4.18 below (right).

4.3.1.7 Visual Processing

Items that measure an infant's responses to things seen are included in the Visual Processing subtest e.g. the infant enjoys looking at shiny objects and the infant avoids making eye contact with his mother (Dunn, 2002:14).

No statistical difference (p=0.61) was found between the visual processing of infants in the experimental group and infants in the control group at the time of the pre-tests. The majority of infants in both groups presented with visual processing difficulties; in the experimental group 66.67% (n=4) and in the control group 83.33% (n=5). These indications are the combined results of the probable and definite difference score ranges as presented in Table 4.19 below (left).

Pre-Test (n=12)	Post-Test (n=21)



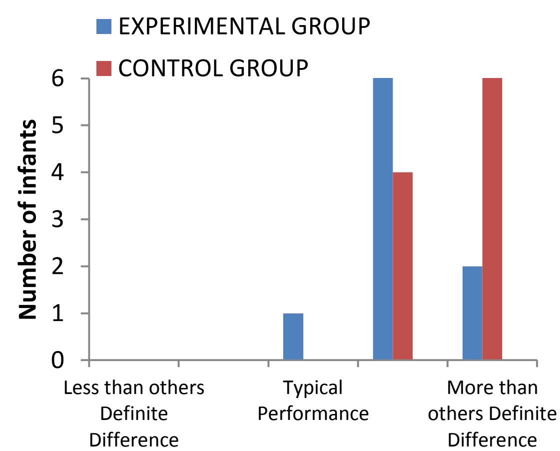


FIGURE 4.19 Visual Processing pre-and post-tests results (Infant/Toddler Sensory Profile).

The post-test visual processing results did not indicate a significant statistical difference (p=0.08) between the results of the experimental and control groups as illustrated in Figure 4.19 above (right). Although only 10% (n=1) of the infants in the experimental group within this age group presented with typical visual processing performance, 60% (n=6) of this group presented with results falling within the probable difference range compared to no infants in the control group presenting with typical visual processing and 54.54% (n=6) of infants that presented with results falling within the definite difference range.

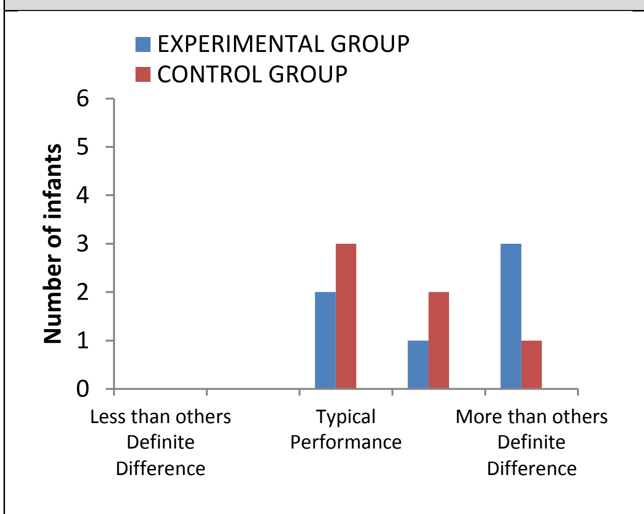
4.3.1.8 Tactile Processing

An infant's responses to stimuli that touch the skin are measured through items included in the Tactile Processing section, e.g. the infant resists to be cuddled and the infant becomes agitated when having his/her hair washed (Dunn, 2002:14).

No statistical difference (p=0.61) was found between the tactile processing of infants in the experimental group and infants in the control group during the pre-tests as illustrated in Figure 4.20 below (left). The largest group of infants in the control group (50%, n=3) presented with typical tactile processing performance compared to the largest group of infants in the experimental group (50%, n=3) that presented within the definite difference range.

The experimental group presented with a significant improvement in terms of tactile processing at the time of the post-tests. A statistical difference (p=0.04) was found between the tactile processing score improvement of the two groups.

Pre-Test (n=12)



Post-Test (n=21)

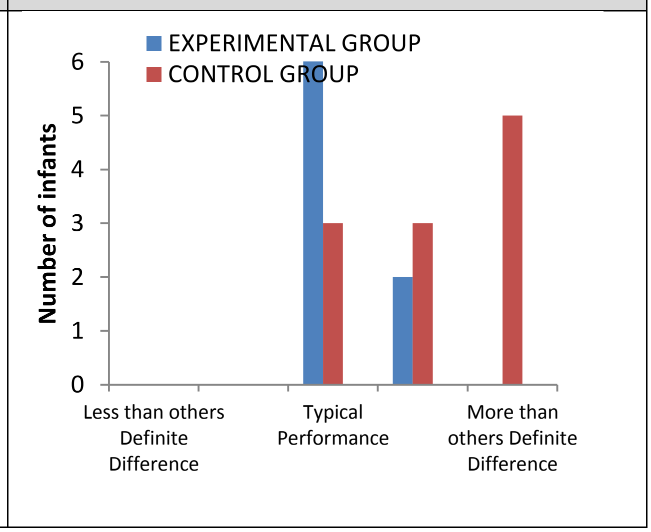


FIGURE 4.20 Tactile Processing pre-and post-tests results (Infant/Toddler Sensory Profile).

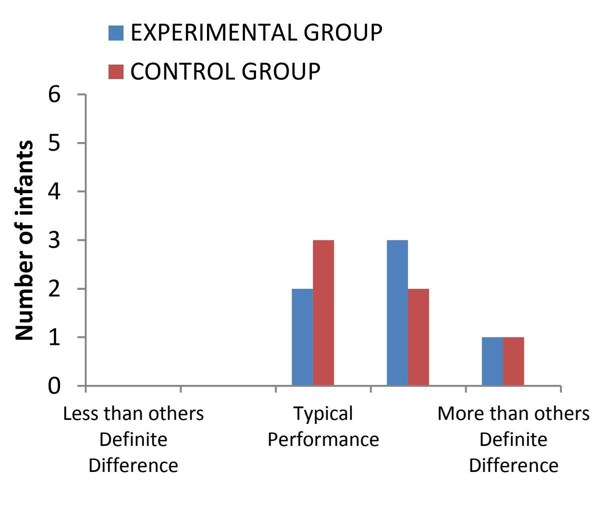
Figure 4.20 above (right) illustrates that within the experimental group 60% (n=6) of the infants presented with typical tactile processing performance and only 20% (n=2) of infants presented with scores within the probable difference range compared to the 27.3% of infants in the control group that presented with typical tactile processing performance and 72% (n=8) of infants in this group presented with tactile processing difficulties.

4.3.1.9 Vestibular Processing

An infant's responses to movement are measured through the Vestibular Processing section e.g. the infant resists having his/her head tipped back during bathing or the infant enjoys physical activity for example bouncing (Dunn, 2002:14).

The infants in both groups presented with similar results in terms of vestibular processing and no statistical difference was found at the time of the pre-tests (p=1.00). More infants in the control group (50%, n=3) presented with scores within the typical performance range compared to infants in the experimental group (33.33%, n=2) at this time as illustrated below in Figure 4.21 (left).

Pre-Test (n=12)



Post-Test (n=21)

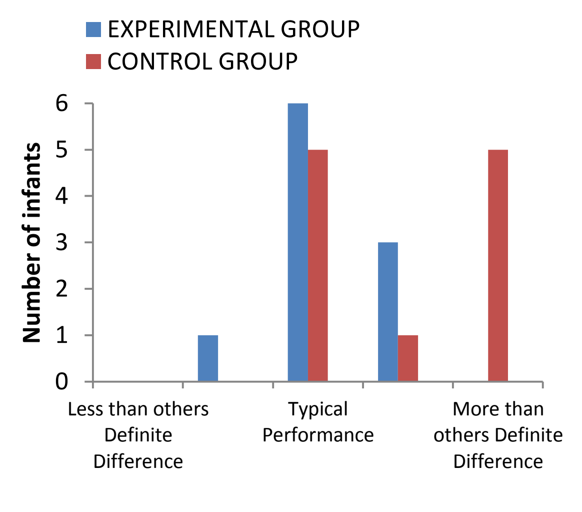


FIGURE 4.21 Vestibular Processing pre-and post-tests results (Infant/Toddler Sensory Profile).

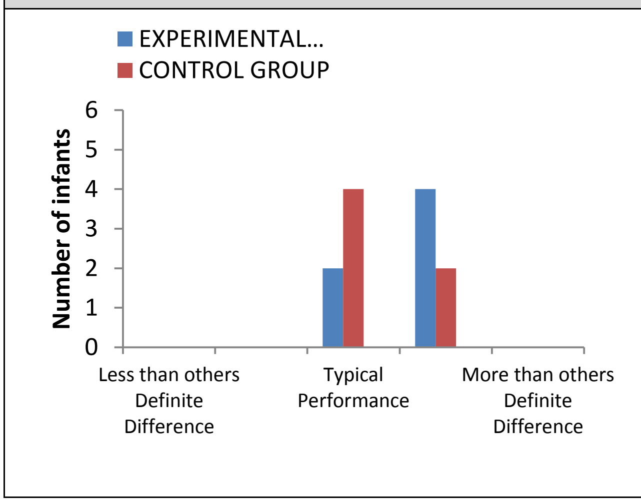
The experimental group showed a significant improvement in terms of vestibular processing at the time of the post-tests. Although there was not a significant statistical difference found (p=0.06) between the results of the two groups, Figure 4.21 above (right) illustrates that the experimental group presented with a majority of 60% (n=6) of the infants in this group that fell within the typical performance range in terms of their vestibular processing. Although a large percentage of 45.5% (n=5) of infants in the control group also presented with typical vestibular processing performance, the majority infants in this group presented with vestibular processing difficulties with 54.5% (n=6) of the infants falling in the definite difference range.

4.3.1.10 Oral Sensory Processing

This section measures an infant's responses to touch, taste and smell stimuli to the mouth, e.g. the infant licks/chews on nonfood objects or the infant resists having his/her teeth brushed (Dunn, 2002:14).

Figure 4.22 below (left) illustrates the oral sensory processing pre-test results of the experimental and control groups. There was no statistical difference (p=0.57) found between the results of the two groups however the control group presented with a majority of the infants (66.67%, n=4) falling in the typical performance range.

Pre-Test (n=12)



Post-Test (n=21)

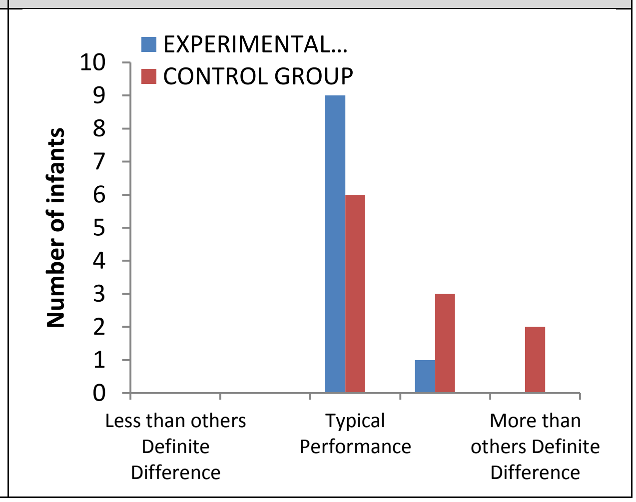


FIGURE 4.22 Oral Sensory Processing pre-and post-tests results (Infant/Toddler Sensory Profile).

The experimental group presented with a significant improvement in terms of their oral sensory processing at the time of the post-tests as illustrated in Figure 4.22 above (right). Within this group 90% (n=9) fell within the typical performance range in terms of oral sensory processing compared with the 54.5% (n=6) of infants in the control group. Although a significant statistical difference (p=0.18) was not found between the results of the two groups, the experimental group's progress in terms of oral sensory processing tended more towards the typical range.

In summary; the experimental groups' improvement in terms of sensory processing was found to be significantly better than that of the control group when the pre- and post-test results were compared as illustrated in Figure 4.23 below.

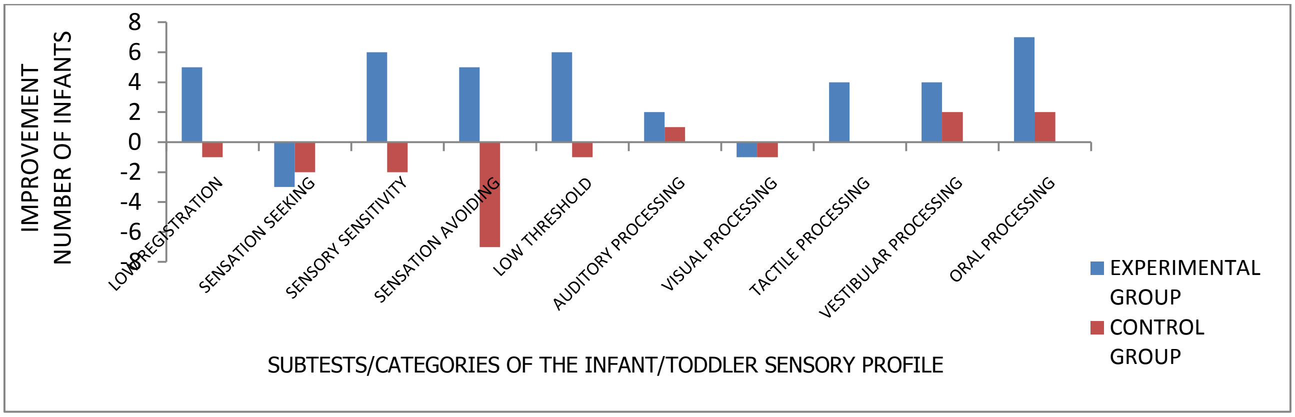


FIGURE 4.23 Improvement in terms of infants falling within the Typical Performance range.

Figure 4.24 below indicates the similarities and/or differences between the experimental and control groups results in terms of p-values. A p-value of <0.05 indicates that there was a statistically meaningful difference between the results of the groups.

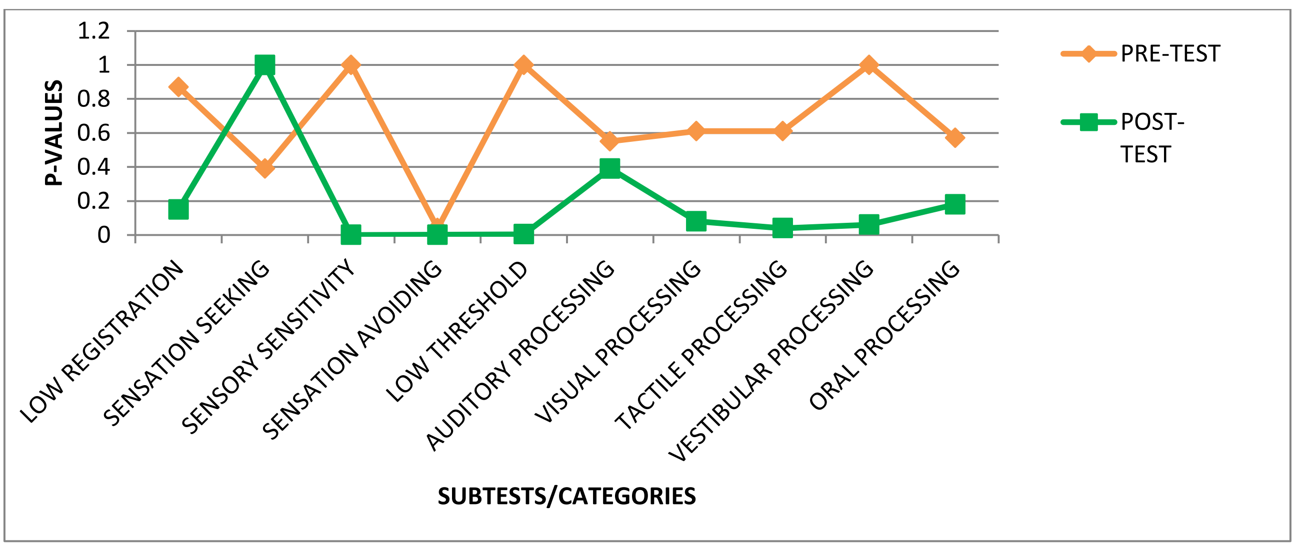


FIGURE 4.24 Indication of statistical similarities/differences between the experimental and control groups pre- and post-test results of the Infant/Toddler Sensory Profile.

The higher p-values in the graph above indicates the two groups' pre-test results were reasonably similar compared to the post-test results with lower p-values, indicating meaningful differences between the two groups.

4.3.2 THE RESULTS OF THE TEST OF SENSORY FUNCTIONS IN INFANTS (TSFI)

The TSFI was developed as both a research and clinical tool, specifically to measure five sub domains of sensory processing and reactivity because these areas have a strong impact on the development of sensory integration in the infant. It can be used in the assessment of infants with developmental delays, regulatory disorders and those at risk for learning and sensory processing disorders including high-risk premature infants. The TSFI can and should be used in conjunction with other developmental tests such as the Bayley Scales III of Infant and Toddler Development and other standardized assessments to provide an overall indicator of the infant's developmental functioning and in order to make decisions regarding the infant's developmental status (DeGangi & Greenspan, 1993:3).

4.3.2.1 Reactivity to Tactile Deep Pressure

Tactile deep pressure is applied to the infant's arms and hands, stomach, soles of feet, mouth and total body when held at the shoulder to measure the infant's reactivity to the applied tactile deep pressure (DeGangi & Greenspan, 1993:1).

Figure 4.25 below illustrates the pre- and post-test results of the infants in the experimental and control groups' reactivity to tactile deep pressure. The pre- test results on the left, indicated that there was not a statistical difference (p=0.09) between the results of the two groups. The control group presented with normal reactivity to tactile deep pressure for 100% (n=12) of the infants in this group compared to the 66.67% (n=8) of the infants in the experimental group.

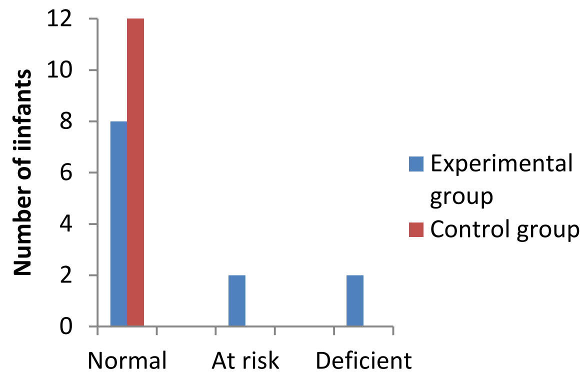
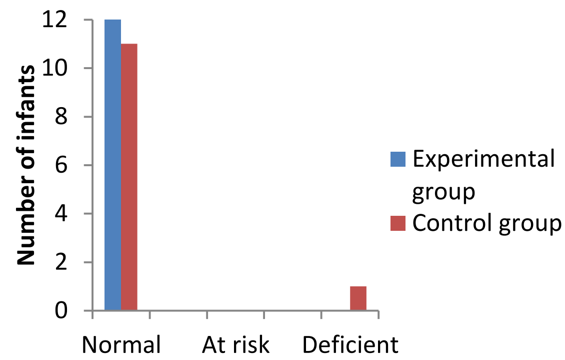
Pre-Test (n-24)	Post-Test (n-24)
	

FIGURE 4.25 Reactivity to Tactile Deep Pressure (TSFI) – pre- and post-test results.

No significant statistical difference was found during the analysis of the post-test results (p=1.00) however the post-test results illustrated on the right of Figure 4.25 above indicated that the experimental group presented with a 33.33% (n=4) increase in terms of normal reactivity to tactile deep pressure with 100% (n=12) infants in this group that fell within the normal range compared to the control group that presented with a slight decrease of 8.33% (n=1).

4.3.2.2 Adaptive Motor Functions

The Adaptive Motor Functions subtest assesses the infant's praxis ability as well as his/her ability to produce exploratory movements when handling textured toys (DeGangi & Greenspan, 1993:1).

No statistical difference (p=1.00) was found between the two groups' pre-test adaptive motor functions as presented below in Figure 4.26 (left), The majority of the infants in both groups; experimental group 83.33% (n=10) and control group 75% presented with deficient adaptive motor functions.

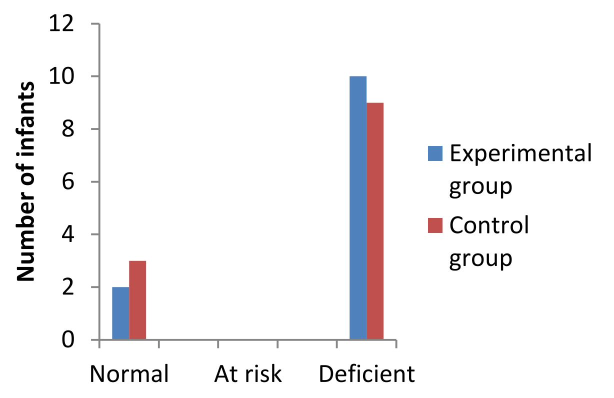
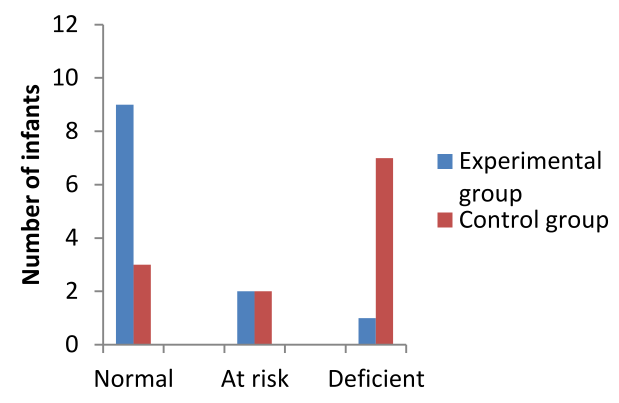
Pre-Test (n-24)	Post-Test (n-24)
	

FIGURE 4.26 Adaptive Motor Functions (TSFI) – pre- and post-test results.

Figure 4.26 above (right) indicates that the experimental group showed an improvement of 58.33% (n=7) in terms of infants functioning within the normal range of adaptive motor functions compared to the control group which showed a slight improvement of 16.67% (n=2) infants that improved from deficient functioning to at risk. The percentage of infants in the control group 25% (n=3) that presented with normal adaptive motor functions remained the same during the pre- and post-tests. A significant statistical difference (p=0.02) was found between the two groups' post-test results.

4.3.2.3 Visual Tactile Integration

The infant's visual response within the toleration of contact with various visually interesting textured toys is assessed through the Visual Tactile Integration subtest (DeGangi & Greenspan, 1993:1).

The results of the pre-tests did not indicate a statistical difference (p=1.00) between the visual tactile integration of the infants in the experimental group and infants in the control group respectively. Both groups presented with 66.67% (n=8) of infants within the normal range as indicated below in Figure 4.27 (left).

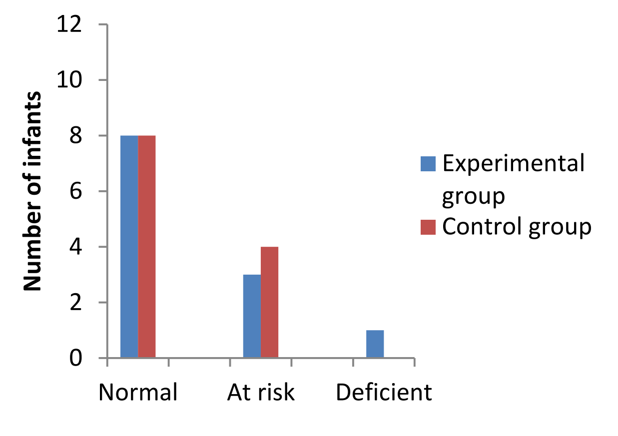
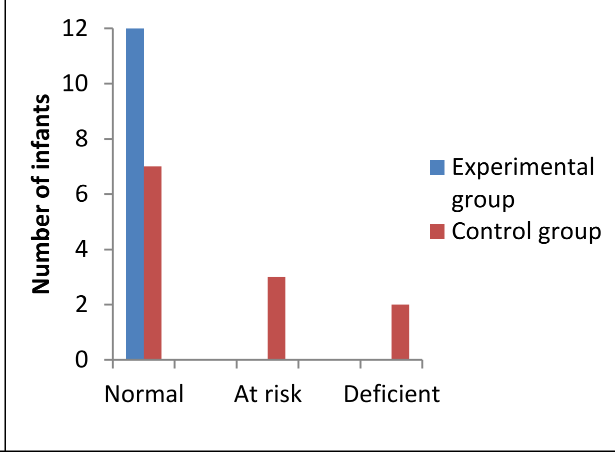
Pre=Test (n-24)	Post-Test (n-24)
	

FIGURE 4.27 Visual Tactile Integration (TSFI) – pre- and post-test results.

Infants in the experimental group however presented with a 33.33% (n=4) improvement during the post-tests, resulting with 100% (n=12) of the infants in this group that fell within the normal visual tactile integration range. The results of infants in the control group however indicated a decrease of visual tactile integration skills as illustrated above in Figure 4.27 (right). A statistical difference (p=0.04) was found between the post-test results of the two groups.

4.3.2.4 Ocular-Motor Control

Infants' ocular-motor control was assessed in terms of lateralization of the eyes as well as visual tracking (DeGangi & Greenspan, 1993:1).

Figure 4.28 below compares the pre-and post-test results of the experimental and control groups in terms of ocular-motor control. No statistical difference was found between the results of the two groups during the pre- (p=0.48) and post-tests (p=1.00).

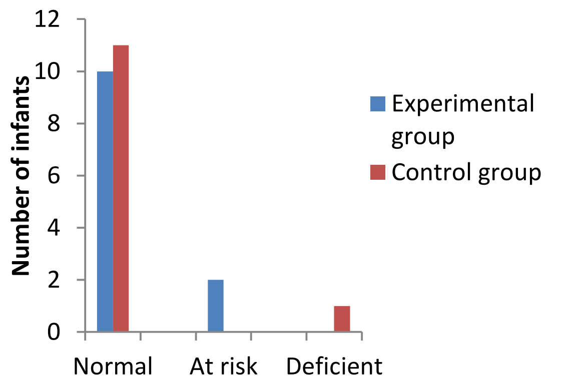
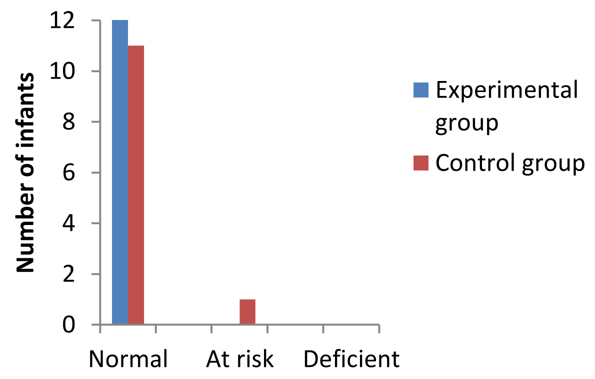
Pre-Test (n-24)	Post-Test (n-24)
	

FIGURE 4.28 Ocular-Motor Control (TSFI) – pre- and post-tests results.

The results indicated a 16.67% (n=2) improvement of infants in the experimental group that presented with normal ocular-motor control which resulted in a total of 100% (n=12) of infants falling within the normal range. The number of infants in the control group (75%, n=11) that fell within the normal range remained the same.

4.3.2.5 Reactivity to Vestibular Stimulation

The infant's response/reactivity to vestibular stimulation in vertical, circular and inverted prone and supine body positions is assessed with the Reactivity to Vestibular Stimulation subtest (DeGangi & Greenspan, 1993:1).

No statistical difference was found between the pre- (p=0.37) and post-test (p=0.22) results in terms of reactivity to vestibular stimulation of infants in the experimental and control groups as illustrated in Figure 4.29 below.

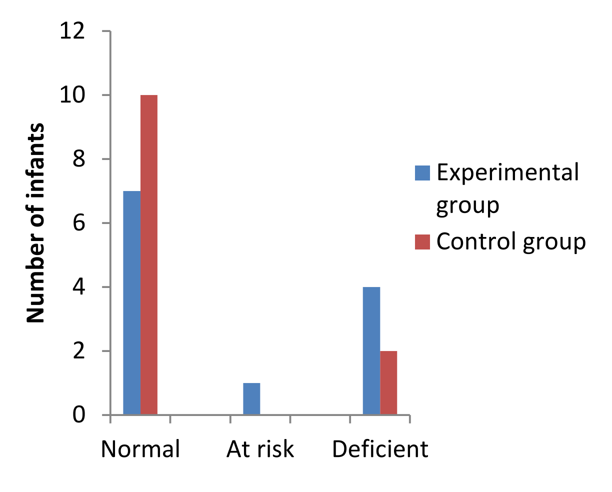
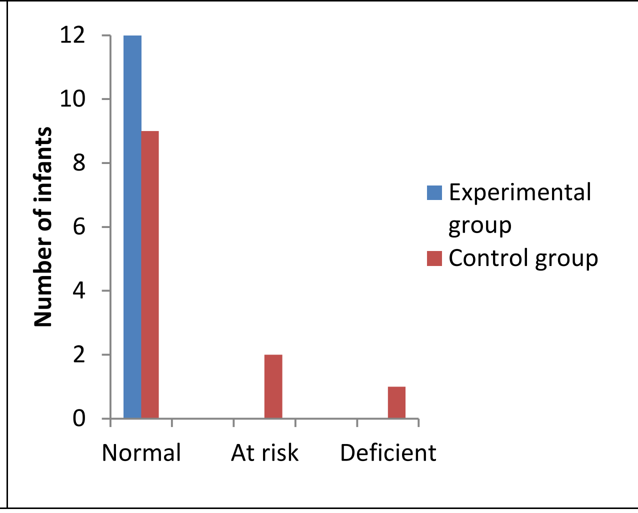
Pre-Test (n-24)	Post-Test (n-24)
	

FIGURE 4.29 Reactivity to Vestibular Stimulation (TSFI) – pre- and post-test results.

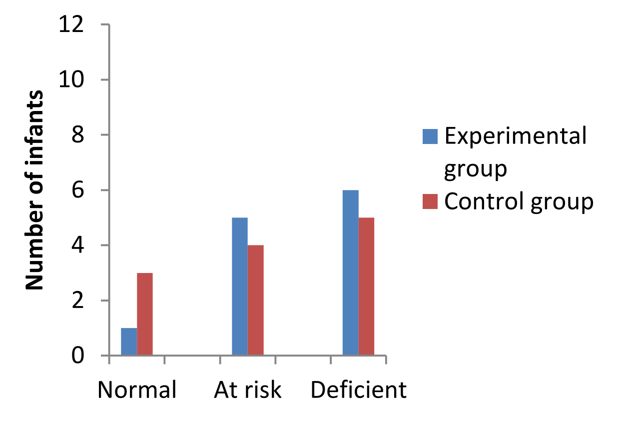
The experimental group presented with 41.67% (n=4) of the infants in this group that improved from deficient vestibular processing to normal processing and 8.33% (n=1) infants that improved from at risk to normal vestibular processing, resulting in 100% of infants in this group that fell within the normal vestibular processing range at the time of the post-tests. The control group however presented with 8.33% (n=1) decrease in infants falling within the normal range.

4.3.2.6 Total Scores

The total scores for infants in both groups in terms of the pre-and post-test results of the TSFI are illustrated below in Figure 4.30. No statistical difference was found (p=0.74) between the pre-tests results of the two groups with 8.33% (n=1) of infants in the experimental group and 25% (n=3) of infants in the control group that presented within the normal sensory function total score range.

A significant statistical difference was found between the post-test results of the two groups (p=0.0013). The experimental group's total score results indicated a 75% (n=11) improvement of infants that fell within the normal sensory function range, which lead to 100% (n=12) of infants in this group that presented within the normal score range at the time of the post-tests.

Pre-Test (n-24)



Post-Test (n-24)

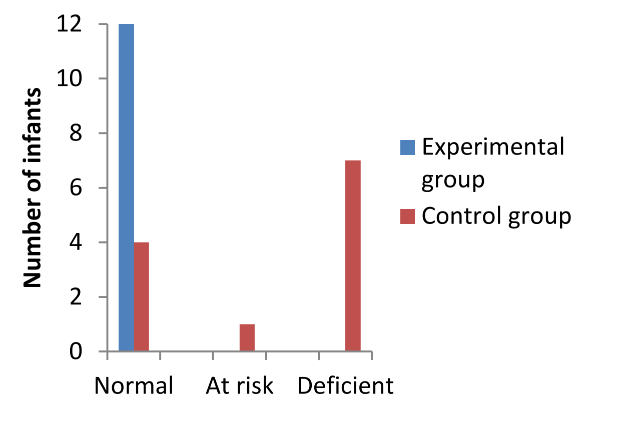


FIGURE 4.30 Total Scores (TSFI) – pre- and post-test results.

The control group however showed only an 8.33% (n=1) improvement of infants that presented with normal sensory functioning (33.33%, n=4), however the majority of infants presented with a deficient sensory functioning score 58.33% (n=7) and 8.33% (n=1) infants with at risk sensory functioning at the time of the post-tests.

4.3.3 THE RESULTS OF THE BAYLEY III SCALES OF INFANT AND TODDLER DEVELOPMENT

The Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) is an individually administered instrument that assesses the developmental functioning of infants and toddlers between 1 month and 42 months of age. The primary purpose of this standardized assessment tool is to identify children with developmental delays and to provide information for intervention planning. The Bayley-III assesses infant and toddler development across five domains namely cognitive, language, motor (fine- and gross motor), social-emotional, and adaptive behaviour.

Assessment of the cognitive, language and motor domains are conducted using tests administered to the infants and toddlers. Assessments of the social-emotional and adaptive behaviour domains are conducted using the parents/primary caregivers' responses to a questionnaire. The additional Behaviour Observation Inventory of the Bayley III, completed by both the assessment occupational therapist and the parent/caregiver assesses the infant's behavior during the testing situation and incorporates the child's behavior at home, aiding in the interpretation of the Bayley-III scales (Bayley, 2006a:1).

4.3.3.1 Cognitive Scale

The Cognitive Scale of the Bayley III assessments includes items that assess infants and toddlers' sensorimotor development, exploration and manipulation, object relatedness, concept formation, memory and other aspects of cognitive processing. The items were uniquely compiled to decrease the impact of motor ability (Bayley, 2006a:3).

Participant T-test: Compares infant groups pre-test results

The pre-test Cognitive Scale results of the experimental and control groups indicated that there was no statistical difference between the cognitive abilities of the infants in both groups (p= 0.19) as presented in Table 4.6 below.

TABLE 4.6 Cognitive Scale: Participant pre-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	1.00	11.00	7.50	7.58	2.57	21.91	0.15	0.88
Control Group	12	3.00	11.00	8.50	7.42	2.75			

These results strengthened the comparability of the two groups in terms of their cognitive function.

Participant T-test: Compares infant groups post-test results

The post-test Cognitive Scale results did indicate a significant statistical difference in the results of the two groups (p=0.03) as presented in Table 4.7 below.

TABLE 4.7 Cognitive Scale: Participant post-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	8.00	12.00	11.00	10.50	1.51	21.60	2.39	0.03
Control Group	12	6.00	11.00	9.00	8.92	1.73			

Infants in both groups did show improvements in terms of their cognitive performance however the median score of the experimental group presented with a more positive improvement of 3.5 standard scores compared with the 0.5 median standard score improvement of the control group.

Groups improvement of cognitive scores

With comparison of the cognitive standard score improvements of the two groups, the results indicated that there was no significant statistical difference between the standard score improvements of the two groups (p=0.19).

TABLE 4.8 Cognitive Scale: Groups improvement (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	-1.00	11.00	2.50	2.92	2.97	19.40	1.37	0.19
Control Group	12	-2.00	5.00	1.50	1.50	2.02			

The maximum standard score improvement by an infant in Group A was 11 compared to the maximum standard score improvement of 5 by and infant in Group B as illustrated in Table 4.8 above.

Paired T-test: Compares individual infant's improvements pre- and post-tests.

Table 4.9 below indicates that both groups showed a statistically significant improvement (p=0.01 for infants in the experimental group and p=0.03 for infants in the control group) in terms of cognitive standard scores of the each individual infant within the two groups.

TABLE 4.9 Cognitive Scale: Paired T-test (n=24).

GROUP	N	Minimum	Maximum	Mean	Std Dev	Df	t	P
Experimental Group	12	-1.00	11.00	2.92	2.97	11.00	3.40	0.01
Control Group	12	-2.00	5.00	1.5	2.02	11	2.57	0.03

Figure 4.31 below illustrates that infants in both groups presented with cognitive standard score improvements when their pre-test results where compared with their post-test results however, one infant in the experimental group presented with the largest standard score improvement of 11 and only one infant in this group presented with a decrease of 1 standard score in terms of cognitive performance.

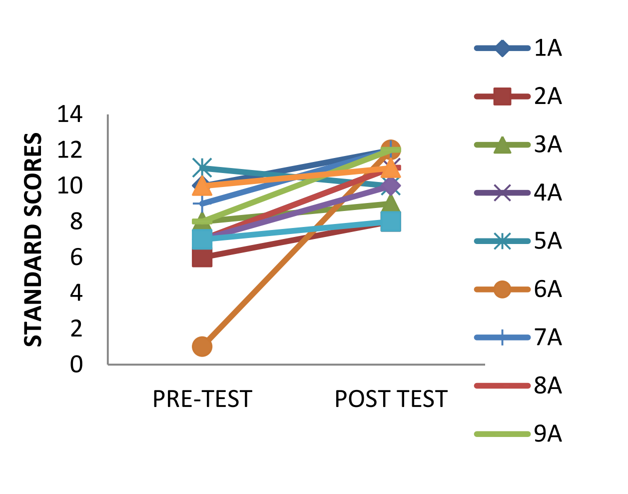
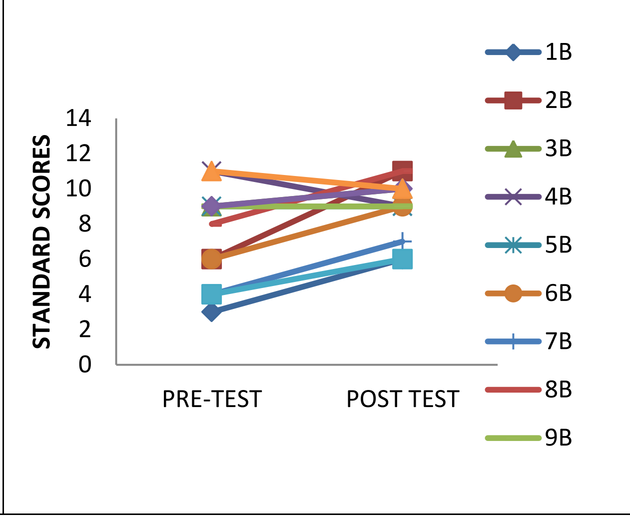
EXPERIMENTAL GROUP (n-12)	CONTROL GROUP (n-12)
	

FIGURE 4.31 GRAPH OF EACH INFANT'S BAYLEY III RESULTS - Cognitive pre and post standard scores.

The control group presented with one infant that improved with a maximum of 5 standard scores, two infants that presented with a decrease of standard scores and one infant whose standard score remained the same during the pre- and post-tests. Therefore, although there was not a significant statistical difference between the improvements of standard scores between the two groups, Figure 4.31 above illustrates that the experimental groups' progress in terms of cognitive performance exceeded the progress of the cognitive performance of the control group.

4.3.3.2 Language Scale

The items included in the Bayley III Language Scale assess receptive and expressive communication skills of infants and toddlers (Bayley 2006a:3).

4.3.3.2.1 Receptive Communication

The receptive communication section is composed of the following items; preverbal behaviours, vocabulary development (ability to identify objects and pictures that are referenced), vocabulary related to morphological development and items that measure an infant or toddler's social referencing and verbal comprehension (Bayley 2006a:3).

Participant T-test: Compares infant groups pre-tests

Table 4.10 below Indicates that there was no statistical difference found between the experimental and control groups pre-intervention tests results (p=0.62).

TABLE 4.10 Receptive Communication: Participant pre-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	4.00	9.00	5.50	6.17	1.95	19.47	-0.50	0.62
Control Group	12	1.00	12.00	6.50	6.67	2.84			

This score strengthened the comparability of the two groups in terms of their receptive language skills.

Participant T-test: Compares infant groups post-tests.

The post-test results of both groups are illustrated below in Table 4.11. A significant statistical difference was found between the results of the two groups (p=0.02). When the results of the two groups were compared it was found that the minimum standard score in the control group remained the same for both the pre- and post-tests (SS=1) compared with the minimum standard score of the experimental group which improved from a standard score of 4 to a standard score of 7.

TABLE 4.11 Receptive Communication: Participant post-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	7.00	13.00	9.50	9.42	1.83	20.10	2.50	0.02
Control Group	12	1.00	10.00	7.00	7.17	2.52			

The maximum standard score in the experimental group improved from 9 to 13 (an improvement of 4 standard scores) compared to the maximum standard score of the control group that showed a decrease of two standard scores (from 12 to 10).

Groups improvement of the receptive language

Table 4.12 below compares the improvement scores in terms of receptive language of the two groups.

TABLE 4.12 Receptive Communication: Groups improvement (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	1.00	6.00	2.50	3.25	1.82	21.84	3.55	0.00
Control Group	12	-3.00	4.00	1.00	0.50	1.98			

A significant statistical difference was found (p=0.00) when the standard score improvements were compared. The experimental group presented with a larger improvement of a maximum of 6.00 and a minimum of 1.00 standard score compared to the maximum standard score improvement of 4.00 and a decrease of -3.00 as minimum standard score improvement for the control group.

Paired T-test: Compares individual infants' improvements between the pre- and post-tests.

Table 4.13 below indicates that the individual improvement of infants in the experimental group did present with a significant statistical difference (p=<0.001) in terms of receptive communication while the individual improvement of infants in the control group did not (p=0.40).

TABLE 4.13 Receptive Communication: Paired T-test Paired (n=24).

GROUP	N	Minimum	Maximum	Mean	Std Dev	Df	t	p
Experimental Group	12	1.00	6.00	3.25	1.82	11.00	6.20	<0.001
Control Group	12	-3.00	4.00	0.50	1.98	11	0.88	0.4

Figure 4.32 below illustrates the results of each infant in both groups in terms of their pre- and post-test results. All 12 infants (100%) in the experimental group presented with a standard score improvement.

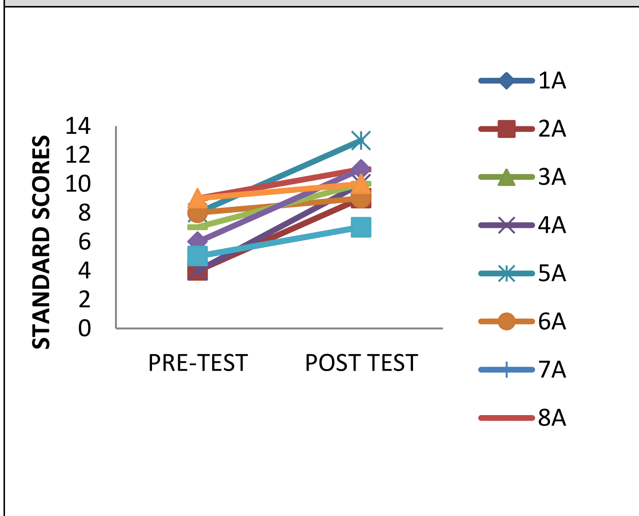
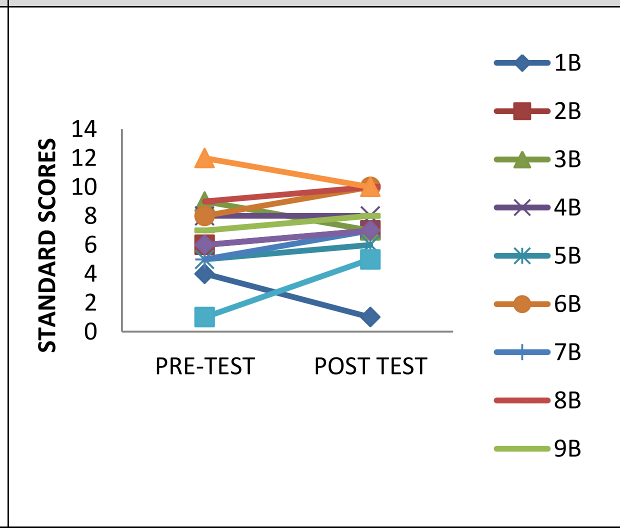
EXPERIMENTAL GROUP (n-12)	CONTROL GROUP (n-12)
	

FIGURE 4.32 GRAPH OF EACH INFANT'S BAYLEY III RESULTS - Receptive language pre and post standard scores.

Compared with the results of the experimental group, three infants (25%) in the control group presented with a decrease of their receptive language skills and one infant (8.33%) in this group's standard score results remained the same.

4.3.3.2.2 Expressive Communication

Through the Expressive Communication subtest items, an infant's preverbal communication such as babbling, gesturing, joint referencing and turn taking, vocabulary development (naming objects, pictures and attributes e.g. colour and size as well as morpho-syntactic development (using two word utterances, plurals and verb tense) are assessed (Bayley 2006a:3).

Participant T-test: Compares infant groups pre-tests

Table 4.14 below indicates that there was no statistical difference found between the two groups pre-test expressive communication results (p=0.27).

TABLE 4.14 Expressive Communication: Participant pre-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	5.00	10.00	8.00	8.08	1.44	17.98	-1.13	0.27
Control Group	12	4.00	12.00	10.00	9.00	2.41			

These results implicated a strong comparability in terms of the infant's expressive communication skills since the infants presented with similar expressive communication abilities

Participant T-test: Compares infant groups post-tests

The results of the experimental and control groups post-test results are illustrated below in Table 4.15. A significant statistical difference was found between the post-test results of the two groups. The average tendency of the scores of the experimental group showed an increase compared to the average tendency of the control group that presented with a decrease.

TABLE 4.15 Expressive Communication: Participant post-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	9.00	12.00	11.00	10.67	1.23	17.71	4.49	0.00
Control Group	12	4.00	10.00	8.00	7.50	2.11			

The median standard score of the experimental group increased with 3 standard scores compared with the median standard score of the control group that indicated a decrease of two standard scores.

Groups improvement of expressive language

The comparison of the two groups' improvement in terms of expressive communication indicated a statistical difference (p=0.00). Table 4.16 below presents the results of the experimental and control groups in terms of their expressive language improvement from the pre-test to the post-test.

TABLE 4.16 Expressive Communication: Groups improvement (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	-1.00	6.00	2.50	2.58	1.88	19.46	4.25	0.00
Control Group	12	-6.00	3.00	-2.00	-1.50	2.75			

The experimental group presented with a minimum standard score decrease of -1.00 compared with a minimum standard score decrease of -6.00. The mean improvement for the experimental group was 1.88 compared with the control group of which presented with a mean decrease in standard scores of -1.50.

Paired T-test: Compares the individual infants' improvements between the pre- and post-tests

Table 4.17 below indicated that the individual infants in the experimental group presented with a statistical significant improvement of their expressive communication standard scores compared to the control group who's individual improvement results did not indicate a significant statistical difference between the pre- and post-tests.

TABLE 4.17 Expressive Communication: Paired T-test (n=24).

GROUP	N	Minimum	Maximum	Mean	Std Dev	Df	t	P
Experimental Group	12	-1.00	6.00	2.58	1.88	11	4.76	0.00
Control Group	12	-6.00	3.00	-1.50	2.75	11	-1.89	0.09

Results of individual infants in the control group also did not indicate a significant difference (p=0.09) however these infant's expressive communication standard score results indicated a decrease in values.

Figure 4.33 below illustrates each infant in both groups' pre- and post-tests expressive language standard score results. The majority of 75% (n=11) of the infants' results in the experimental group showed a noticeable improvement. Only one infant (8.33%) in this group presented with a decrease of one standard score during the post-test.

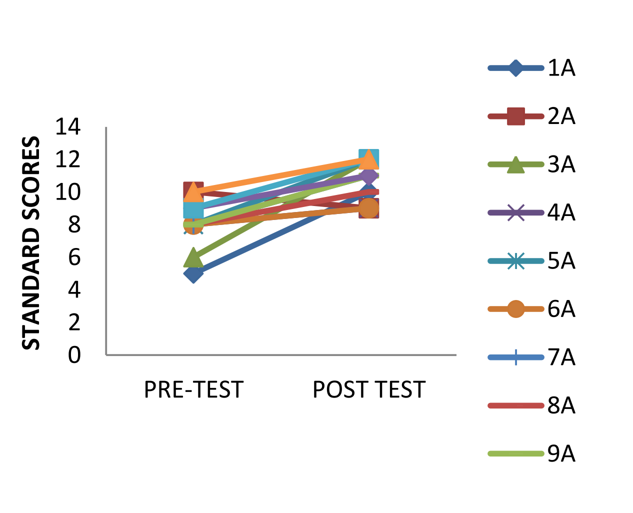
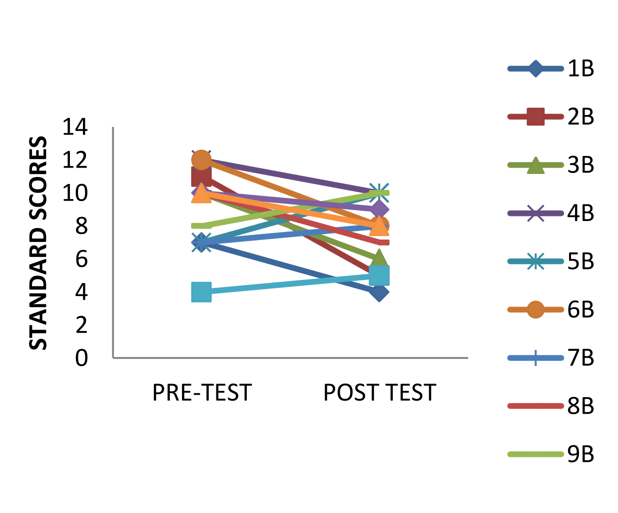
EXPERIMENTAL GROUP (n-12)	CONTROL GROUP (n-12)
	

FIGURE 4.33 GRAPH OF EACH INFANT'S BAYLEY III RESULTS - Expressive language pre and post-tests standard scores.

The control group however presented with a majority of 66.67% (n=8) of the infants who's post-test standard score results showed a decrease and only 38.33% (n=4) infants who's standard score results improved.

4.3.3.2.3 Language Sum of Receptive and Expressive Communication

Participant T-test: Compares infant groups pre-tests

Table 4.18 below presents the pre-test results of the infants in the experimental and control groups language sum results. These results indicated that the infants in the control group presented with a higher maximum score of 22.00, compared with the maximum score of 19.00 of the experimental group. The mean standard score of the control group were also slightly higher than the mean standard score of the experimental group, although the minimum standard score of the experimental group were slightly higher compared to the minimum standard score of the control group.

TABLE 4.18 Language sum: Participant pre-test T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	9.00	19.00	14.50	14.25	2.73	17.24	-0.87	0.39
Control Group	12	5.00	22.00	16.50	15.67	4.91			

A p-value of 0.39 indicates that there was no statistical difference found between the two groups pre-test language sum results, a strong indication of the comparability of the two groups in terms of language skills.

Participant T-test: Compares infant groups post-tests

Table 4.19 below illustrates the language sum standard score results of the post-tests. A significant statistical difference was found between the results of the two groups (p=0.00).

TABLE 4.19 Language sum: Participant post-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	18.00	25.00	19.00	20.08	2.15	16.80	4.11	0.00
Control Group	12	5.00	18.00	16.00	14.67	4.03			

The results of the experimental groups showed a tendency to increase from the results of the pre-tests while the results of the control group showed a tendency to decrease, especially when the maximum scores and mean scores of the two groups are compared with the maximum and mean scores of the pre-tests in Table 4.19.

Groups improvement of sum of language score

The improvement of the language sum results indicated a significant statistical difference (p= <0.0001) between the two groups as presented in table 4.20 below. The mean standard score of the experimental group showed an improvement of 5.83 compared with the mean score of the control group a -1.00 decrease.

TABLE 4.20 Language sum: Groups improvement (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	2.00	10.00	5.50	5.83	2.44	18.33	5.09	<0.0001
Control Group	12	-6.00	5.00	-2.00	-1.00	3.95			

The minimum improvement of the experimental group of 2.00 and a maximum improvement of 10.00 is also noticeable compared to a decrease of -6.00 of the control group and a maximum improvement of 5.00 within this group.

Paired T-test: Compares individual infants improvements pre- and post-intervention assessments

Table 4.21 below indicates that a significant statistical difference was found (p=<0.0001) in terms of the language sum standard score improvement for the infants in the experimental group.

TABLE 4.21 Language sum: Paired T-test (n=24).

GROUP	N	Minimum	Maximum	Mean	Std Dev	Df	t	p
Experimental Group	12	2.00	10.00	5.83	2.44	11	8.27	<0.0001
Control Group	12	-6.00	5.00	-1.00	3.95	11	-0.88	0.40

The improvement of infants in the control group however did not indicate a statistical difference (p=0.04) between the pre- and post-tests results.

Figure 4.34 below indicates each infant in the experimental and control groups' pre and post-test language sum results. All infants in the experimental group (100%, n=12) showed a significant improvement in terms of their language abilities.

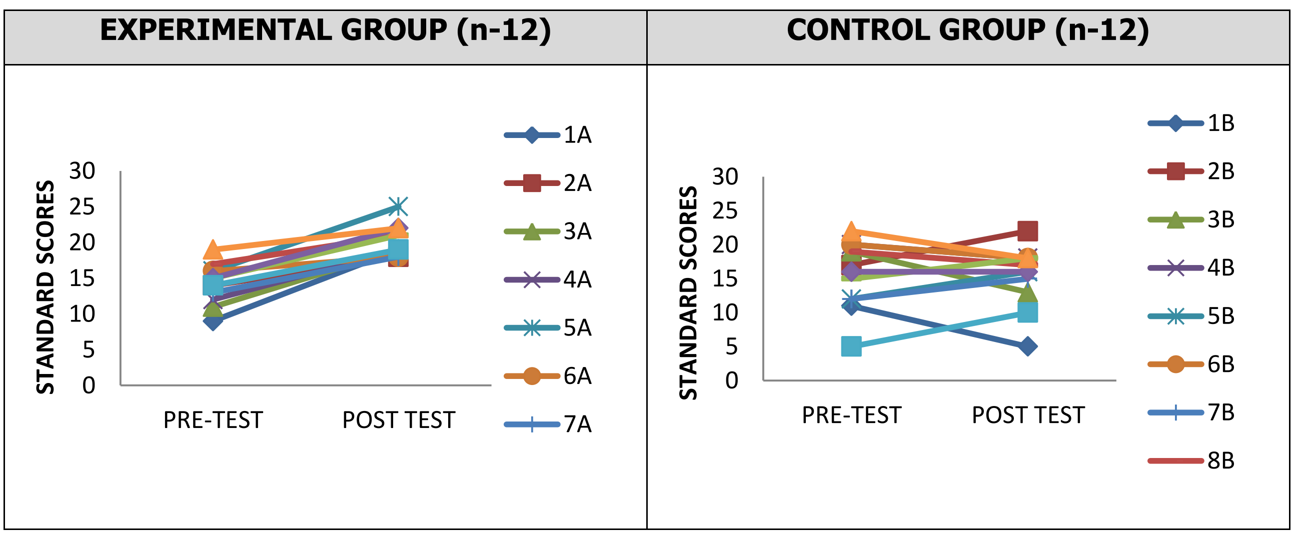


FIGURE 4.34 GRAPH OF EACH INFANT'S BAYLEY III RESULTS - Language sum pre and post-tests standard scores.

The standard scores of infants in the control group however indicated that only 41.46% (n=4) of infant's language skills showed an improvement during the post-intervention assessments with 66.67% (n=8) of infant in this group that presented with a decrease in standard score results.

4.3.3.3 Motor Scale

The Bayley III Motor Scale is divided into a Fine Motor subtest and a Gross Motor subtest (Bayley 2006:3).

4.3.3.3.1 Fine Motor

An infant's skills in terms of visual tracking, perceptual-motor integration, reaching, object manipulation, grasping, motor speed, motor planning, functional hand skills and responses to tactile information are measured through the Fine Motor subtest (Bayley 2006a:3,4).

Participant T-test: Compares infant groups pre-tests

Table 4.22 below indicates that there were no statistical difference (p=0.63) between the two groups fine motor pre-test standard score results which indicates that the two groups were similar in terms of their fine motor functioning at the time of the pre-tests.

TABLE 4.22 Fine Motor: Participant pre-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	3.00	12.00	9.00	8.83	2.62	21.24	-0.49	0.63
Control Group	12	5.00	14.00	10.00	9.42	3.18			

Although a statistical difference was not found between the results of the two groups, the control groups' results indicated a tendency towards slightly higher scores in terms of minimum, maximum and mean standard scores compared with the results of the experimental group as illustrated above in Table 4.22.

Participant T-test: Compares infant groups post-test results

Table 4.23 below presents the two groups' post-test results and with a p-value of 0.0026 indicates that there was a significant statistical difference between the two groups post-test standard score results.

TABLE 4.23 Fine Motor: Participant post-test, T-test results (n=24)

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	7.00	16.00	11.50	12.08	2.61	18.22	3.49	0.0026
Control Group	12	7.00	12.00	9.00	9.00	1.60			

The two groups presented with the same minimum score (SS=7), however the experimental group's maximum scores is 4 standard scores higher than the maximum score of the control group and median score of the experimental group is 2.5 standard scores higher than the median score of the control group.

Groups improvement of fine motor scores

Tabel 4.24 below indicates that a significant statistical difference (p=0.01) was found between the standard score improvement of the two groups with the experimental group that presented with significantly better improvement in terms of fine motor abilities than the control group after the 10 week intervention period.

TABLE 4.24 Fine Motor: Groups improvement (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	-2.00	11.00	3.50	3.25	3.39	21.28	2.89	0.01
Control Group	12	-5.00	6.00	-0.50	-0.42	2.81			

The experimental group presented with a maximum standard score improvement of 11 and a median standard score improvement of 3.5 compared with the control group which presented with a maximum standard score improvement of 6 and a median standard score that indicated a decrease in fine motor performance of -0.50.

Paired T-test: Compares individual infants improvements between the pre- and post-tests

Table 4.25 below indicates that the improvement in terms of fine motor standard scores of the infants in the experimental group presented with a significant statistical difference (p=0.01). Although infants in this group presented with a decrease of -2.00 the maximum standard score improvement was 11.00 with a mean standard score improvement of 3.39.

TABLE 4.25 Fine Motor: Paired T-test (n=24).

GROUP	N	Minimum	Maximum	Mean	Std Dev	Df	T	P
Experimental Group	12	-2.00	11.00	3.25	3.39	11	3.32	0.01
Control Group	12	-5.00	6.00	-0.42	2.81	11	-0.51	0.62

There was no statistical difference found (p=0.62) in terms of fine motor standard score improvement for infants in the control group. The infants in this group presented with a decrease of -5.00 and a maximum standard score improvement of only 6.00. The mean standard score showed a decrease of -0.42 for this group.

Figure 4.35 below indicates that the majority of infants (83.33%, n=10) in the experimental group showed a significance improvement in terms of their fine motor skills when the pre-test and post-test results were compared.

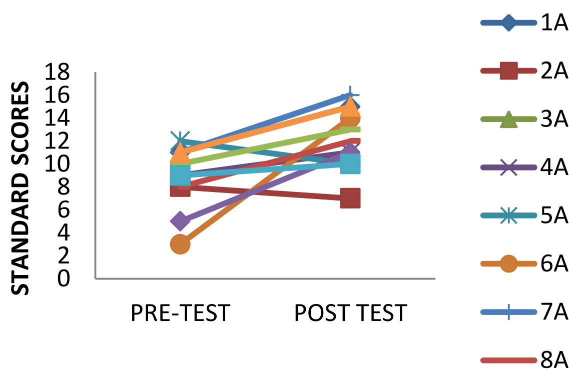
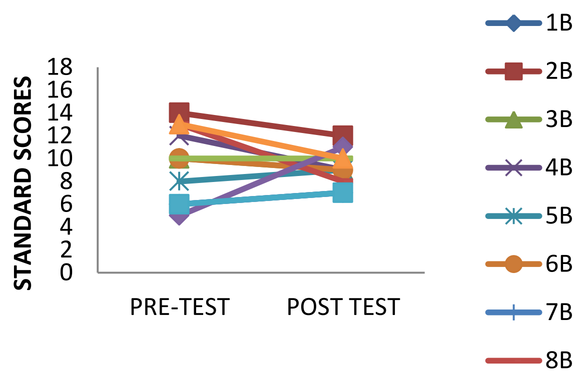
EXPERIMENTAL GROUP (n-12)	CONTROL GROUP (n-12)
	

FIGURE 4.35 GRAPH OF EACH INFANT'S BAYLEY III RESULTS - Fine motor pre and post-tests standard scores.

The comparison of the fine motor pre-test results and post-test results of the control group indicated that only 25% (n=3) of the infants presented with an improvement in standard scores.

4.3.3.3.2 Gross Motor

The movement of the infant and toddler's limbs and torso, static positioning (e.g. sitting and standing), dynamic movement, including locomotion and coordination, balance and motor planning are measured with the Gross Motor subtest of the Bayley III (Bayley 2006a:4).

Participant T-test: Compares infant groups pre-tests

Table 4.26 below indicates that there was no statistical difference (p=0.53) between the pre-test standard scores of the experimental and control groups respectively and therefore presented with similar gross motor skills at the time of the pre-tests.

TABLE 4.26 Gross Motor: Participant pre-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	1.00	9.00	6.00	6.00	2.34	18.11	-0.64	0.53
Control Group	12	1.00	12.00	7.00	6.83	3.86			

Infants in both the experimental and control group presented minimum standard scores of 1.00. Although infants in the control group presented with a slightly higher maximum standard score of 12.00 compared with a maximum standard score of 9.00 for the experimental group, the mean scores for the two groups were similar as presented above in Table 4.26.

Participant T-test: Compares infant groups post-tests

Table 4.27 below indicates that with the post-tests there also was no statistical difference (p=0.32) between the two groups and both groups presented with improvement in terms of their gross motor skills.

TABLE 4.27 Gross Motor: Participant post-test, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	y	p
Experimental Group	12	6.00	15.00	8.50	9.42	2.78	20.79	1.02	0.32
Control Group	12	3.00	14.00	9.00	8.08	3.55			

The results presented above in Table 4.27 does indicate slightly higher minimum, maximum and mean standard scores for the infants in the experimental group compared to the results of the infants in the control group, however, the difference in the results was not enough to indicate a statistical difference.

Groups improvement of gross motor scores

Table 4.28 below indicates the difference between the gross motor skills standard score improvement of the two groups. The experimental group improved with a mean standard score of 4 with the maximum improvement of 8 standard scores and a minimum of 0. The control group's showed improvement of a mean standard score of 1.25, a maximum improvement of only 5 standard scores and a decrease of -6 in standard score.

TABLE 4.28 Gross Motor: Groups improvement (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	0.00	8.00	4.00	3.42	2.54	21.09	1.86	0.08
Control Group	12	-6.00	5.00	1.50	1.25	3.14			

Although these results indicates a noticeably better gross motor scores of the infants in the experimental group, the difference between standard score improvement between the two groups did not presents a significant statistical difference with a p-value of 0.08.

Paired T-test: Compares individual infants improvements between the pre- and post-tests

Table 4.29 below indicates that the improvement in terms of gross motor standard scores of the infants in the experimental group presented with a significant statistical difference (p=0.00). Infants in this group presented with a minimum standard score improvement of 0.00, a maximum standard score improvement of 8.00 and a mean standard score improvement of 3.24.

TABLE 4.29 Gross Motor: Paired T-test (n=24).

GROUP	N	Minimum	Maximum	Mean	Std Dev	Df	t	P
Experimental Group	12	0.00	8.00	3.42	2.54	11	4.66	0.00
Control Group	12	-6.00	5.00	1.25	3.14	11	1.38	0.19

A statistical difference was not found (p=0.19) in terms of gross motor standard score improvement for infants in the control group. This group presented with a maximum standard score improvement on 5.00 but also with a standard score decrease of -6.00. The mean standard score improvement for this group was 1.25.

Figure 4.36 below illustrates both experimental and control group pre- and post-tests standard scores. The post-test results indicated that 83.33% (n=10) of infants in the experimental groups' have shown significant progress in terms of their improvement of gross motor skills with only 16.67% (N=2) of infants who's standard scores remained the same.

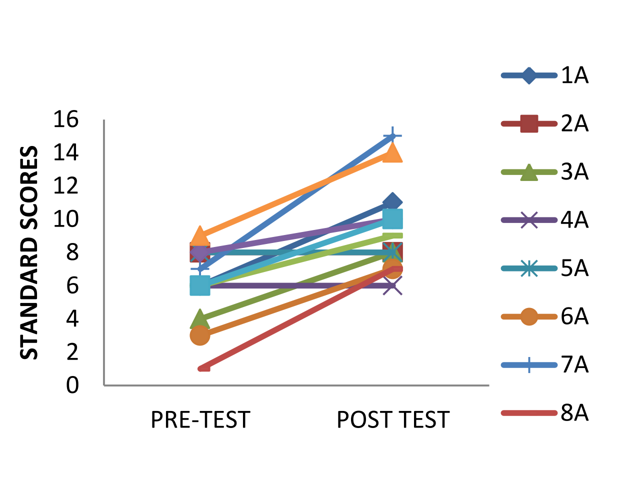
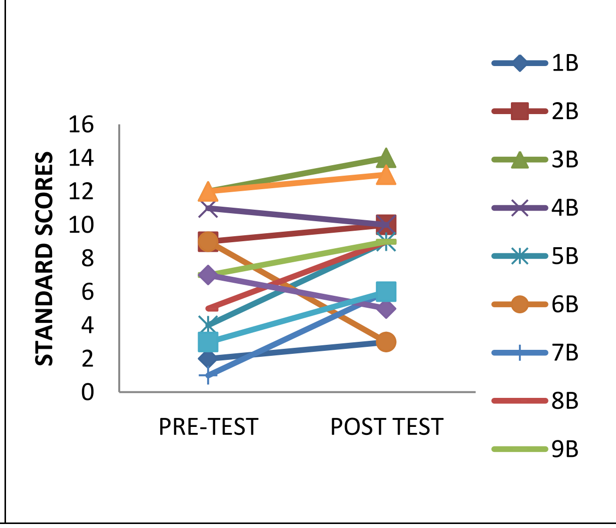
EXPERIMENTAL GROUP (n-12)	CONTROL GROUP (n-12)
	

Figure 4.36 GRAPH OF EACH INFANT'S BAYLEY III RESULTS - Gross motor pre and post standard scores.

The results of the infants in the control group indicated that 75% (n=9) of infants also presented with some gross motor improvement and 25% (n=3) of infants in this group presented with a decrease in their motor skill standard scores.

4.3.3.3.3 Sum of Fine and Gross Motor

Participant T-test: Compares infant groups pre-tests

Table 4.30 below indicated that there was no statistical difference (p=0.53) between the pre-test fine and gross motor sum standard scores of the experimental and control groups.

TABLE 4.30 Fine and Gross Motor Sum: Participant pre-test T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	6.00	20.00	15.50	14.83	4.15	18.82	-0.64	0.53
Control Group	12	7.00	25.00	17.50	16.25	6.43			

When the minimum, maximum and mean scores were compared the results indicated that the two groups were similar in terms of the motor development at the time of the pre-tests.

Participant T-test: Compares infant groups post-tests

Table 4.31 below presents a summary of the post-test fine and gross motor sum of both groups. The results indicated a statistical difference (p=0.03) between the standard scores of the two groups with the experimental group that presented with a greater tendency for improvement.

TABLE 4.31 Fine and Gross Motor Sum: Participant post-test T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	15.00	31.00	20.50	21.50	4.83	21.91	2.27	0.03
Control Group	12	10.00	24.00	17.50	17.17	4.53			

When the minimum, maximum and mean standard scores of the two groups are compared as illustrated above in Table 4.31, the experimental group presents with overall higher post-test results.

Groups improvement of fine and gross motor sum

Table 4.32 below presents the summary of the fine and gross motor sum standard scores of the two groups. A significant statistical difference (p=0.01) indicated a larger improvement in terms of motor skills by the infants in the experimental group compared to the infants in the control group.

TABLE 4.32 Fine and Gross Motor Sum: Groups improvement (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	-2.00	15.00	7.00	6.67	5.16	20.74	3.05	0.01
Control Group	12	-7.00	6.00	2.00	0.92	4.01			

The experimental group presented a maximum standard score improvement of 15 compared to the control group with a maximum standard score improvement of 6. The median standard score improvement in the experimental group was 7 and in the control group 2.

Paired T-test: Compares individual infants improvements between the pre- and post-tests

Table 4.33 below indicates that the improvement in terms of fine and gross motor sum standard scores of the infants in the experimental group presented with a significant statistical difference (p=0.00). The results of the control group however did not indicate a statistical difference (p=0.45) in terms of fine and gross motor sum standard score improvement.

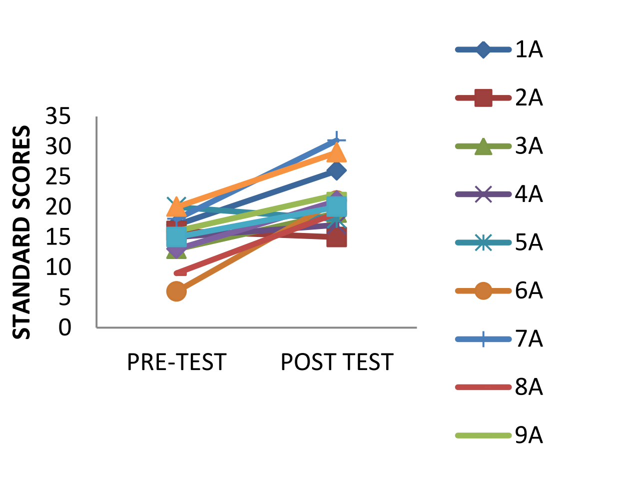
TABLE 4.33 Fine and Gross Motor Sum: Paired T-test (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	-2.00	15.00		6.67	5.16	11	4.48	0.00
Control Group	12	-7.00	6.00		0.92	4.01	11	0.79	0.45

When the results of the two groups in terms of fine- and gross motor sum improvement presented above in Figure 4.33 above are compared, the control group presents with a significant standard score decrease of -7.00 compared to the -2.00 decrease in the experimental group. The maximum standard score improvement in the experimental group of 15.00 is also significantly higher than the maximum standard score improvement in the control group of 6.00.

Figure 4.37 below clearly illustrates the Fine and Gross Motor Sum improvement reported of infants in the experimental group. The experimental group presented with a large majority of 83.33% (n=10) that showed a significant improvement of motor skills during the post-tests. Only two infants (16.67%) showed a slight decrease in results.

EXPERIMENTAL GROUP (n-12)



CONTROL GROUP (n-12)

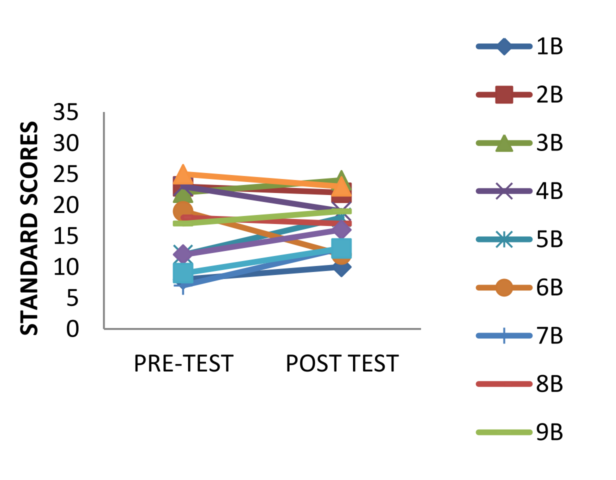


FIGURE 4.37 GRAPH OF EACH INFANT'S BAYLEY III RESULTS - Sum of gross and fine motor pre and post-tests standard scores

The infants in the control group presented with 58.33% (n=7) infants that showed a slight improvement in standard score results and 41.67% (n=5) infants that showed a slight decrease in the sum of fine and gross motor skills standard score results.

4.3.3.4 Social Emotional Scale

The items included in the Bayley III Social Emotional Scale questionnaire assesses an infant or toddler's mastery of functional emotional skills such as self-regulation and interest in the world, communicating needs, engaging others and establishing relationships, using emotions in an interactive, purposeful manner and using emotional signals or gestures in problem solving (Bayley 2006a:4). These results are obtained through the completion of a questionnaire with the parents of the infants.

Participant T-test: Compares infant groups pre-tests

The summary of the Social-Emotional pre-test results indicated that there was no statistical difference (p=1.00) between the standard score results of the infants in the two groups as presented in Table 4.34 below.

TABLE 4.34 Social Emotional Scale: Participant pre-test, T-test results (n=24)

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	4.00	15.00	6.00	7.17	3.49	21.72	0.00	1.00
Control Group	12	1.00	12.00	8.00	7.17	3.90			

The participant pre-test results compared above in Table 4.34 illustrates that results of infants in both groups were similar with both groups presenting a mean standard score of 7.17.

Participant T-test: Compares infant groups post-tests

The summary of the Social Emotional post-test results also indicated that the standard score results of the two groups showed no statistical difference (p=0.74) as presented below in Table 4.35.

TABLE 4.35 Social Emotional Scale: Participant post-test T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	7.00	16.00	9.00	9.83	2.44	22.00	0.34	0.74
Control Group	12	6.00	15.00	9.50	9.50	2.43			

The similarities between the Social Emotional Scale standard scores are evident when the minimum, maximum and mean standard scores presented in Table 4.35 above are compared.

Groups improvement of social emotional scores

The two groups presented with similar improvements in terms of standard scores from the time of the pre-tests to the post-tests (p=0.81) as presented below in Table 4.36.

TABLE 4.36 Social Emotional Scale: Groups improvement (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	-5.00	5.00	3.00	2.67	2.77	19.82	0.24	0.81
Control Group	12	-3.00	9.00	2.00	2.33	3.92			

The mean standard score improvement for infants in the control group of 2.67 is compared with a similar standard score improvement for infants in the experimental group of 2.33.

Paired T-test: Compares individual infants improvements between the pre-and post-tests

Table 4.37 below indicates that the improvement in terms of the Social Emotional Scale standard scores of the infants in the experimental group presented with a significant statistical difference (p=0.01).

TABLE 4.37 Social Emotional Scale: Paired T-test (n=24).

GROUP	N	Minimum	Maximum	Mean	Std Dev	Df	t	p
Experimental Group	12	-5.00	5.00	2.67	2.77	11	3.33	0.01
Control Group	12	-3.00	9.00	2.33	3.92	11	2.06	0.06

There was not a statistical difference found (p=0.06) in terms of the Social Emotional Scale standard score improvement for infants in the control group as indicated above in Table 4.37.

Figure 4.38 below illustrates each infant's pre- and post-tests results. The experimental group presented with 75% (n=11) of infants that showed an improvement in their standard score results from the pre- to the post tests with only one infant (8.33%) that showed a significant decrease in standard score results.

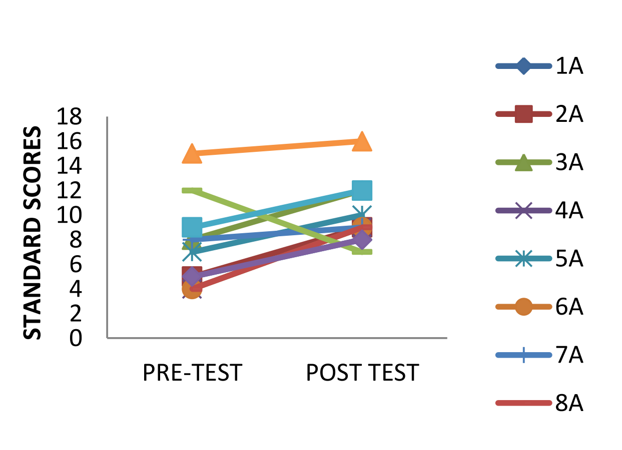
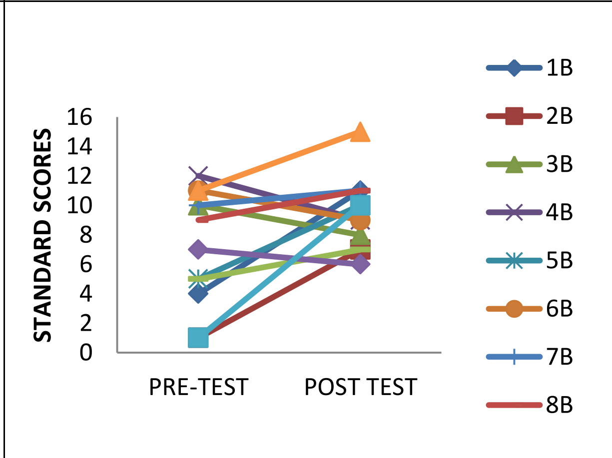
EXPERIMENTAL GROUP (n-12)	CONTROL GROUP (n-12)
	

FIGURE 4.38 GRAPH OF EACH INFANT'S BAYLEY III RESULTS - Social-Emotional pre and post tests standard scores

The infants in the control group presented with 66.67% (n=8) infants that showed significant improvement in terms of their social emotional skills however 33.33% (n=4) infant showed a decrease in their social-emotional skills from the time of the pre-tests to the time of the post-tests.

4.3.3.5 Adaptive Behaviour Scale

The daily functional skills of an infants and toddlers are assessed through the items included in the Adaptive Behaviour Scale. Communication (speech, language, listening and nonverbal communication), health and safety (showing caution and keeping out of physical danger), leisure (playing, following rules and engaging in recreation at home), self-care (eating, toileting, bathing), self-direction (self-control, following directions and making choices), social (getting along with other people, using manners, assisting others and recognizing emotions) and motor areas (locomotion and manipulation of the environment) are included in this subtest. The combined scores for all these items form a series of composites including the General Adaptive Composite (GAC) which serves as an overall measure of the infant or toddler's adaptive development (Bayley 2006a:4).

Participant T-test: Compares infant groups pre-tests

Table 4.38 below presents the summary of the infants in both groups pre-tests standard score results. The results did not indicate a significant difference (p=0.98) between the standard scores of both groups indicating that the two groups were similar with regards to their adaptive behaviour at the time of the pre-tests.

TABLE 4.38 Adaptive Behaviour Scale: Participant pre-tests, T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	44.00	70.00	47.50	52.50	9.01	20.74	0.02	0.98
Control Group	12	32.00	74.00	54.50	52.42	11.60			

When the two groups Adaptive Behaviour Scale mean standard score results of 52.50 and 52.42 are compared, these similar results strengthens the comparability of the two groups in terms of adaptive behaviour.

Participant T-test: Compares infant groups post-tests

Table 4.39 below presents the summary of the infants in both groups post-test standard score results in terms of their Adaptive Behaviour Scales. These results did not indicate a significant statistical difference (p=0.09) between the adaptive behaviour standard score results of the experimental and control groups.

TABLE 4.39 Adaptive Behaviour Scale: Participant post-test T-test results (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	44.00	72.00	55.00	56.92	8.35	21.08	1.74	0.09
Control Group	12	36.00	74.00	47.50	50.25	10.32			

When the mean standard scores of the two groups presented above are compared, the results of the experimental group do however indicate higher standard scores than the results of the control group.

Groups improvement of adaptive behavior scores

The results of the difference between the improvements of adaptive behaviour of the two groups indicated that the experimental group showed a median standard score improvement of 6 compared to the control group that showed a median standard score decrease of -1.

TABLE 4.40 Adaptive Behaviour Scale: Groups improvement (n=24).

GROUP	N	Minimum	Maximum	Median	Mean	Std Dev	Df	t	p
Experimental Group	12	-16.00	16.00	6.00	4.42	9.21	21.01	1.55	0.14
Control Group	12	-21.00	17.00	-1.00	-2.17	11.49			

The results did not indicate a significant statistical difference between the two groups in terms of their standard score improvement (p=0.14) as indicated in Table 4.40 above.

Paired T-test: Compares individual infants improvements between the pre- and post-tests

Table 4.41 below indicates that the improvement in terms of the Adaptive Behaviour Scale standard scores of the individual infants in the experimental- and control groups did not present with a statistical difference (p=0.12, experimental group and p=0.53, control group).

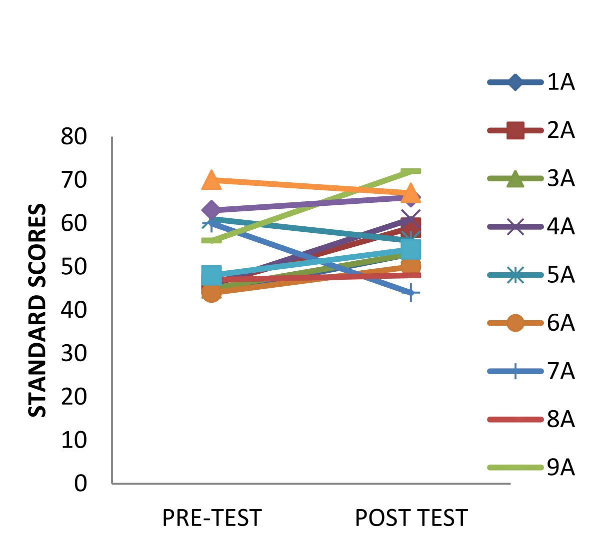
TABLE 4.41 Adaptive Behaviour Scale: Paired T-test (n=24).

GROUP	N	Minimum	Maximum	Mean	Std Dev	Df	t	P
Experimental Group	12	-16.00	16.00	4.42	9.21	11	1.66	0.1248
Control Group	12	-21.00	17.00	-2.17	11.49	11	-0.65	0.5270

When the mean standard score improvements of the two groups are compared the experimental group shows a meaningful improvement of 4.42 compared with a -2.17 mean standard score decrease of the control group.

Figure 4.39 below indicates the standard score results of all the infants in the experimental and control groups' pre- and post-assessment results. The experimental group's results indicated that 75% (n=9) of the infant showed a slight improvement in terms of their adaptive behaviour after the 10 week intervention period however 25% (n=3) infants in this group presented with a slight decrease in adaptive behaviour standard score results.

EXPERIMENTAL GROUP (n-12)



CONTROL GROUP (n-12)

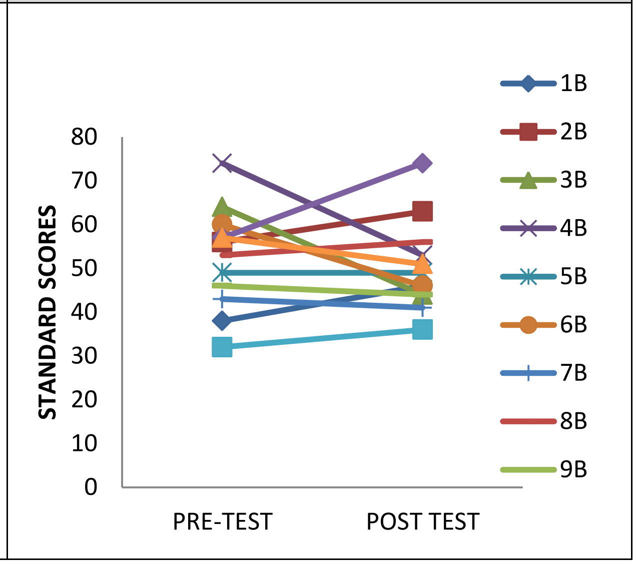


FIGURE 4.39 GRAPH OF EACH INFANT'S BAYLEY III RESULTS - Adaptive behaviour pre and post-test standard scores.

The results of the infants in the control group indicated however that only 41.67% (n=5) presented with a slight increase in standard score results, 50% (n=6) infants presented with a decrease of standard score results and one infant's (n=8.33%) standard score results remained the same at the time of the post-intervention assessment.

4.4 ASI Fidelity Measure

According to Parham *et al.* (2007:216) validity of sensory integration outcomes studies is threatened by weak fidelity in regard to therapeutic process. It is necessary to address fidelity adequately in outcomes research before conclusions regarding sensory integration effectiveness can be drawn. For the purpose of this study it was therefore necessary for the intervention sessions to be evaluated by an independent occupational therapist trained to administer the ASI Fidelity Measure. All intervention sessions were video recorded and after completion of the study, nine intervention sessions were randomly selected for evaluation according to the ASI Fidelity Measure. To comply with the requirements of the Fidelity measure for ASI intervention, an average total score of 80% is required for the evaluated intervention sessions of the research study. The results obtained are presented below in Table 4.42.

TABLE 4.42 ASI Fidelity Measure Scoring

	Scoring of sessions with Ayres sensory integration intervention Fidelity Measure									
	01A: 8	**02A: 9**	**04A: 7**	**05A: 5**	**06A: 6**	**07A: 10**	**08A: 4**	**09A: 2**	**12A: 10**	
Total score	72	88	97	85	82	82	75	88	97	766
									Average:	**766/9 =85.1**

The average score for the evaluated intervention sessions was 85.1%, which indicated that the sessions met the criteria as stipulated for ASI intervention according to the ASI Fidelity Measure. According to these findings, the researcher is able to make valid conclusions regarding sensory integration intervention effectiveness in terms of developmental progress of the ELBW to VLBW premature infants.

4.5 Summary

Chapter 4 presented the anthropometric, demographic, pre- and post-tests results of participants in the experimental and control groups as well as the ASI Fidelity Measure results through brief summaries and illustrations with graphs and tables. The obtained results will be interpreted, discussed and compared with relevant literature in Chapter 5.

CHAPTER 5
DISCUSSION OF RESULTS

5.1 INTRODUCTION

The study results were presented in Chapter 4 in the form of graphs, tables and short discussions. Pre- and post-test results of the experimental and control groups were compared. In Chapter 5 the collected data are interpreted, discussed and conclusions are made and compared with relevant literature for scientific purposes. The limitations of the study are also identified.

5.2 INTERPRETATION OF RESULTS

Since this study was an experimental pre-test/post-test control group design it was possible for the researcher to determine whether ASI intervention was responsible for differences in developmental progress between the experimental and control groups as well as eliminate other possible explanations as to why the change has taken place (cf. 3.1). It was therefore important that the infants in both the experimental and control groups were, as far as possible, similar in terms of collected anthropometric and demographic data before the intervention part of the study commenced as this allowed for the investigation of the effect of the ASI intervention on the experimental group (cf. 4.1.1).

The results of the study will be interpreted according to the anthropometric and demographic information of the study population to establish the comparability of the two groups in terms of developmental status at the time of the pre-tests as well as developmental progress at the time of the post-tests. Thereafter the results obtained from the pre- and post-tests will be discussed, compared and interpreted according to the Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions, illustrated in Figure 2.10 (cf. 2.5.1) to determine the effect of the ASI intervention on the experimental group and finally, the results of the ASI fidelity measure will be addressed.

5.2.1 Anthropometric profile

The anthropometric profile of the study population for the purpose of this study included the infants' gestational ages and corrected ages, genders and birth weights as well as other relevant post-natal information namely reasons for premature birth, self-soothing methods used by participants before the study, the implementation of Kangaroo Care in the NICU and the number of weeks hospitalized (cf. 4.1).

The 24 infants participating in this study, were born with VLBW or ELBW, resided in or near Bloemfontein and were referred from the Universitas Academic Hospital High Risk Infant Clinic. All participants met the inclusion criteria prescribed for participating in this study (cf. 3.3.1) and none of the participants received any previous ASI, occupational therapy intervention or had any additional diagnosis that might affect their development as prescribed by the exclusion criteria (cf. 3.3.2).

5.2.1.1 Gestational ages

The participants' gestational ages (cf. Table 4.2) varied from 28 weeks until 35 weeks and therefore all participants classified as premature infants (cf. 2.2). A p-value of 0.69 indicated that there was not a significant statistical difference between the gestational ages of the infants in the experimental and control groups. The mean gestational age of the infants in the experimental group (30.33 weeks) were similar to the mean gestational age of the infants in the control group (30.67 weeks) and therefore the two groups were comparable in terms of their gestational ages. The gestational ages of participants were important for the purpose of selecting possible participants according to the inclusion criteria of the research study (cf. 3.3.1).

5.2.1.2 Corrected ages

Since a premature infant's corrected age is generally used in assessing developmental status, at least until 12 months (cf. 2.2.4) the participants corrected ages were important to include in the inclusion criteria for the purpose of this study. Other factors that determined the range of the corrected ages for study participants, namely 4-12 months, included; the aim of the study (cf. 1.3.1), to investigate the effect of sensory integration intervention on the developmental progress of the ELBW to VLBW premature infant, at an age of 12 months and younger, as well as the use of the TSFI assessment which assess sensory functions in infants from 4 to 18 months (cf. 3.6.1).

Participating infants were matched according to their corrected ages (and genders, cf. 5.2.1.4), then randomly allocated to the experimental and control groups respectively to ensure the comparability of the groups in terms of the infants' corrected ages (cf. Figure 4.1). The participant's corrected ages were used to determine their developmental statuses during the pre- and post-tests. At the time of the pre-tests a p-value of 0.94 indicated that no statistical difference existed between the corrected ages of infants in the two groups and therefore the researcher was able to use this data as a strong indication of the comparability of the two groups in terms of corrected ages. The researcher was able to match the participants appropriately according to their corrected ages (cf. 4.1.1.1).

5.2.1.3 Birth weight

Research done by Powers *et al.* (2008:1258-1265) indicated that VLBW infants exhibited growth patterns that corresponded with poor developmental progress in the first three years of life. Another study done by Vohr *et al.* (2000:1216-1226) found that ELBW premature infants are at a significant risk of neurologic, developmental and functional delays. With consideration of the possible significant impact of ELBW and VLBW on the development of premature infants, the inclusion criteria of the ELBW and VLBW premature infants were deemed appropriate for the purpose of this study.

The 24 study participants' birth weights ranged from 750g (ELBW) to 1175g (VLBW) and a p-value of 0.27 indicated that there was no statistical difference between the birth weights of infants in both groups (cf. 4.1.1.4). A difference of only 107 grams between the mean birth weights of the two groups also strengthened the comparability of the two groups in terms of birth weight as illustrated in Table 4.3.

5.2.1.4 Gender

Recent research (Lenroot *et al.,* 2007:1072) has found that the most profound difference between girls and boys in terms of brain development is the sequence and tempo of development of the various brain regions. Research in terms of developmental differences between boys and girls during infancy, however is limited. This aspect was therefore necessary for the researcher to consider during the matching process since the developmental progress of infants in the two groups was compared.

Table 4.1 illustrates the matching of participants according to gender. A total of 10 boys and 14 girls participated in this study. As a result of the number of infants referred from the High Risk Infant Clinic at Universitas Academic Hospital and the number of these referred infants that met the inclusion criteria it was only possible for the researcher to match 10 out of 12 infant pairs according to their genders (cf. 3.3.4). A p-value of 0.68, however did not indicate a significant statistical difference between the genders of the two groups and therefore did not affect the results of the study.

5.2.1.5 Reasons for premature birth

Preeclampsia (pregnancy induced hypertension) is a condition related to increased blood pressure and protein in the mother's urine and typically starts after the 20th week of pregnancy. Preeclampsia affects the placenta, and can affect the mother's kidneys, liver and brain. The condition cannot be prevented however most women who develop signs of preeclampsia are closely monitored to lessen or avoid related problems. Preeclampsia is the leading cause of foetal complications which include premature birth and delivering the baby is the only medical solution to prevent fatalities (Redman & Sargent, 2005:1592). This correlates with this research study's parent questionnaire findings that indicated preeclampsia as the reason for premature birth of the majority of the participating infants (cf. 4.1.2.1). As illustrated in Figure 4.2, 66.67% (n=8) of infants in the experimental group and 75% (n=9) of infants in the control group respectively were born premature due to preeclampsia.

The cause for premature birth of 25% (n=3) infants in the experimental group were multiple pregnancies. Prematurity is a risk for a majority of multiples with the consequences of an early birth that varies from miniscule to life-threatening. Fierro (2012) reports, according to the March of Dimes an estimation of more than 50% of twins are born premature. Another cause for premature birth for 8.33% (n=1) of infants in this group was infection of the uterus. The cause for Chorioamnionitis (bacterial infection of the uterus) is bacteria having breached the normal defences of the uterus. Treatment usually involves antibiotics however immediate delivery of the baby may be needed in some cases (Danielsson, 2010).

Only one other known reason for premature birth, namely Hydramnios, was listed for 8.33% (n=1) of infants in the control group. This is an abnormal condition of pregnancy which is characterized by an excess of amniotic fluid and occurs in less than 1% of pregnancies. Possible premature rupture of the membranes, premature labour and perinatal mortality is increased with this condition (Mosby, 2009). A p-value of 0.11 indicated that there was not a statistical difference found between the two groups in terms of reasons for premature birth which contributes to the pre-test similarities of infants in both groups.

5.2.1.6 Self-soothing methods used by participants

The dynamic process of SI model (cf. 2.4) explains the relationship of SI to engagement in daily occupations as a rolling wheel with sensory integration as the hub and sensory modulation the spokes of the wheel which supports social engagement and emotional well-being (Spitzer & Smith-Roley, 2000:5). DeGangi (2000:10-12) further explains that the process of self-regulation involves the infant's ability to modulate mood, self-calm, delay gratification and tolerate transitions in activities. Most babies are able to self-calm by bringing a hand to the mouth to suck, touching their hands together, rocking themselves or by looking at or listening to a preferred visual or auditory stimuli. Infants with regulatory disorders however are unable to use these methods to calm themselves and once upset, require extreme efforts by their mothers to calm down. These infants might seem to be fussy, irritable and escalate quickly from a pleasant mood to an intense cry. Importantly, difficulties experienced with this most basic task has a negative impact on the development of cognition, language, skilled movement, behaviour and emotional control as well as sensorimotor modulation up to the age of 3 years.

The Model for Clinical Reasoning on Possible SI Integration Difficulties and Dysfunctions (Figure 2.10) illustrates the importance of adequate modulation of sensory input in the learning process of a child since it supports the ability of an infant to sustain optimal levels of arousal to engage in activities and contributes to stability in emotions and behaviour (van Jaarsveld, 2011:9). Especially in consideration of the above mentioned impact of modulation on an infant's learning and development, it was necessary for the researcher to address self-regulation in terms of intervention goals and to include this aspect in the interpretation of results for this study.

Figure 4.3 illustrates the self-soothing methods used by infants in both groups at the time of the pre-tests. A p-value of 1.00 is a strong indication that there was not a statistical difference between the methods used by both groups and added value to the study since it strengthened the comparability of the two groups. As discussed in Chapter 4 (cf. 4.1.2.2) the majority of infants used finger sucking or both finger and dummy sucking for self-soothing methods. Both groups presented with 8.33% (n=1) that did not use finger or dummy sucking and the infant in the experimental group was dependent on her mother since only breastfeeding could calm her down once she was upset, however this was also the only option provided to her by her mother.

During the intervention period of 10 weeks the researcher made mothers of infants in the experimental group aware of the value and importance of appropriate self-soothing methods for their infants to help them to self-regulate. All 12 mothers in this group were encouraged to facilitate finger sucking with their infants for the purpose of self-regulation and in addition to this were provided with a dummy and a soft taglet on the second week of intervention as part of the home activities.

The post-test results illustrated in figure 4.4 indicated that 83.33% (n=10) infants in the experimental group used either finger sucking, dummy sucking or both as methods to self-sooth and 100% (n=12) infants in this group made use of the provided soft taglet at the time of the post-test (cf.4.1.2.2). As reported in Chapter 4, 16.67% (n=2) infants in this group did not use either dummy or finger sucking however both of them used the provided soft taglet for self-soothing after the 10 week intervention period. Although the one infant still relied on her mother for breastfeeding to self-sooth as a personal and cultural choice of the mother which was respected by the researcher, the other infant was identified as a possible regulatory disorder infant by the researcher and at the time of the post-test he relied to be held by his mother to be calmed. This affected the infant's participation in activities and was addressed during the intervention sessions although further therapy was recommended by the researcher at the end of the study.

The control group presented with a 25% (n=3) decrease in use of self-soothing methods. Although the control group increased with 33.33% (n=4) infants that used dummies at the time of the post-tests, this group also presented with a 33.33% (n=4) decrease of infants that used finger sucking as a self-soothing method and 25% (n=3) decrease of infants that used both finger and dummy sucking at the time of the post-tests. These results indicated that the experimental group had more consistent self-soothing strategies in place and in general, infants in this group made use of more than one method to self-sooth compared to the control group at the time of the post-tests. Even the two infants in the experimental group that did not use dummy or finger sucking for self-soothing, used in addition to relying on their mothers for either breast feeding or holding, the soft taglets which was provided as part of the intervention programme.

The researcher concludes from these findings that due to the parents' involvement in their infants' intervention sessions and through taking responsibility for participating in the home activities as part of the intervention, the parents of infants in the experimental group gained insight into the importance of appropriate self-soothing methods for their infants for the purpose of self-regulation and therefore encouraged these techniques to be used by their infants. According to the Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions (Figure 2.10) premature infants firstly have to register sensory stimuli (visual, vestibular, proprioceptive, tactile or auditory), before modulation of the sensory stimuli can help the infant to maintain optimal levels of arousal to sustain engagement in activities or interaction with family for learning and/or development to take place. Due to the immature nature of the premature infant's CNS after birth, stressors exposed to in the NICU as well as Developmental Care approach followed in the NICU to protect the premature infants from being overstimulated (cf. 2.2.2, 2.2.3 and 2.2.4), encouragement of appropriate self-soothing methods post-discharge is of utmost importance to include in the intervention approach to help these infants process sensory information to be able to discriminate and perceive the spatial and temporal qualities of the information and obtain meaning through this process.

With consideration of the infants in the experimental groups significant progress towards typical performance in terms of Low Registration (Fig 4.13) compared to the infants in the control group who's Low Registration scores in general indicated a decrease towards the definite difference range, as well as taking into account the tendency of infants in the experimental group's to rely on more than one appropriate self-soothing technique compared to the infant's in the control group, the researcher concludes that the use of appropriate self-soothing techniques by infants in the experimental group improved their sensory modulation abilities.

5.2.1.7 Kangaroo Care

The numerous benefits Kangaroo Care holds for both infants and parents (cf. 2.2.2) indicates clearly that for the purpose of this study it would be relevant to also consider the number of weeks infants received Kangaroo Care since this could have a positive effect on the developmental progress of the participants. The data obtained from the parent questionnaire regarding the number of weeks participants received skin-to-skin Kangaroo Care are illustrated in Figure 4.5. A p-value of 0.16 did not indicate a statistical difference between the number of weeks infants in both groups received skin-to-skin Kangaroo Care and therefore proved the two groups to be comparable in terms of skin-to-skin Kangaroo Care received.

5.2.1.8 Weeks in hospital

Although it is not known what the impact of the number of weeks hospitalized could have on premature infants, it is evident and unfortunately unavoidable that premature infants do experience stress within the NICU, however, practices are in place in most NICU's to reduce these stressors for premature infants as far as possible for better developmental outcomes (cf. 2.2.2). A Developmental Care programme is implemented at Universitas Academic Hospital's NICU.

The results obtained for the parent questionnaires indicated that a significant statistical difference ($p=0.01$) was found between the number of weeks the infants in the experimental group were hospitalized compared to the time hospitalized of the infants in the control group (cf. 4.1.2.4, Figure 4.6). Infants in the experimental group were hospitalized for an average of 8.42 weeks while infants in the control group were hospitalized for an average of 5.91 weeks. The infants in the control group held the advantage in terms of the possible negative effect the number of weeks hospitalized could have had on their development, since they were hospitalized for a shorter period. Considering this information and the limited improvement of infants in the control group in terms of sensory processing, sensory function and development, it is evident that despite the advantage of less time spent in hospital, the infants in the experimental group that received the ASI intervention made better progress.

5.2.2. Demographic profile

The demographic profile of the study participants included; the geographic and socio-economic information of infants; the ages, marital status, educational levels and occupations of parents as well as home languages (cf. 4.2). As discussed in Chapter 4 all 24 participants resided in or near Bloemfontein and infants in the experimental and control groups resulted in comparability with regards to; the ages of mothers ($p=0.43$), ages of fathers ($p=0.45$), marital status of parents ($p=0.32$), educational level of mothers ($p=0.48$), educational level of fathers ($p=0.55$), mothers occupations ($p=0.16$) and fathers occupations ($p=0.59$). Through consideration of especially the similarity in terms of parents' educational background, occupations and marital statuses as well as exclusion criteria of previous occupational therapy- or sensory integration intervention, the researcher was able to conclude that the two groups were comparable in terms of their home environments, material available in terms of stimulation and parents' educational levels.

The demographic profile together with the anthropometric profiles of the infants indicated a strong comparability between the experimental and control groups respectively since the two groups were similar in all the relevant factors except for the number of weeks hospitalized, where the results were in favour of the control group that did not receive the ASI intervention as discussed (cf. 5.2.1.8). The researcher was therefore able to make valuable conclusions regarding the effect of ASI intervention on the development of the premature infants through analysing and interpreting the pre- and post-tests results of the Infant/Toddler Sensory Profile, Test of Sensory Functions in Infants and Bayley Scales III of Infant and Toddler Development.

5.2.3 Interpretation of the pre-and post-tests results

For the purpose of this study the pre- and post-tests results will be interpreted according to the improvement of the two groups in terms of the three standardized assessments used. The results improvement of the two groups will be compared and discussed accordingly. The pre-test results were also used by the researcher for intervention planning of participants in the experimental group, individual case studies will however not be discussed but rather the results will be looked at in terms of group improvement.

Ayers (1983:34), Dunn (2002:7), Van Jaarsveld (2011:9-12) as well as Williamson and Anzalone (2001:28) explain that the brain needs to register all sensory information. The amount of sensory information needed to be registered is partially dependent on neurological thresholds and differs from person to person. Sensory registration can also differ within the different sensory systems. The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions (van Jaarsveld, 2011:9), illustrated in Figure 2.10, indicates that sensory information needs to be registered before adequate modulation of sensory information can take place. Modulation then enables a person to maintain engagement in activities through sustaining optimal levels of arousal, necessary for learning, stability in emotions and behaviour. The child will subsequently be able to interpret the qualities of the sensory information and add meaning to it through sensory discrimination and in the process, form perceptions. This enables the child to develop spatial and temporal qualities (conscious memory) of information that leads to motor skills, praxis abilities and developmentally appropriate, organized behaviour and motor actions relative to time and space. Poor sensory discrimination however can lead to vestibular ocular difficulties, the infant for example will not be able to focus on an object while his/her head is moving or postural ocular difficulties which include balance reactions, postural responses during physical engagement in an activity, activation and co-activation of muscles during movement, maintaining an upright position against gravity and moving efficiently through space, which will hinder the learning process of the child further and lead to greater developmental delays.

5.2.3.1 The results of the Infant/Toddler Sensory Profile

The experimental and control groups pre- and post-test results of the Infant/Toddler Sensory Profile are analysed and compared in terms of behaviours consistent with high neurological thresholds and behaviours consistent with low neurological thresholds, as well as the progress of the two groups over the 12 week period of the research study in terms of these behaviours.

5.2.3.1.1 High neurological thresholds

Behaviours consistent with Low Registration and Sensation Seeking represent high neurological thresholds however a child with low sensory registration responds differently to sensory stimuli compared to a child who seeks sensory input (Dunn, 2002:43-44).

LOW REGISTRATION

At the time of the pre-test there was not a significant statistical difference between the Low Registration results of the two groups (p=0.87). Infants in both groups presented within the typical low sensory registration range of behaviour, 75% (n=9) of infants in the experimental group and 66.67% (n=8) infants in the control group. Within the experimental group, 50% (n=6) infants presented within the definite difference range compared to 33.33% (n=4) infants in the control group, therefore indicating that the experimental group presented with a higher percentage of infants who's behaviour were consistent with low registration of sensory input (Figure 4.13).

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions (Figure 2.10, cf. 2.5.1) these results of children with low sensory registration were indicative that the brain took longer to register sensory information or more sensory information were needed to generate behavioural responses. These infants' tendency to respond in accordance with their high thresholds may have led to an apathetic, self-absorbed appearance, uninterested to participate in play activities or interaction with their parents, with a low affect, low energy levels and seemed as if they were overly tired all the time. According to Dunn (2002:43-44) it is hypothesized that these children with low registration to sensory stimuli have inadequate neural activation to support sustained performance in activities.

Together with the inability to self-regulate with adequate techniques for example sucking a dummy to increase their arousal levels (cf. 5.2.1), these infants' low registration may most probably lead to poor discrimination of sensory stimulation e.g. vestibular, proprioceptive, tactile, auditory or visual stimulation. Consequently these infants will experience poor vestibular ocular control, which will cause them to experience difficulties to focus on objects while their head is moving (cf. 2.4.1.3), an important developmental building block from early infancy. They may also consequently experience poor postural-ocular control e.g. poor balance reactions during sitting, crawling, pulling up on furniture, postural responses when reaching for an object or changing position from standing to sitting etc., activating muscles during movement e.g. grasping a toy during swinging, maintaining an upright position against gravity and moving efficiently through space e.g. crawling. These difficulties will lead to further developmental challenges and can hinder them to develop adequate motor skills and praxis abilities, their developmental outcome in areas such as organized behaviour and motor actions can as a result be affected negatively.

The overall goal in terms of intervention for low registration of sensory stimuli is to make all experiences more concentrated with sensory information so there is better likelihood that thresholds will be met and the child will be able to notice and respond to cues in the environment (Dunn, 2002:43-44). This has been implemented for infants in the experimental group through various activities e.g.,

- tactile and visual stimulation, playing with white shaving cream on a dark therapy block and enhancing both tactile and visual sensory input, playing with lentils and pushing lights in a bucket, etc.
- Proprioceptive and visual/auditory stimulation, crawling over crash mats and sponge-block duvets following musical toys or flashing coloured lights,
- Vestibular and visual stimulation, changing speed and direction of movement on various swings while reaching for a sugar-filled coloured balloon, bright rubbery tactile toy or ribbon-forest etc.

A significant statistical difference between the post-test Low Registration results were not found (p=0.15) however the difference between the groups were slightly larger than with the pre-tests. When the results were compared it was evident that infants in the experimental group presented with a significant improvement in terms of Low Registration with 66.67% (n=8) infants that fell within the typical performance range and only 33.33% (n=4) infants that presented with Low Registration difficulties of which only 16.67 (n=2) fell in the definite difference range. The results of the control group presented with a decrease of infants in the typical performance range and an increase of infants falling both within the probable and definite difference ranges (Figure 4.13). These results indicated that the infants exposed to ASI intervention showed noticeable improvement in terms of Low Registration compared to the infants in the control group.

The noteworthy increase of 41.67% (n=5) of infants in the experimental group who presented within the typical performance range for Low Registration at the time of the post-tests compared to the infants in the control group who's results indicated a decrease of infants who presented within the typical performance range for low sensory registration (Figure 4.13) enabled the researcher to conclude that the ASI intervention sessions together with the encouragement of additional self-soothing methods for self-regulation as part of the home activities had a positive effect on the sensory registration and modulation of infants in the experimental group. The researcher hypothesizes that this have had a further positive effect on the infants sensory discrimination abilities which would be discussed in terms of the results of the TSFI assessment results.

SENSATION SEEKING

The infants in both the experimental and control groups presented with similar Sensation Seeking sensory processing during the time of the pre-tests. A significant statistical difference could not be found between results of the two groups with a p-value of 0.39 and the majority of infants in both groups (66.67%, n=8) presented within the typical performance range. Within the experimental group a small percentage of 16.67% (n=2) infants presented with probable difference (more than others) sensation seeking behaviour and the same percentage of infants with probable difference (less than other) behaviours. Within the control group 33.33% (n=4) infants presented within the probable difference (more than others) range.

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions (Figure 2.10, cf. 2.5.1) these results of children with sensation seeking behaviour indicated under-responsiveness to sensory stimuli, adding sensory input to every experience through making noises during play, fidgets or rubs objects with their hands, constantly chewing objects and wraps their bodies around furniture or mom as ways to increase input. They have a tendency to be active and work to meet these high thresholds. According to Dunn (2002:45) it is hypothesized that these children who are sensation seekers have inadequately neural activation, but they are driven to meet their thresholds and so create opportunities to increase input to meet their high thresholds.

Together with the inability to self-regulate with adequate techniques for example sucking a dummy, sucking their fingers or fiddling with a soft taglet to provide extra proprioceptive or tactile input to lower their arousal levels, and help them to focus their attention to a task (cf. 5.2.1), these infants' sensory seeking behaviour may most probably lead to poor discrimination of sensory stimulation e.g. vestibular, proprioceptive, tactile, auditory or visual stimulation. Consequently these infants may experience poor vestibular ocular control, which will cause them to experience difficulties to focus on objects while their head is moving (cf. 2.4.1.3). They may also consequently experience poor postural-ocular control e.g. poor balance reactions during sitting, crawling, pulling up on furniture, postural responses when reaching for an object or changing position from standing to sitting etc., activating muscles during movement e.g. grasping a toy during swinging, maintaining an upright position against gravity and moving efficiently through space e.g. crawling. These difficulties may lead to further developmental challenges and can hinder them to develop adequate motor skills and praxis abilities; this will consequently affect their development of appropriate, organized behaviour and motor actions relative to time and space negatively.

Dunn (2002:45) recommends that intervention planning for these children who are sensation seekers should be started with skilled observation since they create sensation for themselves and their behaviour is an indication of what sensory input they need. This has been implemented for the 33.33% (n=4) infants in the experimental group that presented with sensory seeking behaviour and observations by the researcher was not only done during the pre-tests but also during the weekly intervention sessions. These infants' difficulty with performance are related to the interference of their sensory seeking behaviour with everyday tasks and therefore the most effective intervention approach is to incorporate needed sensory input into daily routines e.g.

- Eating; sucking yogi-sip in a bottle for infants seeking proprioceptive input (5-12 months) or eating crunchy fruit e.g. apple pieces. Allowing a child that needs vestibular input to obtain vestibular input during mealtimes through letting him sit on mom or dad lap and provide some movement or rocking. These children need to move to be ready and available to eat or play.
- Personal hygiene; firm rubbing the child with a towel after a bath or providing deep pressure infant massage techniques as demonstrated and taught by the researcher after bath time when applying cream/moisturizer.
- Dressing; letting the child sit on mom/dad's lap or during dressing providing rocking or movement while getting dressed. The 6 to 12 month infant can be allowed to crawl or push a basket to fetch clothes on one side of the room before dressing. This increases movement opportunities while also encouraging the infant to keep attention to the task.

Through applying these techniques and adaptations in daily functional tasks the infant seeking sensory stimuli is able to remain alert and does not need to interrupt daily routines with often disrupting type of behaviour/activities to meet his/her sensory needs. It is always important that during intervention planning the selection of activities chosen depends on the home setting, the family's needs, and the child's preferences (Dunn 2002:45).

The post-test results again did not indicate a significant statistical difference between the two groups however both groups' results regressed towards the probable difference range. Within the experimental group 58.33% (n=7) infants now presented with sensation seeking behaviour, indicating a 41.67% (n=5) increase in this range and within control group 50% (n=6) infants presented with sensation seeking behaviour indicating a 16.67% (n=2) increase.

Children who presents with sensation seeking behaviour are active and continuously engaged in their environments. They add sensory input to experiences in daily life. One might hypothesize that children who are sensation seekers have inadequate neural activation, but they are driven to meet their neurological thresholds and so create opportunities to increase input to meet their high thresholds. The overall goal is to incorporate additional sensory input into the child's routines so that thresholds can be met while conducting daily life (Dunn 2002:44).

In consideration of the experimental groups' results improvements in terms of low threshold (figure 4.13), sensory sensitivity (figure 4.15) and sensory avoiding (figure 4.16) behaviour, the researcher hypothesizes that these infants, after exposure to 10 weeks ASI intervention were at the time of the post-tests more able to tolerate various sensory stimuli, were more aware of their environment and the possible sensory input it contains and therefore their behaviour tended towards seeking sensory input. As discussed above, it is important to observe these infants not only during assessments but also during the intervention sessions to provide appropriate stimuli to optimize their arousal levels for optimal function in daily life activities and also for optimal learning and developmental experiences through their seeking behaviour. This will also lead to increased exploration of their world.

Since the percentage of infants in the control group presenting with sensory seeking behaviour increased with a smaller percentage of 16.67% (n=2), and the infants in this group also increased in terms of low threshold (figure 4.13), sensory sensitivity (figure 4.15) and sensory avoiding (figure 4.16) behaviour the researcher hypothesizes that due to the lack of ASI intervention as well as lack of insight of parent's in terms of their infants sensory behaviour, the infants in this groups presented with difficulties in terms of sensory seeking behaviour which could, if not attended to appropriately as discussed above through ASI intervention lead to sensory discrimination difficulties and affect their learning, development and socio-emotional behaviour negatively.

5.2.3.1.2 Low Neurological Thresholds

Behaviours consistent with Sensory Sensitivity, Sensation Avoiding and Low Threshold represent low neurological thresholds however a child with sensory sensitive behaviour responds differently to sensory stimuli compared to a child who avoids sensory input (Dunn, 2002:45-46).

SENSORY SENSITIVITY

The pre-tests results did not indicate a significant statistical difference between the two groups in terms of Sensory Sensitivity (p=1.0) with the majority of both groups falling within the probable difference range (50%, n=6 of infants in both groups) as illustrated in Figure 4.15. In general the control group performed better during the pre-tests with more infants 41.67% (n=5) with typical sensory sensitivity performance, compared to the 33.33% (n=4) infants in the experimental group which also had 8.33% (n=1) infant in the definite difference range.

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions (Figure 2.10, cf. 2.5.1), the difficulties these children experience with sensory registration involves over-responsiveness to sensory stimuli though the inability to tolerate tactile, vestibular, proprioceptive, auditory or visual input. These children who present with sensory sensitive behaviour may tend to be distractible and seem to be hyperactive. They direct their attention to the latest stimulus that presents itself, which draws them away from the task at hand. It can be hypothesized that children who have sensory sensitivity have over-reactive neural systems that make them aware of every stimulus that becomes available while they do not have the commensurate ability to habituate to these stimuli (Dunn 2002:44).

Together with the inability to self-regulate with adequate techniques, for example sucking a dummy or fingers and fiddling with a security object such as a soft taglet or blanky to decrease their arousal levels (cf. 5.2.1) through modulation and enable them to sustain engagement and attention despite various sensory input, these infants' sensory sensitive behaviour may most probably lead to poor discrimination of sensory stimulation since their unorganized, emotional and intense response to stimuli hinders their development of adequate motor skills and praxis abilities as well as overall developmentally appropriate, organized behaviour and motor actions relative to time and space.

The overall goals for intervention would be to provide the infant with sensory experiences as part of active performance within activities that supports him/her to continue with an activity and to minimize the chances for the thresholds to be fired repeatedly (Dunn, 2002:44). This was implemented in the ASI intervention sessions through:

- Introducing additional self-soothing techniques for example dummy sucking and a soft security object e.g. taglet or blanky, explaining the importance of this to parents so that they could encourage their infants to use additional self-soothing techniques for the purpose of self-regulation.
- Sensory experiences during interventions were planned to minimize additional sensory input, and slowly introducing one stimulus (tactile, movement or proprioception) at a time. The grading of sensory input within sessions in terms of intensity was child-directed and a slow process.
- Helping parents to understand the meaning of their infants' distractible behaviours and the importance of not withholding stimulation from infants since they still need input to operate however their mechanisms of habituation are underdeveloped, they cannot tolerate the influx of random input.

The post-test results did however indicate a significant statistical difference between the results of the two groups (p=0.004). These results indicated that after the 10 week ASI intervention period, 83.33% (n=10) infants in the experimental group presented with typical performance in terms of Sensory Sensitivity with only 16.67% (n=2) of these infants that still fell within the probable difference range, indicating a significant decrease of sensory sensitive behaviour for infants in the experimental group while the infants in the control group on the contrary showed an increase in terms of Sensory Sensitive behaviour. The majority of infants in the control group (75%, n=9) presented with Sensory Sensitive behaviour at the time of the post tests of which 50% (n=6) of infants in this group that fell within the definite difference range.

Since there was no statistical difference found between the infants' anthropometric and demographic information as well as the pre-test results in terms of sensory sensitive behaviour, the researcher hypothesizes that the ASI intervention as well as the increased use of additional self-soothing techniques by the infants in the experimental group over a short period of 10 weeks were responsible for the significant improvement in terms of sensory sensitive behaviour of these premature infants. The significant increase in sensory sensitive behaviour observed at the time of the post-tests therefore is a strong indication that a lack of ASI intervention and appropriate self-soothing techniques contributes to an increase in sensory sensitivity for premature infants which further affects their normal development negatively.

SENSATION AVOIDING

As presented in Chapter 4, Figure 4.16 the majority of infants in the experimental group (66.67%, n=8) presented with Sensation Avoiding difficulties within the probable difference range compared to the majority of infants in the control group (66.67%, n=8) that presented with typical Sensation Avoiding sensory processing at the time of the pre-tests. These results indicated a statistical difference between the two groups with a p-value of 0.04.

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions (Figure 2.10, cf. 2.5.1) these children have difficulties with sensory registration as a result of over-responsiveness to sensory stimuli however they try to avoid the stimuli. They may engage in very disruptive behaviours due to the fact that meeting thresholds is an uncomfortable or frightening experience. Pushing up on their arms during prone lying or crawling, might provide too much proprioceptive input for an infant who is sensitive for proprioceptive input. These normal developmental actions could be experienced as uncomfortable and the infant would respond through avoiding this input through withdrawal or engaging in an emotional outburst that enables them to get out of the threatening situation. The infant will attempt to create a situation to limit sensory input to those events that are familiar and therefore easy for the nervous system to interpret for example lying supine or just remain in a sitting position. Children who avoid sensation are resistant to changes because change represents an opportunity to be bombarded with unfamiliar stimuli (Dunn, 2002:45-46).

Together with the inability to self-regulate with adequate techniques for example sucking a dummy, sucking their fingers or fiddling with a soft taglet to enable them to lower their arousal levels and help them process the sensory information in a calm-alert state (cf. 5.2.1), these infants' avoiding behaviour that will provide unknown/uncomfortable/threatening sensory input. It will also probably withhold them form vital experiences to explore their world and new challenges. This in turn could lead to poor discrimination of sensory stimulation e.g. vestibular, proprioceptive, tactile, auditory or visual stimulation and consequently these infants will experience poor vestibular ocular control, which will cause them to experience difficulties to focus on objects while their head is moving (cf. 2.4.1.3). They may also consequently experience poor postural-ocular control e.g. poor balance reactions during sitting, crawling, pulling up on furniture, postural responses when reaching for an object or changing position from standing to sitting etc, activating muscles during movement e.g. grasping a toy during swinging, maintaining an upright position against gravity and moving efficiently through space e.g. crawling. These difficulties will lead to further developmental challenges and can hinder them to develop adequate motor skills and praxis abilities, hindering their normal developmental process.

According to Dunn (2002:45,46) the overall goal for intervention is to honour the child's need to limit unfamiliar sensory input both at home and during intervention sessions and gradually broaden the sensory processing experiences within the child's accepted habits. This was implemented during the study's ASI intervention sessions through:

- Firstly, additional self-soothing techniques were introduced, for example dummy sucking and a soft security object e.g. taglet or blanky. The importance of this was explained to parents so that they could encourage their infants to use additional self-soothing techniques for the purpose of self-regulation.
- Infants' need to reduce sensory input was honoured, since unfamiliar input generates sensitization which interferes with on-going performance.
- Events were carefully constructed to introduce a wider range of sensory experiences so the child could develop habituation for them through taking one of the infant's in bedded rituals and expand it in one sensory way at a time e.g. mixing two different textures of cereal together during sensory/messy play etc.
- Sensory experiences during interventions were planned to minimize additional sensory input, and slowly introducing one stimulus (tactile, movement or proprioception) at a time. Grading sensory input in terms of intensity was child-directed and a slow process.

After the 10 week ASI intervention with the infants in the experimental group, the post-test results of the experimental group indicated a significant improvement and presented with the majority of infants in this group (66.67%, n=8) falling within the typical performance range for Sensation Avoiding sensory processing. The control group that did not receive the intervention's behaviour in terms of Sensation Avoiding, increased significantly. The post-test results for this group indicated that 91.67% (n=11) infants in this group presented with Sensation Avoiding behaviour, 50% of infant is the control group fell within the definite difference range. These results indicated that the ASI intervention did not only significantly improve infants sensory processing in terms of Sensation Avoiding, but a lack of ASI intervention lead to a significant increase in terms of Sensation Avoiding behaviour.

LOW THRESHOLD

The pre-test Low Threshold results of the two groups indicated no statistical difference between the two groups with a p-value of 1.00. Both groups presented with 50% (n-6) of infants within the probable difference range for Low Threshold.

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions (Figure 2.10, cf. 2.5.1) these children have difficulties with sensory registration as a result of over-responsiveness to sensory stimuli. Infants with behaviour consistent within this category, represents low neurological thresholds using both active and passive self-regulation strategies. Infants may be described as fussy, inconsistent in their behaviour and require a great deal of structure. This inconsistency in behaviour reflects the nervous system's attempts to simultaneously respond to stimuli and protect itself by reducing input and in the process producing variable responses. This will affect their sensory modulation and discrimination abilities negatively and hinder them to develop adequate motor skills and praxis abilities, their overall developmentally appropriate, organized behaviour and motor actions relative to time and space will as a result be affected negatively.

A very important factor in intervention planning, is providing information about the range of performance to be expected, from irritability to shutting down and helping the parents or caregivers to understand these patterns in performance in terms of what triggers reactions and what parameters help to keep the child functional (Dunn, 2002:46-47).

Following the 10 week ASI intervention 75% (n=9) infants in the experimental group fell within the typical performance range and the other 25% (n=3) infants in this group fell within the probable difference range compared to the infants in the control group that presented with only 25% (n=3) infants falling within the typical performance range, 16.67% (n=2) infants within the probable performance range and the majority of 58.33% (n=7) infants in this group falling within the definite difference range. A significant statistical difference (p=0.004) was found between the post-test results of the two groups. The researcher hypothesizes that these results indicate that the ASI intervention had a positive effect on the Low Threshold sensory processing of the infants in the experimental group and that a lack of ASI intervention lead to an increase in terms of Low Threshold behaviour for the infants in the control group.

5.2.3.1 Test of Sensory Functions in Infants

Van Jaarsveld (2011:8) explains that discrimination within the different sensory systems is not only about the registration or tolerance of sensory information as in sensory modulation any more but about interpreting the qualities of the sensory information and adding meaning to it in the form of forming perceptions. It means that the infants at this stage have to use past experiences and memories to form associations about the spatial and/or temporal qualities of what he/she is experiencing and then have to act on it through an appropriate adaptive response.

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions adapted by van Jaarsveld (Figure 2.10), if an infant experiences difficulties with sensory discrimination, he/she will not know the qualities of the sensory experiences within the sensory system since the necessary sensory information is not provided by the sensory system. Discrimination difficulties can be found in a single system but it is often seen in a combination of sensory systems e.g. somato-sensory or vestibular-proprioception (van Jaarsveld, 2011:10).

According to DeGangi and Greenspan (1993:16-17) the results of the TSFI can be incorporated with the results of a comprehensive neuromotor assessment or other relevant tests such as cognitive and motor skills to help diagnose problem areas related to sensory functions and to aid in intervention planning. For the purpose of this study the pre-tests results were used in combination of the Infant-Toddler Sensory Profile and Bayley III Scales of Infant and Toddler development for intervention planning of the participants in the experimental group as well as to measure determine the progress of the two groups over the 12 week period. The improvement of the pre- and post-test results of the two groups will now be compared and discussed in terms of the effect of the 10 week ASI intervention on the experimental group. Table 5.1 below illustrates the experimental and control group tendencies towards improvement, no change or decrease at the time of the post-tests in terms of the five subtests of the TSFI as well as Total scores.

TABLE 5.1 Improvement summary of the TSFI subtests

	REACTIVITY TO TACTILE DEEP PRESSURE			ADAPTIVE MOTOR FUNCTIONS			VISUAL TACTILE INTEGRATION			OCULAR MOTOR CONTROL			REACTIVITY TO VESTIBULAR STIMULATION			TOTAL SCORES		
	N	AR	D	N	AR	D	N	AR	D	N	AR	D	N	AR	D	N	AR	D
EG	+4	-2	-2	+7	+2	-9	+4	-3	-1	+2	-2	-	+5	-1	-4	+11	-5	-6
CG	-1	-	+1	-	+2	-2	-1	-1	+2	-	+1	-1	-1	+2	-1	+1	-3	+2

N – NORMAL **AR** – AT RISK **D** – DEFICIENT **EG** – EXPERIMENTAL GROUP **CG** – CONTROL GROUP

Indicates improvement

Indicates decrease

\- Indicate no change

5.2.3.2.1 Reactivity to tactile deep pressure

Although the pre-test results of the experimental and control groups did not indicate a significant statistical difference (p=0.09), within the control group 100% (n=12) of the infants presented with normal reactivity to tactile deep pressure as applied to the forearms and hands, soles of feet, abdomen, around the mouth and when the infant was held at the shoulder compared to the 66.67% (n=8) infants in the experimental group. Within the experimental group 16.67% (n=2) infants presented with at risk reactivity to tactile deep pressure and another 16.67% (n=2) infants presented with deficient reactivity to tactile deep pressure.

According to DeGangi and Greenspan (1993:16) scores within the at-risk ranges is an indication of suspect functioning while scores falling in the deficient range indicate definite problems in toleration of tactile deep pressure. Infants obtaining these scores should be considered as tactually defensive.

During the intervention planning for the infants in the experimental group the pre-test results were analysed to determine the appropriate areas of therapeutic intervention for the infants in the deficient and at risk ranges. If for example the infant presented with defensiveness to touch on the arms and/or hands, legs and/or feet during the TSFI pre-tests and also presented with difficulties tolerating certain clothing or textures as found in the tactile processing subtest of the Sensory Profile pre-tests, normalization of responses to touch on the arms and/or hands and legs and/or feet were a priority in the overall intervention programme. Other areas, for example, sensitivity around the mouth in combination with feeding difficulties were also addressed. Some examples of intervention strategies implemented to address these aspects included:

- Providing a variety of tactile stimuli during intervention sessions. These stimuli were graded for example first introducing texture beanbags, blankets, matrasses and crash mats to using textured rubbery toys, a ribbon forest and explorative tactile mediums for example buckets with lentils, white bobbles with flashlights, sand, feather play, shaving cream and a variety of messy play mediums (examples illustrated in ADDENDUM E). These activities were also, where appropriate combined with vestibular input.
- Teaching of infant massage techniques to mothers for the purpose of normalization of responses to touch and to increase the infant's body awareness (cf. 2.3.1, ADDENDUM G) for the importance and relevance of infant massage for the purpose of this research study. During these sessions the researcher demonstrated the techniques to the mother on a doll and the mother practised the techniques on the infant. Grape seed oil and massage cards were provided to the mothers and the routine was recommended as part of the home programme to implement after bath time.
- Other home activities were also recommended where necessary e.g. rubdown with a towel after bath, messy play activities (Jelly/instant pudding where provided by the researcher) and adjustment of clothing in terms of textures.

The post-tests results in terms of reactivity to tactile deep pressure also did not indicate a statistical difference with a p-value of 1.00 (cf. 4.3.2.1, Figure 4.25), however the difference between the groups' post-test results were higher and the results indicated that the experimental group did present with an improvement during the post-test compared to the control group that presented with a slight decrease. Table 5.1 above illustrates that the experimental group improved with a 33.33% (n=4) increase of infants that fell within the normal range for this subtest. These results indicate that 16.67% (n=2) infants improved from the at risk range to the normal range, and 16.67% (n=2) infants improved from the deficient range to the normal range within a 10 week intervention period. The majority of infants in the control group 91.67% (n=11) remained in the normal range after the 10 week period of no intervention although 8.33% (n=1) infants performance decreased from normal functioning to deficient functioning.

These results enabled the researcher to hypothesize that the ASI intervention had a significant positive impact on the infants performance in the experimental group and that a lack of intervention has the risk of infants presenting with a decrease in performance in terms of reactivity to tactile deep pressure.

5.2.3.2.2 Adaptive motor functions

The pre-test results indicated that infants in both groups presented with significant adaptive motor difficulties. The literature review has indicated that these results could have been expected from the participants due to their immature CNS's at birth. Within the experimental group 83.33% (n=10) infants and within the control group 75% (n=9) fell within the deficient range. Only 16.67% (n=2) infants in the experimental group and 25% (n=3) infants in the control group presented with normal adaptive motor functions at the time of the pre-tests. These results were a clear indication that premature infants experienced difficulties in terms of discrimination of sensory input for adaptive, functional use.

DeGangi and Greenspan (1993:16) recommended that infants with poor adaptive motor functions should be evaluated for possible abnormal neuro-motor functions and/or delayed motor skills. Infants with scores in the at-risk range should be considered suspect for adaptive motor functions while infants with scores within the deficient range presents with definite abnormalities in adaptive motor functions.

Since the majority of the research population presented with definite adaptive motor difficulties which plays a critical role in normal infant development, this aspect was seen as a high priority within the planning of intervention for the infants in the experimental group. Infants were continuously challenged within sessions to elicit appropriate adaptive motor reactions (cf. 2.4.1). This was incorporated with all activities e.g.:

- Vestibular input: the infant needed to adjust posture and/or motor actions during movement on various swings etc. to elicit the appropriate response e.g. touching, reaching or grasping a suspended rubbery toy/balloon etc., facilitate rolling and reaching through visual tracking and utilizing tactile toys for motivation to elicit the required action.
- Tactile and proprioceptive input: appropriate sensory input was provided and structured in such a way to facilitate enough challenge for the infant and elicit an adaptive response e.g. crawling over various surfaces for proprioceptive input to reach a desired tactile/visual/auditory toy. Hiding toys for motivation within a variety of tactile material to elicit reaching and grasping.
- Visual and auditory toys were continuously used in combination with the main vestibular, tactile and proprioceptive activities in aid to elicit adaptive motor responses (ADDENDUM E).

The significant improvement of infants in the experimental group (cf. 4.3.2.2) in terms of adaptive motor functions, which is also seen as discriminative functions, as illustrated in Figure 4.26, indicated that the ASI intervention had a positive effect on the adaptive motor functions of the infants that received the interventions. According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions in Figure 2.10 this is an indication that these infants improved in terms of their sensory registration and modulation, to have been able to attend selectively to sensory stimuli and appropriately react through an adaptive response. The results of the control group that did not receive the ASI intervention only presented with a 16.67% (n=2) improvement of infants from the deficient range to the at risk range indicating minimal improvement in terms of normal development of adaptive motor functions while the 25% (n=3) of infants in this group that presented with normal adaptive motor functions remained the same over a 10 week period for these premature infants. The researcher can therefore hypothesize that the value of ASI intervention in terms of adaptive motor function development is critical for premature infants.

5.2.3.2.3 Visual tactile integration

Without a significant difference found (p=1) between the pre-tests results of the two groups, with 33.33% (n=3) infants in the control group and 25% (n=2) infants in the experimental group that presented with at risk and 8.33% (n=1) infants in the experimental group with definite visual tactile integration difficulties the researcher was able to make reliable conclusions regarding the post-test results.

Scores falling in the at-risk range indicates suspect visual-tactile integration while scores falling in the deficient range indicate definite abnormalities. Individual items should be analysed for these infants to determine if tactile defensiveness or hypo-reactivity to touch persists for particular parts of the body (DeGangi & Greenspan, 1993:16).

If determined that an infant was tactile defensive or hypo-reactive to tactile input during the pre-tests, this aspect was addressed in terms of intervention aims for the intervention sessions of infants in the experimental group. Intervention for infants who presented with tactile defensiveness focused on the normalization of tactile deep pressure (cf. 5.2.3.1.2 and 5.2.3.2.1) in combination with encouragement on visual integration e.g. visual attentive lights and colours with tactile rubbery toys or material. Intervention for infants that presented with hypo-reactivity to touch was approached in terms of low thresholds through making all experiences more concentrated with sensory information (cf. 5.2.3.1.1).

Again the 33.33% (n=4) improvement of infants in the experimental group (cf. 4.3.2.3) in terms of Visual Tactile Integration illustrated in Figure 4.27, indicated that the ASI intervention had a positive effect on the Visual Tactile Integration of the infants in the experimental group. All infants in this group (100%, n=12) presented with normal visual tactile integration skills at the time of the post-test compared to the control group who's results indicated a slight increase in Visual Tactile integration difficulties (Figure 4.27).

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions in Figure 2.10 this is an indication that these infants improved in terms of their sensory registration and modulation, to have been able to attend to sensory stimuli and appropriately react through visually attending to the stimuli and perceiving the information to add meaning to it. The results of the control group, indicating a slight decrease in their visual tactile integration skills over a 10 week period, are cause for concern in terms of long term developmental outcomes for these infants.

5.2.3.2.4 Ocular motor control

The majority of infants in both groups presented with normal Ocular Motor Control at the time of the pre- and post-tests. Both groups also presented with improvement in terms of their results. The experimental group improved with 16.67% (n=2) which resulted in 100% of the infants falling within the normal range, the control group presented with an 8.33% (n=1) of infants that improved from the deficient range to the at risk range. Since both groups did not present with significant ocular motor control difficulties and both groups presented with improvement in terms of their results, ASI could not be singled out as the main reason for improvement of ocular motor control for the infants in the experimental group.

As with the other subtest scores of the TSFI, results falling in the at-risk range indicated suspect ocular-motor functions, while subtest scores in the deficient range indicated definite abnormal ocular-motor control functions. Infants who presents with ocular motor difficulties should be referred for further examination by a developmental optometrist or ophthalmologist (DeGangi & Greenspan, 1993:16).

Since careful consideration has been made in terms of in- and exclusion criteria (cf. 3.3) for the research sample with the help of an experienced pediatrician who screened all possible candidates referred from the High Risk Infant Clinic at Universitas Academic Hospital, no infants with known ocular motor difficulties as a result of additional complications to the premature birth were included in the study. The similar pre- and post-test results of the two groups in terms of ocular motor control strengthens the similarities and comparability of the two groups for reliable conclusions in term of the effectiveness of ASI intervention on other areas.

5.2.3.2.5 Reactivity to vestibular stimulation

Although there was not a significant statistical difference found between the pre- and post-test results of the two groups in terms of reactivity to vestibular stimulation, the control group presented with 83.33% (n=10) infants with normal vestibular processing compared to the 58.33% (n=7) infants in the experimental group. The control group presented with only 16.67% (n=2) infants that experienced vestibular processing difficulties compared to the 33.33% (n=4) infants in the experimental group within the deficient range and 8.33% (n=1) infants in the at risk range. These results indicated that the experimental group presented with more infants that experienced vestibular processing difficulties compared with the control group.

Scores falling in the at-risk range indicate suspect responses to movement in space while scores in the deficient range indicate abnormal reactivity to movement in space. Infants with definite deficiency on this subtest may be considered to be postural insecure and should normally be referred for therapeutic intervention with an occupational or physiotherapist. Evaluation of neuro-motor functions, especially righting and equilibrium reactions and muscle tone should be conducted to determine if other vestibular-based functions are affected (DeGangi & Greenspan, 1993:17).

Vestibular stimulation plays an important role in terms of normal CNS development (cf. 2.3.1) and therefore also in the approach to ASI intervention, therefore the researcher considered the relevant results of infants in the experimental group during the intervention planning of infants in the experimental group. Vestibular stimulation was facilitated with every intervention session of infants in the experimental group however the amount and type of stimulation provided were determined according to a child-centred approach and graded accordingly. For infants’ who experienced vestibular sensitivity, activities were graded accordingly and where appropriate the mother was asked to hold the infant on a moving surface instead of the infant been on his/her own or with the therapist holding the infant (ADDUNDUM E).

The significant improvement of infants in the experimental group (cf.4.3.2.5) in terms of reactivity to vestibular stimulation as illustrated in Figure 4.29, indicated that the ASI intervention had a positive effect on the vestibular processing of the infants that received the intervention. According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions in Figure 2.10 this is an indication that these infants improved in terms of their sensory registration and modulation, to have been able to tolerate vestibular input. The results of the control group that did not receive the ASI intervention presented with an 8.33% (n=1) decrease of infants from the normal range to the at risk range but also with a slight increase of 8.33% (n=1) infants whom improved from the deficient range to the at risk range. The value of ASI in terms of vestibular processing development was also noticeable.

5.2.3.2.6. Total scores

The total TSFI scores of infants in the experimental group showed a significant improvement (cf.4.3.2.6) from 8.33% (n=1) infants falling within the normal range at the time of the pre-tests to 100% (n=12) infants falling within the normal range at the time of the post-tests (Figure 4.30). The results of the infants in the control group however only showed an 8.33% (n=1) increase of infants falling in the normal range, their results in general presented a decrease with 8.33% (n=1) infants falling within the at-risk range and the majority of this group (58.33%, n=7) infants presenting with definite sensory function difficulties. These results clearly indicate that ASI intervention had a positive effect on the sensory reactivity and processing of premature infants over a short period 10 weeks.

Infants obtaining total scores within the at-risk or deficient ranges are indicative of potential problems, specifically suspect of abnormal sensory reactivity and processing. If an infant together with at-risk or deficient TSFI total scores, presents with motor or cognitive skills delays (e.g. the Bayley III Scales results) the infant most probably is suspect for abnormal neuro-motor functions, and/or the infant presents with characteristics of regulatory disorder. These infants should be considered at-risk and should ideally be referred to an occupational or physiotherapist to determine whether therapeutic intervention is indicated. Infants with deficient scores on the total test or particular subtest should ideally be monitored through the preschool years to assure that deficits in other areas of sensory integration such as motor planning, bilateral motor coordination or visual-motor skills do not occur (DeGangi & Greenspan, 1993:16).

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions in Figure 2.10 this is an indication that infants in the experimental group improved in terms of their sensory registration and modulation, which positively influenced their ability to discriminate and perceive sensory information. This enabled them to react in an appropriate discriminatory adaptive manner. The researcher therefore hypothesizes that this improvement positively affected the infants in the experimental groups' development in terms of motor skills, appropriate and organized behaviour, as well as motor actions relative to time and space.

5.2.3.3 The Bayley III Scales of Infant and Toddler Development

Through administration of the Bayley III Scales, the therapist is able to obtain a substantial amount of quantitative and qualitative information with which to compare the child to his or her peers. This assessment instrument is mainly used to identify infants and toddlers with developmental delay, to assist with intervention planning and is also suitable for research purposes (Bayley 2006a:6).

The Bayley III Scales of Infant and Toddler Development results will be discussed and interpreted in terms of the five main subtests namely Cognitive Scale, Language Scale, Motor Scale, Social-Emotional Scale and Adaptive-Motor Scale around The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions by A van Jaarsveld (2011). The subtests of the Bayley III Scales of Infant and Toddler Development listed above represents the end products of normal sensory integration as presented in Figure 2.10 as developmentally appropriate, organized behaviour and motor actions relative to time and space, at the top of the model. These include the ability to concentrate, academic learning abilities, capacity of abstract thought and reasoning, organizing behaviours, good self-esteem, self-control and self-confidence as well as specialization of each side of the body and the brain (van Jaarsveld, 2011:12). However, for an infant to reach these age appropriate end-products and to be able to participate meaningfully and developmentally appropriately in daily activities and occupations, the infant must first be able to register, modulate and discriminate sensory input adequately as discussed in previous sections.

5.2.3.3.1 Cognitive Scale

The experimental and control groups presented with similar Cognitive Scale standard score results during the pre-tests with mean standard scores of 7.58 and 7.42 respectively and a p-value of 0.88 indicating that there was not a significant statistical difference between the two groups as illustrated in Table 4.6 (cf. 4.3.3.1). With a p-value of 0.03, the post-test results did indicate a significant statistical difference between the two groups as illustrated in Table 4.7. The experimental group presented with a higher mean standard score of 10.50 compared with the mean standard score of the control group of 8.92. Although both the groups' presented with similar improvement in results (p=0.19) as illustrated in Table 4.8, the mean standard score improvement of infants in the experimental group of 2.92 was higher than the mean standard score improvement of infants in the control group of 1.50. The maximum standard score improvement of 11 of an infant in the experimental group was also found to be significantly higher than the maximum standard score improvement of an infant in the control group of only 5. Figure 4.31 illustrates the pre- and post-tests results of all 24 participants. When the graphs of the experimental and control groups were compared, only one infant in the experimental group presented with a slightly lower standard score during the post-test however, the control group presented with three infants that scored lower in terms of standard scores during the post-tests.

With consideration of all the above mentioned factors and the Model for Clinical Reasoning, the researcher concludes that although both groups presented with a general improvement in terms of Cognitive Scale standard scores over the 12 week period, the experimental group did indicate better improvement than the control group. The pre-tests results with no statistical difference between the experimental and control groups' cognitive abilities, strengthens the comparability of the two groups and relevance of the randomized selection for inclusion in the experimental and control groups. Therefore it is also reasonable to expect some improvement in terms of cognitive function over a period of 10 weeks with the infants in the control groups since, due to the in- and exclusion criteria no other factors or complications should have affected their cognitive abilities.

The pre-tests results with no statistical difference between the two groups' cognitive abilities strengthen the comparability of the two groups and relevance of the randomized selection of infants in the two groups. It is also reasonable to expect some improvement in terms of cognitive function over a period of 10 weeks (normal growth and development) with the infants in the control groups since due to the in- and exclusion criteria no other factors or complications should affect their cognitive abilities.

The researcher hypothesizes that the greater improvement in terms of cognitive standard score results of infants in the experimental group is the result of these infant's general improvement of sensory registration, improvement of modulation abilities to reach the optimal calm-alert state during activities which allowed them to present with improvement in terms of discrimination of sensory input, enabling them to add meaning to what they experienced and react adaptively.

The researcher therefore concludes that ASI intervention had a positive effect on the cognitive progress of the infants in the experimental group over a short period of 10 weeks and that if the study were performed over a slightly longer period as well as if the study population were bigger, a more significant statistical difference would have been found between the standard score results of the two groups.

5.2.3.3.2 Language Scale

The experimental group presented with significant improvements in terms of Receptive and Expressive Communication skills compared to the control group at the time of the post-tests.

In terms of Receptive Language, both groups presented with similar Receptive Language standard score results during the pre-tests with mean standard scores of 6.17 and 6.67 respectively and a p-value of 0.62 indicating that there was not a significant statistical difference between the two groups as illustrated in Table 4.10 (cf. 4.3.3.2.1). With a p-value of 0.02, the post-test results did indicate a significant statistical difference between the two groups as illustrated in Table 4.11. The experimental group presented with a higher mean standard score of 9.42 compared with the mean standard score of the control group of 7.17. The control group also presented with a much lower minimum standard score of 1.00 at the time of the post-test compared with the minimum score of 7.00 of the experimental group. The two groups' improvement presented in Table 4.12 indicated a significant statistical difference between the two groups with a p-value of 0.00, the mean standard score improvement of infants in the experimental group of 3.25 was significantly higher than the mean standard score improvement of infants in the control group of 0.50. Figure 4.32 illustrates the pre- and post-tests results of all 24 participants. When the graphs of the experimental and control groups are compared, the post-test standard scores of all infants in the experimental group presented with improvement compared to the post-test standard scores of infants in the control group that presented with a tendency to either remain the same or present with a decrease of value.

In terms of Expressive Language, both groups presented with similar Expressive Language standard score results during the pre-tests with mean standard scores of 8.08 and 9.00 respectively and a p-value of 0.27 indicating that there was not a significant statistical difference between the two groups as illustrated in Table 4.14 (cf. 4.3.3.2.2). With a p-value of 0.00, the post-test results did indicate a significant statistical difference between the two groups as illustrated in Table 4.15. The experimental group presented with a higher mean standard score of

10.67 compared with the mean standard score of the control group of 7.50. The control group also presented with a much lower minimum standard score of 4.00 at the time of the post-test compared with the minimum score of 9.00 of the experimental group. The two groups' improvement presented in Table 4.16 indicated a significant statistical difference between the two groups with a p-value of 0.00, the mean standard score improvement of infants in the experimental group of 2.58 was significantly higher than the mean standard score improvement of infants in the control group of -2.00. Figure 4.33 illustrates the pre- and post-tests results of all 24 participants. When the graphs of the experimental and control groups are compared, the post-test standard scores of all infants in the experimental group presented with significant improvement compared to the post-test standard scores of infants in the control group that presented with a strong tendency to decrease in value.

These results enabled the researcher to conclude that ASI intervention had significant positive effect on the Expressive Language development of the infants in the experimental group within a short period of 10 weeks intervention and that infants in the control group that did not receive ASI intervention regressed in terms of their Expressive Language skills.

Consequently the sum of Receptive and Expressive communication indicated a significant statistical difference between the improvement of the two groups with a p-value of <0.0001 with the experimental group that presented with a mean standard score improvement of 5.83 compared with a decrease in terms of mean standard score for the control group of -2.00 as illustrated in Table 4.20.

These results enabled the researcher to conclude that ASI intervention has a positive effect of language development of ELBW to VLBW premature infants within a short period of 10 weeks.

The researcher hypothesizes that the significant progress in terms of the Receptive and Expressive Language skills of infants in the experimental group is the result of these infant's improvement in auditory, vestibular and visual sensory registration. Their general improvement in terms of sensory modulation abilities enabled them to reach the optimal calm-alert state which allowed them to better pay attention, interact, observe and integrate sensory stimuli (discrimination of sensory input), enabling them to add meaning to what they experience and eventually allowing them to respond adequately through e.g. emotional expressions, copying sounds and indicating needs (appropriate adaptive responses), motor skills and praxis. This lead to developmentally appropriate, organized motor action relative to time and space as illustrated in the Model for Clinical Reasoning Figure 2.10.

The researcher therefore concludes that ASI intervention had a significant positive effect on the language development of the infants in the experimental group over a short period of 10 weeks.

5.2.3.3.3. Motor Scale

The Motor Scale will be discussed in terms of Fine Motor skills, Gross Motor Skills and the Sum of Fine and Gross Motor Skills improvement at the time of the post-tests.

FINE MOTOR

In terms of Fine Motor skills, both groups presented with similar Fine Motor standard score results during the pre-tests with mean standard scores of 2.62 and 3.18 respectively and a p-value of 0.63 indicating that there was not a significant statistical difference between the two groups as illustrated in Table 4.22 (cf. 4.3.3.3.1). With a p-value of 0.0026, the post-test results did indicate a significant statistical difference between the two groups as illustrated in Table 4.23. The experimental group presented with a significantly higher mean standard score of 12.08 compared with the mean standard score of the control group of 9.00. Although both groups presented with a minimum standard score of 7.00 at the time of the post-test the maximum score of 16.00 of the experimental group was significantly higher than the maximum standard score of the control group of 12.00. The two groups' improvement presented in Table 4.24 indicated a significant statistical difference between the two groups with a p-value of 0.01. The mean standard score improvement of infants in the experimental group of 3.25 was significantly higher than the mean standard score improvement of infants in the control group presenting with a decrease of -0.42. The maximum standard score improvement of an infant in the experimental group of 11 is also significantly higher than the maximum standard score improvement of an infant in the control group of 6. Figure 4.35 illustrates the pre- and post-tests results of all 24 participants. When the graphs of the experimental and control groups are compared, the post-test standard scores of all infants in the experimental group presented with improvements compared to the post-test standard scores of infants in the control group that presented with a tendency to either remain the same or decrease in value.

GROSS MOTOR

The Gross Motor Skills pre-tests of both groups presented with similar standard score results with mean standard scores of 6.00 and 6.83 respectively and a p-value of 0.53 indicating that there was not a significant statistical difference between the two groups as illustrated in Table 4.26 (cf. 4.3.3.3.2). With a p-value of 0.32, the post-test results also did not indicate a significant statistical difference between the two groups as illustrated in Table 4.27 with mean standard score of 9.42 and 8.08 respectively. The two groups' improvement presented in Table 4.28 did not indicate a significant statistical difference between the two groups with a p-value of 0.08, however when the minimum, maximum and mean scores of the two groups were compared, it seemed that the experimental group presented with meaningful higher improvement than the control group. The minimum standard score of the experimental group was 0.00, compared to the minimum standard score of the control group of -6.00. The mean standard score improvement of infants in the experimental group of 3.42 was also noticeably higher than the mean standard score improvement of infants in the control group of 1.25. Figure 4.36 illustrates the pre- and post-tests results of all 24 participants. When the graphs of the experimental and control groups are compared, the post-test standard scores of all infants in the experimental group presented with significant improvement compared to the post-test standard scores of infants in the control group that presented with a strong tendency to either decrease in value or remain the same.

SUM OF FINE AND GROSS MOTOR

The sum of Fine- and Gross Motor standard score results indicated a significant statistical difference between the improvement of the two groups with a p-value of 0.01. The experimental group presented with a mean standard score improvement of 6.67 compared with the mean standard score improvement for the control group of 0.92 as illustrated in Table 4.32.

With consideration of all the above mentioned factors, these results enabled the researcher to conclude that ASI intervention had a significant positive effect on the motor development of the infants in the experimental group especially fine motor skills of ELBW to VLBW premature infants within a short period of 10 weeks.

According to Jean Ayers' basic principles of child development (cf.2.4.1) and in consideration of The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunctions (Figure 2.10) the most important principle in child development is the process of organizing sensation in the nervous system and the greatest sensorimotor organization occurs during an adaptive response to sensation (cf. 2.4.1.1).

With consideration of the building blocks of child development (cf. 2.4.1.3), the inner drive of an infant used to develop sensory integration (cf. 2.4.1.2) and the fact that motor actions develop from head to toe (Table 2.3) the infant at three months with open hands already responds to tactile sensory information registered through a reflex grasping reaction (cf.2.4.1.3). This basic fine motor skill therefore already starts to develop before the infant has develop the basic vestibular-ocular postural control skills of balance reactions, postural responses when physically engaging in an activity, activation and co-activation of muscles during movement, maintaining an upright position against gravity and moving efficiently through space which only starts to develop between 6 – 12 months (cf. Van Jaarsveld, 2011:11).

It is therefore reasonable to expect fine motor skills to develop first and with a faster rate than gross motor skills for an infant within the first 12 months of development. Although both groups presented with a general improvement in terms of Gross motor skills over the 12 week period, the experimental group did indicate better improvement than the control group.

The researcher concludes that the better improvement in terms of gross motor standard score results of infants in the experimental group are the outcome of these infant's general improvement of sensory registration, improvement of modulation abilities to tolerate movement stimulation during activities and adapt their posture and motor actions accordingly. This allowed them to present with improvement in terms of vestibular and proprioceptive discrimination, improving their vestibular-ocular and postural-ocular skills and preparing them for better motor and praxis skills.

The researcher also hypothesizes that if the study were performed over a slightly longer period as well as if the study population were bigger, a more significant statistical difference would have been found between the gross motor standard score results of the two groups.

5.2.3.3.4 Socio-Emotional Scale

The experimental and control groups presented with similar Socio-Emotional standard score results during the pre-tests and post-tests. The two groups also presented with similar standard score improvement with mean standard score improvements of 2.67 and 2.33 respectively and a p-value of 0.81 indicating that there was not a statistical difference between the standard score improvement of the two groups as illustrated in Table 4.36 (cf. 4.3.3.4).

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunction by van Jaarsveld (Figure 2.10) skills assessed in the Socio-Emotional scale represents the end products at the top of the model namely, developmentally appropriate, organized behaviour and motor actions relative to time and space. These Socio-Emotional skills include the infants mastery of functional emotional skills namely self-regulation and interest in the world, communication needs, engaging others and establishing relationships, using emotions in an interactive purposeful manner and using emotional signals or gestures to solve problems (cf. 4.3.3..4).

The experimental group presented with significant improvement in terms of self-regulation in the use of self-soothing techniques (cf. 5.2.1.5.2), receptive and well as expressive communication skills (cf. 5.2.3.3.2) which included the infants interest in the world to communicate and interact with play, communication needs through engaging with mom and others and establishing relationships, using emotions in an interactive purposeful manner as well as using emotional signals or gestures to solve problems. These results therefore contradict the results of the Socio-Emotional subtest which did not indicate a significant statistical difference between the social-emotional progress of the two groups.

5.2.3.3.5 Adaptive Behaviour Scale

The experimental and control groups also presented with similar Adaptive Behaviour standard score results during the pre-tests and post-tests. Although a statistical difference was not found between the two groups standard score improvement with a p-value of 0.14, the mean standard score improvement of the experimental group of 4.42 were significantly higher the mean standard score improvement of the control group of -2.17, which presented with a decrease as illustrated in Table 4.40 (cf. 4.3.3.5).

According to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunction adapted by van Jaarsveld (Figure 2.10), skills assessed in the Adaptive Behaviour scale also represents the end products at the top of the model; developmentally appropriate, organized behaviour and motor actions relative to time and space, which implies that the infant should be able to participate meaningfully and developmentally appropriately in daily activities and occupations. These adaptive behaviour skills appropriate for the age group of the participants include the daily functional skills of the infant namely; communication (speech, language, listening and nonverbal communication), community use (interest in activities outside the home and recognition of different facilities), health and safety (showing caution and keeping out of physical danger), self-care (eating, toileting and bathing), self-direction (self-control, following directions and making choices), social (getting along with other people and recognizing emotions) and motor (locomotion and manipulation of the environment) (Bayley 2006:4).

Again the experimental group's significant improvement of self-regulation in terms of use of self-soothing techniques (cf. 5.2.1.5.2), receptive and well as expressive communication skills (cf. 5.2.3.3.2) which include the infants interest in the world to communicate and interact with play, communication needs through engaging with mom and others and establishing relationships, using emotions in an interactive purposeful manner as well as using emotional signals or gestures to solve problems, fine and gross motor skill and cognitive skills improvement supports the higher mean standard score improvement of the experimental group Table 4.40 (cf. 4.3.3.5) in terms of the Adaptive Behaviour Scale.

5.2.4 The Fidelity Measure

Parham *et al.* (2007:216) emphasized that the development of the Fidelity Measure has made a major contribution to protect the field of sensory integration that is strongly imbedded within the occupational therapy profession and has also contributed to know when research, articles, books etc. is about authentic sensory integration and when it is about techniques, intervention methods, programs etc. derived from the work of Jean Ayres but not pure sensory integration.

The outcomes of the Fidelity Measure conducted on the intervention sessions of this research study confirmed that ASI intervention has been implemented by the researcher during the 10 week intervention period of the study on the infants in the experimental group (cf. 4.4), and that the sessions met the criteria as stipulated for ASI intervention. According to these findings, the researcher therefore is able to conclude that the positive results in terms of the developmental outcomes of infants in the experimental group can be attributed to the ASI intervention the infants in this group received.

5.3 LIMITATIONS OF THE STUDY

Implementing ASI intervention on ELBW to VLBW premature infants was not only a complex process in terms of individual, child-centred intervention planning for each participant in the experimental group but the importance of involving parents in the intervention of their infants, the administration of three standardized assessments for each of the 24 participants pre- and post-tests, the logistical administration for parents to be able to attend weekly sessions and the strict in- and exclusion criteria (cf. 3.3.1 and 3.3.2) posed additional challenges.

The following limitations were identified:

- The larger study population would most probably have increased the statistical significance of the study results. Various factors contributed to the size of the study population (cf. 3.3) of 24 participants with 12 infants in the experimental group and 12 infants in the control group respectively, e.g. only one assessment therapist conducted the pre- and post-tests and the researcher implemented the ASI intervention which was necessary to eliminate measurement errors. This however placed a limitation on the number of participants that could be included due to the labour intensity of the study as well as limited funding available for the study. Another factor that affected the size of the study population was the number of infants referred from the High Risk Infant Clinic at Universitas Academic Hospital. The in- and exclusion criteria, also caused that all referred infants could not be included in the study.

- The study period of 12 weeks, with pre-tests in week one, implementation of intervention from week two – 11 and post-tests during week 12. Although the timeframe of ASI intervention for the infants in the experimental group has been thoroughly discussed and determined according to developmental stages of infants, it would have been valuable for the study if the implementation of the ASI intervention could have been implemented over a slightly longer period of 16 – 20 weeks. This however would have had other implications in terms of funding available as well as possible fall outs due to parents that would not have been able to commit to weekly sessions over such a long period.

- The population group from which the study sample was recruited mainly resorted in the lower socio-economic status. This aspect strengthened the comparability of the infants in both groups (cf. 5.2.1 and 5.2.2) and consequently the reliability of the study results. If however the same study could be implemented on ELBW TO VLBW premature infants resorting from a higher socio-economic group it would be valuable to compare the results of both studies.

- The study was limited to infants from Bloemfontein and close surroundings. Again this aspect strengthened the comparability of the infants in both groups (cf. 5.2.1 and 5.2.2) and consequently the reliability of the study results however only selecting ELBW to VLBW premature infants from one area does place a limitation on the study results in terms of generalizing the results and conclusions.

- Limited funding was available for the research.

- Although most infants in the experimental group has made significant progress, it would have benefitted some infants in this group as well as most infants in the control group to continue with weekly ASI intervention sessions after completion of the study. At risk infants in both groups were identified and followed-up at the High Risk Infant Clinic and also followed up for further occupational therapy intervention at Universitas Academic Hospital Occupational Therapy Department. This was unfortunately not practically feasible for all infants due to limited staffing and funding available. Parents of infants were also not able to commit to weekly sessions due to funding and transport limitations as well as work responsibilities.

- The home activities provided to the parents formed part of the ASI intervention as it is important to empower the parents to engage their child in activities that are according to their infant's sensory needs and will complement the intervention sessions as discussed in Chapter 3. The researcher recorded weekly feedback from parents however, it was not possible to formally assess the implementation of these activities since the researcher had to rely on the parents feedback in terms of activities.

5.4 SUMMARY

Through the discussion and interpretation of the study results presented in Chapter 4, the researcher was able to make valuable conclusions regarding each aspect assessed through the standardized assessments used in this study in terms of the effect of ASI intervention.

From these results it was evident that a short period of weekly ASI intervention sessions (in combination with appropriate home activities) had a significant positive effect on premature infants' sensory processing in terms of registration, modulation of sensory input and discrimination of the sensory input for use, therefore contributing to their ability to develop adequate skills for better general developmental progress. The limitations of the study was also identified and discussed.

Chapter 6 will discuss the conclusions, recommendations and value of the study.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

Chapter 5 interpreted the study results in terms of the comparison of the improvement of the two groups from the pre-tests to the post-tests as well as referring to relevant literature. Valuable conclusions have been made in terms of the effect of ASI intervention on the development of the study population over a short period of 10 weeks. In this Chapter the conclusion, recommendations and value of the study will be discussed.

6.2 CONCLUSIONS

The conclusions that can be made on the effect of ASI intervention on the developmental progress of the ELBW to VLBW premature infant between four and 12 months corrected ages in terms of sensory registration, processing and development of adequate skills for age appropriate organized behaviour and motor actions, will now be discussed according to the objectives of the study (cf.1.3.2). The conclusions are also discussed according to The Model for Clinical Reasoning on Possible Sensory Integration Difficulties and Dysfunction by van Jaarsveld (2011).

- The effect of ASI intervention on sensory registration, thresholds and self-regulation: The exposure of ELBW to VLBW premature infants from four to 12 months corrected ages to graded vestibular, tactile and proprioceptive input adjusted according to each individual infant's unique sensory threshold as determined by objective 1 (cf. 1.3.2.1), with additional visual, auditory and taste sensory input, as needed for motivation to activity participation, as well as additional and appropriate self-soothing methods as part of the home activities, has improved these infants' ability to modulate the sensory input appropriately and consequently adapting their arousal levels to sustain engagement in activities and behavioural emotions.

This has been determined by objective 3 (cf. 1.3.2.3). The results indicated that infants exposed to these intervention strategies improved significantly in terms of tactile (cf. 4.3.1.8, 4.3.2.1 and 4.3.2.2), vestibular (cf. 4.3.1.9, 4.3.2.4 and 4.3.2.4) and oral (cf. 4.3.1.10) sensory registration although auditory (cf. 4.3.1.6) and visual (cf. 4.3.1.7, 4.3.2.3 and 4.3.2.4) registration also indicated noticeable improvements. Infants with low neurological thresholds presented with less sensory sensitive (cf. 4.3.1.3) or avoiding (cf.4.3.1.4) behaviour and were able to sustain their engagement in activities for age appropriate learning and exploration. Although infants that presented with low registration behaviour as a result of high neurological thresholds were more alert and able to sustain engagement in activities for learning, infants sensation seeking behaviour increased.

- The effect of ASI intervention on sensory discrimination and perception for skill development: The exposure of ELBW to VLBW premature infants from four to 12 months (corrected ages) to graded vestibular, tactile and proprioceptive input with additional visual, auditory and taste sensory input, as needed for motivation to activity participation, as well as additional and appropriate self-soothing methods as part of the home activities, had a positive impact on the sensory processing of these infants.

  These infants were now able to interpret the qualities of the sensory input and add meaning to it by forming perceptions. Through being exposed to the graded variety of sensory input these infants were able to use past experiences and memories gained in the ASI intervention sessions and form associations about the spatial and temporal qualities of what he/she experiences and then act on it (cf. 2.4). This has been determined by objective 3 (cf. 1.3.2.3). The results indicated that infants exposed to these intervention strategies improved significantly in terms of Adaptive Motor Functions (cf. 4.3.2.2), Visual Tactile Integration (cf. 4.3.2.3), Reactivity to Vestibular Stimulation (cf. 4.3.2.5) and General Progress in terms of Sensory Function (cf. 4.3.2.6).

- The effect of ASI intervention of developmentally appropriate, organized behaviour and motor actions relative to time and space in terms of cognitive, language, motor, socio-emotional and adaptive behaviour developmental skills: Infants exposed to ASI intervention improved significantly in terms of Receptive and Expressive communication (cf. 4.3.3.2) and Fine Motor Skills (cf. 4.3.3.3.1) however a noticeable improvement were also found in terms of Gross Motor skills (cf. 4.3.3.2, Table 4.27), Cognitive skills (cf. 4.3.3.1, Table 4.6) and Adaptive Behaviour skills (cf. 4.3.3.5).

6.3 RECOMMENDATIONS

In the light of the positive outcomes of the study, the researcher has made the following recommendations:

- ASI intervention should be considered as essential as part of the post-discharge occupational therapy approach for ELBW to VLBW premature infants for the first year of development since sensory processing plays such an integral role in the normal development of infants. Premature infants, with their immature CNS, especially benefits from the correct approach in terms of their neurological thresholds. Thereafter, infants could be re-assessed as recommended to determine if further intervention is needed or if only regular follow-up visits would be necessary to monitor the infants' progress.

- Parents should already be involved in their infant's progress in the NICU as part of the intervention programme, and information regarding sensory thresholds and infant's stress cues should be explained continuously during pre- and post-discharge intervention sessions. How to adapt or stop activities accordingly should be explained. It is important that parents realize the importance and benefits of ASI intervention on their infants developmental progress since the impact of ASI intervention is strengthened through implementation of appropriate sensory based activities at home during everyday tasks.

- Follow-up research on the long term effect of the sensory integration intervention on this population would be recommended at possibly 18 months, 24 months and 3 years.

- Further research in the field of sensory integration intervention with infants are recommended in terms of specifically the effect of sensory integration intervention on the infant with regulatory disorders, sleeping difficulties and specific sensory disorders e.g. sensory sensitivity or dormancy.

6.4 VALUE OF THE STUDY

The results of this study added value in terms of the following:

- The intervention approach of ELBW to VLBW premature infants in terms of their long-term developmental outcomes: from the review of relevant research it was evident that previous research has focused on intervention approaches with premature infants within the NICU as well as the effect of prematurity on developmental outcomes of school age children, however, research in terms of appropriate and effective early intervention to prevent further developmental delays and learning difficulties was limited.

- This study has indicated specific areas of developmental improvement and functional skills of premature infants as well as identified that a lack of intervention does not only prevent developmental progress but also indicates a tendency to regress.

- Various research studies has been done on ASI intervention on older children with various diagnoses, disorders, learning difficulties etc. however previous research could not be found by the researcher on the effect of ASI on the development of the premature infant.

- The positive outcomes of this research indicated that ASI intervention is an appropriate approach in helping premature infants to reach their developmental milestones and overcome developmental difficulties.

- The researcher is now able to recommend suitable and safe principles for sensory integration intervention with premature infants.

- Therapists can provide parents with guidelines in terms of suitable stimulation for their infants that is complementary and supportive of ASI intervention.

- The researcher is able to recommend preventative measures for intervention with premature infants especially in terms of over- and under stimulation.

- The results of this research strengthened the risk for premature infants in terms of optimal development without intervention.

- The findings of the study will be able to create awareness amongst health professionals working with premature infants in terms of the importance of ASI intervention on the development of premature infants.

6.5 OVERALL CONCLUSION

Since most of the tests presented statistically significant results the researcher was able to make valuable conclusions regarding the effect of ASI intervention on the development of premature infants as well as make recommendations in terms of appropriate sensory stimuli to promote adaptive responses in infants for optimal developmental progress.

The results indicated that early ASI intervention for premature infants is a necessity for optimal cognitive, language, motor and adaptive motor development. Although the Bayley assessment results contradicted socio-emotional progress as a result of ASI intervention, the other test results in terms of self-regulation, receptive and expressive communication as well as adaptive behaviour components indicated that infants exposed to ASI intervention made good progress in terms of social emotional skills.

The literature discussion in terms of the development of the premature infant has again brought attention on the possible developmental difficulties and delays premature infants struggle with and the long term implications the premature birth as well as NICU environment could have on these infants long term development. This study has therefore confirmed the important role of the sensory integration trained occupational therapist not only in terms of a sensory friendly environment within the NICU, but also the utmost importance of early ASI intervention post-discharge and within the first year of development.

The study results did not only indicate the importance of ASI intervention for better developmental outcomes of these infants, but also revealed that a lack of ASI intervention leads to a deterioration of developmental and behavioural outcomes.

Although limitations were identified in this study, the study added value to the profession of occupational therapy and specifically occupational therapists trained in sensory integration since the conclusions made revealed valuable information regarding the effect of ASI intervention in terms of early intervention for premature infants. The findings of this study illustrated that ASI intervention is essential in the intervention approach with premature infants and their parents.

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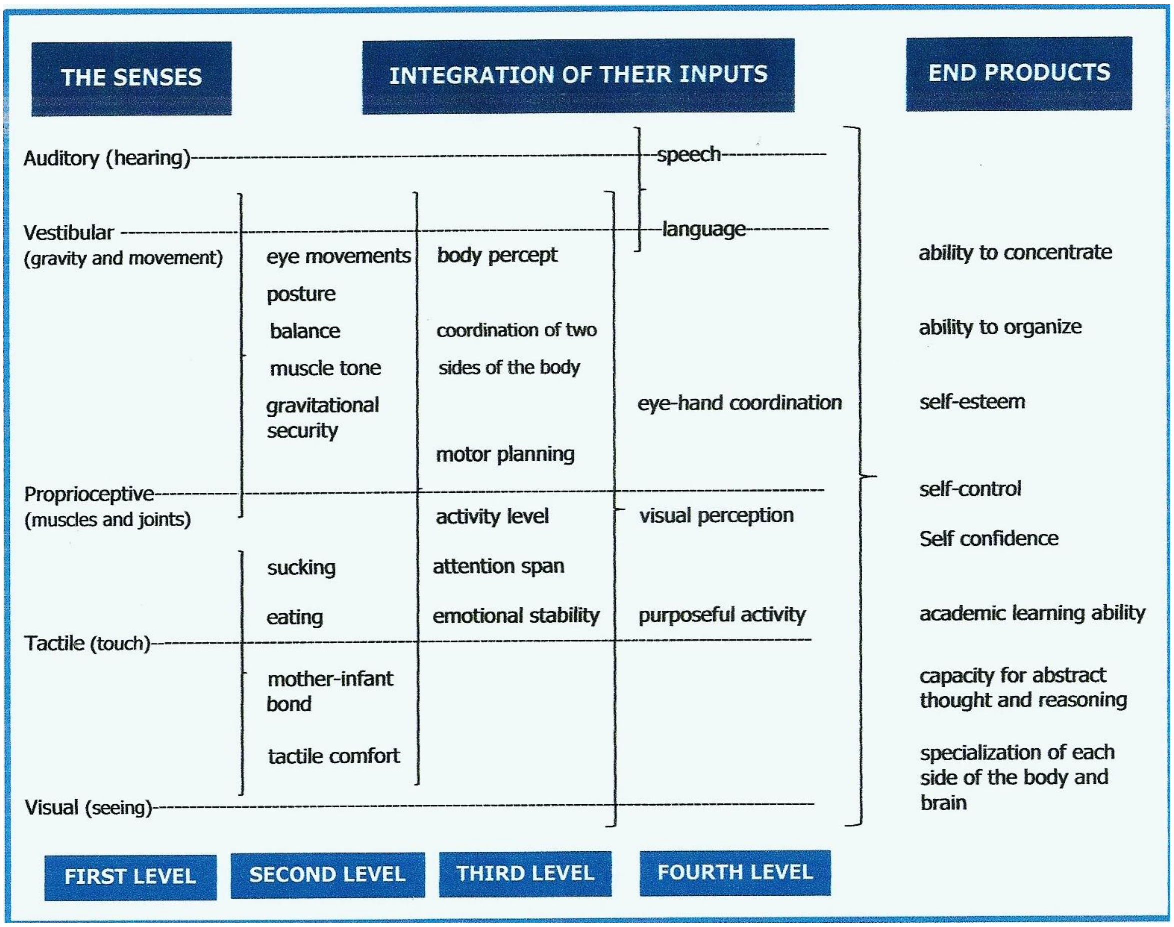
ADDENDUM A

THE PROCESS OF SENSORY INTEGRATION: FOUR LEVELS

Ayres, A.J., 2008. *Sensory Integration and the Child, Understanding Hidden Sensory Challenges*. 25th Anniversary ed. Los Angeles: Western Psychological Services.



THE PROCESS OF SENSORY INTEGRATION (Ayers, 2008:55)

ADDENDUM B

DATA COLLECTION SHEET FROM MEDICAL FILES

and

NEONATAL FOLLOW-UP CLINIC DATA SHEET

(Used by experienced Pediatrician to select possible participants from the High Risk Infant Clinic, according to inclusion and exclusion criteria)

DATA COLLECTION (Meditec/Medical file): CONFIDENTIAL INFORMATION TO BE USED FOR INCLUSION AND EXCLUSION CRITERIA AS WELL AS ADMINISTRATION PURPOSES

Information gathered by__________________________________ **Date**_________________

CODING		**DOB**		**AGE** (Gest.)	
		BIRTH WEIGHT		**AGE** (Corr.)	
PARENT (Mother)		**OCCUPATION**		**TEL**	h/w: cell:
PARENT (Father)		**OCCUPATION**		**TEL**	h/w: cell:

BACKGROUND INFORMATION				
Parents	Married	Divorced	Single/Separated	Other:
Siblings				
Other info				

PREGNANCY HISTORY

BIRTH HISTORY			
Birth weight		APGAR	
Birth: Normal/breech/assisted (forceps)/emergency Caesar?			
Any complications during birth?			
Other information?			
Practiced Kangaroo Care? If yes, for how long?			
Breastfed? If yes, for how long?			
Room density (home environment)?			

MEDICAL HISTORY (Any additional diagnosis/illnesses)

NEONATAL FOLLOW-UP CLINIC

NAME: DATE OF BIRTH:

AGE: CORRECTED AGE:

SOCIAL BACKGROUND:

PREGNANCY AND PERINATAL COURSE:

Pregnancy:

Birth mass: Length: HC:

ROP screen: Hearing Screen:

Complications/Risk Factors:

Ventilation	8-28 days > 28 days	☐ ☐
pH	< 7,0 or < 7,15 > 1 hour Cardiopulmonary arrest	☐ ☐
Seizures	Not controlled on 1 drug Status epilepticus > 12 hours	☐ ☐
IVH	Blood in ventricles Intraparenchymal blood	☐ ☐
PVL	Definite (resolved Cysts/atrophy	☐ ☐
Infection	Septic shock Meningitis	☐ ☐
Hypoglycemia	Symptomatic < 24 h > 24 h	☐ ☐

Feeding/supplements:

Immunizations:

History:

ON EXAMINATION:

Mass: Length: HC:

Vision: Hips:

Hearing:

Systems:

Development:

Neurodevelopmental Assessment score/ Bayley screen

High risk

Medium risk

Low risk

Assessment:

Plan:

Follow-up:

ADDENDUM C

- CODED PARENT QUESTIONNAIRE
- CODED PRE-TEST DATA COLLECTION SHEETS
- CODED POST-TEST DATA COLLECTION SHEETS

SENSORY INTEGRATION AND THE DEVELOPMENT OF THE EXTREMELY LOW BIRTH WEIGHT PREMATURE INFANT

PARENT QUESTIONNAIRE

Instructions:

Mark the appropriate block with a X or write your answer in the space provided.

For Office Use

[ ][ ][ ] 1-3

1 Date questionnaire is completed (dd/mm/yy) ____/____/_____ — [ ][ ][ ][ ][ ][ ] 4-9 (d d m m y y)

2 Date of Birth - participant (dd/mm/yy) ____/____/_____ — [ ][ ][ ][ ][ ][ ] 10-15 (d d m m y y)

3 Chronological Age ____________ M.D — [ ][ ][ ][ ] 16-19 (m m d d)

4 Gestational Age ____________ Weeks — [ ][ ] 20-21

5 Corrected Age ____________ M:D — [ ][ ][ ][ ] 22-25 (m m d d)

6 Birth Weight ____________ g — [ ][ ][ ][ ] 26-29 (m m d d)

PARENT INFORMATION

7 What is your relation to the study participant? — [ ] 30
- 1 Mother
- 2 Father
- 3 Other, please specify. ____

8 Mother's age? ____________________ Years — [ ][ ] 31-32

9 Mother's Date of Birth? ___/___/___ (dd/mm/yy) — [ ][ ][ ][ ][ ][ ] 33-38 (d d m m y y)

10 Father's age? ________________________Years — [ ][ ] 39-40

11 Father's Date of Birth' ___/___/___ (dd/mm/yy) — [ ][ ][ ][ ][ ][ ] 41-46 (d d m m y y)

12 What is your marital status? — [ ] 47
- 1 Unmarried/living together
- 2 Married/Traditional marriage
- 3 Divorced/Separated
- 4 Widow/Widower
- 5 Single parent

13 What is your home language?
- [ ] Afrikaans — [ ] 48
- [ ] English — [ ] 49
- [ ] Sotho — [ ] 50
- [ ] Tswana — [ ] 51
- [ ] Xhosa — [ ] 52
- [ ] Zulu — [ ] 53
- [ ] Other, specify. ____ — [ ] 54

14 Mother's occupation? — [ ] 55
- 1 Not working
- 2 Unqualified/Casual ____
- 3 Qualified/Professional ____

15 Mother's highest qualification? — [ ][ ][ ] 56-58
- 1 No Scooling
- 2 School grade [ ][ ]
- 3 Matric
- 4 University/College
- 5 Other (Please spesify.)____

SENSORY INTEGRATION AND THE DEVELOPMENT OF THE EXTREMELY LOW BIRTH WEIGHT PREMATURE INFANT

16 Father's occupation? [ ] 59
- 1 Not working
- 2 Unqualified/Casual ______________________
- 3 Qualified/Professional ______________________

17 Father's highest qualification? [ ][ ][ ] 60-62
- 1 No Scooling
- 2 Grade [ ][ ]
- 3 Matric
- 4 University/College
- 5 Other (Please spesify.) ______________________

18 Do you have any knowledge on:
- 1 How to stimulate your baby to encourage his/her development? [ ] 63
- 2 Sensory intergration? [ ] 64
- 3 None? [ ] 65

19 How many siblings? [ ][ ] [ ][ ] 66-67

PRENATAL AND BIRTH HISTORY

Pregnancy

20 Was your pregnancy…? [ ] 68
- 1 planned
- 2 unplanned

21 Was this your first pregnancy? [ ] 69
- 1 yes
- 2 no

22 Have you suffered any losses? [ ] 70
- 1 yes
- 2 no

If yes, please specify. ______________________

23 Did you attend clinics for prenatal care? [ ] 71
- 1 yes
- 2 no

24 Did you experience any complications during your pregnancy? [ ] 72
- 1 yes
- 2 no

If yes, please specify.

______________________ [ ][ ] 73-74

______________________ [ ][ ] 75-76

25 Did you suffer from headaches during your pregnancy? [ ] 77
- 1 yes
- 2 no

26 Did you take any of the following during your pregnancy?
- [ ] Alcohol/Drugs [ ] 78
- [ ] Medication Please specify: ______________________ [ ][ ] 79-80
- [ ] None [ ] 1

Birth and Post-natal History

27 APGAR Scores? (out of ten)
- After 1 minute [ ][ ] [ ][ ] 2-3
- After 5 minutes [ ][ ] [ ][ ] 4-5
- After 10 minutes [ ][ ] [ ][ ] 6-7

28 Was the delivery…..? [ ] 8
- 1 Natural (Early)
- 2 Emergency Ceasar

29 Reason for premature birth? ☐ 9
- 1 Preeclampsia (High blood pressure)
- 2 Antepartum hemorrhage
- 3 Uterine abnormalities
- 4 Hydramnios (excess of amniotic fluid around the fetus)
- 5 Placenta Previa
- 6 Twins/multiples
- 7 Other, please specify. ______________________________
- 8 Don't know

30 Any Complications during birth? ☐ 10
- 1 yes
- 2 no

If yes, please specify.
______________________________ ☐☐ 11-12
______________________________ ☐☐ 13-14

31 Did your baby cry immediately after delivery? ☐ 15
- 1 yes
- 2 no
- 3 Don’t know

32 Were there any breathing problems after delivery? ☐ 16
- 1 yes
- 2 no

33 Except for prematurity, where there any other problems noted at birth? I ☐ 17
- 1 yes
- 2 no

If yes, please specify.
______________________________ ☐☐ 18-19
______________________________ ☐☐ 20-21

34 Did your baby have difficulty with sucking or swallowing? ☐ 22
- 1 yes
- 2 no

35 Did your baby have difficulty settling into a routine? ☐ 23
- 1 yes
- 2 no

36 Did you experience "baby blues" after the birth? ☐ 24
- 1 yes
- 2 no

37 Are you breastfeeding your baby? ☐ 25
- 1 Yes
- 2 No
- 3 Past

38 Does your baby suffer from reflux? ☐ 26
- 1 Yes
- 2 No
- 3 Past

39 Does your baby make use of the following methods for self-soothing? ☐ 27
- 1 Dummy
- 2 Sucking his/her fingers
- 3 Both
- 4 None of the above
- 5 Other? Please specify: ______________________ ☐ 28

40 Did you Kangaroo-mother care your baby
- 1 Yes If Yes, for how long (weeks) ☐☐ ☐☐☐ 29-31
- 2 No

SENSORY INTEGRATION AND THE DEVELOPMENT OF THE EXTREMELY LOW BIRTH WEIGHT PREMATURE INFANT

Developmental Milestones

41 Does your baby Roll over? — 32
- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)* — 33-34

____

42 Does your baby sit without support? — 35
- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)* — 36-37

____

43 Does your baby crawl on all fours? — 38
- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)* — 39-40

____

44 Does your baby walk unaided? — 41
- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)* — 42-43

____

45 Does your baby smile? — 44
- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)* — 45-46

____

46 Does your baby babble? — 47
- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)* — 48-49

____

47 First words spoken? — 50
- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)* — 51-52

____

Medical History

48 Has your baby suffered any illnesses?
- [ ] Meningitis/Encephalitis — 53
- [ ] High tempreture — 54
- [ ] Convulsions — 55
- [ ] Allergies — 56
- [ ] Sinusitis — 57
- [ ] Asthma — 58
- [ ] Ottis media (ear infections) — 59
- [ ] Tonsilitis — 60
- [ ] Head injury — 61
- [ ] Operations — 62
- [ ] Other, please specify ______________________ — 63

49 How long and how many times has your child been hospitalised?

Weeks? [|] — 64-65

How many times? [|] — 66-67

Reasons for subsequent admissions to hospital if any? ____________ — 68-69

Self-Calming

50 What methods do you use to calm your baby?

☐	Rocking	☐ 70
☐	Feeding	☐ 71
☐	Leave your baby to cry it out	☐ 72
☐	Singing	☐ 73
☐	Push in a pram/stroller	☐ 74
☐	Give your baby to someone else	☐ 75
☐	Dummy/pacifier	☐ 76
☐	Swaddling/wrapping lightly	☐ 77
☐	Carrying in sling/pouch	☐ 78
☐	Take a walk/ride in the car	☐ 79
☐	Distracting baby with obile/toy	☐ 80
☐	Put baby with you in bed	☐ 1
☐	Other, please specify ____________________	☐ 2

51 Are your baby's sleep patterns irregular? ☐ 3

1 Yes
2 No
3 Past

52 Is it difficult to get him/her to sleep? ☐ 4

1 Yes
2 No
3 Past

53 Does your baby have a structured sleep/wake routine? ☐ 5

1 Yes
2 No

Mood

54 Would you describe your baby as fussy? ☐ 6

1 Yes
2 No
3 Past

55 How many hours during the day does your baby fuss or cry? ☐ 7

1 Less than an hour
2 1-3 hours
3 3-5 hours
4 More than 5 hours

56 Are there any factors affecting your child emotionally? ☐ 8

1 Yes
2 No

If yes, please specify.

____________________ ☐☐ 9-10

ADDITIONAL CODING - PARENT QUESTIONNAIRE

13	Home language - Other	1	Bangali
24	Complications during pregnancy	1	Mother diabetic during pregnancy
		2	High blood pressure
		3	Carried baby very small
26	Medication used during pregnancy	1	ARV's
		2	High blood pressure meds
30	Complications during birth	1	Prolonged birth
		2	High blood pressure
		3	Blood transfusion - baby
		4	Prolonged contractures - 1 week prior to birth
33	Problems noted at birth	1	Eyes - blood vessels?
		2	Intestine problems
50	Calming techniques - Other:	1	Breastfeeding
56	Factors that affects baby emotionally?	1	Fighting with father

ADDITIONAL CODING - Post-test parent questionnaire

89	Self-soothing/Calming techniques - Other:	1	Baby Sense Taglet
		2	Breastfeeding
		3	Mom holding baby and singing

PRE-TEST DATA

Instructions:

Mark the appropriate block with a X

For Office Use [ ][ ][ ] 1-3

INFANT/TODDLER SENSORY PROFILE Winnie Dunn

								For Office Use	
Low Registration									
1	Raw Score	[ ]						[ ][ ]	4-5
2	Birth to 3 months		2 65-49	3 48-39	4 38-13				
	4 - 6 months		2 65-52	3 51-42	4 41-13			[ ]	6
	7-36 months		2 55	3 54-46	4 45-43	5 42-11			
Sensation Seeking									
3	Raw Score	[ ]						[ ][ ]	7-8
4	Birth to 6 months		2 30-16	3 15-7	4 6				
	7 - 12 months	1 70-44	2 43-36	3 35-19	4 18-14			[ ]	9
Sensory Sensitivity									
5	Raw Score	[ ]						[ ][ ]	10-11
6	Birth to 6 months		2 60-58	3 57-45	4 44-12				
	7-36 months		2 55-53	3 52-41	4 40-36	5 35-11		[ ]	12
Sensation Avoiding									
7	Raw Score	[ ]						[ ][ ]	13-14
8	Birth to 6 months			3 25-19	4 18-5				
	7-36 months		2 60-57	3 56-45	4 44-39	5 38-12		[ ]	15
Low Threshold									
9	Raw Score	[ ]						[ ][ ][ ]	16-18
10	Birth to 6 months		2 85-82	3 81-64	4 63-17				
	7-36 months		2 115-108	3 107-87	4 86-77	5 76-23		[ ]	19

Infant/Toddler Sensory Profile - Sensory processing (only 7 - 36 months)

								For Office Use	
General processing									
	No section raw score								
Auditory Processing									
11	Raw Score	[ ]						[ ][ ]	20-21
12	7-36 months	1 50-49	2 47-44	3 43-35	4 34-31	5 30-10		[ ]	22
Visual Processing									
13	Raw Score	[ ]						[ ][ ]	23-24
14	7-36 months	1 35-32	2 31-28	3 27-20	4 19-16	5 15-7		[ ]	25
Tactile Processing									
15	Raw Score	[ ]						[ ][ ]	26-27
16	7-24 months	1 75-68	2 67-62	3 61-48	4 47-42	5 41-15		[ ]	28
Vestibular Processing									
17	Raw Score	[ ]						[ ][ ]	29-30
18	7-36 months	1 30-27	2 28-24	3 23-18	4 17-15	5 14-6		[ ]	31

	Oral Sensory Processing							
19	Raw Score	[ ]					[ ][ ]	32-33
20	7-12 months	1 35-33	2 32-30	3 29-21	4 20-17	5 16-7	[ ]	34
TSFI - TEST OF SENSORY FUNCTION IN INFANTS								
	Reactivity to Tactile Deep Pressure							
21	Raw Score	[ ]					[ ][ ]	35-36
22	4-18 months	1 9-10	2 8	3 0-7			[ ]	37
	Adapive Motor Functions							
23	Raw Score	[ ]					[ ][ ]	38-39
24	4-6 months	1 7-15	2 6	3 0-5			[ ]	40
	7-9 months	1 11-15	2 10	3 0-9				
	10-12 months	1 14-15	2 13	3 0-12				
	Visual Tactile Integration							
25	Raw Score	[ ]					[ ][ ]	41-42
26	4-6 months	1 4-10	2 3	3 0-2			[ ]	43
	7-18 months	1 9-10	2 7-8	3 0-6				
	Occular Motor Control							
27	Raw Score	[ ]					[ ][ ]	44-45
28	4-6 months	1 1-2	2	3 0			[ ]	46
	7-18 months	1 2	2 1	3 0				
	Reactivity to Vestibular Stimulation							
29	Raw Score	[ ]					[ ][ ]	47-48
30	4-12 months	1 10-12	2 9	3 0-8			[ ]	49
	Total							
31	Raw Score	[ ]					[ ][ ]	50-51
32	4-6 months	1 49-33	2 32-30	3 29-0			[ ]	52
	7-9 months	1 49-41	2 40-38	3 37-0				
	10-18 months	1 49-44	2 43-41	3 40-0				
BAYLEY SCALES OF NFANT AND TODDLER DEVELOPMENT (Third Edition)								
	COGNITIVE							
33	Raw Score	[ ]					[ ][ ]	53-54
34	Scaled Score	[ ]					[ ][ ]	55-56
35	Composite Score	[ ]					[ ][ ][ ]	57-59
36	Percentile Rank	[ ]					[ ][ ][ ]	60-62
37	Conf. Interval	[ ] 90%					[ ][ ][ ][ ][ ][ ]	63-68
		[ ] 95%					[ ][ ][ ][ ][ ][ ]	69-74
	LANGUAGE							
	Receptive Communication							
38	Raw Score	[ ]					[ ][ ]	75-76
39	Scaled Score	[ ]					[ ][ ]	77-78

	Expressive Communication		
40	Raw Score		79-80
41	Scaled Score		1-2
	Sum (Receptive and Expressive Communication)		
42	Scaled Score		3-4
43	Composite Score		5-6
44	Percentile Rank		7-9
45	Conf. Interval	90%	10-15
		95%	16-21
	MOTOR		
	Fine Motor		
46	Raw Score		22-23
47	Scaled Score		24-25
	Gross Motor		
48	Raw Score		26-27
49	Scaled Score		28-29
	Sum (Fine and Gross Motor)		
50	Scaled Score		30-31
51	Composite Score		32-34
52	Percentile Rank		35-37
53	Conf. Interval	90%	38-43
		95%	44-49
	SOCIAL-EMOTIONAL		
54	Raw Score		50-51
55	Scaled Score		52-53
56	Composite Score		54-55
57	Percentile Rank		56-58
58	Conf. Interval	90%	59-64
		95%	65-70
	ADAPTIVE BEHAVIOUR		
	Communication (Com) *		
59	Raw Score		71-72
60	Scaled Score		73-74
	Health and Safety (HS) *		
61	Raw Score		75-76
62	Scaled Score		77-78

	Leisure (LS)*			
63	Raw Score			79-80
64	Scaled Score			1-2
	Self-Care (SC) *			
65	Raw Score			3-4
66	Scaled Score			5-6
	Self-Direction (SD) *			
67	Raw Score			7-8
68	Scaled Score			9-10
	Social (Soc) *			
69	Raw Score			11-12
70	Scaled Score			13-14
	Motor (MO) *			
71	Raw Score			15-16
72	Scaled Score			17-18
	Sum Adaptive Behaviour Components			
73	Scaled Score			19-20
74	Composite Score			21-22
75	Percentile Rank			23-25
76	Conf. Interval		90%	26-27
			95%	28-29

SENSORY INTEGRATION AND THE DEVELOPMENT OF THEEXTREMELY LOW BIRTH WEIGHT PREMATURE INFANT

POST-TEST DATA

Instructions:

Mark the appropriate block with a X

For Office Use [ ][ ][ ] 1-3

								For Office Use
INFANT/TODDLER SENSORY PROFILE Winnie Dunn								
	Low Registration							
1	Raw Score	[ ]						[ ][ ] 4-5
2	Birth to 3 months			2 65-49	3 48-39	4 38-13		
	4 - 6 months			2 65-52	3 51-42	4 41-13		[ ] 6
	7-36 months			2 55	3 54-46	4 45-43	5 42-11	
	Sensation Seeking							
3	Raw Score	[ ]						[ ][ ] 7-8
4	Birth to 6 months			2 30-16	3 15-7	4 6		
	7 - 12 months		1 70-44	2 43-36	3 35-19	4 18-14		[ ] 9
	Sensory Sensitivity							
5	Raw Score	[ ]						[ ][ ] 10-11
6	Birth to 6 months			2 60-58	3 57-45	4 44-12		
	7-36 months			2 55-53	3 52-41	4 40-36	5 35-11	[ ] 12
	Sensation Avoiding							
7	Raw Score	[ ]						[ ][ ] 13-14
8	Birth to 6 months				3 25-19	4 18-5		
	7-36 months			2 60-57	3 56-45	4 44-39	5 38-12	[ ] 15
	Low Threshold							
9	Raw Score	[ ]						[ ][ ][ ] 16-18
10	Birth to 6 months			2 85-82	3 81-64	4 63-17		
	7-36 months			2 115-108	3 107-87	4 86-77	5 76-23	[ ] 19
Infant/Toddler Sensory Profile - Sensory processing (only 7 - 36 months)								
	General processing							
	No section raw score							
	Auditory Processing							
11	Raw Score	[ ]						[ ][ ] 20-21
12	7-36 months		1 50-49	2 47-44	3 43-35	4 34-31	5 30-10	[ ] 22
	Visual Processing							
13	Raw Score	[ ]						[ ][ ] 23-24
14	7-36 months		1 35-32	2 31-28	3 27-20	4 19-16	5 15-7	[ ] 25

Tactile Processing

15	Raw Score						26-27
16	7-24 months	1 75-68	2 67-62	3 61-48	4 47-42	5 41-15	28

Vestibular Processing

17	Raw Score						29-30
18	7-36 months	1 30-27	2 28-24	3 23-18	4 17-15	5 14-6	31

Oral Sensory Processing

19	Raw Score						32-33
20	7-12 months	1 35-33	2 32-30	3 29-21	4 20-17	5 16-7	34

TSFI - TEST OF SENSORY FUNCTION IN INFANTS

Reactivity to Tactile Deep Pressure

21	Raw Score				35-36
22	4-18 months	1 9-10	2 8	3 0-7	37

Adapive Motor Functions

23	Raw Score				38-39
24	4-6 months	1 7-15	2 6	3 0-5	40
	7-9 months	1 11-15	2 10	3 0-9	
	10-12 months	1 14-15	2 13	3 0-12	

Visual Tactile Integration

25	Raw Score				41-42
26	4-6 months	1 4-10	2 3	3 0-2	43
	7-18 months	1 9-10	2 7-8	3 0-6	

Occular Motor Control

27	Raw Score				44-45
28	4-6 months	1 1-2	2	3 0	46
	7-18 months	1 2	2 1	3 0	

Reactivity to Vestibular Stimulation

29	Raw Score				47-48
30	4-12 months	1 10-12	2 9	3 0-8	49

Total

31	Raw Score				50-51
32	4-6 months	1 49-33	2 32-30	3 29-0	52
	7-9 months	1 49-41	2 40-38	3 37-0	
	10-18 months	1 49-44	2 43-41	3 40-0	

BAYLEY SCALES OF NFANT AND TODDLER DEVELOPMENT (Third Edition)

COGNITIVE			
33 Raw Score			53-54
34 Scaled Score			55-56
35 Composite Score			57-59
36 Percentile Rank			60-62
37 Conf. Interval		90%	63-68
		95%	69-74
LANGUAGE			
Receptive Communication			
38 Raw Score			75-76
39 Scaled Score			77-78
Expressive Communication			
40 Raw Score			79-80
41 Scaled Score			1-2
Sum (Receptive and Expressive Communication)			
42 Scaled Score			3-4
43 Composite Score			5-6
44 Percentile Rank			7-9
45 Conf. Interval		90%	10-15
		95%	16-21
MOTOR			
Fine Motor			
46 Raw Score			22-23
47 Scaled Score			24-25
Gross Motor			
48 Raw Score			26-27
49 Scaled Score			28-29
Sum (Fine and Gross Motor)			
50 Scaled Score			30-31
51 Composite Score			32-34
52 Percentile Rank			35-37
53 Conf. Interval		90%	38-43
		95%	44-49

SOCIAL-EMOTIONAL			
54	Raw Score		50-51
55	Scaled Score		52-53
56	Composite Score		54-55
57	Percentile Rank		56-58
58	Conf. Interval	90%	59-64
		95%	65-70
ADAPTIVE BEHAVIOUR			
Communication (Com) *			
59	Raw Score		71-72
60	Scaled Score		73-74
Health and Safety (HS) *			
61	Raw Score		75-76
62	Scaled Score		77-78
Leisure (LS)*			
63	Raw Score		79-80
64	Scaled Score		1-2
Self-Care (SC) *			
65	Raw Score		3-4
66	Scaled Score		5-6
Self-Direction (SD) *			
67	Raw Score		7-8
68	Scaled Score		9-10
Social (Soc) *			
69	Raw Score		11-12
70	Scaled Score		13-14
Motor (MO) *			
71	Raw Score		15-16
72	Scaled Score		17-18
Sum Adaptive Behaviour Components			
73	Scaled Score		19-20
74	Composite Score		21-22
75	Percentile Rank		23-25
76	Conf. Interval	90%	26-27
		95%	28-29

PARENT QUESTIONNAIRE

Developmental Milestones

77 Does your baby Roll over?

- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)*

______________________________ ☐ 1 ☐☐ 2-3

78 Does your baby sit without support?

- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)*

______________________________ ☐ 4 ☐☐ 5-6

79 Does your baby crawl on all fours?

- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)*

______________________________ ☐ 7 ☐☐ 8-9

80 Does your baby walk unaided?

- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)*

______________________________ ☐ 10 ☐☐ 11-12

81 Does your baby smile?

- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)*

______________________________ ☐ 13 ☐☐ 14-15

82 Does your baby babble?

- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)*

______________________________ ☐ 16 ☐☐ 17-18

83 First words spoken?

- 1 Yes
- 2 Not yet

If yes, please specify when started. *(0 if not known)*

______________________________ ☐ 19 ☐☐ 20-21

Self-Calming

84 Does your baby make use of the following methods for self-soothing? ☐ 22

- 1 Dummy
- 2 Sucking his/her fingers
- 3 Both
- 4 None of the above
- 5 Other? Please specify: ______________________________ ☐ 23

85 Are your baby's sleep patterns irregular? ☐ 24

- 1 Yes
- 2 No
- 3 Past

86 Is it difficult to get him/her to sleep? ☐ 25

1 Yes
2 No
3 Past

87 Does your baby have a structured sleep/wake routine? ☐ 26

1 Yes
2 No

Mood

88 Would you describe your baby as fussy? ☐ 27

1 Yes
2 No
3 Past

89 How many hours during the day does your baby fuss or cry? ☐ 28

1 Less than an hour
2 1-3 hours
3 3-5 hours
4 More than 5 hours

90 Are there any factors affecting your child emotionally? ☐ 29

1 Yes
2 No

If yes, please specify.

____ ☐☐ 30-31

Only for parents of infants in the intervention group

91 Do you think your baby benefitted from the intervention programme? ☐ 32

1 Yes
2 No

Please comment: ____

____

____

ADDENDUM D

ORGANIZING ASSESSMENT DATA FOR INTERVENTION

ORGANIZING ASSESSMENT DATA FOR INTERVENTION

COMPONENT	QUESTIONS FOR INTERVENTION	PROMOTE ORGANISATION OR DISORGANIZATION?	INTERVENTION IMPLICATIOS
Parents	▪ Ability to read cues ▪ Insight into child's difficulties ▪ Synchrony or reciprocity ▪ Ability to scaffold		
Goodness-of-fit	▪ Social environment ▪ Physical environment		
Infant's Sensory Processing: State of nervous system and threshold	▪ Hyper responsive ▪ Sensory Avoider ▪ Hypo responsive ▪ Sensory Seeker ▪ Mixed		
Infant's Sensory Processing: Self-regulation	▪ Arousal (Including sleep/wake) ▪ Activity level ▪ Recovery or calming		
Infant's Sensory Processing: Specific sensory systems	▪ Tactile ▪ Vestibular ▪ Visual ▪ Proprioceptive ▪ Auditory ▪ Olfactory ▪ Temperature ▪ Oral ▪ Pain		
Infant's Sensory Processing: Sensory-based behavioural organization	▪ Arousal ▪ Attention ▪ Affect ▪ Action		
SUMMARY			
Intervention Focus	Parent:	Goodness-of-Fit:	Child:

(Schaaf & Anzalone, 2001:289)

ADDENDUM E

SENSORY INTEGRATION INTERVENTION ACTIVITIES AND EQUIPMENT (Some examples used during the intervention sessions with infants in the experimental group)

SENSORY INTEGRATION INTERVENTION ACTIVITIES AND EQUIPMENT UTILIZED (some examples)

VESTIBULAR (Gravity and movement)

<table>
<tr>
<td>

Flying saucer swing

Spandex material/swing

</td>
<td>

Bolster swing/"riding horsy"

Platform swing

Rolling in or over a barrel

</td>
<td>

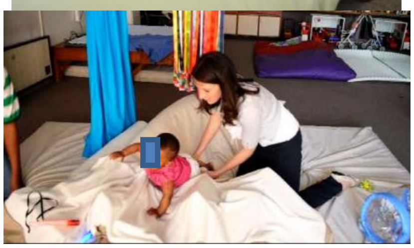
Hammock swing with mattress

Rolling over a big therapy ball/inflated roller

</td>
</tr>
</table>

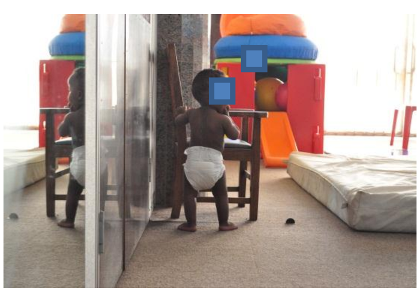
PROPRIOCEPTIVE (Muscles and joints)

Crawling-up/climbing over low density crash matt, mattress, big flop mat, sponge-blocks duvet etc.



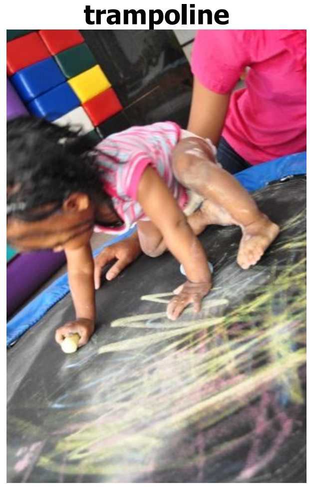
Obstacle course e.g.joliecushon, big-flop mat, mattresses, sponge-block duvet, steps etc.

Pulling up on furniture



Playing in prone

Chalk drawing on a trampoline



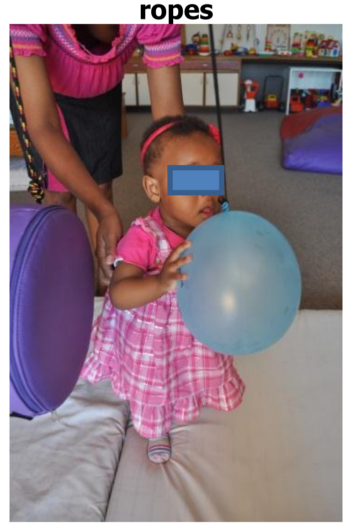
Pushing against therapy ball, therapist providing vibration sensation through ball

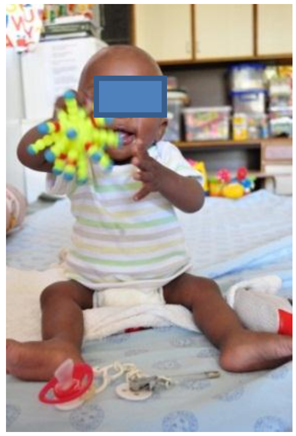
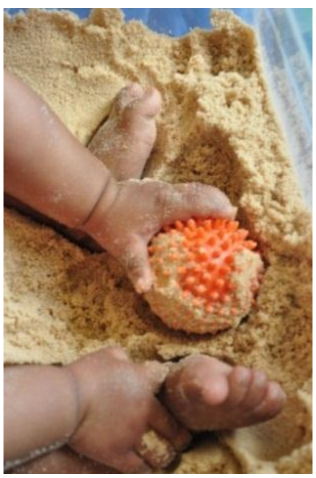
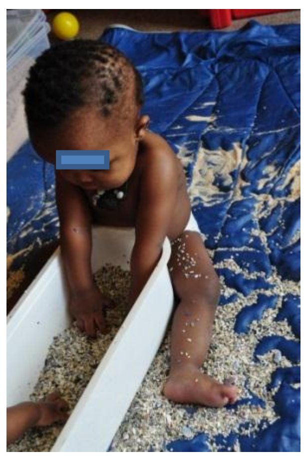
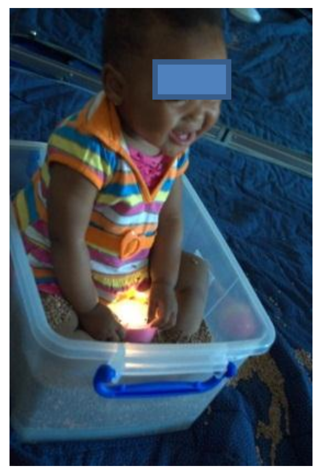
Furniture walking

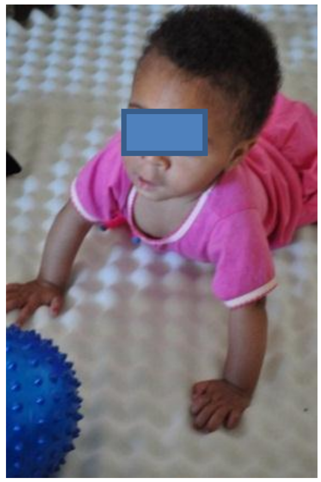
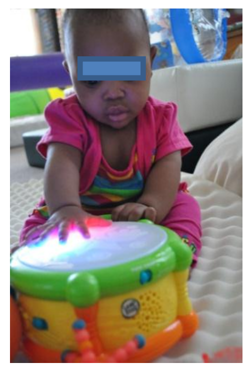
Crawling through tunnels

Textured, weighted bean bags

Rubber strips with toys attached and pulling ropes



TACTILE (Touch)		
Bobble play with lights 	**Variety of tactile based manipulative and oral toys** 	**Lentils/beans/rice buckets** 
Sandplay 	**Broken sea shell play** 	
Shaving cream play 	**Ball pitt play** 	**Water play** 

TACTILE (continue)		
Feather play 	**Play on an egg-shell mattress** 	**Ribbon-forrest utilized during play** 
Tactile blanket 	**Messy play** 	**Other**   Variety of visual and auditory toys e.g. balloons, hanging objects as well as toys to support engagement in play e.g. balls, stuffed animals, dolls, musical toys, visual toys, rattles, coloured light sticks and puppet

ADDENDUM F

INTERVENTION SESSIONS PROGRESS NOTES
(for infants in the experimental group)

INTERVENTION PROGRESS NOTES

CODING				**DOB**			**AGE** (Gest.)		**AGE** (Cor.)	
WEEK	1	2	3	4	5	6	7	8	9	10

Date	**Aims**	**Intervention/Activity/Apparatus**	**Duration**	**Response/parent's involvement/Comments**
	Vestibular			
	Proprioceptive			
	Tactile			
	Visual/Auditory			
	Olfactory/Taste			
	Vestibular			
	Proprioceptive			
	Tactile			
	Visual/Auditory			
	Olfactory/Taste			

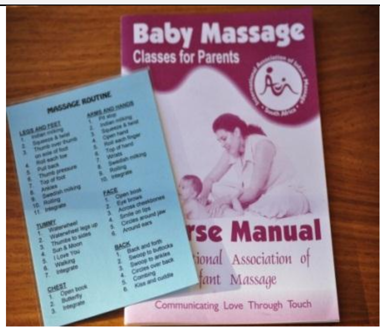
Researcher: Elise Lecuona

ADDENDUM G

HOME ACTIVITIES
(Some examples of activities recommend to parents of infants in the experimental group, complementary to the intervention sessions)

AND

THE ROLE OF INFANT MASSAGE AS PART OF THE HOME PROGRAMME

HOME PROGRAMME ACTIVITIES (some examples)	
VESTIBULAR (Gravity and movement	
• "Riding horsey" on dad's knee, • Swing in a blanket over a bed/mattress with mum and dad holding the blanket on both sides, • Sit on mom's lap on a play park swing, and • Rolling over an inflatable roller or parent's leg	
PROPRIOCEPTIVE (Muscles and joints)	
• Playing in prone, • Toys/objects attached on elastic bands (provided by researcher) for play in prone, supine, sitting or standing, • Crawling/creeping over pillows and mattresses on the floor, • Front carrying snuggle pack (mom), • Pulling up furniture, • Furniture walking, and • Pushing/pulling objects e.g. a box filled with pillows or a washing basket.	
TACTILE (Touch)	
• Infant massage (daily) as demonstrated during session 1 with all infants in the experimental group (International Association of Infant Massage information booklet, stroke card and grape seed oil provided by researcher). The role of baby massage in this study will be discussed below.	
• Messy play at home with jelly/instant pudding (provided by researcher), • Water play during bath time, • Drinking from a sipper cup.	

OTHER	
• Variety of visual targets e.g. balloons, hanging objects/toys, • Toys to support engagement in play e.g. balls, stuffed animals, dolls, visual toys, rattles or bells.	
SELF-REGULATION/MODULATION	
• Baby sense taglet (provided by researcher – sponsored by Baby Sense), • Dummy (provided by researcher), • Encourage sucking hands/fingers.	

The role of infant massage as part of the home programme:

According to the four levels of the sensory integrative process in infants (ADDENDUM A), the tactile (touch) component in the first level of the sensory integrative process is very important to help the infant form a mother-infant bond, comfort and/or console the infant as well as help the infant with sucking and eating (cf. 3.8.2). Ayers (2008:16) stated that touching between an infant and his/her mother is not only essential for the development of the mother-child bond but also for brain development.

A parent's touch provides valuable tactile input and together with talking to the infant facilitates interacting and bonding. The infant's response to this touch and interactions is an indication of an adaptive response to the sensory stimulation provided and therefore was suitable to be used by the researcher as part of the home programme for parents.

During each infant in the experimental group's first intervention session, the researcher demonstrated the International Association of Infant Massage (IAIM) infant massage techniques on a doll to the parents while the parent/caregiver performed the strokes on their infants. The benefits and importance of infant massage were explained to the parents and they were provided with an IAIM information and instruction booklet for parents, a laminated baby massage stroke card as well as a container with massage oil (grape seed oil). The parents had time to practice all the strokes under guidance of the researcher. Parents also had the opportunity to ask questions and this was monitored with the weekly intervention sessions.

As qualified and experienced sensory integration therapist as well as infant massage instructor with the International Association of Infant Massage (IAIM) the researcher values the importance of infant massage for the many benefits it holds for the infant and parents, however for the purpose of this study the researcher included teaching IAIM massage techniques to the parents of the participating infants in the experimental group as part of the home programme for mainly the value of the tactile sensory input it provides during every day activities at home, e.g. after bath time.

Infant massage also holds the following benefits for parents and their premature infants:

BENEFITS FOR PARENTS OF PREMATURE INFANTS

- to promote a nurturing relationship with the infant,
- to help the parent feel more confident in the care and handling of her/his baby,
- to strengthen parenting instincts and promote caring loving behaviour,
- to provide parents with a sense of independence and empowerment, and
- to increase the parent's awareness and understanding of her/his baby's cues and body language (Coetzee & Neser, 2000:2-4).

BENEFITS FOR THE PREMATURE INFANTS

- promotes interaction, bonding and interaction with his/her parent,
- to help the infant to experience positive touch, the pleasant touch of a parents hands, voice and smile are relaxing and reliefs discomfort caused by overstimulation of odours, sounds and sights,
- positive influence of the body's systems:
    - *the nervous system*
        - infant massage promotes the myelination of nerves of the immature nervous system of infants,

- during infant massage the parent stimulates four senses namely touch (through gentle massage techniques, skin to skin), smell (smell of mom/dad), hearing (the parents soft voice) and sight (looking at the parents face),
- infant massage stimulates the activity of the vagus cranial nerve which leads to higher levels of hormone production such as; insulin, this promotes food absorption and therefore also promotes growth,
- the release of serotonin, a neurotransmitter that provides an individual with a feeling of wellbeing, as well as endorphin, which acts as the body's natural painkiller are also increased through infant massage.

  - *the immune system*: Massage lowers anxiety and cortisol levels and therefore an infant's body becomes less vulnerable to disease.
  - *the digestive system*: Massage increases peristalsis, promotes digestion, relief of colic, wind, constipation and promotes elimination of waste products.
  - *circulatory system*: Massage has a direct influence on blood and lymph circulation. Oxygen and nutrient supplies are increased, and waste products such as carbon dioxide are removed more effectively. Better lymph circulation also strengthens the immune system. Optimal muscle health is obtained, healing is accelerated and skin texture is improved.
  - *endocrine system*: Stress hormones are balanced by touch and growth hormones are increased. Relaxing and calming hormones are released, which promote deeper sleep, and
  - *the respiratory system*: Massage helps a baby to open his chest and deep breathing is promoted. The stroking also helps suggest more rhythmic breathing. Deep breathing helps promote relaxation.

- Massage help to improve an infant's body image, suppleness and increases the quiet-alert state and therefore benefits general development (Coetzee & Neser, 2000:2-4).

REFERENCES:

Ayres, A.J., 2008. *Sensory Integration and the Child, Understanding Hidden Sensory Challenges*. 25th Anniversary ed. Los Angeles: Western Psychological Services.

Coetzee, R. and Neser, E., 2000. *Baby Massage Classes for Parents. Course Manual of the International Association of Infant Massage.* South Africa.

ADDENDUM H

WEEKLY HOME PROGRAMME FEEDBACK RECORD SHEET

WEEKLY HOME PROGRAMME FEEDBACK RECORD SHEET
(Completed weekly by the researcher with regards to parent feedback of home activities)

CODING				**DOB**				**AGE** (Gest.)	
WEEK	1	2	3	4	5	6	7	8	9	10

DAY/DATE		**ACTIVITIES**	**RESPONSE/COMMMENT**	**TIME**
DAY 1	e.g.: Wed. 12/10/'11	Movement:		
		Proprioception:		
		Touch:		
		Vision:		
		Sound:		
DAY 2		Movement:		
		Proprioception:		
		Touch:		
		Vision:		
		Sound:		
DAY 3		Movement:		
		Proprioception:		
		Touch:		
		Vision:		
		Sound:		
DAY 4		Movement:		
		Proprioception:		
		Touch:		
		Vision:		
		Sound:		
DAY 5		Movement:		
		Proprioception:		
		Touch:		
		Vision:		
		Sound:		
DAY 6		Movement:		
		Proprioception:		
		Touch:		
		Vision:		
		Sound:		
DAY 7		Movement:		
		Proprioception:		
		Touch:		
		Vision:		
		Sound:		

ADDENDUM I

INFORMATION AND PARENT CONSENT FORM

- English
- Afrikaans
- Sotho

INFORMATION DOCUMENT

Study title: Sensory integration intervention and the development of the extremely low to very low birth weight premature infant.

Dear Parent/Caregiver,

I, Elise Lecuona an occupational therapist, am doing a research study on a therapy programme aiming to help premature babies with their development in the first 12 months.

Research is just the process to learn the answer to a question. In this study we want to learn if sensory integration therapy, a technique of occupational therapy, which provides playful meaningful activities that enhance a baby's sensory intake and leads to more adaptive functioning in daily life can be used to enhance the development of a premature baby.

Upon discharge, you have been advised by your doctor, occupational therapist and nurses to monitor your baby's progress. Most premature babies manage to catch up with their physical growth at more or less 3 years of age. However, it is possible that an Extremely Low Birth Weight (ELBW) or Very Low Birth Weight (VLBW) premature baby could only catch up in terms of growth and development when he/she starts school. Some premature infants do grow slower and are smaller adults.

As explained to you in the parent groups while your baby was still in hospital, it is always important to use your baby's corrected age to evaluate his/her developmental milestones. It is important to identify possible physical and developmental delays as early as possible.

We would like to see if sensory integration therapy could have a positive effect on your baby's development. The programme of the study will consist of a once weekly therapy session of 30 - 45 minutes over a period of 10 weeks with at least two additional activities shown to you to do at home with your baby each week.

We are asking/inviting you and your premature baby to participate in this research study and therefore ask for your permission to include yourself and your premature baby in this study.

This study however entails that the premature babies participating in this study will be allocated by chance alone (randomly, selected with a process similar to picking names from a hat) into two groups, Group A: that will receive the specific sensory integration therapy and Group B: will not receive the sensory integration therapy. Both groups will continue to attend the follow-up clinics offered by Universitas Hospital.

All babies (group A and group B) will participate in assessments during the first week as well as the last week of the 12 week period. These assessments will take place only in one session of more or less one hour per baby in week 1 and week 12 respectively. You as parents or caregivers will be present during these assessments.

This study seeks to measure and compare the outcomes of the assessments of the infants after the infants in Group A received the therapy programme.

For your baby to enroll in this clinical trial, your baby must

- have been born on 26 and 36 weeks (gestational age)
- have had a birth weight of 750g – 1500g
- have reached between 4 months to 10 months corrected age when the study starts

- your baby must not be diagnosed with any additional diagnosis for example Cerebral Palsy, Down Syndrome etc.

If your baby has received any previous occupational therapy, sensory integration therapy and/or developmental intervention; or if you as parent are familiar with occupational therapy, sensory integration therapy and/or developmental intervention through previous experience with your older child, you and your baby cannot take part in the study.

If you grant permission for your baby to participate in this study, you will be kindly asked to let the researcher know immediately if you or your baby falls ill and cannot attend a session, or if your baby is diagnosed with an additional diagnosis during the 12 week period of the study. You may only miss a maximum of 2 sessions during the 10 week intervention period if necessary and these sessions must not be in a row. If you or your baby is on any form of medication you must please inform the researcher before enrolling into the study.

It is planned that a total of 24 premature infants within the Bloemfontein district will take part in this study at the Occupational Therapy Department, Universitas Hospital. The study will be conducted according to the Declaration of Helsinki and the guidelines of the International Conference on Harmonzation (ICH) for Good Clinical Practice (GCP). The trial has been approved by the Committee on Human Research Ethics of the University of the Free State (ECUFS NR 117/2011).

No discomfort or risks should be associated with the study:
Your baby's responses to stimulation will be closely monitored according to stress cues. Discomfort or risks should not be experienced by your baby as a result of this study however if your baby seems to be uncomfortable or restless during or after sessions, the session will be stopped or stimulation will be adjusted immediately. You as parent will be attending all the assessment and treatment sessions with your baby.

Potential benefits:
All participants of the study will receive a behavioural and developmental assessment by an occupational therapist. This can be both educational and reassuring for you as parent.

You will receive information and guidance on stimulating your baby in terms of reaching his/her developmental milestones either during the study or after the study if your baby falls into the control gorup. All results obtained from the study could be used for recommendations or further investigation if needed once the study has been completed.

Alternative procedures
Other than the standard programme and out patient clinics offered at Universitas Hospital, no alternative procedures are available. You do not have to participate in this study to receive advice and guidance from the occupational therapists at Universitas Hospital or your doctor. If you decide not to take part in this study, it will not affect your baby's follow-up appointments in any way at Universitas Hospital.

The right to ask questions/withdraw from the study
You have the right to ask questions at any time about the study. Any new or pertinent information, that becomes available during the course of the study, will be made available to you.

You may withdraw your baby's participation from the study at any time. If you decide to withdraw you baby from the study you will not be penalized in any way and your current and future treatment will not be in any way affected. Your baby may also be withdrawn from the study if the researcher feels it is in your baby's best interest.

Reimbursements
You will not be paid to let your baby take part in this study. Only a contribution towards transport will be offered as compensation to participate in the study.

Confidentiality
Efforts will be made to keep all personal information obtained from this study confidential. The results of this study may be published in a medical and/or occupational therapy journal or presented at academic meetings by the researcher, but this will not reveal your or your baby's names or identity in any way.

Digital media will be used as part of the assessment of the therapy process in this study to ensure that the therapy techniques are based on sensory integration principles. This material may be used by the researcher for presenting this study in academic lectures however all personal information will be kept confidential.

Absolute confidentiality however cannot be guaranteed. Personal information may be disclosed if required by law.

Continuation of treatment
Your baby will continue to receive therapy and advice as necessary at out-patient clinics or follow-up clinics at Universitas Hospital with regards to your baby's progress and development once the study is completed. If you would like to continue with sensory integration therapy for your infant, the researcher will be able to refer your infant to an occupational therapist.

Researcher's contact details: Elise Lecuona, Tel. (051) 4053405
For further information, queries in regards to the home activities or your baby's appointments.

Contact details of REC Secretariat and Chair: Tel. (051) 405 2812
For reporting of complaints/problems.

You are entitled to a signed copy of this leaflet.

If you agree for you and your baby to take part in the study, please complete the section attached.

DECLARATION BY RESEARCHER/RESEARCHER'S REPRESENTATIVE

I,……

declare that the information contained in the above document has been explained to the participant's parent/parents/caregiver:

………………………………………………………………………………..…………………………………………

That the participant's parent/parents/caregiver has been invited to ask me questions about anything that may be unclear about the study, and

that this conversation took place in English/Afrikaans, with/without a translator.

Signed at ………………………………………..………………on …..……/…………/20

………………………..……..……………… ………………..………………………………

Researcher: Name Researcher: Signature

……………………………………..…………… …………………………………………………

Witness: Name Witness 1: Signature

……………………………………..…………… …………………………………………………

Translator: Name Translator: Signature

(Where applicable)

CONSENT FOR YOUR INFANT TO PARTICIPATE IN RESEARCH

You have been asked to give permission for your premature baby to participate in a research study.

You have been informed about the study by ……………………………………………………………..

You may contact the researcher, Elise Lecuona at telephone number (051) 4053405 any time if you have questions about the study, related home activities or appointments.

You may contact the Secretariat of the Ethics committee of the Faculty of Health Sciences, UFS at telephone number (051) 405 2812 if you have questions about your rights as a parent/caregiver participating in a research subject.

Your permission for your baby's participation in this research is voluntary, and you or your baby will not be penalized or lose benefits if your refuse to participate or decide to terminate participation.

If you agree for your baby to participate, you will be given a signed copy of this document as well as the research study information sheet, which is a written summary of the research project.

The research study, including the above information has been verbally described to me. I understand what my and my premature baby's involvement in the study means, therefore

I…….
(Full name)

agree to give permission for my premature baby ……………………………………………………………
to take part in the research study explained above. I have read and understand the attached document.

I understand that the results will be used for research purposes and that all information will be kept confidential.

I have been informed that I may withdraw myself and my baby from the study at any time, and that this will not impact negatively on my baby's current and/or future treatment.

I understand that the researcher may withdraw me from the trial if she deems it to be in my baby's best interest.

I understand my baby's participation in this trial involves no additional costs to me as parent/caregiver.

I give permission for digital media to be used as part of assessment of the therapy process and that it might be used by the researcher for presenting this study in academic lectures.

I willingly agree to my own and my baby's participation in the above mentioned project.

Signed at…………………………………… on ………../………../20…….

………………………………………………… ………………………………………………
Parent: Name Parent: Signature

………………………………………………… ………………………………………………
Witness: Name Witness: Signature

………………………………………………… ………………………………………………
Translator: Name Translator: Signature
(Where applicable)

INLIGTINGS DOKUMENT

Studie titel: Sensoriese integrasie intervensie en die ontwikkeling van die van die Ekstreme Lae Geboortegewig tot Baie Lae Geboortegewig premature baba.

Geagte Ouer/Versorger,

Ek, Elise Lecuona, 'n arbeidsterapeut doen tans 'n navorsing studie op 'n behandelings program wat ten doel het om premature babas met hul ontwikkeling in die eerste 12 maande te help.

Navorsing is net die proses om 'n antwoord op 'n vraag te kry. In die studie wil ons uitvind of sensoriese integrasie terapie; 'n arbeidsterapie tegniek, wat betekenisvolle spel-aktiwiteite voorsien wat bydra tot 'n baba se sensoriese ervaring, kan gebruik word om die ontwikkeling van die premature baba te verhoog.

Met ontslag van die hospitaal is u deur u dokter, arbeidsterapeut en verpleegsters aanbeveel om u baba se ontwikkeling te monitor. Meeste premature babas haal op min of meer 3 jarige ouderdom hul fisiese groei in. Dit is egter moontlik dat 'n premature baba met 'n Ekstreme Lae Geboorte Gewig of Baie Lae Geboorte Gewig eers in die vroeë skool jare ten opsigte van sy/haar groei en ontwikkeling kan inhaal by hul tydgenote. Sommige premature babas groei stadiger en word kleiner volwassenes.

Soos aan u verduidelik is in die ouer groepe terwyl u baba nog in die hospitaal was, is dit altyd belangrik om u baba se gekorrigeerde ouderdom te gebruik om sy/haar ontwikkeling te evalueer. Dit is belangrik om u baba se fisiese en ontwikkelings agterstande so vroeg moontlik te identifiseer.

Ons wil graag ondersoek of die sensoriese integrasie intervensie spesifiek 'n positiewe effek op 'n premature baba se ontwikkeling kan hê. Die program bestaan uit weeklikse terapie sessies van 30 – 45 minute elk oor 'n tydperk van 10 weke met ten minste twee aktiwiteite wat aan u gedemonstreer sal word om tuis met u baba te doen.

Ons vra/nooi u en u premature baba om deel te neem aan die navorsing studie.

Die studie behels dat die deelnemende premature babas in die studie in twee groepe verdeel word deur byvoorbeeld name uit 'n hoed te trek. Groep A: wat die spesifieke sensoriese integrasie intervensie sal ontvang en Groep B: wat standaard prosedures ontvang en opvolg klinieke bywoon by Universitas Hospitaal.

Babas in Groep A en Groep B sal deelneem in evaluerings gedurende die eerste week asook gedurende die laaste week van die 12 week periode. Die evaluerings sal plaasvind in net een sessie van min of meer 60 minute per baba in week 1 en week 12 respektiewelik. Die babas se ouers of versorgers sal teenswoordig wees gedurende die evaluerings.

Hierdie studie poog om die evaluerings van babas te meet en vergelyk na afloop van die intervensie tydperk wat babas in Groep A sal ontvang.

Vir u baba om in die navorsing studie ingesluit te word, moes die baba

- op tussen 26 tot 36 weke gebore wees (gestasie ouderdom),
- 'n geboortegewig van 750g – 1500g gehad het,
- 4 maande tot 10 maande gekorrigeerde ouderdom bereik het wanneer die studie begin

- behalwe vir premature geboorte, nie met 'n addisionele diagnose gediagnoseer wees nie bv. Serebrale Gestemdheid, Down Sindroom ens.

As u baba enige vorige arbeidsterapie, sensoriese integrasie terapie en/of ontwikkelings terapie; of as u as ouer kennis van arbeidsterapie, sensoriese integrasie terapie en/of ontwikkelings terapie deur vorige ondervinding met 'n ouer kind, kan u en u baba nie deelneem aan die studie nie.

Indien u toestemming verleen vir u baba om aan die studie deel te neem, sal u versoek word om die navorser in kennis te stel as u of u baba siek word en nie instaat sal wees om 'n sessie by te woon nie of indien u baba met 'n addisionele diagnose gediagnoseer word binne die 12 week periode van die studie. U mag alleenlik 'n maksiimum van 2 sessies mis gedurende die 10 week intervensie periode indien nodig en hierdie 2 sessies mag nie opeenvolgend wees nie. Indien u of u baba enige medikasie neem moet u die navorsing daarvan inlig.

Die navorser beplan dat 'n totaal van 24 premature babas binne die Bloemfontein distrik aan hierdie navorsing studie deelneem by die Arbeidsterapie Departement, Universitas Akademiese Hospitaal. Die studie sal uitgevoer word volgens die Deklarasie van Helsinki en riglyne van die Internationale Konferensie van Harmonzation (ICH) vir Goeie Kliniese Praktyk (GCP). Hierdie studie is goedgekeur deur die Etiese Komittee van menslike navorsing van die Universiteit van die Vrystaat (EKUVS no. 117/2011).

Geen ongemak vir U baba behoort met die studie geassosieer te word nie:
U baba se reaksie teenoor stimulasie sal noukeurig gemonitor word volgens stres tekens. U baba behoort geen ongemak te ondervind as gevolg van die studie nie. Indien u baba ongemaklik of rusteloos is gedurende of na een van die sessies sal die sessie dadelik gestop word of die stimulasie aangepas word. U as ouer sal by al die assesserings en behandeling sessies van u baba teenwoordig wees.

Potensiële voordele:
Al die deelnemers aan die studie sal 'n gedrags en ontwikkelings assessering deur 'n arbeidsterapeut ontvang. Dit kan baie leersaam en gerusstellend vir u as ouer wees.

U sal inligting en leiding ontvang om u baba te stimuleer om sy/haar ontwikkelings mylpale te bereik gedurende of na afloop van die studie. Al die resultate verkry gedurende die studie kan gebruik word vir aanbevelings of verdere ondersoeke vir u baba indien nodig nadat die studie voltooi is.

Alternatiewe prosedures
Behalwe die standaard prosedures en buite pasiente klinieke wat by Universitas Akademiese Hospitaal aangebied word, is geen alternatiewe prosedure beskikbaar nie. U hoef nie deel te neem aan die studie om advies en leiding te ontvang van die arbeidsterapeute by Universitas Akademiese Hospitaal of u dokter nie. Indien u besluit om nie aan die studie deel te neem nie sal dit glad nie u baba se verdere behandeling of opvolg afsprake by Universitas Akademiese Hospitaal beïnvloed nie.

Die reg om vrae te vra/te onttrek van die studie
U het die reg om enige tyd vrae te vra oor die studie. Enige nuwe of pertinente inligting wat beskikbaar kom gedurende die uitvoer van die studie sal aan u beskikbaar gemaak word.

U mag u baba se deelname enige tyd van die studie onttrek. Indien u besluit om u baba van die studie te onttrek sal u geensins gepenaliseer nie. U baba se huidige of toekomstige behandelings sal glad nie geaffekteer word nie. U baba mag ook van die studie onttrek word indien die navorser voel dit is in u baba se beste belang.

Vergoeding
U sal nie vergoed word om u baba aan die studie te laat deelneem nie. Daar sal slegs 'n bydrae aangebied word vir u vervoer as kompensasie om deel neem aan die studie.

Vertroulikheid
Pogings sal aangewend word om alle persoonlike inligting wat in die studie verkry word vertroulik te hou. Die resultate van die studie kan in 'n mediese en/of arbeidsterapie joernaal gepubliseer word of by akademiese vergaderings geraporteer word deur die navorser, maar u of u baba se naam of identiteit sal nie bekend gemaak word nie.

Digitale media gaan gebruik word as deel van die evaluering van die intervensie proses in hierdie studie om te verseker dat die intervensie tegnieke gebaseer is op sensoriese integrasie beginsels. Die materiaal mag gebruik word deur die navorser om die studie aan te bied in akademiese lesings, alhoewel persoonlike inligting sal ten alle tye vertroulik gehou word.

Absolute vertroulikheid kan egter nie verseker word nie. Inligting mag bekend gemaak word indien dit deur die wet vereis word.

Voortsetting van behandeling
U baba sal voortaan soos benodig opgevolg word by Universitas Akademiese Hospitaal se buite pasient klinieke na afloop van die studie. Indien u graag wil voortgaan met sensoriese integrasie terapie vir u baba, sal die navorser u baba na 'n privaat arbeidsterapeut kan verwys.

Navorser se kontak besonderhede: Elise Lecuona, Tel. (051) 405 6555
Vir verdere inligting aangaande die tuis aktiwiteite of in verband met bywoning van afsprake.

Kontak besonderhede van REC Sekretariaat en Voorsitter: Tel. (051) 405 2812
Vir rapportering van klagtes/probleme.

U is geregtig op 'n getekende kopie van hierdie dokument.

Indien u instem vir u en u premature baba om deel te neem aan hierdie navorsings studie, voltooi asseblief die aangehegte vorm.

VERKLARING DEUR NAVORSER/NAVORSER SE VERTEENWOORDIGER

Ek……

Verklaar dat die inligting ingesluit in die bogenoemde dokument aan die deelnemer se ouer/ouers/versorger verduidelik is:

……………………………………………………………………………..……………………………………………

Dat die ouer/ouers/versorger genooi is om my vrae te vra oor enigiets wat onduidelik is aangaande die studie, en

dat die gesprek in Afrikaans met/sonder 'n tolk plaasgevind het.

Geteken te ……………………………………..………………………op …..……/…………/20…

……………………….………..……………… ……………….……………………………
Navorser: Naam Navorser: Handtekening

…………………………………..…………… …………………………………………………
Getuie: Naam Getuie: Handtekening

…………………………………..…………… …………………………………………………
Tolk: Naam Tolk: Handtekening
(Waar toepaslik)

TOESTEMMING VIR U BABA OM AAN DIE NAVORSING DEEL TE NEEM

U is gevra om u toestemming te gee vir u premature baba om aan 'n navorsing studie deel te neem.

U is ingelig oor die studie deur………..……………………………………………………….

U mag die navorser, Elise Lecuona, kontak by telefoon nommer (051) 4056555 indien u vrae het oor die navorsing , verwante tuis aktiwiteite of afsprake.

U mag die Sekretariaat van die Etiese komitee van die Fakulteit van Gesondheids Wetenskappe, UVS by telefoon nommer (051) 405 2812 kontak indien u vrae het oor u regte as ouer/versorger of 'n navorsings onderwerp.

U toestemming vir u baba se deelname in die navorsing is vrywillig en u en u baba sal nie gepenaliseer word of voorregte verloor indien u weier om deel te neem of besluit om deelname te staak nie.

Indien u instem dat u baba mag deelneem sal u 'n getekende kopie van die dokument asook die navorsing studie inligtings dokument ontvang, wat 'n geskrewe opsomming van die navorsings projek is.

Die navorsing studie, asook bogenoemde inligting is mondelings aan my beskryf. Ek verstaan wat my en my premature baba se betrokkenheid by die studie beteken, daarom,

Ek,…….
(Volle name)

stem in om toestemming te gee vir my premature baba……………………………………………………………..
Om deel te neem aan die kliniese proef hierbo aan my verduidelik. Ek het die aangehegte dokument gelees en verstaan dit.

Ek verstaan dat die resultate gebruik sal word vir navorsings doeleindes en dat alle inligting vertroulik gehou sal word.

Ek is ingelig dat ek myself en my baba enige tyd van die studie kan onttrek, en dat dit nie 'n negatiewe impak op my baba se huidige en/of toekomstige opvolg besoeke as deel van die standard program sal hê nie.

Ek verstaan dat die navorser my baba kan onttrek van die proef indien dit in my baba se beste belang is.

Ek verstaan dat my baba se deelname aan die proef geen bykomende koste aan my as ouer/versorger impliseer nie.

Ek verstaan dat die digitale media gebruik sal word as deel van die evaluering van die intervensie proses an dat dit deur die navorser gebruik kan word vir die aanbieding van die studie in akademiese lesings.

Ek stem vrywillig in vir my en my baba se deelname aan die bogenoemde projek.

Geteken te……………………………………………………………….op ………../………../20…..

………………………………………………………	………………………………………………………
Ouer: Naam	Ouer: Handtekening
………………………………………………………	………………………………………………………
Getuie: Naam	Getuie : Handtekening
………………………………………………………	………………………………………………………
Tolk: Naam *(Waar toepaslik)*	Tolk: Handtekening

INFORMATION DOCUMENT

Sehloho sa khuto: Kamo ya sensory integration le kgolo ya bana ba banyane hoholoholo le ba banyane hoholo selateng ba hlahileng pele ho nako.

Motswadi/Mohlokomedi,

Nna, Elise Lecuona, occupational therapist, ke etsa patliso lenaneng la tshebetso. Se sosa e le ho thusa bana ba hlahileng pele ho nako (premature) ka kgolo ya bana di kgweding tse 12 tse qalang.

Patliso empa e le dikgato tsa ho ithuta karabo ya potso e itseng. Thutong ena, re batla ho ithuta hore ekaba pheko tshebetso ena ya sensory integration, e leng mokgwa o itseng wa occupational therapy, o tlisang diketso tsa dipapadi tse nang le moeleto o itseng, tse ntlafatsanq boleng ba motho ba ho nka kutio e akaretsang kutlo ya ditsebe, pono, ho nkga, tatso le ho angwa/amuwa letalo (sensory intake) tse isang tshebetsong e nepahetseng ya ketso e itseng bophelong, e ka sebediswang ho tswellisa pele kgolo ya ngwana ya hlahileng pele ho nako.

Nakong ya ho lokollwa sepetlele, O ile wa kgothalletswa ke ngaka ya hao, occupational therapist le bo mme nese ho lekola tswelopele ya ngwana wa hao. Bongata ba bana ba hlahileng pele ho nako, bakgona ho hola mmeleng ho fihlella ba ba dilemong tse kalo ka tse 3. Le ha ho le jwalo, ho ntse ho kgoneha hore ngwana ya hlahileng a le monyane haholoholo kapa. Ba ba nyane hoholo sekaleng ba hlahileng pele ho nako ba ka kgona feela ho lekana le ba hlahileng hong le bona nakong tse qalang tsa ho kena sekolo. Ba banq ba bang ba hlohileng pele ho nako, ba hola butle e be batho ba baholo empa ba ntse ba le banyane.

Jwalo ka ha le hlaloseditswe di kopanong tsa batswadi, nakong eo ngwana a ntseng a le sepetlele, ho bohlokwa ho sebedisa dilemo tseo ngwana a tlamehang ho ba tsona, re shebile nako e nepahetseng eo a neng a lebelletswe ho ba yona (corrected age), ho lekola kgolo eo a e fihlellang. Ho bohlokwa h sheba dikgato tsa mmele le tsa kgolo, tse salletseng morao e sa le nako. Ka tsela eo o thusa ho fokotsa ho se itekanele ho itseng, le ho dieha ho ya sekolong se qalang (pre-school).

Leha ngwana wa hao a ntse a tsamaya/bonwa kliniking dikgwedi tse mmalwa ka morao hore a lokollwe sepetlele, le hore o filwe dikgothaletso tse itseng ho thusa ngwana hao hae. Re rata ho batlisa hore ekaba lenane la sensory integration ka bo-kgethehi, le akaretsang dithuso/pheko (therapy sessions) bekeng tse nkang metsotso e ka bang 30 – 45 nakong ya dibeke tse 10, mmoho le lenane leo o le fuweng ha o ya hae, di ka bang le molemo kgolong ya ngwana hao.

Re ya o kopa re bile re o mema le ngwana hao ya hlahileng pele ho nako ho nka karolo patlisong ena. Re bile re kopa tumello ya hao, hore wena le ngwana hao ya hlahileng pele ho nako, ho ba korolo ya patliso ena.

Patliso ena, e leng teko ya pheko e itsenq e se nang mokgwa o ikqethileng O e laolang, e akaretsa hore bana ba hlahileng pele ho nako ba, nkonq karolo thutong ena ba tla orolwa ho ya ka lehlohonolo la bona feela (Ntle le mokgwa o itseng o ikgethileng) Ba kgethwa ka mokgwa o tshwananq le wa ho nka kgetha lebitso le le lenq hara mabitso a mangata ko hara katiba, ba arotswe Dihlopha tse pedi Sehlopha A Sehlopha sa teko e itseng se a fumantshwha pheko/thuso ya sensory integration. Sehtopha B, Sehlopha se laolwang se tla fumantshwa mehato ya boemo bo tseng le di kliniki tseo ba tla tlang ho tsona tse tshwarelwang Sepetlete sa Universitas. Thuto ena e tla nka sebaka nakong ya dibeke tse 12. Batswadi ba bana ba Sehlopha A, ho tla lebellwa hore ba tlise bana ba bona lefapheng la occupational therapy ha nngwe ka beke nakong ya dibeke tse 12 ka matsotsi a kgethlweng a o ba a filweng. Batswadi ba sehlopha B, bo tla lebelwa ho thusa bana ba bona lefapheng la occupational therapy, Sepetlele sa Universitas ha bedi fela nok eo bat la e fuwenq, dib eke tse 12 di arotswe.

Bana ba Sehtopha A le ba Sehlopha B bat la nka karolo hlahlobong bekenq ya pele le bekeng ya ho qetela ya beke tse 12. Di hlahlobo tse di tla nka sebaka feela nakong e gethilweng e ka banq metsotso e o ngwana ka mong beke ya pele le beke ya bo 12, mme di tla akaretsa maqhepe a tla be a na le dipotso tse itsenq, tse tlamehileng ho arajwa ke batswadi, le diteko tse pedi tse ikqethileng. Batswadi ba bana kapa bahlokomedi, ba tla be ba le teng ka nako ya dihlahlobo tsena.

Bana ba sehlopha A, batla be ba bonwe ha nngwe bekeng ngwana ka mong, nakong e kgethilweng ya metsetso e 30 ho ya ho e 45 ba feheleditswe ke bo mme ba bona kapa bahlokomedi ba bana. Batswadi ba bana ba tla lebellwa ho latela lenane leo ba tla be ba le fuwe ho le etsa hae (home programme) beke e nngwe le e nngwe. Lenane la thuso la sensory integration le tla be le latelwa le sehlopha A, le tla akaretsa dipapadi tlse nang le boleng bo itseng, bo nang le tjhebelo-pele ya ho tswellisa kamohelo e itsenq ya kutlo e seng e hlalosiswe (sensory intake) tse latelanq ho tswellisa menyetta ya kqolo.

Bana ba sehlopha B ha ba no fiman a dithuso tsa bona tsa beke le beke kapa lenane tsamaiso la hae lapeng, empa ba tla fumana lenane la boemo bo itseng, ho tswa sepetlele sa Universitas, ha ntse baya dikliniking.

Teko ena ya pheko e itseng e se nanq mokgwa o ikqethileng e batla ho metha le ho sheba phapang ya dikarabo tsa di hlahlobo tsa bang, ka mora hore bana ba sehlopha A ba fumantshwe lehane la thuso.

Hore ngwana hao a kenele teko ena ya pheko e ikgethileng, ngwana hao otlamehile:

- Ho ba pakeng tsa dibeke tse 26 le tse 36,
- Ha a ne a hlaha, a, be a se a na le boima bo pakeng tsa 750g – 1500g,
- Ha thuto ena e qala, a ba se a le pakenq tsadiqwedi tse 4 ho ya ho tse 10, ho sthebilwe dilemo tse nepahetseng (corrected age),
- Ntle le ho hlaha pele ho nako, a se ke a ba te bothata bo itseng kapa ho se itekanele ka bokong.

Ha e ba ngwana hao, o kile a fumana lenane la occupational therapy, sensory integration le thuso e amang kgolo ya ngwana, kapa we na motswadi o kile wa fumana tsebo ya occupational therapy, sensory integration kapa thuso e amang thuso ya kgolo tsebong ya hao ka ngwana e mong, wena le ngwana hao le ke ke la nka karolo thutong ena.

Ha e ba o fana ka tumello hore ngwana hao a nke karolo thutong ena, o tla kopuwa ho tsebisa motho ya ikarabellong patlsong ena hang hang ha ho ka etsahala hore wena kapa ngwana hao a ka kula, mme a se gone ho tla, ha e le nako ya hae ya ho tla, kapa ha nqwana hao, a ka fumanwa a na le ho kula ho itseng nakong ya dibeke tse 12 tsa thuto ena. O ka fetwa bonyane ke maqetlo a mapedi nakong ya dibeke tse 10 tsa thuso ha ho hlokeha, hape e se ke ya ba magetlo a mabedi a latellanang. Haeba wena kapa ngwana wa hao, le nka meriana kapa dipilisi se itseng, ka kopo tsebisa motho ya ikarabellag poklisong ena.

Ho hlophisitswe hore palo ya bana ba 32 ba hlahileng pele ho nako seterekeng sa Bloemfontein, ba ka nka karolo lefapheng la occupational therapy, sepetlele sa Universitas. Thuto ena e tla tsamaiswa ho ya ka Tsebiso (Declaration) ya helsinki le Melaotheo ya tumellano ya tshebetso ya Pheko e ntle (International Conferece of Harmonization [ICH] for Good Clinical Practice). Teko ena e amohetswe ke komiti ya patliso ya botho ya Univesithi ya Foreisitata. (Committee on Human Research Ethics of University of the Free State)

Ha ho na ho se phutholohe kapa monyetla wa kotsi e amanonq le thuto ena:
Dintho tseo ngwana hao a tla be a di etsa kamorao hore o mo etse dintho tseo o rutilwenq hore o di etse ho yena, di tla lekolwa ho ya ka ponahatso eo ba e bontshang ya ho ameha maikutlo. Ho se phutholohe kapa monyetla wa kotsi e ka hlahang, ha di ya tlameha ho bonahala ngwanenq wa hao ka lebaka la thuto ena, le ha ho le jwalo, ha ngwana hao a sa bonahala a phutholaha kapa a se na phomolo hantle, pele kapa kamora tshebetso ya hae, tshebetso e tla emiswa, mme a sebetswe feela ho ya ka mo a kgonang ho o mamella kateng hang hang. Wena jwaloka motswadi o tla tsamaya di hlahlobo le Ditshebeletso tsa kalafo le ngwana wa hao.

Dintho tse molemo tse ka fumanwang:
Ba nka karolo kaofela ba thuto ena, ba tla Fumantshwa hlahlobo ya kqolo le ya maikutlo ho tswa ho occupational therapist. Hona ho ka fana ka thuto le ho netefaletsa batswadi bohle ba bana ba hlahileng pele ho nako dihlopheng tsena tse pedi.

Batho ba fanang ka therapy (therapists) ba etsang dihlahlobo, bat la hlahloba le ho thusa ho hodisa batswadi ka kutlwisiso le tsebo e ikgethileng, e ho bona hantle/Ela hloko le ho gona ho thusa bang ka matshwao a kgatello ya maikutlo le ho tsetsepela (stability) ho tla thusa batswadi ho utlwisisa boitshwaro ba bana hantle.

Batswadi kaofela ba tla fumana tsebo le tataiso ya hore ba etse bana ba bona jwang hore ba tle ba filhelle dikgato tsa bona tsa kgolo nakong ya thuto kapa kamora thuto ena. Dikarabo tse tla. Pumanwa ho tswa thutong ena di ka sebedisetswa di kgothaletso kapa ho tswellisa patliso ha ho hlokoha, ha thuto ena e se e qetilwe.

Mekgwa/Ditsela tse dingtse ka sebediswang
Nle le mekgwa/Ditsela tse sebediswang ke Dikliniki tsa bakudi ba s a robaletseng (out patient) tse teng sepetlele sa Universitas. Ha ho na mekgwa/ditsela tse ding tse teng. Ha ho hlokehe hore o nke karolo thutonq ena hore o fumane khothatso le tataiso ho tswa ho occupational therapist sepetlele sa Universitas kapa ngaka ya hao. Ho kgetha ho se nke karolo thutong ena, Ho keke ha ama thuso eo ngwana hao a ntseng a e fumana le dinako tsa hae tsa hlahlobo ka tsela e itseng sepetlele sa Universitas.

Tokelo ya ho botsa dipotso/ho ikgula thutong eng
O na le tokelo ya ho botsa dipotso nako enngwe le enngwe ka thuto ena. Tlhahiso enngwe le ennqwe e ntjha kapa e nepahetseng, e fumanweng nakong ya thuto ena, le tla e fumantshwa.

O dumelletswe ho ntsha ngwana hao nako enngwe le e nngwe ha o se o sa baole a nke karolo thutong ena. Ha o nka qeto ya ho ntsha ngwana hao, ha o no fuwa kotlo ka tsela efe kapa efe, mme thuso eo o e fumananq ha jwale le eo o tla e fumana dilemong tse tlang, ha e no ameha ka tsela efe kapa efe. Ngwana hao a ka tswa thutong ena ha motho ya etsang patliso a bona ho lo molemong wa ngwana hao.

Ho patalwa
Ha o tlo patalwa, ha ho dumella ngwana hao ho nka karolo thutong ena. O tla fuwa bonyane feela ho thusa ka sepalangwang (transport) hore o nke karolo thulonq ena.

Confidentiality/Ho boloka lekunulu

Matsapa a tla nkuwa ho boloka ditaba tsohle tsa motho, tse fumanweng thutong ena e le lekunutu di karabo tsa thuto ena di tla phatlalatswa koranteng ya bongaka kapa occupational therapy kapa di tla rutwa dikopanong tsa baithuti, empa hona ha ho tlo ntsha seemo kapa lebitso la ngwana hao ka tsela efe kapa efe.

Divideo di tla nkuwa e le karolo ya hlahlobo ya mehato ya hathusa (teko e nepahetsenq) thulong ena ho netefatsa hore mokgwa wa thuso o itshetlehile melaong ya Ayres sensory integration. Divideo di ka sebediswa ho hlahisa thuto ena dipoledisanong kapa nakong ya dithuto tsa bana ba sekolo kapa batho ba rutehileng (professionals) le ha ho le jwalo ditaba tsa motho ka mong di tla bolokwae le sephiri.

Ho boloka ditaba tse hlahisitsweng thulonq ena ka hohle hohle e le sephiri ha se ntho e ka tshepiswang. Ditaba tsa motho di ka tsebahatswa ha ho hlokeha ke molao.

Tswelopele ya thuso kapa pheko

Ngwana wa hao o tla tswela pele ho fumana thuso le keletso ka moo hohlokahalong di klinikng tsa batho ba sa robaleng (outpatient) sepetlele kapa dikliniking tse boning/ batho kgafetsa (follow up clinics) ho ya ka moo ho hlokehang. Sepetlele sa Universitas matapi le tswelopele le kgolo ya ngwana hang ha thuto ena e qetilwe. Ha a batla ho tswela pele ka thuso ya Tshebetso ena ya sensory integration molemong wa ngwana hao. Motho ya etsanq pantliso o tla kgona ho romela ngwana hao ho occupational therapist e itshebetsang, ho tswela pele ka tshebetso kapa thuto ya sensory integration.

Mabitso le dinomoro tsa mmatlisi: Elise Lecuona, Tel. (051) 4056555

Ha o batla ho tseba haholo ka lenane (homeprogramme) leo o le filweng ho le etsa hae kappa mabapi le dinako tsa tshebetso (appointments).

Dinomoro tsa mongodi wa REC le Modulasetulo: Tel. (051) 405 2812

Ho tlaleha ditlehebo/mathata.

O na le tokelo ya ho fuwei pampiri ena e saenilweng/Tekennweng

Ha o dumela hor e wena le ngwana hao le nke karolo thutong ena, o kopuwa hore o tlatse ka tlase.

Ho ikana ha mmatlisi/Motho ya emetseng mmatlisi

Nna,…….

Ke ikanahore ditaba tse ngotsweng ka nodmo, di ile tsa hlalosetswa motswadi/batswadi/mohlokomedi wa motho ya nkang karolo.

……

Le hore Motswadi/Botswadi/Mohlokomedi wa motho ya nkang karolo o ile a memuwa ho mpotsa dipotso ka ntho e nngwe le e nngwe e sa hlakang ka thuto ena le hore.

Puisano e nkile sebaka ka Sesotho ho sebediswa mofekoledi (translator).

E teknnwe ……………………………………………………..…………ka………../…………./20….

…………………………..…………………	………………..………………………………
Mmatlisi: Lebitso	Mmatlisi: Tekena
…………………………………..……………	…………………………………………………
Paki: Lebitso	Paki: Tekena

TUMELLO YA HORE NGWANA HAO A NKE KAROLO PATLISONG

O kopilwe ho fana ka tumello hore ngwana hao ya hlahileng pele ho nako a nke karolo thutong ena ya patliso.

O tsebisitswe ka thuto ena ke ………………………………………………………………………………..

O ka ikopanya le mmatlisi, Elise Lecuona nomorong ena (051) 4056555 nako e nngwe le e nngwe ha o na le dipotso ka lenane leo o le etsanq hae kapa (home programme) ka dinako tsa ho tla sepetle e tse amanang le patliso.

O ka ikopanya le mongodi wa komiti e lekolang moitshwaro a nepahetseng le a sa nepahalang (Ethics committee), Lefapheng la bophelo bo botle (Faculty of Health science), Univesithing ya Foreistata (UFS) dinomorong tsena (051) 405 2812, Ha o na le dipotso ka ditokelo tsa hao jwoloka motswadi kapa mohlokomedi ka sehloho sa patliso.

Tumello eo o faneng ka yona hore ngwana hap a nke karolo, o fane ka yana o ithaopa mme wena kapa ngwana hao le k eke la fuwa kotlo kapa la lahlehelwa ke menyena ha o hana ho nka karolo kapa wa nka qeto ya ho kgaotsa ho nka karolo.

Ha o dumella hore ngwana hao a nke karolo, a tla fuwa pampiri e tshwanang le ena e tekennweng le pampiri ya thuto ya patliso ena e ngoteweng ha kgutshawane (in summary) ya patliso.

Thuto ena ya patliso, ho kenyeleditswe ditaba tse hlolositsweng ka hadimo le ka di hlalosetswa te.

Ke utliwsisa karolo eo nna le ngwana wa ka ya hlahileng pele ho nako re e bapalang le hore e bolea eng mme.

Nna,……………………………………………………………………………………(Mabitso ka botlaho)
Ke dumela ho fana ka tumello hore ngwana ………………………………………………………. wa ka a nke karolo tekong ena ya pheko jwalo ka ha ho hlalosiwe ke badile mme ke utlwisisa pampiri e ka morao.

Ke utlwisisa hore dikarabo kse fumanweng di tla sebediswa mabaka a amang patliso le hae ditaba tse boletswang di tla bolokwa o le lekunutu.

Ke ile ka tsebiswa hore nka ikgula, nna le ngwana ka thutong ena nakong e nngwe le enngwe, mme hona, ha ho no ama thuso pheko a e fumanang le eo a tlang ho e fumana hampe.

Ke utlwisisa hore mmatlisi a ka ntlosa tekong haeba a bona ho le molemong wa ngwana wa ka.

Ke utlwisisa hore karolo eo ngwana wa ka a e bapalang tekong ena ha e kenyelletse tjhelete kahodimo ho nna jwaloka motswadi/mohlokomedi.

Ke utlwisisa hore divideo di tla sebediswa e le karolo ya hlahlobo ya thuso/pheko, le hore e ka nna ya sebediswa tlhalosong ya thuto ena ditherisanong tsa baithuta nakong ya dithuto barutwaneng ba, dikolo le batho ba seng ba rutehile (professionals). Ke fana ka kumello hore di tshebetso tse etsuwang le ngwana wa ka, di ka nkuwa ka video.

Ke ithaopa ke dumela hore nna le ngwana wa ka ho nka karolo thutong ena.

E tekennwe……………………………………………………………..ka ………../………../20…..

…………………………………………………	…………………………………………………
Motswadi: Lebitso	Motswadi: Tekena
…………………………………………………	…………………………………………………
Paki: Lebitso	Paki: Tekena

ADDENDUM J

APPROVAL LETTER FROM THE ETHICS COMMITTEE,
UNIVERSITY OF THE FREE STATE
FACULTY OF HEALTH SCIENCES

ECOFS NO 117/2011

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

Direkteur: Fakulteitsadministrasie / Director: Faculty Administration
Fakulteit Gesondheidswetenskappe / Faculty of Health Sciences

Research Division
Internal Post Box G40
☎(051) 4052812
Fax (051) 4444359

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

Ms H Strauss

2011-09-21

REC Reference nr 230408-011
IRB nr 00006240

MS ER LECUONA
P O BOX 28077
DANHOF
9310

Dear Ms Lecuona

ECUFS NR 117/2011
PROJECT TITLE: SENSORY INTEGRATION INTERVENTION AND THE DEVELOPMENT OF THE EXTREMELY LOW TO VERY LOW BIRTH WEIGHT PREMATURE INFANT.

- You are hereby kindly informed that the Ethics Committee approved the above project at the meeting held on 20 September 2011 after the protocol has been revised according to the proposed changes.
- Committee guidance documents: Declaration of Helsinki, ICH, GCP and MRC Guidelines on Bio Medical Research. Clinical Trial Guidelines 2000 Department of Health RSA; Ethics in Health Research: Principles Structure and Processes Department of Health RSA 2004; Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa, Second Edition (2006); the Constitution of the Ethics Committee of the Faculty of Health Sciences and the Guidelines of the SA Medicines Control Council as well as Laws and Regulations with regard to the Control of Medicines.
- Kindly note that permission letters from the authorities have to be submitted to the Ethics Committee prior to collecting data/conducting the study.
- Any amendment, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.
- The Committee must be informed of any serious adverse event and/or termination of the study.

339, Bloemfontein 9300,RSA ☎ (051) 405 2812 StraussHS@ufs.ac.za

- A progress report should be submitted within one year of approval of long term studies and a final report at completion of both short term and long term studies.
- Kindly refer to the ECUFS reference number in correspondence to the Ethics Committee secretariat.

Yours faithfully

....
CHAIR: ETHICS COMMITTEE

Cc Ms A van Jaarsveld

ADDENDUM K

PERMISSION LETTERS FROM APPROPRIATE AUTHORITIES TO CONDUCT THE RESEARCH STUDY AT UNIVERSITAS ACADEMIC HOSPITAL

- Dr. Nic van Zyl
  Head: Clinical Services
  Universitas Academic Hospital

- Prof. Andre Venter
  Head: Department of Paediatrics and Childhealth
  Faculty of Health Sciences
  University of the Free State

- Dr. David Griessel
  Lecturer: Department of Paediatrics and Childhealth
  Faculty of Health Sciences
  University of the Free State

- Ms. Marin Taljaard
  Head of Department: Occupational Therapy
  Universitas Academic Hospital

health
Department of Health
FREE STATE PROVINCE

24 June 2011

Me Elise Lecuona
Senior Occupational Therapist
Universitas Academic Hospital

Dear Me Lecuona

RESEARCH PROJECT: SENSORY INTEGRATION INTERVENTION AND THE DEVELOPMENT OF THE EXTREMELY LOW TO VERY LOW BIRTH WEIGHT PREMATURE INFANT

Herewith permission for the mentioned project to be done at Universitas Academic Hospital on condition that approval is obtained from the Ethics Committee

The Chief Executive Officer must be notified if the findings of the project will be published.

Yours sincerely

DR NIC R J VAN ZYL
HEAD: CLINICALSERVICES
UNIVERSITAS ACADEMIC HOSPITAL

HEAD: CLINICAL SERVICES: DR NRJ VAN ZYL
Private Bag X20660, Bloemfontein, 9300. Tel. No.: 051-4052866,
Fax: 051-4053500, Room 1077, First Floor, Universitas Academic Hospital
E-mail: vanzylnr@fshealth.gov.za

Departement Pediatrie en Kindergesondheid • Department of Paediatrics and Child Health
Fakulteit van Gesondheidswetenskappe • Faculty of Health Sciences

Die Universiteit van die Vrystaat • The University of the Free State
Box / Bus 339 (G69) • Bloemfontein • 9300 • RSA • E-pos / E-mail: GNPDAV@med.uovs.ac.za
Tel: +27 (0)51 405 3181 • Faks / Fax: +27 (0)51 444 3230

Elise Lecuona
Senior Occupational Therapist
Universitas Academic Hospital
Bloemfontein
9300

Dear Miss Lecuona

Re:- **PERMISSION TO CONDUCT THE CLINICAL TRIAL AS PART OF RESEARCH STUDY AT THE OCCUPATIONAL THERAPY DEPARTMENT, UNIVERSITAS ACADEMIC HOSPITAL**

I hereby give permission for the study to be performed on extremely low birth weight babies, or very low birth weight premature babies that are treated at Universitas Hospital.

I note that the study has been approved by the Committee of Human Research Ethics, but would like to emphasize that the study can only be performed if there is parental consent and with the cooperation of the consultancy in the Department of Paediatrics.

I wish you well with the study and hope that it is going to be fruitful venture.

PROF A VENTER
PROFESSOR AND HEAD
DEPARTMENT OF PAEDIATRICS AND CHILDHEALTH
DATE: 24/06/2011
c:\my documents\algemene tikwerk\prof venter tikwerk\prof a venter occupational therapy letter.docx

P.O.Box 28077
Danhof
9310

24 June 2011

Dr. D. Griessel
Lecturer: Department of Pediatrics
Universitas Academic Hospital
P.O.Box 339 (469)
Universitas
Bloemfontein
9301

PERMISSION TO CONDUCT A CLINICAL TRIAL AS PART OF A RESEARCH STUDY AT THE OCCUPATIONAL THERAPY DEPARTMENT, UNIVERSITAS ACADEMIC HOSPITAL.

Study title: Sensory integration intervention and the development of the extremely low to very low birth weight premature infant.

Dear Dr. Griessel,

I am requesting permission to conduct a clinical trial as part of my Magister in Occupational Therapy degree (UFS) research study at the Occupational Therapy Department, Universitas Academic Hospital.

The aim of this research is to determine the effect of sensory integration therapy, a technique of occupational therapy, which provides playful meaningful activities that enhance an individual's sensory intake and leads to more adaptive functioning in daily life on the development of the Extremely Low Birth Weight (ELBW) or Very Low Birth Weight (VLBW) premature baby.

I would like to investigate whether the Sensory Integration programme specifically, which consist of weekly therapy sessions of 30 - 45 minutes each over a period of 10 weeks, together with a home programme could have a positive effect on the development of these premature infants within the first 12 months and therefore ask for your permission to conduct this study at Universitas Academic Hospital with parents and premature infants that has been discharged from the Universitas Academic Hospital, Neonatal Intensive Care Unit and followed-up in the premature infant clinics.

This study will be a randomized controlled clinical trail and only infants who's parents have given informed consent will be included in the study. The premature infants participating in this study will be allocated randomly into two groups, Group A: an experimental group that will receive the specific sensory integration intervention and Group B: a control group that will receive standard procedures and follow-up clinics offered by Universitas Academic Hospital. Parents with infants in Group A will be expected to bring their babies to the Occupational Therapy Department at Universitas Academic Hospital once a week over the 12 week period on selected appointment dates. Parents with infants in Group B will be expected to bring their babies to the Occupational Therapy Department at Universitas Academic Hospital only for two assessment appointments, 12 weeks apart.

The study will be conducted according to the Declaration of Helsinki and the guidelines of the International Conference on Harmonzation (ICH) for Good Clinical Practice (GCP). This research proposal has been approved by an Expert Committee on 22 of June 2011 and will be presented to an Evaluation Committee in July 2011 and the Committee on Human Research Ethics of the University of the Free State either on 26 July 2011 or 16 August 2011.

Potential benefits include the following:
All participants of the study will receive a behavioural and developmental assessment by an occupational therapist. This can be both educational and reassuring for all the parents of participating premature infants in both groups.

The therapists conducting the assessments will also assess and nurture all parents' understanding and skills in recognizing and responding appropriately to their infant's cues of stress or stability which will help parents understand their infant's behaviour better.

All parents will receive information and guidance on stimulating their infants in terms of reaching their developmental milestones either during the study or after the study. All results obtained from the study could be used for recommendations or further investigation if needed once the study has been completed.

The results of this study are specifically aimed at the infant's long-term developmental needs. Through obtaining results in terms of the effect of sensory integration therapy on the development of the premature infant in his first year, the researcher will be able to:

- Recommend intervention programmes for occupational therapists using sensory integration intervention and home programmes for parents, and therefore helping premature infants to reach their developmental milestones and/or overcome developmental difficulties easier,
- empower and educate therapists with suitable and safe principles for sensory integration therapy with premature infants,
- provide parents with guidelines in terms of suitable stimulation for their infants,
- implement preventative measures for treating premature infants,
- identify premature infants that are at risk for optimal development,
- present a publication on the findings of the study to health professionals working with premature infants to make them aware of the importance of sensory integration in the development of premature infants, and
- recommend further studies in the field of sensory integration therapy with premature infants.

Thank you for your attention, please contact me if any further information is needed.

Yours sincerely

Elise Lecuona
Senior Occupational Therapist
Universitas Academic Hospital
Tel: 051 405 3405
Cell: 082 783 9870

I hereby grant permission for Elise Lecuona, to conduct the above described clinical trial with the study title: *Sensory integration intervention and the development of the extremely low to very low birth weight premature infant*, as part of her Magister in Occupational Therapy degree (UFS) research study at the Occupational Therapy Department, Universitas Academic Hospital.

Dr. D. Griessel
Universitas Academic Hospital

P.O.Box 28077
Danhof
9310

24 June 2011

Marin Taljaard
Head of Department: Occupational Therapy
Universitas Academic Hospital
1 Logeman Street
Bloemfontein
9301

PERMISSION TO CONDUCT A CLINICAL TRIAL AS PART OF A RESEARCH STUDY AT THE OCCUPATIONAL THERAPY DEPARTMENT, UNIVERSITAS ACADEMIC HOSPITAL.

Study title: Sensory integration intervention and the development of the extremely low to very low birth weight premature infant.

Dear Ms. Taljaard

I am requesting permission to conduct a clinical trial as part of my Magister in Occupational Therapy degree (UFS) research study at the Occupational Therapy Department, Universitas Academic Hospital.

The aim of this research is to determine the effect of sensory integration therapy, a technique of occupational therapy, which provides playful meaningful activities that enhance an individual's sensory intake and leads to more adaptive functioning in daily life on the development of the Extremely Low Birth Weight (ELBW) or Very Low Birth Weight (VLBW) premature baby.

I would like to investigate whether the Sensory Integration programme specifically, which consist of weekly therapy sessions of 30 - 45 minutes each over a period of 10 weeks, together with a home programme could have a positive effect on the development of these premature infants within the first 12 months and therefore ask for your permission to conduct this study at Universitas Academic Hospital with parents and premature infants that has been discharged from the Universitas Academic Hospital, Neonatal Intensive Care Unit and followed-up in the premature infant clinics.

This study will be a randomized controlled clinical trail and only infants who's parents have given informed consent will be included in the study. The premature infants participating in this study will be allocated randomly into two groups, Group A: an experimental group that will receive the specific sensory integration intervention and Group B: a control group that will receive standard procedures and follow-up clinics offered by Universitas Academic Hospital. Parents with infants in Group A will be expected to bring their babies to the Occupational Therapy Department at Universitas Academic Hospital once a week over the 12 week period on selected appointment dates. Parents with infants in Group B will be expected to bring their babies to the Occupational Therapy Department at Universitas Academic Hospital only for two assessment appointments, 12 weeks apart.

The study will be conducted according to the Declaration of Helsinki and the guidelines of the International Conference on Harmonzation (ICH) for Good Clinical Practice (GCP). This research proposal has been approved by an Expert Committee on 22 of June 2011 and will be presented to an Evaluation Committee in July 2011 and the Committee on Human Research Ethics of the University of the Free State either on 26 July 2011 or 16 August 2011.

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The therapists conducting the assessments will also assess and nurture all parents' understanding and skills in recognizing and responding appropriately to their infant's cues of stress or stability which will help parents understand their infant's behaviour better.

All parents will receive information and guidance on stimulating their infants in terms of reaching their developmental milestones either during the study or after the study. All results obtained from the study could be used for recommendations or further investigation if needed once the study has been completed.

The results of this study are specifically aimed at the infant's long-term developmental needs. Through obtaining results in terms of the effect of sensory integration therapy on the development of the premature infant in his first year, the researcher will be able to:

- Recommend intervention programmes for occupational therapists using sensory integration intervention and home programmes for parents, and therefore helping premature infants to reach their developmental milestones and/or overcome developmental difficulties easier,
- empower and educate therapists with suitable and safe principles for sensory integration therapy with premature infants,
- provide parents with guidelines in terms of suitable stimulation for their infants,
- implement preventative measures for treating premature infants,
- identify premature infants that are at risk for optimal development,
- present a publication on the findings of the study to health professionals working with premature infants to make them aware of the importance of sensory integration in the development of premature infants, and
- recommend further studies in the field of sensory integration therapy with premature infants.

Thank you for your attention, please contact me if any further information is needed.

Yours sincerely

Elise Lecuona
Senior Occupational Therapist
Universitas Academic Hospital
Tel: 051 405 3405
Cell: 082 783 9870

I hereby grant permission for Elise Lecuona, to conduct the above described clinical trial with the study title: *Sensory integration intervention and the development of the extremely low to very low birth weight premature infant*, as part of her Magister in Occupational Therapy degree (UFS) research study at the Occupational Therapy Department, Universitas Academic Hospital.

M. TALJAARD

Marin Taljaard
Head of Department: Occupational Therapy
Universitas Academic Hospital

ADDENDUM L

AGREEMENT CONTRACT BETWEEN RESEARCHER AND THE ASSESSMENT OCCUPATIONAL THERAPIST

AGREEMENT BETWEEN THE RESEARCHER AND EVALUATION THERAPIST

I, Elsa Viljoen hereby agree to participate as an evaluation therapist for the research study; Sensory integration intervention and the development of the extremely low to very low birth weight premature infant.

I agree to perform the following assessments to the best of my ability on all infants participating in the study in a professional manner for the pre- and post intervention tests, 10 weeks apart:

- The Infant/Toddler Sensory Profile (Dunn)
- The Test of Sensory Function in Infants, TSFI (De Gangi)
- The Bayley III Development scale for Infants and Toddlers

I will comply to the Ethical code prescribed by the HPCSA and OTASA and will handle patient information with confidentiality. I understand that I will be paid a honorarium of R150 per assessment for participating in this study.

Signed at ......Bloemfontein...................... on ....28..../....06..../2011

Elsa Viljoen ....
Evaluation Therapist: Name

E Viljoen ....
Evaluation Therapist: Signature

Elise Lecuona ....
Researcher: Name

E Lecuona ....
Researcher: Signature

Anlia Meteler kamp ....
Witness: Name

Meteler kamp ....
Witness: Signature