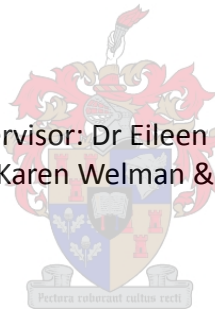


# **A SENSORY-MOTOR INTEGRATION PROGRAMME FOR BOYS WITH AUTISM SPECTRUM DISORDER: TWO CASE STUDIES**

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*Thesis presented in partial fulfilment of the requirements for the degree of  
Master of Science in Sport Science at  
Stellenbosch University*



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December 2014

## DECLARATION

I, Carla-Rae Hagemann, hereby declare that the information in this thesis is my original work, that I am the owner of the copyright thereof (unless to the extent explicitly otherwise stated). I have not previously submitted its entirety or in part for obtaining a qualification from any other Institution.

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**Signature**

December 2014  
**Date**

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## SUMMARY

Autism Spectrum Disorder (ASD) has been described as a neuro-developmental disorder influencing the social interaction and communication skills of individuals. Those with ASD have been observed to experience sensory input challenges, which could result in motor delays. Descriptive research was conducted with two case studies, who were boys aged 6- and 8-years, diagnosed with ASD. The purpose of the study was to design and implement a Sensory-Motor Integration (SMI) programme for each boy and to assess the effect it had on the sensory motor skills of the boys over time.

At the start of the intervention, the boys were assessed with three neuro-developmental and diagnostic evaluations (Social Communication Questionnaire, Autism Diagnostic Interview Revised and Autism Diagnostic Observation Schedule-2<sup>nd</sup> Edition) conducted by a psychiatrist to re-affirm their previous ASD diagnoses. The two boys (Subject A and Subject G) participated in individualised sessions of 30 minutes each, twice a week for seven months. The SMI programme focused on vestibular and somato-sensory (proprioceptor) variables. The Quick Neurological Screening Test-3 (QNST III) and the Sensory Input Systems Screening Test (SISST) were used to evaluate the latter at baseline. These were repeated regularly, every 4 to 5 weeks, over the 7-month period and included a retention test of 5 weeks. Based on the results from the subtests of the motor skill tests, a self-designed SMI programme was integrated into the planning of the intervention programme for each boy according to their sensory-motor needs.

Subject A showed improvement in the following vestibular subtests in the QNST-III: *Stand on one leg* (67%) and *Tandem walk* (83%) and retaining his standard from the Post-test to the Retention test. For muscle tone ability and proprioception, the *Arm and leg extension* subtest also demonstrated improvement (67%) from the Pre-to the Post-test. The results of the subtest were not retained over the retention period and increased only slightly being 33% from the baseline score.

The proprioceptive function of Subject A showed great improvement in the following QNST-III subtests: *Finger to nose* (67%), *Rapidly reversing repetitive hand movements* (88%) and *Left and right discrimination* (67%). The results of vestibular-related subtests for Subject G showed improvement in the following: *Stand on one leg* (33%) and the *Arm and leg*

*extension* task (33%). Some of the scores of Subject G started in the functional category of “severe discrepancy”; however there was improvement in the following proprioception-related subtests: *Finger to nose* (43%), *Thumb and finger circles* (20%), and *Reversing repetitive hand movements* (86%). Although Subject G showed gradual improvement over time, his two sensory systems struggled to integrate with the more complex tasks. The outcome of the individualised SMI programmes showed that the sensory-motor skills improved by enhancing the stimulation of their vestibular and somato-sensory (proprioception) function.

Regarding the SISST, Subject A progressed from a ‘fail’ to ‘pass’, in the following test items: the *Tonic Labyrinthine Supine* (TLS), *Tonic Labyrinthine Prone* (TLP), *Positive Support Reflex* (PSR) and the *Ocular Alignment test* items. Results from the *Vestibular test* for both Subject A and Subject G appeared to be ‘hypo-vestibular’ (under-stimulated) according to the Post-Rotary Nystagmus test (PRN) score at baseline. These scores were inconsistent during the intervention. The only test item to show positive improvement for Subject G was the *Equilibrium Reactions*. Lastly, both Subject A and Subject G remained in the ‘fail’ category for *Kinaesthesia*, which may indicate their ongoing poor proprioception and spatial orientation.

There is a need for further research in the area of sensory-motor individualised programmes for children with ASD. Suggestions for future research interventions are to conduct the individualised programmes either over a longer period of time and more frequently at three times a week.

**Key words:** Autism Spectrum Disorder (ASD); Boys; Sensory-motor integration programmes; Quick Neurological Screening Test-3 (QNST III); Sensory Input Systems Screening Test (SISST).

## OPSOMMING

Outisme Spektrum Versteuring (OSV) word beskryf as 'n neuro-ontwikkelingsversteuring wat die sosiale interaksie en kommunikasie van individue beïnvloed. Daar is waargeneem dat diegene met OSV, uitdagings met betrekking tot sensoriese insette ervaar, wat kan lei tot motoriese agterstande. Beskrywende navorsing is toegepas met twee gevalle-studies. Die ouderdom van die twee seuns wat met outisme gediagnoseer was, was 6- en 8-jaar oud.

Die doel van die studie was om 'n Sensories-Motoriese Integrasie (SMI) program te ontwikkel en te implementeer as intervensie wat op elk van die seuns spesifiek toegespits is. Die intervensie-program het voorsiening gemaak om aan die uitvoering van bepaalde motoriese vaardighede aandag te skenk en om die uitwerking daarvan oor die 7-maande tydperk te assesser. Die twee seuns (Geval A en Geval G) het individuele sessies van 30 minute elk twee keer per week bygewoon. Die SMI program het op die vestibulêre en somato-sensoriese (proprioceptor) sisteme gefokus om hul vermoë en vordering waar te neem.

Aan die begin van die studie is drie neuro-ontwikkelings- en diagnostiese meetinstrumente (SCQ, ADIR-R en ADOS) deur 'n psigiater gelei om die vorige OSV diagnose van die seuns te bevestig. Die "Quick Neurological Screening Test" (QNST III) en die "Sensory Input Systems Screening Test" (SISST) is benut om hul aanvangsvermoë as basislyn te bepaal. Hierdie toetse was gereeld herhaal, elke 4 tot 5 weke oor 'n tydperk van 7 maande en het 'n retensie toets van 5 weke ingesluit. Op grond van die resultate van die sub-toetse van die vermelde motoriese vaardigheidstoetse, is die self-ontwerpte SMI intervensie-program vir elke seun, volgens sy persoonlike sensoriese-motoriese behoeftes, beplan.

Geval A het verbetering getoon in die volgende QNST-III sub-toets: *Staan op een been* (67%) en *Tandemloop* (83%), en handhaaf sy standaard vanaf die na-toets tot en met die retensie toets. Vir spiertonus en proprioepsie, het die *Arm- en been-ekstensie* sub-toets ook 'n verbetering (67%) van die voor-toets tot die na-toets getoon. Die resultaat van hierdie sub-toets is nie oor die hele tydperk gehandhaaf nie, en het net effens verhoog (33%) van die basislyn telling. Die proprioseptiewe funksie van Geval A het 'n groot verbetering in die volgende QNST-III sub-toets getoon: *Vinger na neus* (67%), *Vinnige omkeer, herhalende hand bewegings* (88%) en *Links en regs diskriminasie* (67%). Geval G se resultate vir die

vestibulêre-verwante sub-toetse het verbetering in die volgende getoon: *Een been staan* (33%) en *Arm- en Been-ekstensie* (33%).

Sommige van die resultate van Geval G het op 'n ernstige diskripsie begin, maar daar was verbetering in die volgende proprioseptiewe verwante sub-toetse: *Vinger na neus* (43%), *Duim en vinger sirkels* (20%) en *Vinnige omkeer, herhalende hand bewegings* (86%). Ten spyte daarvan dat Geval G 'n geleidelike verbetering oor tyd getoon het, het sy twee sensoriese stelsels gesukkel om met die meer komplekse take met mekaar te integreer. Die uitkoms van die geïndividualiseerde SMI programme het getoon dat die sensoriese-motoriese vaardighede by beide seuns verbeter as gevolg van die verbeterde stimulering van hul vestibulêre en somato-sensoriese (proprioseptiewe) funksie.

Die SSIST resultate toon dat Geval A van 'druip' na 'slaag' in die volgende toetsitems gevorder het: *Tonic Labyrinthine Supine (TLS)*, *Tonic Labyrinthine Prone (TLP)*, *Positive Support Reflex (PSR)* en die *Ocular Alignment* toetsitems. Resultate van die vestibulêre toets, blyk dit dat sowel Geval A as Geval G 'hipo-vestibulêr' (onder-gestimuleer) was volgens die "*Post-Rotary Nystagmus toets*" (PRN) meting wat by die basislyn toetsing behaal is. Hierdie tellings was veranderlik tydens die intervensie. Die enigste toetsitem wat 'n positiewe verbetering by Geval G getoon het, was die *Ekwilibrumsreaksie*. Laastens, beide Geval A en Geval G het in die 'druip' kategorie vir *Kinestese* gebly wat daarop dui dat hul swak proprioepsie en ruimtelike oriëntasie steeds teenwoordig was.

Daar is 'n behoefte aan verdere navorsing op die gebied van sensoriese-motoriese individuele programme vir kinders met OSV. Toekomstige navorsing wat individuele programme benut, moet oorweeg om die intervensie oor 'n langer tydperk (bv. een jaar) te laat geskied met meer sessies per week (bv. drie sessies).

**Sleutelwoorde:** Outisme Spektrum Versteuring (OSV); Seuns; Sensoriese-Motoriese Integrasie programme; "Quick Neurological Screening Test-3" (QNST III); "Sensory Input Systems Screening Test" (SISST).

The source of my heartbeat and all that I am:

*“You hem me in-  
behind and before;  
You have laid your hand upon me.  
Such knowledge is too wonderful for me,  
too lofty for me to attain.”*

Psalms 139:5-6

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**Chapter 1**  
**STATEMENT OF THE PROBLEM**

**INTRODUCTION**

“Our brains organize all that we do. They create order out of chaos and make sense of the constant flow of stimulation coming our way.”  
 (Baniel, 2012:29)

About 70 years ago, a psychiatrist, Leo Kanner, provided the first clinical description of Autism, by defining a group of children (eight boys and three girls) as having “extreme autistic aloneness” (Kanner, 1943:242).

**Table 1.1 DESCRIPTION OF AUTISM FROM ORIGIN TO RECENT (1943-2013)**

| PORTRAYING AUTISM FROM KANNER TO DSM-V * |   |
|--|---|
| Leo Kanner                               | “Autistic Disturbances of Affective Contact” (1943): describes 11 children with “extreme autistic aloneness,” delayed echolalia, and an “anxiously obsessive desire for the maintenance of sameness”; have extraordinary memory skills  |
| 1950–60s                                 | Autism was widely regarded as early presentation of childhood schizophrenia, an emotional disturbance rooted in parent–child psychodynamics; no consistent definition   |
| 1970s                                    | Decline of psychogenic paradigm; Autism understood as biologic in origin and no longer incompatible with mental retardation.  |
| 1980 DSM-III                             | Defines infantile Autism as a pervasive developmental disorder (distinct from schizophrenia) involving three domains: “lack of responsiveness to other people (Autism), gross impairment in communicative skills, and bizarre responses to various aspects of the environment, all developing within the first 30 months of age”.   |
| 1987 DSM-III                             | Provides a more complex definition of autistic disorder that requires meeting 8 of 16 criteria among the three domains of social interaction, communication, and restricted interest or activities; drops requirement for early onset in life and provides new category: “Pervasive Developmental Disorder, Not Otherwise Specified (PDD-NOS)” for children meeting some but not all diagnostic criteria for autistic disorder.   |
| 1994 DSM-IV<br>2000 DSM-IV               | Further refinement of increasingly complex criteria for autistic disorder; number of pervasive developmental disorders expanded to five, including Asperger’s disorder and Rett’s syndrome.   |
| 2013 DSM-5                               | Autism spectrum disorder defined in terms of two categories: “persistent impairment in reciprocal social communication and social interaction” plus “restricted, repetitive patterns of behaviour”, both present from early childhood; Asperger’s disorder, PDD-NOS and other subcategories, such as atypical Autism are eliminated; diagnosis requires specifying presence or absence of accompanying intellectual disability, language impairment or associated medical or genetic condition. |

\* Source: Baker, 2013:1090

Eventually, in 1980, autism featured with its own category and diagnostic criteria in the *Diagnostic and Statistical Manual of Mental Disorders, 3<sup>rd</sup> Edition (DSM-III)* (Baker, 2013:1091). Overtime, (Table 1.1), psychiatrists, parents and educators have observed how the strongest genetically influenced childhood psychiatric disorder (Palmen & Van Engeland, 2004:32) has developed and spurred on in research. Table 1.1 reveals how the diagnostic criterion has developed in the *Diagnostic and Statistical Manual of Mental Disorders (DSM)* in the progression of different editions published (DSM-III, DSM-IV, DSM-5).

Unfortunately, with regard to research in Africa, there have not been many publications completed on Autism (Bakare & Munir, 2011:210; Springer *et al.*, 2013:95). The prevalence of Autism Spectrum Disorders (ASD) in South Africa is currently unknown (Bakare & Munir, 2011:209; Elsabbagh *et al.*, 2012:171; Springer *et al.*, 2013:95).

Diagnostic criteria for individuals with ASD require evident deficits in social interaction and communication discrepancies, including repetitive behaviours with restricted interests (Lord *et al.*, 2000:355; Worley & Matson, 2012:969; APA, 2013:49). As ASD has been classified as a neuro-developmental disorder (Baranek *et al.*, 2007:233; APA, 2013:31), research has confirmed that sensory dysfunctions are also widespread in children with ASD, as they may be under or over responsive to sensory input (Ben-Sasson *et al.*, 2009:10; Gal *et al.*, 2010:458; Hilton *et al.*, 2010:942; APA, 2013:50; Cheldavi *et al.*, 2014:12,13).

A connection has been made with poor sensory processing or sensory dysfunction and motor delays and poor motor skills in children with ASD (Weimer *et al.*, 2001:99; Jasmin *et al.*, 2009:239). Despite motor impairments being deemed to be associated symptoms, they are not considered part of the diagnostic criteria in the DSM-5 for ASD (Green *et al.*, 2009:315; APA, 2013:55).

The motor impairments that have been observed in individuals with ASD, include clumsiness, unusual gait (APA, 2013:55), unstable balance and poor postural control (Freitag *et al.*, 2007:956; Whyatt & Craig, 2012:1805; Cheldavi *et al.*, 2014:12), unusual gait (Jansiewicz *et al.*, 2006:619; Ming *et al.*, 2007:568), reduced object control and locomotion skills (Jasmin *et al.*, 2009:238; Pan *et al.*, 2009:1702; Staples & Reid, 2010:214).

Research has confirmed that children with ASD and sensory processing challenges have also been observed to display impairment in their sensory-motor skills (Whyatt & Craig, 2013:7).

These involve the functioning of the visual, vestibular and somato-sensory systems (Minshew *et al.*, 2004:2058, 2059; Jasmin *et al.*, 2009:239; Hilton *et al.*, 2010:942; Izawa *et al.*, 2012:10). Dysfunction in these sensory areas and motor skills also correlate with the severity of poor social skills and behavioural irregularities (Baranek, 1997:93, 94; Baranek *et al.*, 2007:241; Baranek *et al.*, 2013:313), as it is likely that motor skill impairment may be delaying social and communication skills to develop and grow in children with ASD due to the severity of poor motor skills (Sutera *et al.*, 2007:105; MacDonald *et al.*, 2013:278). However, this area still needs to be explored.

Even though there are many findings indicating motor impairment in children with ASD, there is limited research presently on the effects of sensory-motor therapy, which highlights its importance for future research (Bhat *et al.*, 2011:1126; Lloyd *et al.*, 2013:144; MacDonald *et al.*, 2013:277). Recent findings from a meta-analysis of ASD and motor dysfunction, suggest that when treating those with ASD, interventions should involve providing sensory-motor experiences along with developing motor coordination to improve motor performance in balance, gait, upper limb function and motor planning (Baranek, 2002:418; Fournier *et al.*, 2010:1237).

This has led to the approach of sensory-motor integration therapy, which is a multi-faceted approach that has been used for children with learning needs, developmental delays and ASD. Abbruzzese and Berardelli (2003:232) describe sensory-motor integration (SMI) as the development and procedure of the central nervous system receiving sensory information and integrating it to create a motor reaction or movement (Velasques *et al.*, 2013:4).

As the brain or central nervous system has the ability to adapt (neuro-plasticity) (Lane & Schaaf, 2010:387; Haibach *et al.*, 2011:215), a study about SMI programmes for children with Autism has been conducted and improvement was seen in the cognitive skills of the children between the years of three- to four-years old (Woo & Leon, 2013:5).

## **PROBLEM STATEMENT**

The main purpose of the current study was to observe the potential impact of an individualised sensory-motor integration programme. The aim of the study was to design and implement an 8-month individualised sensory-motor integration programme for two boys (six and eight years of age) diagnosed with Autism Spectrum Disorder (ASD). The

objectives first followed the ASD diagnosis of the two boys. Secondly, motor delays relating to the vestibular and somato-sensory (proprioception) systems, were required to be identified through a testing procedure before and after the intervention. In addition the researcher aimed to regularly monitor and assess the relevant sensory-motor variables (balance, muscle tone, eye tracking, ball skills, motor planning and body and spatial awareness). Lastly, a retention period of 5 weeks was conducted in order to observe if there was a prolonging effect of the SMI programmes on the two boys.

### **Motivation of study**

There are not many individualised movement intervention programmes for children with ASD (MacDonald *et al.*, 2013). Also when researching the topic on sensory-motor integration, limited findings are presented regarding children with ASD and improving their sensory-motor delays (Baranek, 2002:397). There is also a need for sensory-motor integration programmes specifically assessing the vestibular and proprioceptor systems in children with ASD (Bhat *et al.*, 2011; Lloyd *et al.*, 2013). Due limited publications in these areas, this has created a space for research and motivated this study.

## **METHODOLOGY**

### **Research design**

This study applied a mixed method approach which combined qualitative and quantitative information and focused on two case studies. Conducting case studies enables a more in-depth, holistic approach to the problem than a survey study may provide (Thomas *et al.*, 2011:19; Yin, 2014:6).

### **LIMITATIONS**

The possible restrictions of this study are related to the ASD characteristics of the boys involving the social communication challenges and the symptoms of delayed responding to instructions. Therefore, the participation in the SMI programmes, as well as having to learn new skills would take longer than expected. Another limitation was that there are very few published studies available that focused specifically on ASD, sensory-motor integration impairments and motor skill challenges (Baranek, 2002:397; Woo & Leon, 2013:8).



## **STATISTICAL ANALYSIS**

The results of the relevant sensory-motor skills test were analysed with the assistance of the official consulting statistician at Stellenbosch University. He assisted with the analysis, interpretation and presentation of the results using Statistica 12, and provided graphic representations of the results to show the trends for the two boys over time. In addition to the quantitative data using the time series design, continual observations were recorded by the main researcher. This provided the in-depth, descriptive information about each case study during the 8-month intervention.

## **ETHICAL ASPECTS**

A proposal for the study was submitted to the Stellenbosch University Ethics Committee (Protocol #: HS895/2013) and approval was granted to proceed with the intervention. This was followed by approaching the principal of the private school who gave permission for the study to take place at the school. Once the boys had been selected, the researcher gave them the opportunity to participate in an individual interview concerning some items of the consent form. This took time as one of the boys first needed to become familiar with the researcher. The parents were also involved and were interested to view the consent forms. They were assured that no offensive or dangerous activities would be enforced on the boys and that the boys would be at minimal risk while participating in the study. The boys and the parents were informed that they could withdraw from the study at any time, if they felt any discomfort or fatigue. The parents were assured that the name of their son would remain confidential. The parents signed the consent form willingly.

## **SEQUENCE OF CHAPTERS**

Chapter 1 provides the introduction for and problem statement of the current study. This is followed by Chapter 2, which focuses on the review of related literature regarding the relevant information and theories concerned with the specific topic of this study. Chapter 3 presents the details of the methodology implemented to assess the two case studies. An analysis and discussion of the results follows in Chapter 4. Finally, Chapter 5 concludes the report of this study with a summary of the findings, along with the limitations of the study and recommendations for future research.

\*Referencing method: Modified Harvard

“Movement is life; without movement life is unthinkable.”  
Moshe Feldenkrais, 2010 cited in Baniel, 2012:47

## Chapter 2

# LITERATURE REVIEW

### INTRODUCTION

“The human body is made up of systems that keep it alive. The one that keeps you breathing, the one that keeps you standing, the one that makes you hungry and the one that makes you happy. They're all connected, take a piece out and everything else falls apart. And it's only when our support systems look like they might fail us that you realize how much we depended on them all along.”

*(Meredith: From “Greys Anatomy”- Season 8, episode 9)*

This review explains the foundations of sensory systems and how the delays or dysfunctions in these sensory systems may affect children with Autism Spectrum Disorder (ASD). The physiology of the vestibular and somato-sensory systems (proprioception), as well as their roles and purpose in motor skills, will be discussed. This will lead onto introducing rehabilitation methods that have been used for children with ASD. Followed by literature providing the motivation for this study, sensory-motor integration (SMI) and the possible benefits it may have for children with ASD.

### AUTISM SPECTRUM DISORDER (ASD)

#### Prevalence of ASD

A neuro-developmental disorder which has persevered in effecting the social communication and social interaction skills of individuals has been described as Autism Spectrum Disorder (ASD) (Palmen & van Engeland, 2004:31,32; Worley & Matson, 2012:969). The latest research of the *Center for Disease Control and Prevention* (CDCP) reports that the occurrence of ASD is 1 child in 88 who are diagnosed with ASD compared to 1 out of 150 recorded in 2008 for children in the United States (CDCP, 2012:16). Higher prevalence has occurred in males, recording 1 in 54, compared to females which have shown 1 in 252 is diagnosed.

## Characteristics of ASD

Over the last 20 years, ASD was classified under the ‘umbrella category’ of Pervasive Developmental Disorders (PDD), which was made up of the Autistic Disorder (AD), Asperger’s Disorder (AS), Pervasive Developmental Disorder– Not Otherwise Specified (PDD-NOS), Childhood Disintegrative Disorder and Rett’s Syndrome (Baker, 2013:1091). However, the new *Diagnostic and Statistical Manual of Mental Disorders, 5<sup>th</sup> Edition* (DSM-5) has removed PDD-NOS, Asperger’s Disorder and Autistic Disorder and all their characteristics have been included under the term of ASD. When diagnosing a child, there is a limited criteria to choose from, such as the child must qualify for the three subcategories of social interaction, social communication and restricted, repetitive and stereotypical patterns of behaviour (APA, 2013:51; Baker, 2013:1091). However, each individual with ASD will compensate in their own distinctive manner for his or her delay in development. Even two people, who may have the same observational score for ASD, will not express themselves in the same way (Savarese, 2013:2).

Currently, or by history, an individual must meet criteria A, B, C, and D to be diagnosed with ASD, according to the DSM-5 (APA, 2013:51)

- A.** Persistent deficits in social communication and social interaction across contexts, not accounted for by general developmental delays.
- B.** Restricted, repetitive patterns of behaviour, interests, or activities.
- C.** Symptoms must be existent in early childhood (but may not become fully manifest until social demands exceed limited capacities.
- D.** Symptoms together restrict and delay everyday functioning.

Included in the diagnostic criteria of the DSM-5, under the developmental section of “restricted, repetitive patterns of behaviour” for individuals with ASD, there are certain types of behaviours which could be displayed. One of them is being drawn to or away from certain sensory stimuli (hypo-or hyperactive) (APA, 2013:50). This may suggest an imbalance in one or more of their sensory systems. Based on information provided about children with ASD, the sensory system plays a major role in the development. Therapists, who aim to design interventions and assess the outcomes of treatments on subjects with ASD, need to grasp the functioning of how the brain responds to information received by the sensory

systems (Marco *et al.*, 2012:347). This introduces the next section involving the underlying processes of the central nervous system.

## **BASIC PRINCIPALS OF NEUROPHYSIOLOGY**

### **Central Nervous System**

In the first three years of a child's life, the brain increases in size until it is about 80% in weight of that of an adult brain. This great increase in dimension is due to the numerous connections created between nerve cells the brain develops. With regard to the brain's function, Baniel (2012:95) states its role in a clear and concise way:

“The brain's function is creating maps of the child's body and its movements, creating cognitive structures, and organizing its emotions”.

Johnson and Soucacos (2010:10) have referred to the brain as having two maps. One involves the body schema, which interprets the location of the body in space (Fazlioglu & Gunsen, 2011:357) and the other map is the body's explanation which deciphers the position of each segment of the body. The different sensory systems form part of these maps and make up the central nervous system (CNS).

The nervous system consists of the peripheral nervous system (PNS) and the CNS. The PNS contains neurons that send signals from the nervous system with sensory information or movement (Powers & Howley, 2001:112; Silverthorn, 2007:246). The CNS is divided into the brain and the spinal cord (Glomstad, 2004:8) where signals or neurons travel to these areas and are interpreted (Cheatum & Hammond, 2000:187).

There are numerous connections that link the PNS with the lower areas of the spinal cord and the brain. These connections involve the processing of sensory responses and feedback about the external environment, producing awareness of the body's position in space and convey this to the brain to respond (Strominger *et al.*, 2012:156). This reveals that the CNS has the ability to process a variety of incoming sensory information from the rest of the body (Johnson & Soucacos, 2010:7).

During this complex process, the CNS organises and refines the received information and conveys it accordingly to the correct places for the purpose of producing different motor actions (Johnson & Soucacos, 2010:7). The CNS receives information from the PNS via sensory inputs which communicate important information regarding the regulation of

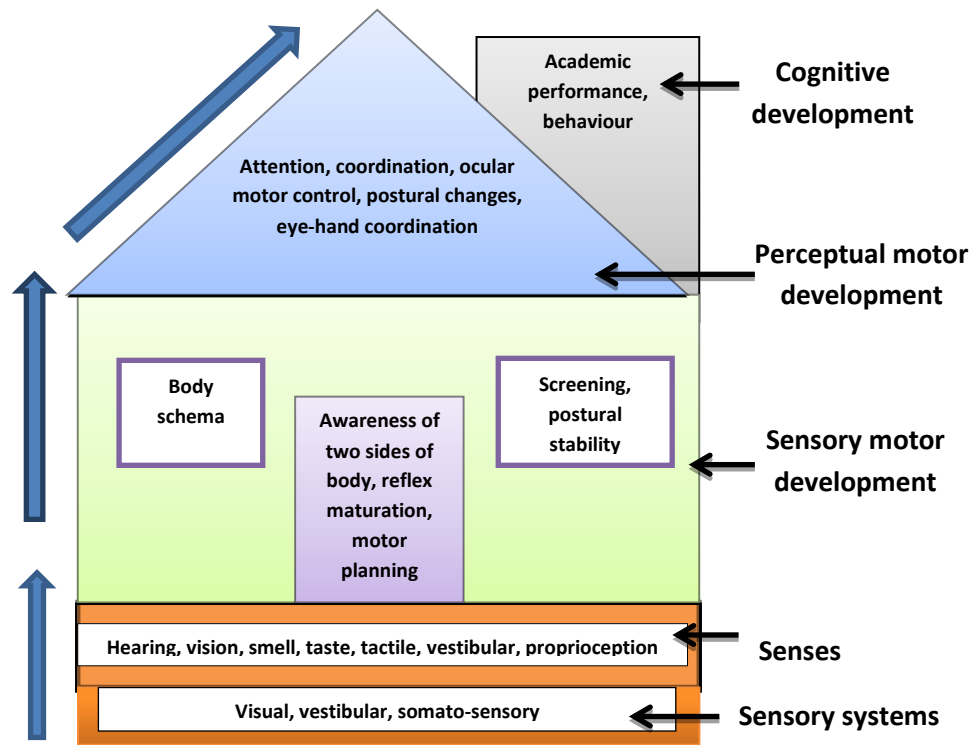
movement and controlling the body (Cherng *et al.*, 2007:923; Shumway-Cook & Woollacott, 2007:174). The instruments in the PNS and CNS work in unison to constantly orientate the position of the head. They also process information with regard to coordination of movements by implementing basic motor reflexes and the eyes, head, limbs and trunk movements (Day & Fitzpatrick, 2005 cited in Rine & Wiener-Vacher, 2013:508).

It is important to grasp the association of the CNS with sensory-motor integration and movement, which leads to describing the three different levels of the CNS. Velasques *et al.* (2013:3) explain these subdivisions where the spinal cord is the first level. The second level involves the areas in the brain that receives information from the spinal cord, such as the cerebellum, basal ganglia including the vestibular nuclei and reticular formation. This information originates from the brainstem which forms a 'bridge' between the brain and the spinal cord (Humphries *et al.*, 2006:503). These areas work with the spinal cord to assist in controlling posture. The third level involves the cerebral cortex, which controls the integration of movements and modifies them into more complex and advanced actions (Velasques *et al.*, 2013:3).

The senses that form part of the PNS and are integrated with the CNS include, the visual (sight), auditory (hearing), olfactory (smell), gustatory (taste) and tactile (touch) senses, which supply information to the brain from the world outside of the body (Dunn *et al.*, 2002:173). The two sensory systems, the vestibular and somato-sensory, provide information about the sensations occurring inside of the body (Damann *et al.*, 2008:884; Johnson & Soucacos, 2010:1). However, these sensory systems do not work alone in initiating movement, as they rely on each other for the understanding or the interpretation of the information received (Cheatum & Hammond, 2000:127).

As a result, these systems bridge the gap between the brain and the body in order for the brain to receive information about the body's position and initiate a reaction (Dunn *et al.*, 2002:173; Glomstad, 2004:12; Shumway-Cook & Woollacott, 2007:174; Angelaki & Cullen, 2008:126).

The three specific sensory systems, namely visual, vestibular and somato-sensory, are involved with the position of the body in space, as well as when the body is in motion (Ricci *et al.*, 2009:165).



**Figure 2.1** SENSORY SYSTEMS LEADING TO DIFFERENT BODY FUNCTIONS AND MOTOR SKILLS (Adapted from Andersen, 2012)

Figure 2.1 shows the processes which cause the development skills and eventually the academic performance of a child. The arrows represent the growth and development from the base up toward the roof and chimney. The sensory systems are the foundation of functional motor movements and skills and serve as the sensory information to the CNS. According to Auxter *et al.* (2010:141), the sensory systems (vestibular, visual and somato-sensory) in the body need to be stable and functional so that the information can be sent correctly to the CNS for interpretation. This leads onto *sensory processing* of the senses in the second base of Figure 2.1 (hearing, vision, smell, taste, touch, vestibular, proprioception).

Then follows the green section, the ‘walls of the house’ (Figure 2.1) that represents *sensory motor development* and the function’s derived from the integration of sensory information. Further development progresses to perceptual-motor development, which involves skills combining cognitive processes and movement (Haywood & Getchell, 2009:192). The ‘chimney’ is the highest level of more complex and intricate skills of the cognitive ability of the child that assists academic work. Therefore, if one of the sensory systems or a child’s

maturation milestones are delayed or do not occur, it may lead to challenges in the above areas later on in the life of the child (Voight *et al.*, 2011:103; Goddard-Blythe, 2014:12,18).

Rine and Wiener-Vacher (2013:513) did an in-depth study of the vestibular system and reported that a central nervous system disorder could result in vestibular problems, which may affect the ability to balance and to perform coordinated movements. Therefore, feedback from the sensory systems has the ability to identify the external surroundings and body position (Strominger *et al.*, 2012:155). In order to understand how motor skills occur, the vestibular and somato-sensory (proprioception) systems and sensory systems need to be studied. The physiology of the vestibular system will be discussed in order to portray its important role in the functioning and movement ability of the human body, especially of it relates to children.

## **Vestibular system**

The vestibular system is a significant sensory system that has the most influence on all the other sensory systems in the body and their ability to function normally. It is known as the balance organ and our “sixth sense” due to its involvement in the activation of receptors to help keep the body in equilibrium (Angelaki & Cullen, 2008:126; Writer & Arora, 2012:54). The physiology and structure of the vestibular system is part of a complex multi-sensory relationship between the cortex, cerebellum, brain stem, spinal cord, the eyes, the inner ear and somato-sensory responses (Day & Fitzpatrick, 2005:1; Rine & Wiener-Vacher, 2013:508).

Rine *et al.* (1998:21) tested the sensory organisation in children from three to seven and half years of age and found that even by the age of seven-years old their postural control had not yet developed fully. Regarding the ability of the vestibular system to function completely, Glomstad (2004:12) stated that the vestibular system may only reach maturity around the age of 10. The debate continues as more recent research conducted by Peterson *et al.* (2006:462) comparing children to adults and the age at which balance control would mature. Their findings suggest that the response of children to balance and postural control mature around 12 years of age or even later.

For motor development to take place, the vestibular system integrates sensory information from other systems which are vital for balance, the control of eye movements, as well as for



an individual to feel stable and to be coordinated while moving in space (Writer & Arora, 2012:54). For example, the sensory and motor systems work together to stabilise a balanced position (static balance). Therefore, there needs to be specific apparatus in place.

Hidden in the inner ear, are specific organs that make up the vestibular apparatus. They contain sensory receptors which identify sensations related to balance and equilibrium (Solan *et al.*, 2007:1; Shumway-Cook & Woollacott, 2007:67; Writer & Arora, 2012:54). These include the peripheral sensory apparatus, a primary processor and the motor neurons for motor output (Writer & Arora, 2012:54). The peripheral sensory apparatus will be discussed in the following section and will lead onto the other two which involve processing the information.

### ***Vestibular receptors***

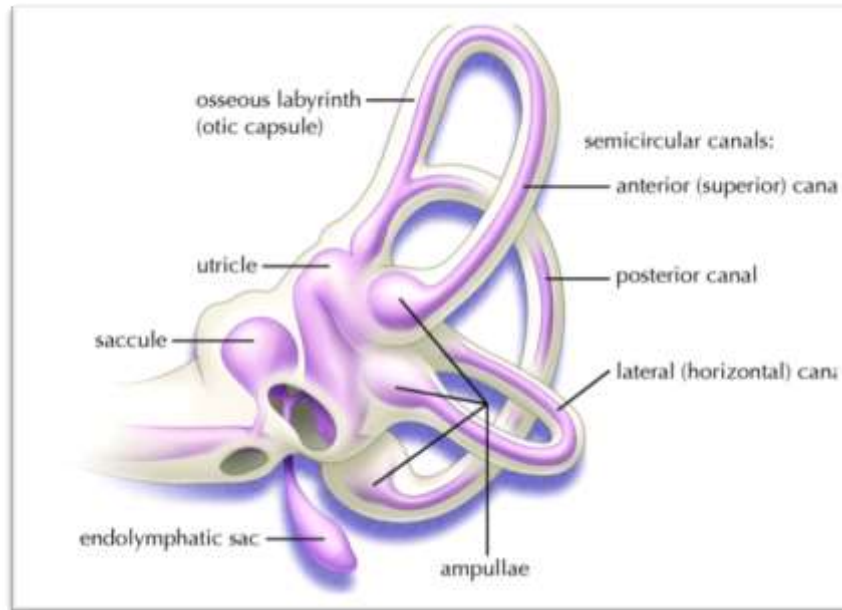
The peripheral apparatus is specifically situated in the labyrinth (Figure 2.2) of the inner ear (Tascioglu, 2005:24) which also includes the vestibular receptors. They are the three semi-circular canals and the vestibule which respond to body movement in relation to gravity and are sensitive to angular and linear motions (Rine & Wiener-Vacher, 2013:508). Therefore, it is gravity and movement that stimulate these receptors (Fazlioglu & Gunsen, 2011:353; Writer & Arora, 2012:55).

Located in the semi-circular canals are small motion sensors, hair cells (cilia), (Fernandez & Goldberg, 1971:661; Tascioglu, 2005:24; Herdman *et al.*, 2007:3) which direct information about the position of the head to the CNS (Writer & Arora, 2012:55). They also facilitate movements by communicating mechanical information about the movement of the head in space (Damann *et al.*, 2008:883). The other receptor, the vestibule, is made up of the utricle and saccule, which contain fluid-filled sacs (Phelps, 1996:1103).

The semi-circular canals sense rotational and angular movements and the utricle and the saccule are sensitive to linear movements that change speeds (Angelaki & Cullen, 2008:126; Rine & Wiener-Vacher, 2013:508). Therefore, when the head is tilted in different directions, it will stimulate these receptors (Cheatum & Hammond, 2000:187; Herdman *et al.*, 2007:4).

To remain in equilibrium, the body needs information from visual, somato-sensory and vestibular inputs including the integration of the information about the body of an

individual in the environment (Cherng *et al.*, 2007:914). *Vertigo* is the most common problem when it comes to problems with maintaining equilibrium.



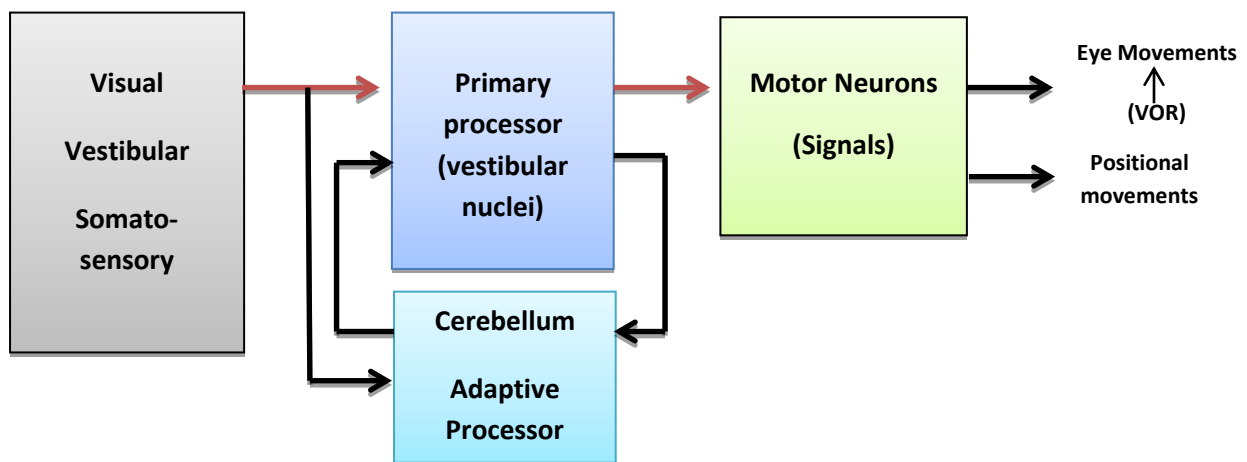
**Figure 2.2 VESTIBULAR APPARATUS AND RECEPTORS OF LEFT INNER EAR**  
(Parnes *et al.*, 2003:683)

It has been described as the distortion of sensory information due to dysfunctions in the vestibular system or the apparatus involved in the head and body's movement. Therefore, the visual system experiences an overload of information when the head is moving or when the eyes are trying to fixate to maintain a position (Rine & Wiener-Vacher, 2013:509-513). Nystagmus occurs when the semi-circular canals are stimulated. This involves rapid eye movements where the eyes can move horizontally, vertically, in a tilted manner, in rotation or even in a combination of these directions (Parnes *et al.*, 2003:681).

In order for movement to be synchronised and balanced, the semi-circular canals and the utricle and saccule communicate with the cerebellum (Billek-Sawhney & Perry, 2006:178). As the vestibular system is linked to the cerebellum (Glomstad, 2004:14), the brain assists in adapting posture and motor movements to the specific environment (Billek-Sawhney & Perry, 2006:178; Shumway-Cook & Woollacott, 2007:174). The cerebellum also works with the vestibular system to regulate eye and head movements (Robinson & Fuchs, 2001:982; Glomstad, 2004:14). As the cerebellum plays a part in assisting with balance, it also helps monitor eye movements and coordinates the head and eye when in motion (Billek-Sawhney & Perry, 2006:187). An integral vestibular system needs to function as a whole, as it is

important for the development of gross motor skills, balance and visual skills and spatial orientation (Rine & Wiener-Vacher, 2013:509). This occurs when the vestibular system delivers information to the brain, regarding the position of the head and its movement. When the body moves, the information of the head position is directed to the muscles in the eyes, the somato-sensory area in the cerebral cortex, the cerebellum and the spinal cord. This information is vital to assist in the positioning of the eyes and to maintain static and dynamic balance (Auxter *et al.*, 2010:154). Baniel (2012:109) states the function of the brain and the relationship with the sensory systems, in a colourful manner: “Without light the eyes cannot see, and without variation the brain cannot learn or organize action very well”.

The process illustrated in Figure 2.3, portrays how balance and equilibrium is sustained due to the visual, vestibular and somato-sensory systems working together. These three systems will integrate while the body is on a normal and stable surface. The systems are able to deliver information about the location of the body in relation to gravity and the base of support of the body (Moussa *et al.*, 2008:9).



**Figure 2.3 FUNCTION OF VESTIBULAR SYSTEM**  
(Adapted from Powers & Howley, 2001:122)

When the head is tilted or moves, the vestibular receptors are stimulated and information is received from the somato-sensory and visual system. These impulses are transported to the cerebellum and vestibular nuclei in the brain stem. When the brain receives this information and the CNS interprets it and adapts this information to evaluate the location of the head and the body. The motor output (motor neurons) (Figure 2.3) from the vestibular system is sent to the ocular muscles and to the spinal cord to communicate with three reflexes: the

Vestibule-Ocular Reflex (VOR), the Vestibulo-Collic reflex (VCR) and the Vestibulo-Spinal Reflex (VSR) (Powers & Howley, 2001:122; Silverthorn, 2007:246). To maintain balance, the function of the VOR is to create eye movements that will help the eyes to have clear vision while the head is moving. The VOR uses the information from the vestibular system (inner ear) to automatically revolve the eyes against the head if it is rotating (Nashner, 2009:21; Rine & Wiener-Vacher, 2013:508). The CNS controls how the VOR reacts (Writer & Arora, 2012:55) and when the VOR is stimulated, eye gaze is secured and balance is controlled (Goldberg *et al.*, 2012:4).

While the head is moving, the VCR stimulates the neck muscles, which stabilises the head and maintains its ability of knowing where it is in space (Cullen & Roy, 2004:1930; Khan & Chang, 2013:442). The VSR is also involved with maintaining head position, posture and balance and produces body movements and muscle activation, which compensate and prevent the body falling over, such as the righting reflex (Cullen & Roy, 2004:1919; Writer & Arora, 2012:55). Therefore, when the vestibular system is stimulated, muscle tone is triggered (as contraction takes place), primitive reflexes are prevented and postural reactions are enhanced (Morrison, 1985 cited in Nicklasson *et al.*, 2010:329). When there has been a delay in a reflex and/or during the development of the vestibular system, it could lead to a child performing and initiating movements, which are clumsy and uncoordinated as their muscles are not activated correctly (Auxter *et al.*, 2010:432). According to the DSM-5, individuals with ASD have been reported to show motor challenges and appear to be clumsy (APA, 2013:55). The following section highlights the occurrence of vestibular impairments in children with ASD.

### ***Vestibular impairments***

A full-functioning, integrated vestibular system creates a foundation for specialists to detect vestibular dysfunction and impairments in individuals during the time of infancy or development (Rine & Wiener-Vacher, 2013:509).

When a child's vestibular system has been delayed in development, they will have problems with balancing on one foot (especially with eyes closed), walking heel-to-toe, will be unable to walk on a balance beam and will not be able to hop and skip. They can also experience unsynchronised walking and running patterns (Auxter *et al.*, 2010:154). In addition to vestibular dysfunction, a child with Autism would find it difficult to visually coordinate

themselves (Case-Smith & Bryan, 1999:489). It has also been proposed that if a disturbance is present in the vestibular system, it can lead to dysfunctions in gross motor development, such as balance skills and gaze stability (Potter & Silverman, 1984:1072; Rine & Wiener-Vacher, 2013:508).

Included in the symptoms of a vestibular disorder are postural sway and the body leaning to the side when in an upright position (Solan *et al.*, 2007:1). As was mentioned in the former section on the vestibular system, sensory stimulation from the somato-sensory and vestibular systems provide information from the head and eyes about the position of the body, which assists in stabilising posture (Rine & Wiener-Vacher, 2013:508). When the vestibular system is stimulated, a child's arousal levels are modulated and will also facilitate in postural tone (Baranek, 2002:408). An example of such stimulation techniques is swinging, spinning and deep pressure-touch activities (Dawson & Watling, 2000:416).

Low muscle tone and poor equilibrium also result from a hypo-vestibular condition when a child does not have the ability to control themselves against the pull of gravity and therefore will affect motor planning activities (Cheatum & Hammond, 2000:163-164; Fazlioglu & Gunsen, 2011:355). In this case a child with ASD may experience reduced muscle tone (hypo-tonic) as muscle has not developed (Ming *et al.*, 2007:568).

Tonic or phasic motor muscle control is involved with an individual sitting and remaining still in their chair or standing still for a long period of time. If a child has poor phasic muscle control, they will struggle to perform these activities and this can cause the child to fall forwards, backwards or sideways, unable to maintain a steady posture. This will also affect the child's performance in the classroom especially when one part of the body needs to be still while another part moves to perform a function, such as sitting at a desk and reaching for a pencil or writing. Therefore, poor phasic muscle control is not having enough muscle strength to support a body part while in a static position (Cheatum & Hammond, 2000:164; Goddard-Blythe, 2014:17).

By looking at the intricate physiology and structure of the vestibular system, it is clear that it is part of a complex multi-sensory relationship between the cortex, cerebellum, brain stem, spinal cord, the eyes, the inner ear and somato-sensory responses (Day & Fitzpatrick, 2005:1; Rine & Wiener-Vacher, 2013:508). Therefore, the next section will discuss another receptor which supplies the CNS with sensory information about the body's position. As the

somato-sensory system is made up of many areas, proprioception will be the one area which will be highlighted in the following section.

## **Somato-sensory system**

The somato-sensory system provides the CNS with specific information about the external world in which the body positions itself. Figure 2.4 shows the four different sensations that are communicated to the CNS via the somato-sensory system. These *sensations* involve pain, temperature, touch and proprioception (Figure 2.4).

Pain notifies the brain of any injured areas in the body; Temperature informs about the hot or cold conditions the body may be experiencing; Tactile sense provides the relevant dimension, form and texture of an object or a surface the skin may be touching. The fourth sensation, proprioception, is the awareness of one's position and movement in space. It also plays a significant role in the body during movements that are not consciously performed, such as being aware of posture during the sitting and standing positions (Johnson & Soucacos, 2010:1; Strominger *et al.*, 2012:155). This sensation will be the area that will be highlighted in this section.

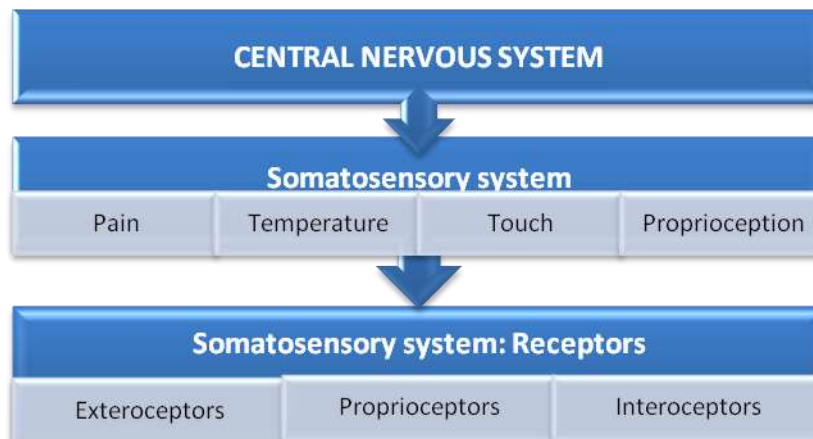
When a stimulation of some type, activates the somato-sensory receptors, perception and awareness of the body are created from any of these four sensations. Depending on where these receptors are situated in the body, they fall under one of three categories (Figure 2.4).

*Exteroceptors* are found near the surface of the skin and are activated through sense of touch, applied pressure, sensation of pain, temperature, smell and taste (Craig, 2003:500).

*Proprioceptors* are found deeper in the structures of the body, such as the head, the core of the body and limbs, which are made up of ligaments, joints, tendons and muscles (Strominger *et al.*, 2012:156). The proprioceptors are activated through balance and a sense of motion and the placement of the body in space, which will be discussed in greater detail further on in this chapter. The third receptor is the *interoceptors*, which are internally located in the blood vessels, visceral organs and are involved with information regarding hunger, thirst and pain (Craig, 2003:500; Strominger *et al.*, 2012:155).

Since the production of movement is the directive for the review, proprioception will be highlighted. Research has assessed it to be associated with more consciously related

actions, such as motor skills and thus the balance abilities (Johnson & Soucacos, 2010:1). To understand the functioning and role of the proprioceptors in the body, Figure 2.5 depicts the



**Figure 2.4: SOMATO-SENSORY SYSTEM TRANSMITTING SENSORY INFORMATION TO CNS**

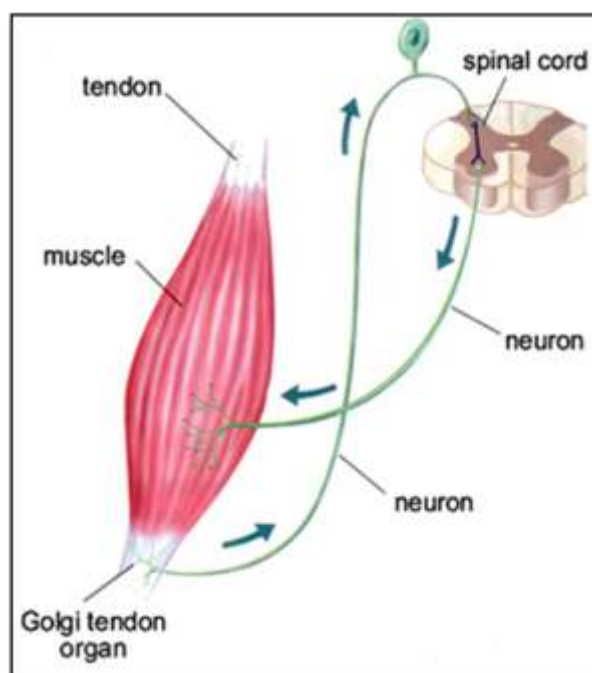
two types of proprioceptors. The first type refers to the receptors found in the skin, muscle spindles, Golgi tendons, joints and ligaments (Voight *et al.*, 1996:348; Kaas *et al.*, 2002:2; Haywood & Getchell, 2009:200; Johnson & Soucacos, 2010:2; Strominger *et al.*, 2012:156). The second concerns the vestibular organs based in the inner ear, which was discussed earlier (Haywood & Getchell, 2009:200) and therefore linking these two systems to work together in a motor functioning relationship to produce and support gross motor skills (Cheatum & Hammond, 2000:185; Moussa *et al.*, 2005:9; Herdman, 2007:12; Chevaldi *et al.*, 2014:9).

Proprioception has been said to already be functioning during the prenatal stages of foetal development. By five months the foetus can be responsive to 'stretching' and once the baby has been born, the system is operating completely. However, when a child is 4- or 5-years old, the responses from the visual system and the proprioceptors begin to develop differently (Glomstad, 2004:10).

However, sensations do not just happen without the proprioceptors being activated due to some type of stimulation applied to the relevant receptors. Silverthorn (2007:330) describes the type of stimulation as 'mechanical energy', which occurs due to force, tremors, tension, stretching or acceleration being applied to the relevant muscles, tendons or ligaments (Glomstad, 2004:10; Proske & Gandevia, 2012:1651, 1658). When the receptors in the skin,

muscles or joints are stimulated in the above-mentioned ways, this information is transported on a path via the spinal cord to the brain stem and eventually reaches the brain (cortex and cerebellum) where this sensory information is interpreted, regarding the positioning of the body (Auxter *et al.*, 2010:155; Johnson & Soucacos, 2010:7,8). The need for a motor response causes the CNS to release this information to respond to these signals for the specific muscles to initiate the motor action that is needed (Glomstad, 2004:12; Shumway-Cook & Woollacott, 2007:174; Angelaki & Cullen, 2008:126).

The receptors in the joints are activated when in flexed (contracted) or extended (stretched) movements (Figure 2.5) and are involved in inhibiting dangerous actions, such as hyper-extension and -flexion (Glomstad, 2004:11). The muscle spindles respond to the change in muscle length and the Golgi tendons, which are attached to the muscle, sense the change in tension from the lengthening of muscle and convey the information to the brain via the spinal cord (Windhorst, 2007:190; Strominger *et al.*, 2012:149; Proske & Gandevia, 2012:1662).



**Figure 2.5 MUSCLE SPINDLES SENDING INFORMATION TO SPINAL CORD**  
(Kirwan, 2009:n.p.)

When a child is performing a motor activity, muscles contract or lengthen and trigger the proprioceptors to assist the joints to stabilise when they need to move (Windhorst, 2007:186). When a sensation notifies the brain (CNS), it creates a picture or perception from



the information about the position of the muscles and joints (Damann *et al.*, 2008:884; Johnson & Soucacos, 2010:7).

There are three types of information regarding the position of the body that the brain needs to interpret and adapt: The first being the *body schema*, which interprets the location of the body in and the surrounding space (Fazlioglu & Gunesen, 2011:357). This is followed by information about the location of each segment and limb of the body and creates the sensation of the limbs in relation to each other. The somato-sensory cortex has been described to receive these inputs along with visual, tactile and vestibular information. It combines the sensory information, which creates the awareness of the body position (limbs) from the skin, muscles and tendons and adds to motor stability and movements that are synchronised and coordinated (Johnson & Soucacos, 2010:10; Proske & Gandevia, 2012:1665). Proprioception is also used in more mindful actions, such as motor skills (Johnson & Soucacos, 2010:1) where it functions along with the vestibular and visual systems (Minshew *et al.*, 2004:2058; Moussa *et al.*, 2005:9; Herdman, 2007:12; Zanelli *et al.*, 2011:586; Chevaldi *et al.*, 2014:9).

In the bigger picture, the proprioceptive function is involved with body awareness, motor planning, motor control and controlling body parts. It influences the way in which the body walks, runs, sits, climbs apparatus and manipulates objects (Dietz, 2002:785; Glomstad, 2004:10-11; Fazlioglu & Gunesen, 2011:357).

If there is a dysfunction or a delay in the nervous system and the sensory information is incorrectly integrated or if there is an irregular response, this can result in a child reacting with unusual behaviours (Lang *et al.*, 2012:1005). It has been recorded that 5-15% of children in the foundation phase of their childhood, experience sensory processing problems. The statistics increase to between 80 and 90% in children with ASD who have abnormal responses to sensory incoming stimulation (Lane & Schaaf, 2010:375). If this is the case, then it is a possibility that children with ASD may have poor proprioception or delays in certain areas of the somato-sensory system. Research pertaining to poor proprioception will be reflected upon in the following section.

***Somato-sensory (proprioception) impairments***

Due to the importance of proprioception for simple motor skills, Fuentes *et al.* (2011:1358, 1359) recently assessed the proprioceptor sensation of adolescents with and without ASD (12- to 16-years old). The study used a test which evaluated their balance skills, fine motor skills at a fast pace and skills that involve vestibular input and proprioception. They specifically assessed proprioception when the limbs are in position. Even though, during proprioceptive tasks the ASD subjects revealed to have motor impairments, they achieved accuracy during upper limb subtests. These results are contradictory to Weimer *et al.* (2001:93,99), who conducted a study on children and adults with Asperger's Syndrome (AS) in comparison to a control group. The purpose of the study was to perform a number of tasks involving proprioception, such as finger tapping, the pegboard task, trail making (motor planning and coordination). The results showed that the AS subjects achieved lower scores than the control group, in the following tests: 1-leg balance (eyes closed), tandem walk, repetitive finger thumb task. The reason suggested for the unsynchronised movements of the AS subjects, was that it may be due to poor proprioception.

Blanche *et al.* (2012:622) used the Comprehensive Observations of Proprioception test on 32 children with ASD, 26 children with developmental disabilities and 28 typically developing children. The results revealed the ASD group experienced clear proprioceptor challenges in the areas of motor planning, tip-toe walking, running, falling and being in contact with others and objects. The researchers also suggested that these proprioceptive problems could add to poor motor planning and postural positions along with influencing the behaviour of the children to be disruptive. Children with ASD have been recorded to experience poor motor planning and imitation skills that derives from poor proprioception (Dewey *et al.*, 2007:253; Dziuk *et al.*, 2007:737; Dowell *et al.*, 2009:567; Todd, 2012:34, 35).

Despite the variety of motor development problems, it is not the main method of diagnosing a child with ASD. There has been an accumulation of research directed at the importance of motor functioning in the process of diagnosing (Provost *et al.*, 2007:327). Research directs the attention to the movement problems of autistic children, which may assist in diagnosis and physical therapy rehabilitation. The different movement dysfunctions may help in classifying subgroups on the Autistic Spectrum (Mari *et al.*, 2003:395).

These two sensory systems have been described in order for the next section to be understood. Research has been developing information regarding motor impairments in children with ASD and if they occur due to sensory dysfunctions.

### **Sensory impairments**

Autism Spectrum Disorder (ASD) contains such a broad spectrum of symptoms and therefore diagnosis is different for each individual. As diagnosis has increased vividly over the years, it has been observed that autistic children portray moderate to severe dysfunctions in sensory skills and tolerance, motor skills and control which influence their experiences and interactions in everyday life (Murphy, 2009:4).

Growth and stimulation of a typically developing child are required in all areas of their senses. In the first four years of a child's life, the sensory systems, namely visual, vestibular and somato-sensory, develop. Once these systems are used for functional purposes, perceptual-motor skills, physical and motor fitness, as well as gross motor skill development will follow (Auxter *et al.*, 2010:146). The sensory and motor systems are involved and integrated together and rely on their complex and closely related relationship (Cowden & Torrey, 2007:196). Even though impairments in the sensory and motor areas have been observed in ASD individuals, it has not been considered diagnostic criteria for ASD (Green *et al.*, 2009:315; APA, 2013:55).

Clinical studies have found that sensory dysfunction has been recognised as the primary deficit in individuals with ASD (Rogers & Ozonoff, 2005:1255) and the occurrence of these defects is relatively high due to the irregular responses of autistic children to sensory stimuli. However, these unusual sensory reactions cannot characterise ASD individuals (Dawson & Watling, 2000:415; Rogers & Ozonoff, 2005:1255; Jasmin *et al.*, 2009:237). Children with ASD, with impaired sensory processing, have shown signs of arousal dysfunctions, problems with interacting with others (Case-Smith & Bryan, 1999:490), delayed learning of motor skills, motor abnormalities (Fazlioglu & Gunsen, 2011:34), coordination and the process of motor planning, such as when peddling a tricycle (Larson *et al.*, 2008:2894).

Hilton *et al.* (2010:939,941) compared a group of children with High Functioning Autism Spectrum Disorders (HFASD) with a control group of the same age. The purpose of the study

was to observe the prevalence of unusual sensory impairments in the sensory systems of visual, vestibular, auditory, tactile and oral, and the senses combined (multi-sensory). The study also observed the responses of those areas which contribute to the most severe social deficits in autism. The area which scored the most unusual impairments was the auditory area, followed by multi-sensory and lastly the vestibular system.

A study compiled by Lane *et al.* (2010:119,121) observed sensory processing dysfunctions detected in individuals with Autism. They confirmed that there are three Sensory Processing (SP) subtypes in children with Autism. One of the subtypes, Sensory Modulation with Movement Sensitivity (SMMS), had subjects which presented the symptoms of being under and over-responsive to sensory stimuli. When participating in a movement sensitivity test, they had particularly low levels of energy, low levels of endurance, feeble muscles and a low ability in grasping. It was suggested that sensory-based interventions should remain in practice in order to assist in improving communication skills and behaviour abnormalities in individuals with Autism. A year later, Lane *et al.* (2011:826) published a study on sensory processing subtypes in Autism. They recognized three subtypes as being: 'Sensory-Based Inattentive Seeking' (SBIS), 'Sensory Modulation with Movement Sensitivity' (SMMS) and 'Sensory Modulation in Taste/Smell Sensitivity' (SMTS). The sensory subtypes were differentiated from each other according to how severe the level of sensory processing dysfunction was. The sensory modalities that were most affected and severe were the SMMS and SMTS. The areas that have been observed to be mostly affected in the SMMS subtype is the vestibular and proprioceptor senses.

Most recently, Lane *et al.* (2014:328) observe the sensory differences amongst children with ASD, ranging from 2- to 10-years old, using the Short Sensory Profile (SSP) which is a questionnaire the parents complete. The results for a child stem from the seven sensory areas: tactile, taste/smell, movement, visual/auditory sensitivity, hypo-responsive/sensation seeker, auditory filtering and lastly, low energy for general functioning in sensory modulation. Highlighting the postural area, there were high scores among the children and they found synchronising body position challenging. This proposes to be problems in multi-sensory integration, as this area involves the visual, somato-sensory (proprioception) and vestibular systems. Former studies confirm these results (Gal *et al.*, 2010:458; Izawa *et al.*, 2012:10). One of the arguments that Lane *et al.* (2014:330) put forward was that unusual

sensory reactions of hypo-or hyper-responsively and sensory impairments may be used as characteristics to identify ASD in early childhood years.

Based on information provided about children with ASD, the sensory system plays a major role in the development. Therapists, who aim to design interventions and assess the outcomes of treatments on subjects with ASD, need to grasp the functioning of how the brain responds to information received by the sensory systems (Marco *et al.*, 2012:346).

Children, who have appeared on the Autism Spectrum, were observed to be extremely sensitive to certain stimuli by producing irregular reactions. They would search for stimulation from their surroundings, which would spur on their behaviour irregularities. These behaviours would make the child appear to be overly absorbed and preoccupied with self-regulation in order to have a sense of balance in their nervous systems. Self-regulation can be described as a way to find ways of coping and compensating for the lack of stimulation being processed and organised to and from their sensory systems (Stadele & Malaney, 2001:212-213).

Miller *et al.* (2007:138), focusing on sensory behaviours and 'Sensory-Based Motor Disorders', mention that one of the consequences of under-responsiveness of the vestibular system and the somato-sensory areas (proprioception) is poor motor coordination. Therefore, observed sensory deficits in individuals led to showing signs of motor dysfunction (Leekam *et al.*, 2007:895). This statement has been confirmed in other studies on evaluating these two sensory systems of individuals with ASD (Minshew *et al.*, 2004:258; Jasmin *et al.*, 2009:239; Hilton *et al.*, 2010:942). In addition, Sigmundson and Rostoft (2003:454) conducted a study on 91 4-year old Norwegian typically developing children. The Movement Assessment Battery for Children (M-ABC), which measures if children may have motor coordination impairment, was applied. Their findings included a higher occurrence of motor dysfunction in boys compared to girls.

Recently, Lui (2013:205,206) conducted a similar study also using the Short Sensory Profile on children with ASD (5- to 11-years old) along with M-ABC, 2<sup>nd</sup> edition. They combined these two tests based on their assumption that sensory deficits may lead to motor delays. The results from 35 children revealed unusual sensory impairments along with motor deficits with the lowest score appearing in the 'manual dexterity' and 'ball skills' subtests. These results correlate with those of Jasmin *et al.* (2009:238), who also performed a similar

study to test sensory responses and motor skills of children (three- to four-years old) with ASD. They utilised the Sensory Profile and the Peabody Developmental Motor Scales, 2<sup>nd</sup> edition. All of the children revealed atypical sensory challenges, including low scores in grasping (fine motor skills) and ball manipulation skills (gross motor skills). One of the outcomes of the study conducted by Lui (2013:206) was the confirmation that problems in processing sensory information can be associated with the inability to execute motor skills. They concluded that sensory problems resulted in poor motor performance in the children with ASD.

Based on the research discussed above, the associated 'partner' and the proposed outcome of poor sensory responses are in the area of motor delays in children with ASD. Supporting studies conducted in the particular area of gross motor skills may provide relevant research regarding the probable motor capabilities of children with ASD. The sensory system plays a huge part in movement, thus the next section will present investigations on motor impairments in children with ASD.

### **Motor impairments**

The role of motor development during the growing stages of a child provides a learning platform for them to use their motor skills while moving and while physically interacting with the environment around them (Fazlioglu & Gunsen, 2011:345). Motor deficits can lead to individuals having problems in how they respond to their physical surroundings and other people. This will result in a poor quality of life due to movement limitations.

Recent literature has indicated that motor impairment is occurring more often in children with ASD (Provost *et al.*, 2007:327; Fournier *et al.*, 2010:1237). However, there are many experimental studies, going way back, confirming that movement problems are highly prevalent in children with ASD.

Manjiviona and Prior (1995:25) used a standardised test (The Henderson Test of Motor Impairment) to measure motor proficiency. They found that 50% of the children with Asperger's Syndrome and 67% of those with Autism had motor problems. A few years later, utilising the MABC, Miyahara *et al.* (1997:601) conducted a study comparing two groups of Japanese children classified with a learning disability or Asperger's Syndrome who struggled with motor skills. Their findings could show no association between intellectual impairment

and motor dysfunction, but both groups experienced high scores in the delay of movement. Specifically, 85% of their subjects scored about two standard deviations below the normative values.

Research conducted on a wider-range of populations by Ghaziuddin and Butler (1998:45) considered children with Asperger's Syndrome (AS), Autism and PDD-NOS. To measure the level of motor performance, the Bruinicks-Oseretsky Test of Motor Proficiency was used to determine if all the subjects with PDD-NOS experienced motor coordination problems. The group who had Autism were observed to be the clumsiest, followed by PDD-NOS children and then AS subjects (Ghaziuddin & Butler, 1998:46). However, this study and the results were based on one single test.

With regard to individuals who appeared on the Autism Spectrum, Mari *et al.* (2003) states that there are three stages of movement dysfunction. The first stage is in the motor function problems appearing in posture, muscle tone, movement involved in producing actions and Tourette Syndrome (TS). This particular syndrome has been termed as a chronic neuropsychiatric disorder characterised by different tics. These are abrupt, irregular, involuntary movements which are motor tics, however vocal tics also occur and result in sudden sounds (Temel & Visser-Vandewalle, 2004:3). Children diagnosed with ASD have been observed to be related to a severe case of tics along with cognitive dysfunction (Canitano & Vivanti, 2007:24).

The second stage of movement dysfunction is when there are problems seen in the motor planning, language and movements that are repetitive and impulsive. The third stage is where the motor disturbance disrupts and affects behaviour by being uncontrolled and be seen to be 'socially inappropriate'. Children with Autism may also be unable to relate to others showing them affection. Researchers have noted that there may be a relationship between the social problems and the motor dysfunctions, such as abnormal posture, muscle tone, and dyskinesia, which is impairment in voluntary movement (Mari *et al.*, 2003:395).

Jansiewicz *et al.* (2006:620) looked at the motor actions of children with High Functioning Autism and Asperger's Syndrome and compared them to a control group. Their findings revealed a variety of motor defects in the group diagnosed with autism and Asperger's Syndrome with regard to balance and praxis (motor planning) of the ASD children. It was suggested that the motor deficits stemmed from a developmental problem in the neural

system executing movement and motor coordination. These affected neural areas in the brain are the basal ganglia and the cerebellum (Jansiewicz *et al.*, 2006:620; Nashner, 2009:24; Fournier *et al.*, 2010:6).

Further research considered children with ASD, Developmental Coordination Disorder (DCD), ADHD and a group with a combination of DCD and ADHD, and performed the BOTMP (the short form) to determine the severity of motor impairment in the different populations. Dewey *et al.* (2007:253) stated that not all children diagnosed with ADHD had movement problems. Most importantly, the results revealed that the ASD population were significantly more challenged with their motor functioning abilities compared to other children who had particular discrepancies in their motor skills. Of the children with ASD, 41% did not perform according to the BOTMP requirements. As mentioned, some other studies have confirmed that 80% of children with Asperger's Syndrome have motor impairments. However, this particular study found that motor skill impairments are widespread across ASD, but this is not worldwide due to these findings being based on the results from the BOTMP short form. The researchers suggest that had they included another test, such as the MABC, they may have received a different outcome (Dewey *et al.*, 2007:253). Motor performance is usually predicted to improve from 12 years old, however the BOTMP does not take into consideration the irregularities of older participants (Green *et al.*, 2002:656).

Research done by Green *et al.* (2009:312) assessed 101 children with ASD across an extensive variety of intellectual disorders. Using the MABC, the results showed that 79% of the children with ASD undoubtedly had movement impairments and 10% were ranked on the border of being impaired.

In a chapter from "A comprehensive book on Autism Spectrum Disorders", Fazlioglu and Gunsen (2011:355) mention some basic and difficult movements that autistic children were observed to experience (Table 2.1). Even though the term "autistic" is no longer used in the DSM-5, motor problems have continued to occur in children with ASD. Most of the disorders mentioned in Table 2.1 can still be observed.



**Table 2.1 DISORDERS DEMONSTRATED BY AUTISTIC CHILDREN**  
(Adapted from Fazlioglu & Gunsen, 2011:355)

| DISORDER                      | EXPLANATION  |
|-------------------------------|--|
| Motor function disorders      | Flexion dystonia, strained flexion in the hip and body, unusual body posture, gnashing of teeth, making a grimace arbitrarily, minimal facial impression in social circumstances, lack of eye contact, involuntary motor twitches, dyskinesia, motor stereotypes, vocal and verbal twitches, immobile arms stable when walking and other joint movement deficits |
| Intentional movement disorder | Slow moving, lack spontaneous movements, Poor motor planning, repetitive impulsive actions, fidgeting with objects by smelling, touching or tasting, locomotor disorders (walking slow, on tiptoes, on heel or by jumping)   |

The social aspect is also prevalent along with the 'motor function disorders' as the neuro-developmental diagnostic evaluations assess some of these characteristics: poor eye contact during social interaction, minimal facial expressions, motor stereotypes, repetitive movements and fidgeting (Lord *et al.*, 1997:507; APA, 2013:54).

Motor dysfunction is not considered part of diagnostic criteria in the DSM-5 yet motor impairments have been observed in individuals with ASD (Green *et al.*, 2009:315; APA, 2013:55). Ming *et al.* (2007:566,568) conducted a study with 154 children (ages 2- to 18-years old) diagnosed with ASD by means of the Autism Diagnostic Interview-Revised (ADI-R) and the Autism Diagnostic Observation Schedule-Generic (ADOS-G) according to the DSM-IV. They tested the motor skills of the participants with the Dever II Developmental Material. They reported motor delays and poor motor coordination in the children. The APA (2013:55) has confirmed the possibility of unusual gait and clumsiness in ASD individuals relating to past research by Jansiewicz *et al.* (2006:619), which was on High function Autism and Asperger's Syndrome (APA, 2013:55).

Along with a vast amount of studies confirming motor impairment in children with ASD, Pan *et al.* (2009:1702) compared children with ASD to those diagnosed with ADHD, all of whom were between the ages of six- and ten-years old. Using the Test for Gross Motor Development (2<sup>nd</sup> edition) (TGMD), the children with ASD achieved lower scores in the locomotion and object control sections than those with ADHD.

Further motor impairments observed by researchers are unstable balance and poor postural control. Recently, Whyatt and Craig (2012:1801, 1802) conducted a study using the MABC-2 to assess children, seven- to 10-years of age with Autism. The 18 children were compared to typically developing children who were capable of communicating verbally and a nonverbal IQ matched group. The results showed that the autistic group had motor impairment specifically in manual dexterity and ball skills which are more intricate tasks or require core stability (Jasmin *et al.*, 2009:238; Pan *et al.*, 2009:1702; Staples & Reid, 2010:214) thus confirming results of Pan *et al.* (2009:1702) for comparison with ADHD participants. Included in the finding of Whyatt and Craig (2012:1807) was that low levels of static and dynamic balance are achieved.

Current studies have brought to attention that fine and gross motor delays are also used as early indicators to identifying Autism in children (Mostofsky *et al.*, 2009:2414). Both fine and gross motor skills are associated with praxis, posture and balance (Dawson & Watling, 2000:416). Individuals with ASD do depict definite motor delays, motor coordination and motor planning challenges, the inability to imitate body movements, perceptual-motor integration and postural control problems (Jasmin *et al.*, 2009:232). As was indicated, the vestibular system is the driving force for balance and postural control. The former sections referred to findings showing that children with ASD revealed clumsy uncoordinated movement, which may be due to low muscles tone.

Some researchers have stated that one of the set-backs of ASD may be the motor challenges hence specialists are encouraged to focus on motor coordination (Saverese, 2013:1). Lloyd *et al.* (2011) found that gross and fine motor variances in autistic children were greatly improved as each six-month period passed in their chronological age. It is strongly recommended that when an individual starts participation in an intervention, direct focus should be given to the motor development of the individual (Savarese, 2013:1). The next section introduces possible interventions for rehabilitating children with ASD.

## **PHYSICAL REHABILITATION INTERVENTIONS**

In the earlier stages of interventions, children can show longer-lasting neuro-biological and behavioural changes. The earlier a child receives intervention and motor experiences, the earlier and greater the affect it has in modelling brain structures. Research has also confirmed that if an individual interacts with particular physical and social surroundings, it

contributes to rehabilitating damages to the CNS (Hannigan & Berman, 2000:108; Howard *et al.*, 2005:360).

In the CNS, the plasticity of the brain allows it to adjust to changes in the environment which can be stored in the memory region involving learning new skills (Johnston, 2009:94; Dayan & Cohen, 2011:451). The brain and the CNS are able to react to environmental change, to injury occurrences and gain novel information by modifying neural connectivity and function. This ability is called neuro-plasticity (Knaepen *et al.*, 2010:766)

Johnston (2009:100) also supports that exercise and electrical stimulation of the brain can improve the recovery process, if the intervention is focused directly on the fundamental brain mechanisms. Children have a tendency to recover from brain injuries much quicker than adults due to having a greater volume of skills to learn and to memorize (Johnston, 2003:105; Johnston, 2009:100).

Physical rehabilitation interventions are created and planned to improve gross motor performance, muscle strength, body's equilibrium and to assist the child, as well as the parents, in adjusting the home and school environments (Levac *et al.*, 2011:690). Participation in interventions aimed at helping children with sensory processing are sometimes difficult to adhere to since educational school environments are mostly unpredictable and complicated (Baranek, 2002:398). Greenspan and Wieder (1998:9) support this by mentioning that if a child has low muscle tone or motor planning impairments they may not respond positively in a formal testing environment. This would lead to results that are not accurately depicting the true cognitive ability of that child.

Considering those with Autism and individuals with attention disorders, Greenspan and Wieder (1998:10, 11) suggest that intervention programmes should look at the differences in children and their distinctive 'patterns' and aim to meet the children at their level for each activity. This can include a child, who is very energetic and disruptive, will be seeking sensory stimulation. Or a child who is affected by touch, sounds and light can be over sensitive and overwhelmed and react negatively.

Baker (2013:1091) writes an interesting review about the requirements for diagnosing Autism in the new Diagnostic and Statistical Manual for Mental Disorders (DSM-5). He also mentions how the new procedures and criteria reflect that Autism increasing:

“...umbrella encompassing a tremendous range of patients, varying greatly in cognitive and social abilities as well as associated genetic or neurologic conditions. Determining what kinds of therapy work, and how much is needed, has become very challenging”.

Greenspan and Wieder (1998:11) also speak of the importance of the ‘individual’s profile’. They suggest that when observing a child with Autism, look at how the child responds to sensations, how he absorbs information, plans actions and arranges his/her behaviour and thoughts. In terms of communication, their level of functional, emotional, social and intellectual abilities should be recorded along with their personal distinctive and essential interaction patterns and structure and set up in their family. This profile will help and guide therapists and parents to set up an intervention plan structured and directed at the personal characteristics of that child. The syndrome that diagnoses a child should not be the standard of determining the appropriate intervention programme. But it is the individual profile of the child that should be understood and used. Therefore, a variety of sensory stimulation activities should be the foundation of interventions designed for autistic individuals to help decrease or redirect these irregular reactions, which can lead to aggression and self-injury (Stadele & Malaney, 2001:212; Van Praag *et al.*, 2000:194; Herdman *et al.*, 2007:4).

It is important to identify the underlying problems which negatively affect and delay performance and health, before designing a programme (Mailloux *et al.*, 2011:150). Occupational therapists (OT) make use of the sensory integration (SI) approach in therapy as a way to re-train the sensory system. This approach is based on providing a child with the necessary sensory stimulation to positively affect the brain and nervous system to correctly process and respond to the sensory information. It aims to improve planning and organising skills of individuals and their quality of sensory response in their everyday life (Lane & Schaaf, 2010:375). Occupational therapists have specifically practised Sensory Integration Training (SIT) for children with developmental and learning impairments (Parham *et al.*, 2007:216). Ayres (Dunkerley *et al.*, 1997) founded the SI theory by recognising a link between some children with learning difficulties and the difficulties in processing sensory information. This led Ayres to discovering the relationship between neurological process and behaviour. In 1972, Ayres (cited in Dunkerley *et al.*, 1997:799) stated:

“A sensory integrative approach to treating learning disorders differs from many other approaches in that it does not teach specific skills. . . . Rather, the objective is to enhance the brain’s . . . capacity to perceive, remember,

and motor plan [as a basis for learning]. . . Therapy is considered a supplement, not a substitute to formal classroom instruction. . .”

Sensory integration (SI) is a technique which is directed at attending to children with sensory dysfunction and specifically for those with developmental delays (Murphy, 2009:1). In 1980, Ayres (cited in Schaaf & Miller, 2005:144) used SI to assist in decreasing the sensitivity of the tactile system to stimuli that interfere with a child while interacting and learning from their environment (Lang *et al.*, 2012:1005). A proposition was made by some researchers that if a deficiency is present in the nervous system and sensory stimuli are incorrectly interpreted, it may lead to unusual and irregular behaviours (Baranek, 2002:220). The SI theory has been explained to have an effect on the organisational skills of the brain. However, the concept of change or maturation in neural organisation can be debated in terms of whether this results from SI focusing on correcting feedback and adaptations (Cermak & Henderson, 1990:4).

As the nervous system is capable of changing, particular sensory stimulation techniques may be used and may contribute to improving the ability to process sensory stimuli by the nervous system. This may lead to improving and decreasing certain behaviour irregularities in children with ASD and assist in their ability to learn (Baranek, 2002; Lane *et al.*, 2010:121). Research has reported that if children with Autism are able to improve sensory processing, it is likely that their motor skill development may also improve due to the close link between sensory dysfunctions and motor deficits. This has motivated therapists to use the SI therapy technique to treat and improve sensory dysfunctions in people with disabilities (Murphy, 2009:4,5).

However, there is currently an on-going debate relating to this area of therapy and critics have different conclusions with regard to the benefits of Sensory Integration Training (SIT) (Lang *et al.*, 2012: 1005). The SI theory seems rational and is established in neuroscience. But unfortunately, there appears to be no dependable scientific proof supporting the processes in the neurological system and how it assists in the rehabilitation of an individual and therefore improving the processing and organising of sensory information (Polenick & Flora, 2012:28).

Lang *et al.* (2012:1015) evaluated and analysed 25 studies where SIT was used. The studies were made up of the characteristics of subjects and the assessments used to detect sensory

deficits as the dependant variable, the intervention techniques and their results. In total, three studies showed that SIT showed positive results, eight had a combination of results and 14 showed that there were no SIT benefits. In the three studies that showed positive benefits, errors were identified relating to the methodologies.

Therefore, with regards to the information provided, SIT as treatment for children with ASD does not have current evidence supporting its theory. Specialists, who work with ASD children, are encouraged to use interventions that are researched and scientifically-based (Lang *et al.*, 2012:1004).

The last section completes this review, is a compilation of the frame work for sensory-motor integration (SMI) and other studies which have utilised the techniques in interventions.

## **SENSORY-MOTOR INTEGRATION**

Even though literature shows that there are definite motor challenges in children with ASD, there seems to be limited findings on the intervention techniques for therapists who are treating sensory-motor impairments. Despite the many findings indicating motor impairments in children with ASD, presently there is limited research on the effects of sensory-motor therapy, which highlights the importance for future research (Bhat *et al.*, 2011:1126; Lloyd *et al.*, 2013:144; MacDonald *et al.*, 2013:277).

At the time of the 1950s and 1960s, a psychiatrist and neurologist, Dr. Vladimir Janda stated that when discussing the control of kinesis, the sensory and motor systems work together as one and cannot be described as functioning apart, therefore he used the term 'sensory-motor system'. When there is development or variation in one part of the sensory-motor system, it is also imitated by the modifications somewhere else in the system (Page, 2006:78). The framework of sensory-motor has been explained through a motor response being produced by the integration of sensory information being put into practice (Stein *et al.*, 2009:1).

Janda pointed out that proprioception plays a very important part in coordinating movements. Through research, he suspected that if there were muscle irregularities (imbalances) this would affect motor planning in the CNS. Page (2006:83) conducted a study using sensory-motor training (SMT) on subjects with musculo-skeletal pain focusing on

controlling their posture. The results were positive as SMT showed improvement of the proprioception, strength and postural stability of the lower limbs. With treatment, Janda (Page, 2006:78) highlights that through the re-learning of motor activities, it can repair the functioning of the nervous system instead of focusing on rehabilitating just one structural area.

Research on ASD and motor dysfunction, suggest that when treating those with ASD, interventions should involve providing sensory-motor experiences along with developing motor coordination to improve motor performance in balance, gait, upper limb function and motor planning (Baranek, 2002:418; Fournier *et al.*, 2010:1237). This has lead to the approach of sensory-motor integration therapy, which is a multifaceted approach that has been used on children with learning needs, developmental delays and ASD. Abbruzzese and Berardelli (2003:232) describe sensory-motor integration (SMI) as the development and procedure of the CNS receiving sensory information and integrating it to create a motor reaction or movement (Velasques *et al.*, 2013:4).

Nicklasson *et al.* (2010:332) set out to expand and build on SMI and conducted a study with eight children who had problems in their sensory-motor and concentration abilities. As part of one of their vestibular stimulation methods, they used rotation by placing the participant on a rotating chair, rotating them clockwise and anti-clockwise at various speeds. Included in the method, the participant would also be blindfolded during the session, which introduces an increase of stimulation on the vestibular system (Valente, 2007:36; Zanelli *et al.*, 2011:586; Cheldavi *et al.*, 2014:12).

In a review, Han *et al.* (2011:195) compiled an informative review on vestibular rehabilitation therapy, which is an exercise-based programme aimed at improving vestibular adaptation. They supported exercises that are associated with eye and head movements and are important for improving gaze stability. Another technique mentioned involved exercises for a participant standing on small surface areas or on a cushion while their eyes are closed to improve postural stability.

Rine and Wiener-Vacher (2013:515) suggest a few guidelines when performing balance training with children. The activities must be age-appropriate and adapted according to the intellectual development level of the child and therefore involving creative ideas in games and with toys to capture the attention and interest of the child.

For everyday activities and movement skills to be performed correctly, the ability to sustain the posture and gaze control is needed. This also involves multifaceted and synchronised movements of various biomechanical processes along with the sensory and motor systems working with the brain (Nashner, 2009:21). The visual system also plays a role in assisting an individual to maintain balance. During activities when the head and body move, the eyes are positioned by the gaze system according to the environment. If object manipulation skills are included in the activity, the eyes are adjusted to track the moving object. Throughout activities concerning the body remaining in equilibrium and working with vision, the vestibular system situates the body in alignment with its centre of gravity in relation to its base of support (Nashner, 2009:21). The visual input involves gaze stability, when the eyes are positioned in relation to objects.

Some sensory-motor intervention treatments for children with Autism concentrate on the underlying sensory hypo- or hyper-sensitivities so that the child can receive adequate arousal or stimulation best needed for reaching a sense of balance in their systems (Rodger & Brandenburg, 2008:2). This leads to an informative study conducted by Woo and Leon (2013:3,5) involving 28 boys (ranging from 3- to 12-years old) who was diagnosed with Autism by the Autism Diagnostic Observation Schedule (ADOS). Thirteen of the children were in the group that were exposed to a sensory-motor stimulation programme, while the remaining 15 received the usual care-giving services. The physical therapy of the intervention programme focused on gross and fine motor skills. The results of the 6-month programme showed improvement in the cognitive skills of the boys along with improving some of their severe autistic characteristics.

When working with the CNS and sensory input, there are three places that need to be targeted according to where the vast amounts of proprioceptors are situated. These three areas are the foot, the sacro-iliac joint and the cervical spine. Janda (Page, 2006:79) focuses on sensory-motor training to increase the incoming information from the proprioceptors in these above mentioned areas. It has been suggested that subjects taking part in SMT should not be inactive but should be given activities that involve a variety of movements in different positions (Lacour, 2006:1653). The subject should be barefoot when performing proprioception exercises to ensure that maximal volume of information stimulates the sensory-motor system. The cervical spine is also involved with posture, thus maintaining balance and posture should be emphasised when SMT is presented (Page, 2006:80-82).



Sensory-motor training consists of three stages which are static, dynamic and functional exercises. Each stage includes involving progression in the exercises, such as changing the base of support, changing body positions, decreasing surface area to develop their strength and develop equilibrium when their centre of gravity is challenged (Page, 2006:80). Recent research has applied these techniques. Chevaldi *et al.* (2013:11,12) explored the benefits and influences of balance training intervention on 10 children with ASD and 10 typically developing children from seven to ten years of age. These children participated in a six-week programme involving a variety of balance exercises including: standing on a compliant surface and standing on a non-compliant surface with eyes open and then with eyes closed. Using the Bertec force plate, they assessed the children's posture. Comparisons with the control group revealed that the balance training enhanced the postural stability even when visual input was absent.

## **CONCLUSION**

This review chapter has reflected on and integrated completed past research pertaining to a variety of topics. Children with ASD were discussed, and specifically findings, pertaining to prevalent sensory and motor impairments. This was followed by providing information on how the CNS processes incoming sensory information to develop the movement skills of children. The physiology of the two sensory system, vestibular and somato-sensory, was presented in more detail as this particular study is rooted in the vestibular and somato-sensory (proprioception) functions of children with ASD and dysfunctions that could lead to sensory motor challenges. Lastly, intervention techniques were examined critically. There were few studies that involved children with ASD who were exposed to sensory-motor integration training.

## Chapter 3

# METHODOLOGY

### INTRODUCTION

“Google’ is not a synonym for ‘research’.”  
Dan Brown, “The Lost Symbol”

The design of the study and the procedures that were applied will be described in this chapter. The research was conducted by applying the descriptive method for a collective investigation based on case studies and making use of a qualitative analysis.

### RESEARCH METHOD

Over the past 20 years, methods for research have expanded and have provided researchers with a variety of choices when conducting a study (Creswell, 2003:3). There are different approaches to research when investigating an explanation or solution to a problem or hypothesis. Thomas and colleagues (2011:17-21) describe the various types of research. The first one being *analytical research* which includes detailed evaluations to clarify an intricate phenomenon such as historical or philosophic research, reviews, meta-analysis. The second one is *descriptive research* which looks at status surveys, questionnaires and interviews. *Experimental research* is the third type of research which influences treatments to create cause-and-effect situations. The fourth type is *qualitative research*, which is a subjective approach observing and interpreting participants and has been described as ethnographic. Lastly, *mixed methods or mixed models* combine quantitative and qualitative approaches when targeting a real-life situation (Thomas *et al.*, 2011:17-21).

This study was based on ethnographic research, which is a descriptive and qualitative method (Mouton, 2001:149). As was formerly mentioned, descriptive research involves questionnaires, interviews, collective case studies, normative surveys, developmental surveys and correlation studies (Thomas *et al.*, 2011:19). Questionnaires, interviews and observations served to secure information about the two case studies in this study. As this type of research aims to grasp a broader understanding of a case study, it also hopes to

extend the understanding of other situations related to these cases. Abercrombie *et al.* (1994:46) cited in Flyvbjerg (2006:220) described a case study as follows:

The detailed examination of a single example of a class of phenomena, a case study cannot provide reliable information about the broader class, but it may be useful in the preliminary stages of an investigation since it provides hypotheses, which may be tested systematically with a larger number of cases.

Collective case studies are when a more than one case study is chosen (Crowe *et al.*, 2011:6). This creates a space to compare a variety of studies. The researcher is required to select cases which are not only interesting but also hospitable for the study and to accommodate the researcher. In addition entail an environment which allows space for the research questions to be answered. Yin, (2014:6) highlights that case studies purpose is to answer the “how” and “why” questions which require explanations which are detailed and are rich with information. To be more specific, an evaluative case study includes explaining and interpreting the information about the case study (Thomas *et al.*, 2011:297). However, the main purpose of this study was to use the data to evaluate the value of a self-designed individualised SMI programme. The case study approach enables a more in-depth and holistic approach to the problem than a survey study may provide (Thomas *et al.*, 2011:297).

## **PROBLEM STATEMENT**

The main purpose of the current study was to observe the potential impact of an individualised sensory-motor integration programme. The aim of the study was to design and implement an 8-month individualised sensory-motor integration programme for two boys (six and eight years of age) diagnosed with Autism Spectrum Disorder (ASD).

This study focused on the following specific objectives:

1. To have a psychiatrist establish the two boys diagnosis according to the Diagnostic and Statistical Manual in Mental Disorders (DSM-5).
2. To identify the motor delays in the two selected boys with ASD, which are related to the vestibular and proprioceptors in the somato-sensory systems. This will be initiate before and after the intervention;
3. To regularly assess the boys every 4-5weeks & during the intervention and continually monitor the influences the 8-months SMI programmes may have on the

boys' sensory-motor skills along with their behaviour irregularities. The following sensory- motor variables will be monitored:

- Static and dynamic balance
  - Muscle tone
  - Eye tracking
  - Motor planning
  - Body awareness and spatial orientation
  - Laterality
  - Object manipulation skills
4. To conduct retention period of 5 weeks, after the post-test, to observe if the SMI programme had a prolonging effect on the two boys.

## **RESEARCH DESIGN**

### **Subjects**

#### ***Recruitment***

Two boys (N=2) were selected as a sample of convenience from an autistic organisation in the Somerset West region. A convenient sampling method was used due to the school being the nearest autistic school in terms of travelling distance which made it easier for the researcher to attend the school on a regular basis.

The study was based on the specific ASD characteristics of the two boys who had shown definite signs of sensory-motor problems while performing activities or just how they responded to their surroundings. This information was taken from the Occupational Therapists (OT) which had written passed reports on the boys which the parents permitted the researcher to observe. The researcher, as specialist in the sensory-motor area, had been working at the school for the past year presenting Kinderkinetics sessions. This made it possible to observe the five children in the school while participating in movement activities. Only two boys appeared to have the characteristics of vestibular and proprioception problems. These specific problems matched the focus of the study. In addition, when the parents arrived to collect their children from school, it was possible to identify their home language based on how they communicated with each other. This factor was important so that the researcher could ensure that she communicated with the boys in their mother tongue.

### ***Inclusion and exclusion criteria***

The following criteria were applied for the participating subjects: the subjects were required to have been diagnosed with ASD; preferably boys who had been identified with vestibular dysfunctions and poor proprioception by former Occupational Therapists (OT); and they were required to attend the autistic school where the study would take place.

A participant would be excluded from the study if he was permanently sick. A child, who was not physically healthy or may have a weak immune system, would also be excluded from the study. These criteria were aimed at attendance of the sessions during the winter when their immune systems may be more susceptible to illnesses. Children with ASD have been reported to have immune dysfunctions and low immune systems (Ashwood *et al.*, 2006:11; Heuer *et al.*, 2009:282). As the neural system is closely connected to the immune system, behavioural changes and symptoms it have been reported to be associated with ASD (Heuer *et al.*, 2009:282). Therefore, the parents of the subjects were requested to provide their medical background.

### **Location for study**

The testing of the boys' sensory-motor skills was conducted by a qualified Kinderkineticist and the neuro-developmental and psychiatric diagnostic tests were conducted by a qualified psychiatrist at the school during school hours. The SMI programme also took place at the school.

### **Ethical aspects**

The proposal was submitted to the Stellenbosch University Ethics Committee (Protocol #: HS895/2013) and it was approved that the candidate could proceed. The principal of the private school also granted permission to conduct the study at the school.

Before the testing process could proceed, assent forms were designed specifically for the autistic boys and were completed during a personal one-on-one interview which was verbally and visually conducted and communicated to the two boys (Appendix A). A time span of three weeks was set aside for the parents and children to contact the researcher and supervisors of the study to ask questions. They were informed that they could ask questions at any given time during the duration of the study. The parents and the two boys were

informed that participation was voluntary and they were allowed to withdraw at any time without an explanation. Both the parents of the two boys gave their informed consent.

All evaluations and participation in this study contained no invasive techniques, therefore minimal risk was expected. The tests and participation in the intervention programme presented no danger to the two boys, although they may have experienced slight discomfort in the form of perspiration in which they could stop at any time. The parents and the two boys were informed that if either of the boys complained of discomfort or did not want to complete the activity he would not be forced to continue. The foundation of what the researcher was to present was suitable for children of their age, was geared to them enjoying play and could accommodate a variety of ways to perform.

Any personal information that was obtained from the parents about the two boys remained confidential and was disclosed only with parental permission or as required by law. The name of the two boys would not be revealed in the thesis or in any future publications. Permission to access the files was only granted to the researcher/instructor, the supervisor and co-supervisors of this study. The parents were also informed that the statistician, who analysed the data of this study, would also have access to the results.

### **Statistical analysis**

The data was collected by the primary researcher and was analysed by the statistician from the Centre for Statistical Consultation of Stellenbosch University. After consultation from the statistician, "time series design" was used to monitor the case studies' change over time and if there was improvement (Smith *et al.*, 2010:594,601). This design reveals the subjects results changing from baseline and continually monitors the influence of the SMI programmes and how that may have different results for when the subjects are not participating in the programmes (Borckardt *et al.*, 2006:77; Thomas *et al.*, 2011:347).

Statistica12 was used to initially create scatter graphs to analyse the trends over time for the two subjects. The graphical information contributed to the descriptive research on the two case studies. The graphs were used to visually depict the relative percentage change over time from baseline. As part of gathering data and information about the subjects, qualitative observations were recorded (Yin, 2003:6) by the researcher, during the testing periods and throughout the intervention. This was a highly important task as the carefully monitored

session-to-session observations provided descriptive information about the possible influences of the SMI programmes on then the subjects' sensory-motor impairments. In addition, this would also influence what would precisely need to change for the next session of the individualised SMI programme. These observations are included in Chapter 4 while discussing the descriptive statistics.

## **STUDY AND INTERVENTION OUTLINE**

The researcher is a qualified kinderkineticist registered with SAPIK (South Africa's Professional Institute for Kinderkineticists) and performed and completed the required testing procedures mentioned in this chapter. She also designed and presented the SMI programmes (Appendixes D & E) based on the foundation of kinderkinetics focusing on the gross motor developmental delays in children.

For more supporting evidence and to add depth to the study, the researcher and the supervisor made contact with the Academic head at the Child and Adolescent Psychiatry based at the University of Cape Town, Department of Paediatrics and Child Health. A professor, who is an internationally accredited trainer, conducted the three scientific diagnostic confirmation tests and questionnaires for these tests. One of the tests was conducted with the children specifically and the other two assessments involved meeting with the parents or caregivers of the children. These three tests are explained in detail in the testing procedure section which follows the information on the motor tests that were used for the study.

Goddard-Blythe (2005:429) supports implementing test batteries when evaluating children and suggests that specific areas should be explored, such as gross muscle coordination, reflexes, balance, visual perceptual skills and skills of particular activities that are age-specific (Bothma *et al.*, 2014:44). Niklasson (2012) mentions specific items used in the studies for 'Retraining for Balance' which has been a technique used to improve sensory-motor ability (Niklasson *et al.*, 2009:660; Niklasson, 2012:266). The tests consist of the primary reflexes involving vestibular stimulation, postural reaction, gross motor milestones (rolling, crawling, skipping), eye movements and gross motor skills (bouncing, catching, tandem walk) (Niklasson, 2012:257). These are the specific areas which guided the search for relevant test batteries and tools for this study.

In terms of the location where the testing took place, it was necessary to ensure that there were no visual or auditory distractions which would influence the boys' attention. Subject A struggled with the lighting of the room as his face would wince when walking into the room and he would rub his eyes during the first test. A big sheet of white paper was placed over the window to block out some of the outside light. The school provided a room in the school that had a big shelf full of books and toys, which could be a distraction at first. Thus a big blanket was used to cover it during the testing and the SMI sessions.

The QNST-III manual advised that the testing be conducted in the earlier hours of the school day as children would be more attentive. Therefore, the first session for testing and the presentation of the programme took place first thing in the morning. The one boy came from 08h30-09h00 and the second boy came at 09h05-09h35. The motor skill test battery and even some test items in the screening test required the subjects to move around, therefore the room needed to be spacious enough. The autistic school could only provide a small amount of space indoors as it is a small school. It was possible to use the entrance hall if more space was needed. For some of the activities in the SMI programme, some adjustments had to be made to perform the tasks outside. This was almost impossible in the winter season. However, it was much easier during spring and the beginning of summer in the last three to four months of the intervention.

## **MEASUREMENTS AND TESTS**

### **Neuro-developmental and diagnostic evaluations**

The two boys in this study were evaluated using three well-known and standardised neuro-developmental and diagnostic tools, namely the Social Communication Questionnaire (SCQ), the Autism Diagnostic Interview-Revised (ADI-R) and the Autism Diagnostic Observation Schedule-2nd Edition (ADOS-2). The psychiatrist, who conducted these evaluations, was also involved in advising the study. The tools are summarised below.

#### ***Social Communication Questionnaire (SCQ)***

The SCQ has been referred to as the Autism Screening Questionnaire (ASQ) (Berument *et al.*, 1999:444). It is a parent-based questionnaire consisting of 40-items used to identify children with possible ASD (Snow & Lecavalier, 2008:630) or other severe behavioural disorders, who are above four years old and have the mental age of about two years (Wiggins *et al.*,



2007:34). It offers norm-referenced information which aids in the diagnosing Autism. It was designed to correspond with the items, Reciprocal Social Interaction, Communication and Restricted, Repetitive and Stereotyped Patterns of Behaviour from the Autism Diagnostic Interview Revised (ADI-R) (Wiggins *et al.*, 2007:34), which has discriminative diagnostic validity.

The SCQ is made up of two forms which vary between the different time periods when observing the child's behaviour: The Lifetime Form and the Current Form. The Lifetime Form is made up of 19 items directed at observing behaviours at any time in the child's life and over the duration of the child's fourth and fifth birthdays. It takes only ten minutes for the parent to complete. The Current Form consists of 20 items focusing on the most recent behaviours witnessed over the last three months of the child's life. This form is applicable to measure the change in the child's behaviour over time (Charman *et al.*, 2007:554).

**Scoring:** Each item requires a 'yes' or 'no' answer with a point value of 1 or 0, which identifies the presence or absence of abnormal behaviour. If a 'yes' was given by the parent to Item 1 on the Lifetime or Current form, all remaining items are scored (items 2-40). However, if the parent answered a 'no' to item 1 on either of the forms, items 2-7 were skipped and items 8-40 completed. The items from the two versions of the SCQ were summated to provide a total score which could range from 0 to 39 for verbal children and from 0 to 33 for non-verbal children. A score of 15 or greater suggests a high likelihood of ASD and referral for further evaluation is indicated (Snow & Lecavalier, 2008:630-632).

#### ***Autism Diagnostic Interview-Revised (ADI-R)*** (Lord & Rutter, 1994)

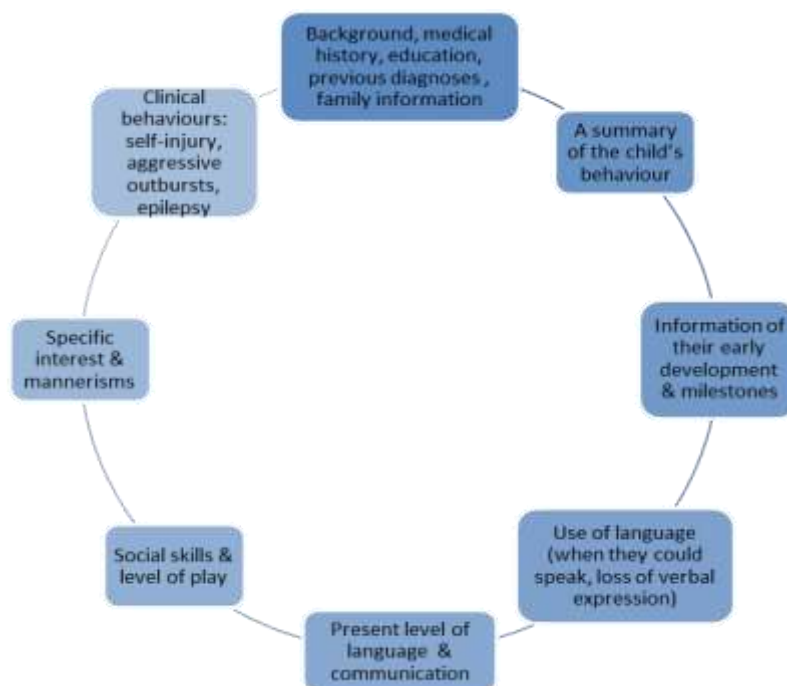
The ADI-R is a standardised, semi-structured investigator-based interview for caregivers of children and adults who may have Autism Spectrum Disorder (ASD). It provides a structure for a detailed neuro-developmental history relevant to ASD and has been validated for use for individuals with a developmental age of 18 months or older (Lord & Rutter, 1994:569).

The ADI-R requires an interviewer who has had a considerable amount of training in administration and scoring. Parents with a three or four year old, who has been assumed to have ASD, can be a respondent for the ADI-R. The time required for the interview is typically about an hour and a half, but may take longer with parents or caregivers who have older children or adults (Le Couteur *et al.*, 2008:364).

During the ADI-R, a trained interviewer asks the parent or guardian of the child a range of semi-structured questions relating to specific behaviours in three functional areas:

- Reciprocal social interaction (for example, emotional sharing, offering, seeking comfort, social smiling and responding to other children);
- Communication and language (for example, stereotyped sounds/noises, pronoun reversal, using language in a social manner);
- Restricted and repetitive stereotyped interests and behaviours (for example, preoccupied with unusual things, hand and finger gestures and unusual sensory interests). This also includes assessing if self-injury and over-activity is present in the child (Matson *et al.*, 2010:742).

This clinical review is made up of 93 items in which the interviewer scores the responses based on how the parent or caregiver describes the behaviour of the child. In the interview itself, the questions are structured around eight content areas and provide explanations to support the responses for all the behavioural items. These content areas are provided in Figure 3.1.



**Figure 3.1 CONTENT AREAS OF ADI-R**  
(Adapted from the ADI-R booklet, Le Couteur *et al.*, 2003)

The introduction to the interview is centred on the individuals' early development and is followed by 41 questions on verbal and non-verbal communication. The ADI-R questions that

follow concern social development and play. It then leads to 13 questions directed at the child's interest and behaviours. The last 14 questions focus on memory skills, motor skills and over-activity (general behaviour) (Le Couteur *et al.*, 2003).

**Coding:** Information is coded to generate a diagnostic algorithm indicating whether an individual meets strict research diagnostic criteria for ASD as defined in the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) and Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) (Lord *et al.*, 1994:664-665). The ADI-R has also been shown to be successful in distinguishing a subject with ASD in comparison to other developmental disorders and measuring the borders of syndromes and discovering new subgroups. The ADI-R interview has been rated in terms of the individual algorithm items, which have revealed a reliability of 0.63 to 0.89 and has been recorded to be a valid tool for diagnosing autistic children (Lord *et al.*, 1994:681; Le Couteur *et al.*, 2008:364). The scores are constructed from the interviewer's observation and her skill in concluding the parent or caregiver's information of the child's behaviour. For each of the 93 items in the interview, the trained interviewer scores the information within a range of 0-3 (Matson *et al.*, 2010:742). Table 3.1 summarises the requirements for each score.

**Table 3.1 SPECIFIED ADI-R SCORES AND DESCRIPTIONS**  
(Lord *et al.*, 1997:507)

| Score | Description   |
|-------|---|
| 0     | "No evidence of abnormality"  |
| 1     | "Behaviour of the type specified is present in an abnormal form, but not sufficiently severe match with criteria for a 2" |
| 2     | "Definite abnormal behaviour"   |

According to the ADI-R requirements, the total cut-off score for 'communication' and 'language' areas is 8 and 7 respectively for those who can or cannot speak. The cut-off in terms of the 'social interaction' area is 10, and lastly the cut-off for *Restricted, Repetitive and Stereotyped Patterns of Behaviour* is 3. Therefore, the child or individual is diagnosed with ASD when the scores in all three content areas (*Reciprocal Social Interaction, Communication and Restricted, Repetitive and Stereotyped Patterns of Behaviour*) are attained or surpass the

definite cut-offs (Matson *et al.*, 2010:742). The final conclusion for ASD can be apparent by 36 months of age (Lord *et al.*, 1994:663-664).

***Autism Diagnostic Observation Schedule-2nd Edition (ADOS-2)*** (Lord *et al.*, 2006)

This was the third test the psychiatrist performed with the two boys individually and the sessions were video recorded by the researcher so that the video footage could be viewed again at a later stage.

The ADOS-2 is a standardised, semi-structured play-based assessment for children and adults who may have ASD. An assessment typically takes 45-60 minutes and is recorded for research reliability purposes. The trained examiner codes the participant's behaviour for the presence or absence of a range of ASD-related behaviours (Lord *et al.*, 2000:205). Similar to the ADI-R, the ADOS-2 scores are transferred to an algorithm, which indicates whether someone falls above cut-offs for ASD, thus generating an 'ADOS classification'. If the thresholds are not met, then a non-spectrum classification is assigned (Gotham *et al.*, 2008:2). Clinical information, ADI-R and ADOS-2 data are combined by an expert clinician to determine an overall diagnosis.

Lord *et al.* (2006) stated that the psychiatrist cannot conduct the assessment on a child who is younger than 12 months of age (Camarata, 2014:62). The child should be able to have the ability to walk and be motor competent in order to take part in the playful activities, which form the foundation of the assessment. However, the ADOS-2 is confined when applying the items for children with hearing or eye sight impairments or cerebral palsy.

The ADOS-2 consists of five modules based on age and expressive language level or their chronological age. According to the ADOS-2 manual, the psychiatrist selects the most suitable module for the individual being assessed (Le Couteur *et al.*, 2008:364). The five modules include:

- Toddler Module for children from 12 to 30 months of age who do not use phrases consistently in their speech;
- Module 1 for children 31 months and older who do not consistently use phrase speech;
- Module 2 for children of any age who use phrase speech but are not fluent verbally;
- Module 3 for children and young adolescents who are fluently verbal expressive;

- Module 4 for older adolescents and adults who are verbally fluent.

The reliability of the test items has been rated  $\geq 0.6$ . The assessment typically takes 45-60 minutes and is recorded for research reliability purposes (Le Couteur *et al.*, 2008:364). The internal consistency for the social area has been rated the highest (0.86-91), while the communication domain has slightly lower internal consistency (0.74-0.84). The repetitive behaviours area have the lowest scores (0.63-0.65) but are still considered to have good enough internal consistency (Lord *et al.*, 2000:219).

**Administering the test:** While assessing, the psychiatrist followed the instructions and guidelines of an ADOS-2 protocol booklet. He observed the child performing activities and took notes. After the assessing process, the behaviours were coded and the Algorithm Form used to score the modules (Le Couteur *et al.*, 2008:364).

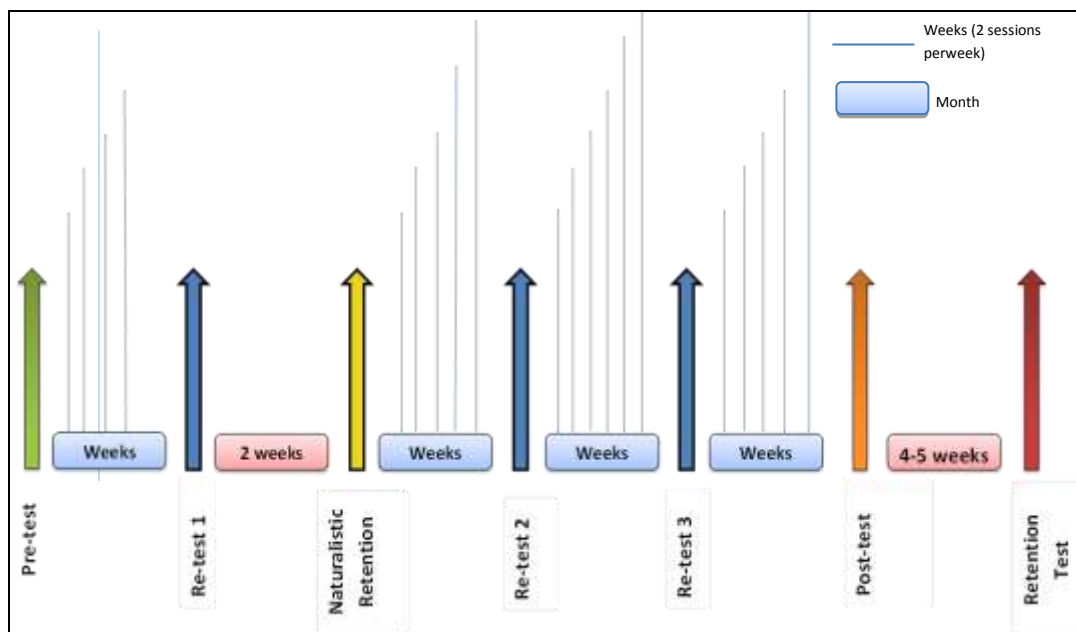
**Coding:** The algorithm for the Toddler Module does not give a classification score but rather ‘ranges of concern’. The Modules 1 to 4 have algorithm scores with cut-off scores for three categories: autism, autism spectrum and non-spectrum. The first classification is for severe symptoms that are more distinct.

### **Procedures for and scheduling of testing**

In order for a Pre- and a Post-test to be performed, one test battery and a screening test were used to evaluate and determine the level of the two boys’ sensory-motor skills. The results from the Pre-test provided the researcher with the required information to design an individualised SMI programme for each boy. The Quick Neurological Screening Test 3<sup>rd</sup> Edition (QNST-III) and the Sensory Input Systems Screening Test (SISST), also known as the Pyfer, were chosen. The reason for each subtest is explained briefly in Appendix C.

Figure 3.2 indicates the structure of the testing procedure. This is also where the “time series design was used to monitor the boys process of change over time (Smith *et al.*, 2010:594,601). The Pre-test for both boys was conducted before the intervention, including once a month (every four-to five weeks or eight to-nine sessions) over the seven-month period. This regular testing is referred to as ‘Re-tests’. There was a two-week holiday in the third month after which the QNST-III and the Pyfer were used to test the boys and this was called the Naturalistic Retention Test (NRT). The Post-test took place at the end of the intervention, followed by the five weeks of the retention period over the December holiday.

The boys were re-tested after this period for the final time and this was called the Retention-test. This completed the eight-month intervention.



**Figure 3.2** OUTLINE AND TIMELINE OF THE STUDY INTERVENTION

### ***Body weight and height (stature)***

Recording these measurements was considered a way to monitor if the boys' experienced physical changes in their weight and growth over the period of seven months. An assistant was required when measuring to help secure the child while the researcher would take and record the measurements.

*Body weight* was determined by using a calibrated weighing scale. The child needed to be barefoot before stepping onto the scale. They were instructed to stand in the middle of the scale with their weight equally distributed on both legs looking straight ahead, while the researcher observed the exact weight in kilograms. An assistant was present to see that the child looks ahead and remains on the scale. *Body height* or stature was measured using a measuring tape (in centimetres) which was secured against a flat wall. The child was asked to stand with his back and feet against the wall, heels placed together and both arms along his sides while looking straight ahead. The assistant helped steady the child in that position whilst the instructor observed and recorded the height of the child in centimetres (Marfell-Jones *et al.*, 2006:57-58).

### ***Sensory-motor assessments***

Specific test batteries were used to evaluate what the level each boy's sensory-motor skills was in terms of vestibular and proprioceptor functioning. The two boys were asked to participate in a eight-month intervention programme, twice a week for 30-40 minutes per session. The following sensory-motor assessments were used to measure motor abilities and to identify any motor developmental delays.

#### Quick Neurological Screening Test, 3<sup>rd</sup> Edition (QNST-III) (Mutti *et al.*, 2012)

The QNST-III measures the degree to which the subjects are challenged with motor planning and performing and completing motor movements. QNST-III is usually only used as a screening test by psychologists, specialists in rehabilitation, occupational therapists, kinderkineticists and professionals working in the area of special needs education.

The QNST-III observes the following areas (Mutti *et al.*, 2012:8):

- Maturity and motor development;
- Skill controlling gross and fine motor movements;
- Motor planning and sequencing;
- Sense of rate and rhythm;
- Spatial organisation;
- Visual and auditory perceptual skills;
- Balance and vestibular function;
- Disorder of attention.

The QNST-III cannot be used as a diagnostic tool, but the results of the task scores in the QNST-III can be used to suggest a diagnostic approach, and assists in designing suitable remediation or intervention for the subject. The QNST-III can also be used to assess if functionality has been recovered during the time of intervention as was needed for this research. In addition, the QNST-III has been found to detect Neurological Soft Signs (NSS) (Mutti *et al.*, 2012:15). These signs are trivial motor abnormalities involving poor motor coordination, sensory perceptual changes and poor sequencing in intricate motor tasks. The symptoms of NSS are poor balance, tremors and reflex irregularities. When these signs occur, it may reveal that there are underlying problems which need to be examined (Seidl *et al.*, 2009:529). With regard to the NSS and in comparison to children without ASD, children diagnosed with ASD have been observed to react in a hypersensitive manner towards sensory stimuli and a high prevalence of NSS has been reported in individuals diagnosed with ASD (Tani *et al.*, 2006:254; Baranek *et al.*, 2006:597; Jansiewicz *et al.*, 2006:620).

In the case of this particular study, the QNST-III was used as a Pre- and Post-test measure. It was also one of the tools used regularly to re-test every four to five weeks during the SMI programmes, to assess if there was any change or improvement in the level of motor ability. It provided a guideline to direct the instructor to pay attention to the specific areas and motor problems during the eight-month intervention programmes.

The QNST-III consisted of 15 tasks which were related to learning and everyday living activities. The test usually takes up to 30 minutes to administer and complete but with both boys being on the Autism Spectrum, some of the testing sessions could take 2-3 30-minute sessions to complete the screening test. The QNST-III manual does suggest that more than one session for testing may be needed when evaluating individuals who are hesitant, resistant and have disruptive behaviours (Mutti *et al.*, 2012:21).

The chronological age needs to be determined prior to the testing procedure. This is important for the correct use of the normative tables when interpreting scores once the tests were completed. The date of testing and the date of birth need to be recorded on the front pages of the record form that is provided for the motor skill test. To calculate chronological age, the birth date must be subtracted from the testing date, starting the 'day' column. The following are the instructions according to QNST-III:

When the date-of-testing day is less than the date of birth day, one may borrow 30 days from the date-of-testing month, as for this calculation all months are assumed to have 30 days. If the date-of-testing month is less than the date-of-birth month, one needs to borrow 12 months from the date-for-testing year column. (Mutti *et al.*, 2012:23)

It was also indicated that one should not round months up when exceeding 15 days. In this case special calculations need to be done twice. An example is presented in Figure 3.3.

|                   | Year        | Month     | Day       |
|-------------------|-------------|-----------|-----------|
| Date of Testing   | 2013        | 05        | 02        |
| Date of Birth     | <u>2005</u> | <u>01</u> | <u>21</u> |
| Chronological Age | <u>8</u>    | <u>3</u>  | <u>11</u> |

**Figure 3.3** EXAMPLE OF CALCULATING CHRONOLOGICAL AGE



**Scoring:** A checklist format is used for the QNST-III tests for motor planning and the incorrect ways the individual performs the task. While the task is performed, the researcher records the error which appears on the checklist alongside the task on the Record Form. The scores given are based on difficulties and errors displayed during the testing.

The QNST-III tasks show specific types of skills and therefore no basals or ceilings need to be resolved. When an error was observed, a 1 or 3 was scored. A score of 1 is considered not as serious as 3, because it can be swayed by developmental, environmental or emotional factors and therefore may not always be an indicator of neurological abnormalities. The score of 3 represents a more severe and serious problem. It can be linked with a severe Learning Disability and can be related to neurological dysfunction (Parush *et al.*, 2002:189; Mutti *et al.*, 2012:24).

Once all 15 tasks are completed and scored, these scores are added up across all the scores to culminate in a total score. The raw scores taken from each task performed and the overall raw score are interpreted according to cut-off scores based on the frequency that the score was obtained at various ages within the normative sample. If any unusual activity or response occurs, it should be described in the *Comments* section of the protocol before the next task is started.

For the QNST-III there are functional categories that are allocated to the cut-off scores and a comparison can be made between specific disabilities (ADD/ADHD, learning disabilities, autism, developmental delays, Alzheimer's disease). In order to report and interpret the performance in the tests, the QNST-III provides these descriptive categories that are based on the regularity of the raw score being observed to take place within the normative sample.

The results can be scored according to the following functional categories (Table 3.2): severe discrepancy (SD), with the maximum total test score exceeding 50; moderate discrepancy (MD) with maximum score from 26 to 50; and/or the no discrepancy score (ND) which involves a maximum total score of 25 or less.

**Table 3.2 FUNCTIONAL CATEGORIES OF QNST-III**  
(Adapted from Mutti *et al.*, 2012:25-45)

| Functional categories     | Total Score | Description of category  |
|---------------------------|-------------|--|
| No discrepancy (ND)       | 25 or less  | Not likely to have specific learning disability<br>Must have <i>no</i> individual tasks scored in SD range   |
| Moderate Discrepancy (MD) | 26-50       | Subject scoring in this range may have 1 or more symptoms having either developmental or neurological etiology, depending on age or severity of symptoms<br><br>MD score category includes persons who do not perform at the level expected for their age<br><br>MD score must have some individual tasks scored in the MD or SD range |
| Severe Discrepancy (SD)   | 50+         | Child is likely to have trouble learning in a regular classroom<br><br>Severe symptoms can also appear to show deficits in visual and auditory perception, in fine and gross motor skills, or in sensory areas such as touch, time, space, balance and directionality  |

**Reliability:** First and foremost, the reliability of a test must be known in order to avoid the scores of a test from confusing and misdirecting the results of the test trials (Parush *et al.*, 2002:194). When selecting a test for evaluating motor skill development, the test must provide consistent scores and present a clear indication of what specific motor problems are experienced. Past research has indicated that coefficients that are at or above 0.80 are acceptable, while those of 0.90 and are most desired (Whiston, 2005 cited in Oluwatayo, 2012:395; Mutti *et al.*, 2012:60). The quality and stability of a test are considered highly important when specialists are considering an approach for an individual's intervention process with regard to therapy, academics or remedial sessions (Mutti *et al.*, 2012:60).

According to Mutti *et al.* (2012:60), there are two types of 'reliability' that examiners and specialists need to consider when selecting a test. The *internal consistency* and the *temporal stability* (Oluwatayo, 2012:395) of the QNST-III will be discussed and whether it will provide the suitable requirements to support the testing process of this study. The QNST-III test battery manual states that the test item scores do not indicate a large level of variability. The *internal consistency* of this test represents the reliability coefficient.

Regarding this particular study, the design accommodates regular retesting over time with the QNST-III. Test-retest reliability reveals confirmation of the stability of the test when it is used to assess the same subject over a set period of time. The *temporal stability* of the QNST-III reveals whether it qualifies as being suitably constant over a period of time regarding the performance of subjects when undergoing one test to the next. It also generally displays the strength and stability needed to carry this study with the regular retesting process (Mutti *et al.*, 2012:61). In conclusion, the QNST-III measures have been reported to have a high standard of consistency from one testing to the next for all the ages for which the QNST-III is suited (Mutti *et al.*, 2012:62).

**Validity:** Validity can be defined as follows:

...validity presupposes that when we write a test we have an intention to measure something that the 'something' is 'real' and that validity enquiry concerns finding out whether a test actually does measure what is intended. (Nouriade, 2013:2)

Pheiffer *et al.* (2011:82) conducted a pilot study of children with ASD between the ages of 6-12 years, using the second edition of QNST. They state that while assessing children with ASD, certain problems may surface. Due to ASD children's behavioural irregularities and developmental delays, incorrect standardised measures may occur while attempting to uphold the validity of the test. Motor tasks used in the third edition of QNST, recommend that the tasks are in a very stable relationship and are "consistent" in working with each other. With regard to the validity of the QNST-III, three types of validity will be discussed: 1) content validity; 2) criterion-related validity; and 3) construct validity (Parush *et al.*, 2002:95; Mutti *et al.*, 2012:64-66).

The *content validity* of a test involves the how the test is specifically designed for a population, the in-depth evaluation of the tasks and the protocol for each task in the items (Thomas *et al.*, 2011:194; Oluwatayo, 2012:393). Kaplan and Steele (2005) describe *criterion-*

*related validity* as the indication of how a group of scores from the test are, in comparison to scores measured from other tests that also examine the similar skills (Oluwatayo (2012:394). Not many tests examine the same skills as the QNST-III. In addition, the scoring system is based on errors and not 'items correct' as is stated in the QNST-III manual. Therefore, QNST-III shows low correlations when compared to other motor test batteries, such as the Bruininks-Oseretsky Test of Motor Proficiency, 2<sup>nd</sup> edition; the Developmental Test of Visual-Motor Integration-6; and the Bend-Gestalt II (Mutti *et al.*, 2012:65).

#### Sensory Input Systems Screening Test (SISST)

This informal screening test is also known as the Pyfer and has been used to identify sensory input delays in an individual. It specifically assesses the reflexes, primitives and equilibrium reflexes, the vestibular, visual, kinaesthetic and tactile system (Auxter *et al.*, 2010:146). This tool was chosen for this study because of the specific test items in the test. The areas of primitive reflexes, postural reactions, vestibular system and eye movements have also been assessed in other tests, with regard to retraining for balance and sensory-motor therapy, in addition to testing children with ASD (Niklasson *et al.*, 2009:650; Krog & Kruger, 2011:77; Niklasson, 2012:257).

**Scoring:** There are 15 items which require a 'Pass' or 'Fail' indication. A 'Pass' can be awarded when the task is executed in the correct manner and within the allocated time. If they could not perform the task correctly, they would receive a 'Fail'. No reference could be found that indicates the time allowed for the test to be completed. It takes about 20 minutes to conduct the test. The first and second testing (Pre-test and Re-test 1) took about 30 minutes as the two boys were not yet accustomed to the routine with regard to the visits and sessions.

A specific test item in this screening tool was applied when designing the SMI programmes. The vestibular test item was conducted by using an office chair that can rotate. The rotating chair has been used traditionally for testing the Vestibular-Ocular Reflex (VOR) function of children with hearing impairments and also assesses the function of the semi-circular canals and vestibular function. This has produced positive results when predicting children's abilities in their balance tasks along with providing certain information to physical therapists for what to include in motor programmes (De Kegel *et al.*, 2012:2837, 2842).

One of the tasks for the vestibular section is the 'Post Rotary Nystagmus test' (PRN). The low scores from the vestibular, hypo-responsiveness and bilateral integration tests have been observed to be associated with the PNR test (Goldberg *et al.*, 2000:521; Schaaf *et al.*, 2012:551). The PNR test has been used to measure vestibular function in the Sensory Integration and Praxis test which is a test battery used to evaluate the functioning of the visual, vestibular and somato-sensory systems, as well as the skills of bilateral coordination, motor planning and spatial awareness (Mailloux, 2011:148).

The vestibular test item followed the procedure which involves the subject's head being slightly tipped down (30 degrees) which stimulates the semi-circular canals (Goldberg *et al.*, 2000:521; Mulligan, 2011:98-99). The subject was rotated clockwise for 10 complete turns and then anti-clockwise for another 10 turns before stopping the chair. The subject's eye movements were observed and the duration that the eyes flicker back and forth recorded. The requirement to receive a 'pass' for this item, is for the eye movements to flicker between 7 to 13 seconds. Anything below 7 or above 13 seconds reveals a vestibular problem (Auxter *et al.*, 2010:147).

It is a relatively quick and easy test to conduct with an individual (provided the subject can understand instructions). For this study, the researcher struggled to convey to Subject G to keep his head upright and at a certain angle and to look at her finger after the rotation. This could influence the results.

**Validity:** Reported research on the validity of SISST could not be found, therefore, the validity of the relevant subtests making up the SISST was investigated.

There has been relevant research and some criticism on the validity of the PRN test that has been measured to show human error. Critics have pointed out that subjects' eyes are affected by light, which enables and increases visual fixations and this therefore can hinder and reduce the duration of the post-rotatory nystagmus (Cohen & Keshner, 1989:332; Mulligan, 2011:103). Taking this information into consideration, the vestibular test was conducted in a darkened room with the window covered and the light off, which was relevant for Subject A who would rub his eyes in conditions with much light.

The PRN test is manually administered and the rotation speeds could be irregular and the child can change the required head position upon rotation. Another factor that has been

considered is the constraint when measuring the VOR (Vestibular-Ocular Reflex), which is not totally reliable because the assessment is being conducted by the researcher (Cohen & Keshner, 1989:332; Westcott *et al.*, 1997:632; Mulligan, 2011:99). The PRN provides some information about vestibular functioning and its collaboration with the visual system. The PRN has been said to measure the different features of vestibular function but not balance and postural control. It has been suggested that the PRN test should be implemented along with other testing materials for vestibular functioning to gain a more intricate and detailed outcome (Mulligan, 2011:102-103).

## **INTERVENTION CHARACTERISTICS**

Baranek (2002:419) compiled and examined a variety of sensory- and motor-based interventions for children with autism. His findings suggest that there should be more intense methodological designs in terms of multiple baseline single-subject designs. With regard to intervention elements, he also mentions that the duration of the intervention should be enhanced and explained in more detail. The use of stimulation and the intensity of exercise should be identified more clearly in conjunction with the regularity of the intervention and specific environments.

### **Intervention period**

The intervention commenced after the Pre-test was conducted. The SMI programmes were conducted during the individual sessions set aside for each of the boys over a period of seven months. The researcher attended the school twice a week when each boy had 30 minutes to take part in the SMI programme. After eight to nine sessions following the Pre-test, the researcher conducted the motor skills test and the sensory input screening test and this occurred approximately once a month. This was to provide continual descriptive evaluation of each boy in order to monitor progress and changes in their motor abilities.

After five months were completed, a Post-test was conducted for each boy. This was followed by a retention period, which was conveniently placed over a school holiday; therefore they were not exposed to any specific professional and intense motor activity/programme during this period.

The SMI programmes were designed and implemented using scientifically researched information offered in the literature and based on the Kinderkineticist's experiences as the

instructor. Figure 3.1 depicts the outline of the intervention. The SMI programme lasted four months. The Pre-test took two weeks (four sessions for each subject) to complete especially as the boys were not yet in a routine. There was a two-week natural retention as this was a school holiday. The Re-test 1 was conducted before the holiday and Naturalistic Retention test (NRT) was directly after the holiday. The final retention followed on the Post-test as this was the end of the SMI programme and it was the December holiday. The two boys were tested again when they returned to school after the holiday.

**Table 3.3 DURATION OF INTERVENTION**

| <b>Structure of study</b>                 | <b>Weeks/Months</b>    |
|---|------------------------|
| SMI programmes                            | 4 months<br>(21 weeks) |
| Total time for tests conducted            | 12 weeks               |
| Sum of weeks for retention periods        | 6 – 7 weeks            |
| Total of tests, programmes and retentions | 8 months<br>(40 weeks) |

In Baker's review, he cites Leo Kanner's (1943) findings and two common features observed in 120 children: intense 'autistic aloneness' and an 'obsessive insistence on the preservation of sameness' (Baker, 2013:1090). Recent research supports this statement and falls under the diagnostic characteristics of ASD. According to the diagnostic criteria, the individuals with ASD are inflexible with their routines and are more comfortable with ritualised patterns. It has been reported that they struggle with change and transitions and have been observed to disrupt their behaviour causing them to be uneasy and inconsistent (APA, 2013:50, 54).

The above information served as motivation to start each session with a warm-up activity which remained similar for the entire duration of intervention. This specific activity created a sense of routine for the boys and became accustomed to it over time and they would know what was required of them in the activity. The warm-up always involved music along with the regular movement. Research has reported how children with autism have responded positively to music and music therapy interventions have resulted in recoveries and improvement for some of the main problem areas, such as language, communication,

cognitive, perceptual/motor and behavioural problems (Kaplan & Steele, 2005:15; Gold *et al.*, 2010:8). Music also has an effect on calming individuals with autism who experience arousal and sensory modulation challenges (Brown, 1999:15). According to Berger (2002:15):

... a sense of well-being is predicted upon a body feeling physiologically balanced. Integration of the sensory systems ultimately promotes intuition, cognition, self-identity, esteem, and holistic goals of music therapy including visual contact and communication.

It was mentioned in the aim and objectives stated for this study that the focus of the instructor would be on two sensory systems, the vestibular system and the somato-sensory (proprioceptors) system. According to Niklasson *et al.* (2010:328), stimulating the vestibular system and the kinaesthetic areas and receptors can enhance sensory-motor development in individuals.

As each boy received an individualised programme, the activities were also designed and modified according to the particular child's abilities and level of motor function, including specific strategies and techniques to encourage stimulation and progression over time. The results from the test-battery, namely the QNST-III and the screening test, SISST highlighted specific areas to be targeted in the intervention.

As the vestibular system was one of the main sensory systems of focus, the Pre-test results from the 'vestibular item' in the SISS revealed that both of the subjects were hypovestibular. Their sensory-motor programmes were designed to include exercises which would stimulate their vestibular systems (Baranek, 2002:408) so that the boys' sensory-motor needs could be met. Both Subject A and Subject G were observed to crave spinning activities, as children with autism have a tendency towards repetition (Mayes *et al.*, 2009:1691; APA, 2013:55), and were observed to be clumsy and uncoordinated in executing motor tasks (Abraham, 2013:18; APA, 2013:55). Therefore, specific exercises were planned, structured and presented to stimulate their vestibular systems.

### **Sensory-motor integration strategies**

The receptors of the vestibular system are sensitive to rotational and angular movements (semi-circular canals) and linear movements which alternate between fast and slow speeds (utricle and saccule) (Solan *et al.*, 2007:1; Angelaki & Cullen, 2008:126; Rine & Wiener-Vacher, 2013:508). Therefore, activities were designed to create situations where they



would be required to tilt their head in different directions. According to Herdman (2007:4), these activities would stimulate these receptors, such as:

- Spinning and rotational activities and changing directions of rotation (clockwise and anti-clockwise at different speeds (Niklasson *et al.*, 2009:649; Auxter *et al.*, 2010:154-155);
- Acceleration and deceleration: of rotation in standing position (Zanelli *et al.*, 2011:586) or while being seated (Ivanenko *et al.*, 1997:420; Becker *et al.*, 2000:473), jumping up and down on a trampoline or ball, then jumping carefully up onto a platform and off again;
- Fast rocking while on a ball in the prone position;
- Visual and somato-sensory (proprioceptors) systems were manipulated when controlling the visual systems and proprioceptors where the subject depends only on vestibular cues (Valente, 2007:36; Rose, 2010:162).
- Compensatory, adaptation and substitution (involving two other sensory systems)

In order to enhance progression and increase stimulation of the vestibular system, the following was implemented in the SMI programmes:

*Compensatory responses* were integrated into the sensory-motor programme. This involved standing and maintaining balance on unstable or uneven surfaces (Hillier & McDonnell, 2010:4). In the earlier stages of the programmes both boys started on flat, stable surfaces in order to first grasp understanding of the movement. As the instructor monitored their progress with the frequent motor skill testing schedule, the boys progressed to balancing on the Bosu ball, slanted 'balance rocks' of different heights and the trampoline.

*Visual tracking* played a role in some of the activities even though it was not one of the main systems on which to focus. This system was included with the strategy to include the technique of *adaptation* into the programmes, combining the visual and vestibular systems and encouraging them to work together. This also included hand-eye coordination during the activities with on-going and stimulating movements of the head and/or eyes to recover and improve the Vestibule-Ocular Reflex (VOR). Ball manipulation skills were introduced as activities leading to throwing and catching a ball and progressing to using a 1kg- or 2kg- medicine ball. This was performed while having to maintain balance on the trampoline, a slanted balance rock or the Bosu Ball (Hillier & McDonnell, 2010:5). The two boys had to first

grasp the concept of focusing on an object and then progress to tracking the object's pathway, before they could combine maintaining balance and tracking an object (Auxter *et al.*, 2010:154).

Subject A was asked to close his eyes at certain times in specific activities, such as standing on an unstable surface, gaining his balance and then closing his eyes. Manipulating visual and proprioception input (somato-sensory) and providing feedback have been used for subjects to totally rely only on vestibular signals and stimulation (Valente, 2007:36). Updated research has expressed that in the absence of visual information, such as the individual being blindfolded, the vestibular system seems more sensitive and therefore dominates over the signals and information received from the somato-sensory system (Zanelli *et al.*, 2011:586). During the task of standing (static balance), the instructor would aim to reduce somato-sensory (proprioception) feedback in the lower limbs (increasing vestibular input) by directing the subject to stand on a soft or manipulated surface, plastic cushion or trampoline with eyes closed. This would force the subjects to be completely reliant on the vestibular system in order to balance (Rajendran *et al.*, 2012:461).

The *somato-sensory system (proprioception)* was also targeted. At the beginning of each session, the subjects were asked to take off their shoes and socks which became a routine for them. For stimulation of the somato-sensory system to be effective, feet must stay in contact with a firm surface. Subjects should be barefoot when performing exercises involving proprioception, to ensure that there is a maximal volume of information stimulating the sensory-motor system (Page, 2006:79). This occurs when the receptors in the soles of the feet are involved in maintaining posture and assist in informing the brain of the location of the body in space (Lackner & Dizio, 2005:126).

Activities designed to enhance stimulation of the somato-sensory (proprioceptors) and kinaesthetic function, implicate increased tension or weight on joints, muscles and tendons (Auxter *et al.*, 2010:155). The SMI programmes involved equipment of different weights of balls (especially alternating between 1kg and 2kg). At times the subjects were asked to move the ball in different directions and heights (up, down, left and right sides of their body) (Rose, 2010:155). When holding an object of a heavy weight, such as the 1kg- and 2kg- medicine balls, the instructor would try and convey to the subjects that they needed to

perform the activities slowly so that the movement does not create momentum (Kisner & Colby, 2007:215).

Cheatum and Hammond (2000:207) mention five techniques used to focus on increasing sensation in the somato-sensory areas (proprioceptors), namely:

- Contraction (shortening) and stretching (lengthening) of muscles;
- Compression (pressure) on and pulling of joints;
- Tonic contraction of muscles around joints;
- Increasing the power the muscles need to execute a movement;
- Increasing the period over which a movement is performed.

Activities such as the 'wheel barrow' or 'upside down spider' crawl require the subject to be on the hands and knees, which increases compression on the joints (co-contraction). The monkey bars and elastic bands were utilised to activate joint traction in the upper limbs and strength in the shoulders (Cheatum & Hammond, 2000:208; Kurtz, 2008:74, 82).

While standing on a firm surface and having to balance, the subjects were either blindfolded or asked to close their eyes. At first Subject G did not understand the instruction of closing his eyes. When a blindfold was placed over his eyes, it bothered him and he would remove it. The instructor taught him how to close his eyes upon instruction by placing her hand over the subject's eyes and counting for a certain amount of seconds. Over time the subject began to close his eyes upon command, however, only up to 10 seconds as this was his counting limit. This aspect forces the subjects to rely on somato-sensory inputs for balance (Rose, 2010:155). Therefore, instead of the boys depending of visual input to help maintain balance, they will depend on their proprioceptors in their joints, skin (being barefoot) and muscles (contracting to stabilise the body).

### **Object manipulation**

Another way that was used to enhance or stimulate the proprioceptors was throwing and catching a ball while they were maintaining balance. While involving vision to try to catch or reach for a moving object, the two boys were given balls of different weights (especially alternating between 1kg and 2kg) and at times they were asked to move the ball in different directions and heights (up, down, left and right sides of their body) (Rose, 2010:155). The feet remain in contact with a firm surface to provide stability and activation.

The somato-sensory (proprioception) system works with the vestibular system while the body is in motion. Especially during 360° rotations, the proprioceptors have an even more vital role compared to movement with other angles (Zanelli *et al.*, 2011:586). The activation of proprioception was also targeted during the spinning activities when the subjects were standing. Therefore, research supports that the vestibular system will take the main lead and control in the imitation of maintaining balance. However, for the repetition of the movement to take place, the proprioceptors may dominate (Zanelli *et al.*, 2011:586).

### **Multisensory-motor strategies**

An integral vestibular system needs to function as a whole, as it is important for the development of gross motor skills, for balance, oculo-motor and visuo-spatial skills (Rine & Wiener-Vacher, 2013:509). Vestibular rehabilitation is known to involve exercises which involve the eyes, head and body moving to stimulate the mechanisms or systems for the body maintaining equilibrium (Medeiros *et al.*, 2005:699). The use of *substitution* was also included in the sensory-motor programmes. Substitution encourages the integration of sensory inputs from the visual and somato-sensory systems (proprioception) in order encourage the individual to compensate for the vestibular dysfunction (Hillier & McDonnell, 2010:5). The warm-up was the first activity for every session which involved the eyes and proprioceptors to compensate for any vestibular dysfunction. Subject G struggled to sit upright himself on the small Swiss ball and bounce without falling off. However, when the warm-up provided a progression of focusing on the Disney movie (on a laptop screen at head height), it provided a point for the subject to focus visually and would hold on the handle of the Swiss ball and bounce to the music, without any assistance.

During locomotor activities (walking, standing and sitting), the visual system is activated to stabilise the body by providing information of the surroundings – gaze stabilising. Research supports that maintaining balance on an uneven surface will also enable the visual system to try and control the body to remain in equilibrium. This will also activate the proprioceptors in the somato-sensory system (Rose, 2010:154). The trampoline and balance rocks were used for many of the activities which compelled all the systems to work together or develop over time.

## Functional activities

As the subjects seemed to begin to understand the simple movement in addition to applying them to different surfaces, the instructor increased the area of the activities and making the activities more functional (from the third month of the sensory-motor programme). Vestibular and proprioceptive information is vitally important for spatial orientation and navigating the body in space (Riecke *et al.*, 2002:444). The sensory programmes continued to adjust for each boy at their own level of functioning. The aim was to challenge the sensory systems by creating a mini-obstacle course with the school's jungle gym consisting of ropes, monkey bars, climbing net and wooden ramps. These activities transferred to each other in the following manner:

- Maintaining dynamic balance and posture climbing a ramp using a rope or climbing the 'spider web' net (proprioceptors and arm strength);
- Hanging from one monkey bar to the next;
- Being 'wheel-barrowed' by the instructor (upper limb proprioceptors);
- Hop on two feet (dynamic balance and lower limb proprioceptors);
- Climb through a tunnel (spatial awareness) leading back to the ramp.

This obstacle course was undertaken up to three times by each subject. Throughout the testing and the sensory-motor sessions, the instructor used short and simple phrases and cues when communicating instructions to the subjects (Dowell *et al.*, 2009:565).

## Adaptations and extras

To make the intervention child-friendly, the activities involved colourful and creative ideas to stimulate the fun factor for the boys participating in the study and try maintain their attention as long as possible. In each sensory-motor programme, there are themes for each activity which were made up according to each boy's interest. Subject A is fascinated by the universe, planets and space, along with 'Hercules' the cartoon character and the Disney movie theme songs, for example: Lion King, Ariel and Hercules. Subject G has a 'Buzz-light-year' figurine (Toy Story), which he always brought to school and therefore he always wanted the Toy Story theme song. These factors were considered when planning all the programmes in order to capture the subjects' attention.

*If we knew what it was we were doing, it would not be called research, would it?*

Albert Einstein

## **Chapter 4**

# **ANALYSIS AND DISCUSSION OF RESULTS**

### **INTRODUCTION**

After presenting the methodological procedures used in this study to assess the neuro-developmental and diagnostic statuses and sensory-motor skills of the two case studies, the results of the relevant tests will be reported and discussed. The subjects were evaluated by a psychiatrist with scientific diagnostic tests to provide a more recent confirmation of their previous Autism Spectrum Disorders (ASD) diagnoses. The researcher conducted a neurological test battery to assess the subjects' sensory-motor skills as well as the ability of their vestibular and somato-sensory (proprioceptors) systems to integrate with each other while performing these sensory-motor skills. In addition, a screening test was used to assess the boys' reflexes, vestibular function and eye movements. Based on their test results, unique SMI programmes were designed for each boy and aimed to stimulate their hypo-responsiveness. These results will be compared to the findings of other studies involving children with ASD and SMI difficulties.

### **NEURO-DEVELOPMENTAL AND DIAGNOSTIC EVALUATIONS**

The following section will present a description of the results of each case study, individually.

#### ***Subject A***

This subject attended the autistic school from the age of seven where this study was conducted. While in the group of five children, Subject A was recorded to be disruptive by demanding attention from the instructor. He was eight years and five months old when the psychiatrist performed the clinical assessment. In the report provided by the parents and from the occupational therapist, the subject also showed symptoms of Attention Deficit Hyperactive Disorder (ADHD) and was confirmed by the psychiatrist based on his previous ASD diagnoses.

According to the questionnaire the Social Communication Questionnaire (SCQ) that the psychiatrist conducted with the parents, Subject A was 26 months when his parents began to show concern about the subject’s anxious, unsettling and aggressive behaviours and his continual disruptive sleeping patterns. When he was two years old, he appeared to be auditory sensitive, as he would place his hands over his ears and cry quite frequently. His first single words to be recorded were at 30 months (atypical if >18 months) and he was 40 months (atypical if >33 months) when he began to first use phrases. Along with his demanding nature, his parents mentioned he always spoke loudly and he lisped when speaking. In terms of locomotor skills, Subject A went straight into attempting to walk at 9 months but did not crawl.

A second standardised interview was conducted with the parents of Subject A. The Autism Diagnostic Interview-Revised (ADI-R) provided three functional domains, to assess if Subject A could be scored according to the ASD diagnostic criteria. In Table 4.1 are the three functional domains for ASD symptoms assessed.

**Table 4.1 SUBJECT A: SUMMARY OF AUTISM DIAGNOSTIC INTERVIEW-REVISED (ADI-R)**

| <b>Qualitative abnormalities in reciprocal social interaction</b>   | <b>Qualitative abnormalities in communication<br/>(Scored as a verbal subject)</b>   | <b>Restricted, repetitive &amp; stereotyped patterns of behaviour</b>   |
|---|--|---|
| <i>Failure to use non-verbal behaviours to regulate social interaction:</i><br>Direct gaze<br>Social smiling                          | <i>Lack of or delay in spoken language and failure to compensate through gestures:</i><br>Nodding, head shaking<br>Conventional gestures | <i>Encompassing preoccupations &amp; circumscribed patterns of interest:</i><br>Unusual preoccupations<br>Circumscribed interests |
| <i>Failure to develop peer relationships:</i><br>Respond to approaches of other children<br>Group play                                | <i>Lack of varied spontaneous make-believe or social imitative play:</i><br>Spontaneous imitation of actions                             | <i>Compulsive adherence to non-functional routines or rituals:</i><br>Verbal rituals of repeating words                           |
| <i>Lack of shared enjoyment:</i><br>Offering to share   | <i>Relative failure to initiate or sustain conversational interchange:</i><br>Social verbalisation/chat<br>Reciprocate conversation      | <i>Stereotyped &amp; repetitive motor mannerisms:</i><br>Walking up and down, jumping   |
| <i>Lack of socio-emotional reciprocity:</i><br>Offering comfort<br>Quality of social overtures<br>Appropriateness of social responses | <i>Stereotyped, repetitive, or idiosyncratic speech:</i><br>Inappropriate questions or statements  | <i>Preoccupation with parts of objects or non-functional elements of material; unusual sensory interest:</i><br>No evidence       |

The information under each heading is relevant to past and present characteristics related to the 15 behaviours an individual demonstrates (Chapter 3, Figure 3.1). Subject A was scored according to his inability to reciprocate *social interaction* through eye contact and smiling. He did not appear to play in a group of other children and did not display sharing. The second column relating to *abnormalities in communication*, the subject was observed to nod or shake his head especially when he is talking or mumbling to himself. The parents stated that he does not do well in group settings and even though he may ask many questions, he does not have the skills to sustain a conversation.

The motor mannerisms (*repetitive stereotyped patterns and behaviour*) that he portrayed was fidgeting with his fingers and constantly licking his lips. Subject A was scored according to the information in Table 3.1 (Chapter 3). Therefore, the outcome of his score re-affirmed the ASD diagnoses (Shao *et al.*, 2003:545) of Subject A that were based on the International Statistical Classification of Diseases and Related Health Problems (ICD-10) (Eisfield, 2014) and Diagnostic and Statistical Manual for Mental Disorders (DSM-5) (Lord *et al.*, 1994:664-665; APA, 2013:51).

The results of the former two interviews (SCQ and ADI-R) correlated with the third assessment the psychiatrist conducted (Corsello *et al.*, 2007:938). The Autism Diagnostic Observation Schedule-2nd Edition (ADOS-2) applied and the results also portrayed the ASD symptoms.

### **Subject G**

According to the SCQ, Subject G's parents were concerned about him when he was 18 months old. He began to use simple words but suddenly a definite change occurred and he lost all speech and expression as he did not respond when his parents would speak to him. In the reports from the parents, he never crawled and only began to walk at 13 months. Currently, Subject G has limited speech which was scored as 'Non-verbal' in the ADI-R summary (Table 4.2). The specific autistic characteristics of social interaction, communication and repetitive and stereotyped patterns of behaviour were summarised in the ADI-R interview. In terms of his level of ASD and according to the ADOS-2 scores, Subject G was categorised as moderate. The symptoms are related to his chronological age and the level of his expressive language.



The ADI-R was also used to question his parents about his qualitative impairments in reciprocal social behaviour, delays in language development and restricted range of interest and/or stereotypic behaviours (Lord *et al.*, 1997:507). According to the scoring criteria in Table 3.1 (Chapter 3), Subject G received a 2 or a 3 for most of the behavioural characteristics. His limited speech may also have contributed to the high scores he received in the sections relating to social interaction. Subject G’s stereotyped behavioural differs from Subject A in that he flaps his hands and he did not display any compulsive routines. His intellectual impairment may have contributed to most of these social behaviours.

**Table 4.2 SUBJECT G: SUMMARY OF THE AUTISM DIAGNOSTIC INTERVIEW-REVISED (ADI-R)**

| <b>Qualitative abnormalities in reciprocal social interaction</b>   | <b>Qualitative abnormalities in communication<br/>(Scored as a verbal subject)</b>   | <b>Restricted, repetitive &amp; stereotyped patterns of behaviour</b>   |
|---|--|---|
| <i>Failure to use non-verbal behaviours to regulate social interaction:</i><br>Direct gaze<br>Social smiling<br>Range of facial expressions used to communicate   | <i>Lack of or delay in spoken language and failure to compensate through gestures:</i><br>Pointing to express interest<br>Nodding, head shaking<br>Conventional gestures | <i>Encompassing preoccupations &amp; circumscribed patterns of interest:</i><br><br>Circumscribed interests   |
| <i>Failure to develop peer relationships:</i><br>Imaginative play with peers<br>Interest in children<br>Respond to approaches of other children   | <i>Lack of varied spontaneous make-believe or social imitative play:</i><br>Spontaneous imitation of actions<br>Imaginative play<br>Imitative social play                | <i>Compulsive adherence to non-functional routines or rituals:</i><br>No evidence   |
| <i>Lack of shared enjoyment:</i><br>Offering to share<br>Seeking to share enjoyment with others   | <i>Relative failure to initiate or sustain conversational interchange:</i><br>Only evaluated when subject is verbal  | <i>Stereotyped &amp; repetitive motor mannerisms:</i><br>Head shaking, hand flapping, fidgeting, hopping in place   |
| <i>Lack of socio-emotional reciprocity:</i><br>Use of other’s body to communicate<br>Offering comfort<br>Quality of social overtures<br>Inappropriate facial expressions<br>Appropriateness of social responses | <i>Stereotyped, repetitive, or idiosyncratic speech:</i><br>Only evaluated when subject is verbal  | <i>Preoccupation with parts of objects or non-functional elements of material; unusual sensory interests:</i><br><br>Repetitive use of objects & interest in parts of objects |

While conducting the tests of the ADOS-2, Subject G seemed more occupied with objects in the room, than in the tasks set by the psychiatrist. This confirmed some of the information

provided from the parents in the ADI-R (Table 4.2). The subject did not use any facial expressions during social interaction and he was fascinated by the balls that were in the testing room. The results of the former two interviews (SQC and ADI-R) correlated with the third assessment the psychiatrist conducted (Corsello *et al.*, 2007:938) and therefore also confirmed Subject G's previous ASD diagnosis.

Minimal research involving children on the Autism Spectrum, has included one of these three diagnostic evaluations (SQC, ADI-R and ADOS-2) when investigating the possibility of sensory or motor impairment (Ming *et al.*, 2007:566,568; Jasmin *et al.*, 2009:232; Staples & Reid, 2010:211; Lloyd *et al.*, 2011:136; Baranek *et al.*, 2013:309). Therefore, a partnership was formed for this study between the psychiatrist and the instructor. The purpose was to confirm the diagnoses of the subjects and to provide specifics about their social and communication abnormalities and if the ASD characteristics may be associated with the sensory and motor impairments in Subject A and Subject G.

The presence of damage to the nervous system or a neurological disease could be the result of poor motor performance in children (Mutti *et al.*, 2012:94). With regard to this study, the various methods applied provided the results of two tests that were conducted and revealed interesting outcomes. A statistical analysis was applied to the sensory-motor integration data of the study, which consisted of the test-battery, *Quick-Neurological Screening Test III* (QNST-III) and the screening tool, *Sensory Input Systems Screening Test* (SISST). These tools were used to measure the degree to which the subjects were challenged in terms of their gross motor skills, and to identify sensory input delays in the vestibular and the somato-sensory systems that may result in sensory-motor integration difficulties. Once the results were analysed, individualised sensory motor integration programmes were designed for each of the two subjects. The influence of the programmes was moderated and assessed by the regular Re-testing of their sensory and motor skills. The main findings will be highlighted and a detailed discussion of results will follow.

The results of the current investigation showed overall improvement in the subjects' gross motor skills, static and dynamic balance abilities in the post-test. However, over the retention period, the results varied between the subjects. Improvement in the subjects' somato-sensory systems (proprioception), also varied but were highlighted in the areas involving spatial awareness and motor planning. The integration of the vestibular system

and proprioception developed gradually which was highlighted in the *Arm and leg extension* subtest. The overall scores for the subjects improved even though they were at different levels of severity. For the screening tool (SISST), Subject A improved in the reflex items and the visual tests. Subject G was not able to perform most of the test items and therefore his results were inconsistent.

## **Stature**

### ***Subject A***

During the application of the QNST-III for the Pre-test and the SISST, his body weight was 26kg and he was 129.5cm tall. However, after the completion of the eight-month intervention, he was only a week away from turning nine-years old. When the final test (Retention-test) of the QNST-III and the SISST were conducted, his weight had increased to 27kg and his height was 132.5cm.

### ***Subject G***

At 6 years and 10 months Subject G started participating in the study when he weighed 24kg and his height was 124cm. After the seven months SMI programme and the eight-months intervention, he was seven years and seven months old and he weighed 23.5kg and his height increased to 130.5cm.

## **RESULTS FOR THE QUICK NEUROLOGICAL SCREENING TEST (QNST-III)**

This section discusses the results collected from the QNST-III. The results of Subject A (blue line) and Subject G (red line) are discussed for each subtest from the Pre-test through the subsequent Re-tests and Post-test culminating with the Retention-test. Raw scores are indicated in brackets as Arbitrary Units (Au) accompanying the relevant tests mentioned. Frequently mentioned in the chapter are the QNST-III functional categories (No Discrepancy, Moderate Discrepancy and Severe Discrepancy). For information describing these three functional categories refer to Chapter 3 (Table 3.2). Refer to Appendix C for the descriptions of each subtest.

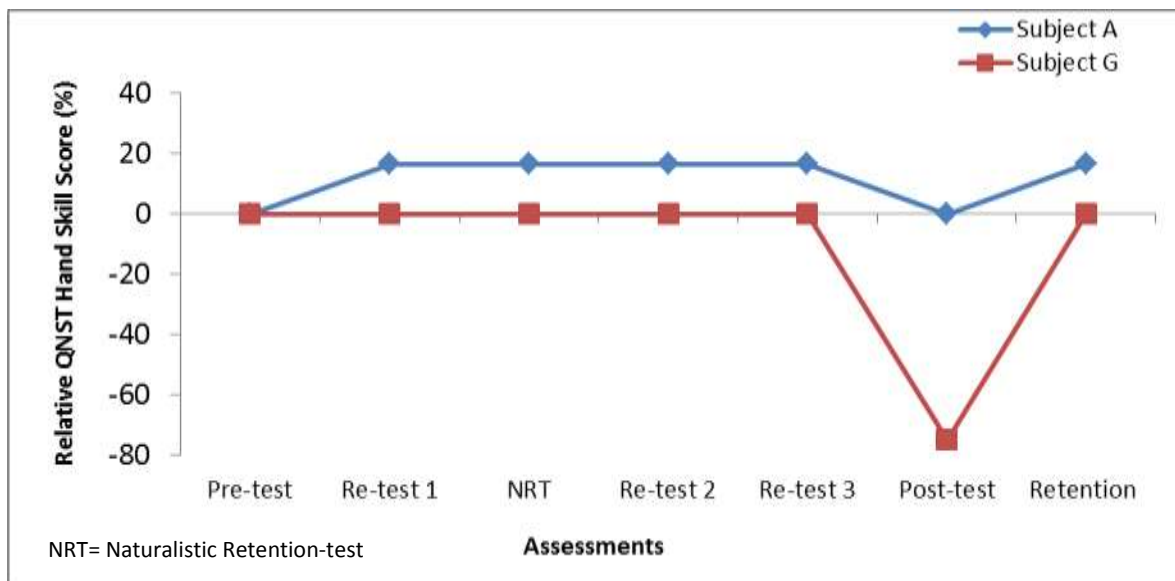
The graphs in the QNST-III section, illustrate the relative percentage change over time from baseline. In other words 0 does not indicate the actual score, but the starting point or the data before the intervention started. The subjects are different ages and therefore 'severe

discrepancy' is scored differently according to the relative QNST-III normative tables. A decrease in scores on the graphs reveals improvement taking place, whereas an increase in score depicts that the errors were committed and therefore the poorer the skills are getting.

During Chapter 4's discussion of each subtest results and graphs, speculations may be noted regarding the possible relationship of the subject's sensory-motor skill delays or improvements on their behaviour and social skills. Former research has suggested a connection between motor skill impairment or sensory processing disorders and the delay in the development of social & communication skills in children with ASD due to the severity of poor motor skills (Sutera *et al.*, 2007:105; Baranek *et al.*, 2013:313; MacDonald *et al.*, 2013:278). However this area and relationship still needs to be explored. For this study the instructor observes and therefore integrates descriptive information during each subtest's assessment, to discern if the subjects' SMI programmes may have influenced their behaviours and speculations made by the psychiatrist.

### Hand Skill

A high-score for the *Hand skill* test indicates the number of errors made. The X-axis indicates the testing sessions. The data in Figure 4.1 shows the relative change in percentage errors that the two subjects made from the initial Pre-test session over the eight-month intervention for *Hand skills*.



**Figure 4.1 QNST - HAND SKILL**

**Subject A**

The results (in blue) depicted in Figure 4.1 show a positive reflection and level of the fine motor skills of Subject A for his age. On the QNST-III Record Form specific errors were listed. There were no errors observed or recorded for the Pre-test. There was no change between the Pre- and the Post-test results. However, there was a slight increase (17%) in the score for Re-test 1 (1 Au), which remained constant until Re-test 3. The *Hand skill* score decreased (17%) after the intervention programme (Post-test) but returned to similar values during the retention as was the case in the former tests. Despite a slight increase in scores, Subject A remained in the 'no discrepancy' category for all the items of this subtest.

It is interesting to note that Subject A scored no errors in the Pre- or the Post-test. As reported in former research (Mostofsky *et al.*, 2009:2414; Lloyd *et al.*, 2013:140; Whyatt & Craig, 2012:1801-1802), children with ASD have poor hand writing and fine motor skills. However, during the other tests he did demonstrate some errors. His teacher went on maternity leave in the second month of the intervention and returned only four months later, which was two months prior to the Post-test. These four months were the crux of the intervention and the increase in score could suggest that the presence of his teacher in his routine and her assistance and guidance in his academic performance, played a major role.

The error observed in Re-test 1 was keeping his eyes too close to the paper. Subject A would also alternate between his hands when writing. Mutti *et al.* (2012:95) maintain that hand preference or mixed dominance alone, does not lead to educational complications and therefore, it was not scored on the QNST-III Record Form. However, Neto *et al.* (2013:869) contradict the former statement. These researchers conducted a study with 44 children between ages eight- to nine-years old, who were right-hand dominant and the second group was 44 children who showed mixed dominance during reading and writing assessments involving laterality (Neto *et al.*, 2013:866). Mixed preference involves body awareness and when the child is not inclined to use one dominant hand, foot or eye, but alternates between the two hands or feet during motor tasks (Cheatum & Hammond, 2000:106). The findings of Neto *et al.* (2013:869) revealed that the group with mixed dominance scored lower in the reading and writing skills and they stated that it confirms the importance of laterality for the maturation of a child's school work.

After Re-test 1, there was a two-week school holiday and the subjects did not attend their SMI sessions. Therefore, this was included into the intervention as a 'Naturalistic Retention'. Following the holiday, the Naturalistic Retention-test (NRT) was conducted to assess if any changes took place in the subjects' sensory-motor skills. The error scores from Re-test 1 were repeated in the NRT included the following: Subject A using his right hand to steady the top of the pencil while the opposite hand (left hand) held closer to the tip of the pencil instead of his left hand solely supporting the grip. This may demonstrate lack of muscle control in coordinating the pencil along with applying sufficient force while writing (Cornhill & Case-Smith, 1996:738). During the testing session of Re-test 2, he was observed to mumble to himself and still used the opposite hand to steady the pencil while writing. This struggle to support the pencil with one hand shows the underlying somato-sensory processes of poor proprioception (Riemann & Lephart, 2002:80). To support the above statement, Liu and Breslin (2013:1247) tested the fine and gross motor skills of three- to 16-year old children with ASD. The researchers used the Movement Assessment Battery for Children-2 (MABC-2) which tests three areas: manual dexterity, ball skills and balance. Their results revealed that despite adjusting the instructions of the MABC-2 test battery with visual aid, the fine motor skills of the subjects remained to be categorised as being delayed. This highlights that children with ASD possibly have poor fine motor skills.

After completing Re-test 2, the instructor incorporated a few proprioception exercises into the SMI programme of Subject A. None of the activities involved drawing, but some activities did involve him using his hands.

In Re-test 3, instead of using the opposite hand to support the left hand while writing, Subject A would press very hard with the dominant hand when trying to write his name and short sentences. Progressive proprioception exercises followed Re-test 3. He was given small objects, which required the application of different levels of pressure and force needed for his hands to squeeze and release for a number of repetitions (Appendix D). A study conducted by Marco *et al.* (2012:8) confirmed that boys with high functioning autism showed diminished somato-sensory responses especially to tactile stimuli processing. Haswell *et al.* (2009:2) found that the more children with ASD relied on proprioceptive feedback, the more it affected their motor function, social skills and their ability to imitate movements and may contribute to dysfunction. These studies may support the scores

attained until the Post-test and improvement in proprioception that only occurred 33 weeks into the intervention.

No errors were observed during the Post-test. The SMI programme did not specifically focus on fine motor skills and improving the handwriting abilities of Subject A. However, therapists have targeted improving motor skills when a child has had handwriting challenges (Naidier-Steinhart & Katz-Leurer, 2007:392). In this current study, his programme involved stimulating proprioception in the upper limbs, but would not necessarily assist him with the pencil grip. Nevertheless, he did not perform any errors. This may have resulted from the progression to enhance proprioception in the SMI programme after Re-test 3.

The Retention-test observed one error that meant Subject A returned to his score of Re-test 3 (4 Au). The QNST-III manual indicates that, if a child is still printing after the third grade instead of doing cursive, this could be a sign of motoric tension guiding him automatically. This is an error due to the child resting between each letter, which makes it easier for the muscles in the hand. There is educative significance in using cursive technique because it exercises and evens out the individual's grip and motor control in their fine-motor skills (Mutti *et al.*, 2012:96). This may be associated with his inability to hold a stable grip without the assistance of the opposite hand during the fine motor task. The increase in score during the retention period, may suggest that the progression in proprioception activities should have been initiated earlier in his SMI programme or repeated more frequently.

### **Subject G**

Figure 4.1 show that the scores (indicated by the red bar) present a significant (75%) change between the Pre- and the Post-test. The score remained at a constant high level all the way until the decrease after Re-test 3. Subject G was in the 'severe discrepancy' category according to his age from the Pre-test (4 Au) to Re-test 3. The results of the Post-test (1 Au) declined from Re-test 3, which placed the subject in the 'no discrepancy' category. However, the score did not remain there as there was a sharp rise (75%) after the retention period (4 Au), which lead him back to the original score recorded in the Re-test 3 ('severe discrepancy category').

On the first day of testing, the first subtest revealed that he could not write his name and would just draw lines as if he thought he was writing letters. Even though the writing was

just pencil lines, the examiner could observe the manner in which the subject would pick up and hold his pen. While he was drawing, it was observed that Subject G had a right-hand preference. There are some requirements in the test which are not scored if a child is under the age of eight. Subject G received a high score in the Pre-test as he could not write his own name which is a requirement of the subtest. As this section could not be tested with a written sentence, the instructor observed while the subject was drawing or holding his pencil. Subject G's pencil grip was scored as 'clumsy' (Elwin *et al.*, 2013:238). He would just draw lines on his page and struggled to attain a firm grip while the pencil moved down and up in strokes. Children with ASD have been reported to have delayed fine motor abilities along with low muscle tone (De Jong *et al.*, 2011:643; Liu, 2013:205; Liu & Breslin, 2013:1247), which would influence their handwriting (Fuentes, 2009:1535).

Along with the Pre-test, Re-test 1 also showed that the subject had a slight tremor when performing the writing or drawing task. The extremely high scores from the Pre-test to Re-test 3 (4 Au) could also have been the result of the scoring received for the behavioural irregularities section recorded on the specific days of testing. The behaviour irregularities will be elaborated on in the final section of this chapter. Subject G was distracted, anxious and unresponsive or even resistant most of the time while performing this subtest over the five testing opportunities. He would attempt to put the pen in the instructor's hand. Children with ASD have been reported to be highly responsive to tactile stimuli and may show aggressive reactions and repetitive verbal expressions during activities (Hilton *et al.*, 2010:942).

Bogdashina (2003:57) refers to hyper-sensitivity (over stimulation) and hypo-sensitivity (under stimulation) to the stimuli that is either lacking in a sensory system or there is too much of it. Subject G can be matched to the hypo-sensitive symptoms that Bogdashina mentions in his book about different sensory experiences in autistic individuals. With regards to the subject flapping his hands, this may also be associated with 'dangling' objects in front of his face to gain the tactile and visual stimulation that those sensory systems need (Bogdashina, 2003:57; Elwin *et al.*, 2013:239). This would also affect his ability to hold and steady his pencil to initiate handwriting thus confirming the need for stimulation of proprioception. The repetitive motor mannerism was also observed and confirmed by the psychiatrist in the ADI-R report (Table 4.2), where Subject G was observed to reveal hand and finger mannerism (flapping and fidgeting). It is interesting to note, that this is scored as



an unusual behaviour (restricted, repetitive and stereotyped pattern of behaviour) as the motor mannerism may prevent the subject from performing the task correctly.

Dysfunction in these sensory areas and motor skills may also correlate with the severity of poor social skills and behavioural irregularities (Baranek, 1997:93, 94; Baranek *et al.*, 2007:241; Baranek *et al.*, 2013:313). It is likely that motor skill impairment may be delaying the development of social and communication skills in children with ASD due to the severity of poor motor skills (Sutera *et al.*, 2007:105; MacDonald *et al.*, 2013:278). However, this area still needs to be explored. More recently, Baranek *et al.* (2013:309) conducted a study using three large groups of children, namely those with autism, developmental delay and typical development, ranging within the ages from 11 to 105 months. The autism group had been diagnosed with the autistic disorder by psychiatrists using the ADI-R, ADOS or the Childhood Autism Rating Scale (CARS). This current study also utilised the ADI-R and ADOS to confirm the diagnosis of the subjects, however, they were categorised as ASD according to the DSM-5.

To evaluate the children's responses to sensory stimuli during their everyday activities and to observe how this may influence social and non-social stimuli, Baranek *et al.* (2013:310) used the Sensory Processing Assessment (SPA) and Sensory Experiences Questionnaire (SEQ). Their findings revealed that sensory processing dysfunctions or delays may also be the underlying reasons for behavioural response patterns, hypo-responsiveness and not just social cognitive discrepancies. Additionally, their results approved the relationship of sensory problems leading to developmental delays in joint attention and language skills in the autism group (Baranek *et al.*, 2013:317). The three specific sensory areas that the latter focused on were auditory, visual and tactile. However, in contrast to this, the current study was directed at vestibular and proprioception-related sensory-motor skills.

Joint attention is how a child may respond or develop in social settings and their ability to reciprocate or initiate actions (Ingersoll & Schreibman, 2006:491). This has shown to assist in language development and imitation skills of three- to four-year old children with autism (Toth *et al.*, 2006:100; Kasari *et al.*, 2012:493). This may reflect on Subject G who is six-years old, has a language and intellectual impairment and was observed to not respond to instructions ie. writing his name and the required sentence, and struggled to imitate skills at the start of the intervention.

The only manual dexterity work Subject G enjoyed was on his I-pad, which could contribute to him not being skilled with a pencil, therefore not strengthening his finger muscles and pencil grip. The high scores from the Pre-test to Re-test 3 may also reflect Subject G's desire for proprioceptive feedback during the intervention period. Stimulating the somato-sensory system was not the main focus for the first two months of the intervention even though some of the activities did require the proprioceptors. The instructor needed to first establish a set routine for him and how to communicate the instructions as this was a vital factor for performing the SMI activities. This routine may have been disrupted when he was absent (Winter months - third and fourth month), as opposed to never missing one session over the first two months of the intervention. The representation of the scores in Figure 4.1 may also reveal that even though the subject performed activities stimulating the proprioceptors later in the intervention (Appendix E), he only started to respond to the stimulation after Re-test 3. This may have led to the results showing a lowered score in the Post-test (1 Au).

The instructor also included more exercises emphasising proprioception in his programme. These fine motor exercises involved pulling rubber bands or hanging from monkey bars, compression of joints in the upper limbs and the 'pumping action' technique (Cheatum & Hammond, 2000:207; Rose, 2010:155). Subject G was a lot more responsive in the Post-test (as opposed to the former Re-tests) along with the absence of tremors. However, he continued to portray a clumsy hand grip.

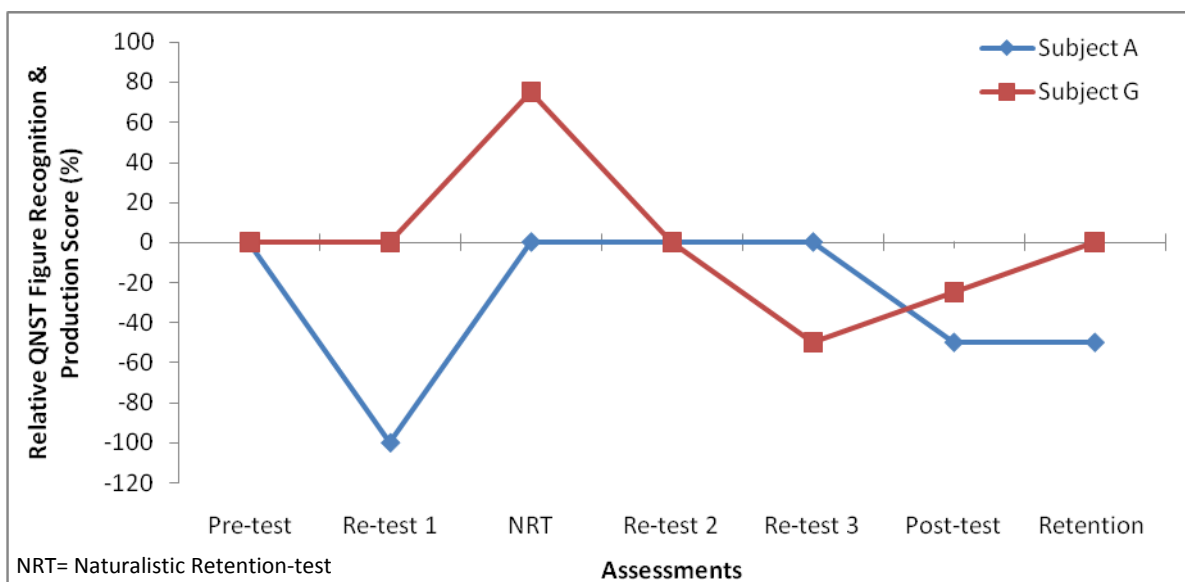
After the four-week holiday in December, Subject G returned to being highly distracted and resisted performing the 'Hand skill' task. Holding the pencil involves the somato-sensory system (proprioception) (Cheatum & Hammond, 2000:203; Krog & Kruger, 2011:74). His grip was still 'clumsy' and he exhibited a slight tremor when pressing the pencil point down on the page. This may suggest he has poor proprioception.

The SMI programme specifically focused on the vestibular system along with stimulating the proprioceptors of the upper limbs (arms) and lower limbs (legs and feet) which forms part of the somato-sensory system. The activities in the SMI programme required the hands to perform ball manipulation skills (Appendix E). However, this may be a speculation reflecting that the level of proprioception activities in the programme may have not been adequate enough to improve his fine motor skills before the Post-test.

Subject G followed a similar pattern to Subject A, despite the two subjects being completely different, not only in age and intellectual functioning, but also in social interaction abilities. It may appear that the subjects have poor proprioception, which seems to have improved only in the Post-test, followed by a decrease after the retention period. Therefore, the results of Subject G and Subject A correlate with each other and confirm that progression in proprioception should have occurred earlier in the SMI programme. However, Subject A may have been slightly more sensitive to change than Subject G, who was affected by the teacher going on maternity leave. This may explain why Subject A showed no errors in the Pre-test but the score was raised after the initiation of the SMI programme and remained at that level until the Post-test. The results of Subject G remained the same until the Post-test. One could speculate that he may not have been as effected by the teacher leaving as Subject A was.

### Figure recognition and production

The X-axis indicates the testing sessions. The data in Figure 4.2 show the relative change in percentage errors that the two subjects made from the initial Pre-test session (baseline) over the eight-month intervention for *Figure recognition and production* skills.



**Figure 4.2** FIGURE RECOGNITION AND PRODUCTION

#### Subject A

Figure 4.2 reveals that the results for Figure recognition and production subtest, decreased from the Pre- to the Post-test by 50%. The results in the Pre-test (2 Au) were classified in the

'no discrepancy' category. There was a positive decrease in the results of Re-test 1 (0 Au) and the score remained in this category for the entire duration of testing. Despite remaining in the 'no discrepancy' category, the score returned to baseline for the NRT, Re-test 2 and Re-test 3 (2 Au). The score improved in the Post-test (50%) while the Retention-test was aligned to the Post-test. The results of these two tests had significantly lower scores compared to the former tests.

Mentioned in the QNST-III Record Form of Subject A, he was always able to name and execute all five shapes correctly in all the six tests. Mutti *et al.* (2012:96) state that 6-year old children and older, who are able to identify five geometric figures correctly, can have an average or above-average intellectual potential. However, it was the manner in which Subject A executed his drawings that led to his achieved scores. In the Pre-test the errors observed by the instructor, was the subject verbally self-directing his drawing of the shapes and he would also execute the shapes at a rapid pace. Nonetheless, in Re-test 1 the instructor did not observe any of the irregularities indicated on the Record Form as he performed the subtest at a positive and responsive level. He did however, demonstrate poor closure for one of the shapes (the square) but as is indicated in the QNST-III manual, this is only taken into account if it was also depicted in more than one of the figures (Mutti *et al.*, 2012:96). The errors recorded in the NRT involved him executing the shapes quite speedily, which can be related to behavioural problems, such as hyperactive and impulsive manners. These are also characteristics of ADHD (APA, 2013:60) which Subject A's former psychiatrist made the diagnosis.

Expressed in the scores of Re-test 2, Subject A displayed poor closure in four of the shapes: the circle, the square, the rectangle and the diamond and would also verbally direct his drawing. In Re-test 3, he executed the circle and the diamond in a slightly irregular manner and was recorded as errors. Again a decrease (50%) in the score was observed for the Post-test indicating positive improvement, as the forms were observed to be more regular in shape than in the past tests. In addition, three shapes seemed to have poor closure. Subject A's behaviour was impulsive and he was very distracted on the day especially in the final week of testing, as it was school holidays and the children were about to embark on the holiday club programme. These progressive results were carried over into the Retention-test with only two shapes having poor closure.

**Subject G**

In terms of a positive improvement, there is no difference between the Pre-test and the Retention-test (Figure 4.2). In addition, there was no change in performance from the Pre-test to Re-test 1 (4 Au). Hereafter, there was a drastic 75% increase from Retest 1 to the NRT (7 Au) in the *Figure Recognition and Production* score, indicating poor performance. The NRT produced the highest score from baseline, which placed Subject G in the 'severe discrepancy' category. This may indicate that the fine motor skills and possibly spatial awareness (proprioception) regressed shortly after only two weeks of the natural retention. Five weeks after Re-test 1, the score decreased in Re-test 2 (4 Au) returning to baseline. The score continued to decrease (50%) in Re-test 3 (2 Au) from baseline, which was his lowest and most improved score and placed him in the 'moderate discrepancy' category. The score did not remain there, as it increased slightly in the Post-test (3 Au). The final stage of testing ended off with the results increasing (33%) once again after the retention period placing Subject G to return to the 'severe discrepancy' category.

In the psychiatrist's report, Subject G was reported to have speech impairment. This may also have contributed to his results as seen in Figure 4.1, the Hand Skill subtest from Pre-test to Re-test 3. Therefore, right from the start of the intervention, the instructor focused on specific ways to communicate with him so that he would respond to instruction.

He was quite capable in naming all five figures (circle, square, rectangle, triangle and diamond). He also understood the given instructions in terms of copying each shape. Yet for both the Pre-test and Re-test 1, Subject G was observed to execute the shapes very slowly, and the shapes were recorded to being irregular compared to the original given form depicted on the Record Form sheet. For Re-test 1 the shapes also had poor closure. As was mentioned earlier, the NRT indicated a sharp increase (75%) in the amount of errors displayed in this subtest. He executed the shapes in a more irregular and larger manner than the printed original form. Each shape was inclined more to the right instead of the shapes being more balanced. This may have been due to him being right handed. Subject G was recorded to be quite distracted and especially resistant and 'fidgety' while drawing the shapes. This may also be related to him being more hypo-sensitive to stimuli as with the *Hand skills* subtest.

Baranek (2002:398) and Bogdashina (2003:57) mentioned that hyper- and hypo-responsiveness have been observed to be prevalent in children with autism or a child may alternate between hyper and hypo. Elwin *et al.* (2013:239) makes mention of the new changes in the DSM-5 (APA, 2013:50) that hyper- and hypo-reactivity to sensory stimuli, along with unusual sensory interests have been included into the diagnostic criteria for ASD. This was also confirmed by the ADI-R summary for Subject G as seen in Table 4.2.

If a child has problems with normal vestibular functioning, it has been found to disrupt his or her motor planning and visual-spatial skills. This leads to challenges in his or her reading and writing (Toomela, 2002:245; Callcott, 2012:133). Therefore, in the case of Subject G, the instructor continued to focus on the underlying sensory processes of relevant motor skills involving vestibular and proprioception function (Appendix E) along with moderating and comparing the other subtests including these sensory processes.

Toomela (2002:236) investigated whether the language skills of children would affect their drawing skills. The results confirmed that spatial organisation is aided by language ability and that verbal skills assist drawing through motor planning skills (Toomela, 2002:238,245). However, with regard to this current study, another factor to consider could be the results of the performance in the vestibular-related subtests for Subject G, which integrate with the proprioceptors, and may possibly be associated with these subtests involving fine motor skills. This is discussed further on regarding *Eye tracking* and *Arm and leg extension* test results (Figure 4.10).

After 16 weeks of intervention, Re-test 2 produced a lowered back to baseline score (75%), which continued to lower in Re-test 3 (50%) due to his improvement in the execution of the shapes. These improvements may also be the result of him having to learn how to understand instructions and to initiate tasks in a more controlled manner. There were some shapes that were irregularly drawn and Subject G would sometimes usher the instructor to do the activity for him. Right from the start of the intervention, the instructor initiated teaching him instructions and movements by using visual and verbal cues. Therefore, the results may reflect that Subject G is responding to the deliberate and constant verbal instruction during the activities involving spatial awareness and cognitive skills, and the encouragement to verbally count or repeat cue words along with the movement. Examples of such activities, was the instructor naming the colour of the object and child walks to it or

had to jump 'up' onto a platform or 'down' (Appendix E). Despite the score increasing slightly in the Post-test (Figure 4.2), improvement was still seen in how the shapes were completed and he executed them with closure. Even though only one shape was drawn bigger than its original (the square), the irregularities of the other four shapes improved slightly. This may be supported by the findings of Toomela (2002:239,245) that verbal skills assist in drawing and the improved response to instruction may be an indication of improvement in his cognitive processing and memory (Sherwood & Lee, 2003:381).

After the December holiday (five weeks), the Retention-test showed an increase (33%) in level of severity and the score returned back to the original score that he achieved in the Pre-test and Re-test 1. On this particular day of testing, Subject G was recorded to being highly distracted with an object in the room (a shining chain). During the subtest, he reacted excitedly while rapidly drawing the shapes which can relate to a sensory abnormality (Leekam *et al.*, 2007:906,907; APA, 2013:54). The shapes were larger than the original forms printed on the Record Form sheet and three shapes had poor closure. Despite this event and the score being higher than the Post-test, the outlook seemed positively interesting when comparing the NRT and the Retention-test. The score for NRT was much higher after a two-week holiday and for the Retention-test conducted after the December holiday of five weeks. The retention period followed 16 weeks of the SMI programme (which also included the sessions before Re-test 3), as opposed to just five weeks at the start of the intervention. Therefore, this may show that he not only responded to the SMI programme after a longer period of sessions (including the former Re-tests), but his response did not regress to 75% from baseline or its former score, such as at the NRT. The proprioception and spatial awareness activities did not seem to assist in retaining his level of performance on the tests after the holiday. Consequently, he did not improve his fine motor skills. However, being out of routine could be a factor to consider when interpreting the high score in the NRT, as the ADI-R summary reveals that Subject G did not adhere to non-functional routines (Table 4.2). With reference to his behaviour in the NRT, he had not received any vestibular or somato-sensory (proprioceptors) stimulation for two weeks, which could have contributed to the 75% increase from baseline. The two weeks away also included him missing his daily routine with school activities, which involve structure, drawing and the 'sensory room'. The teachers structure his day according to his needs. In the ADI-R summary, under the section, 'Restricted, repetitive and stereotyped patterns of behaviour', the psychiatrist recorded that

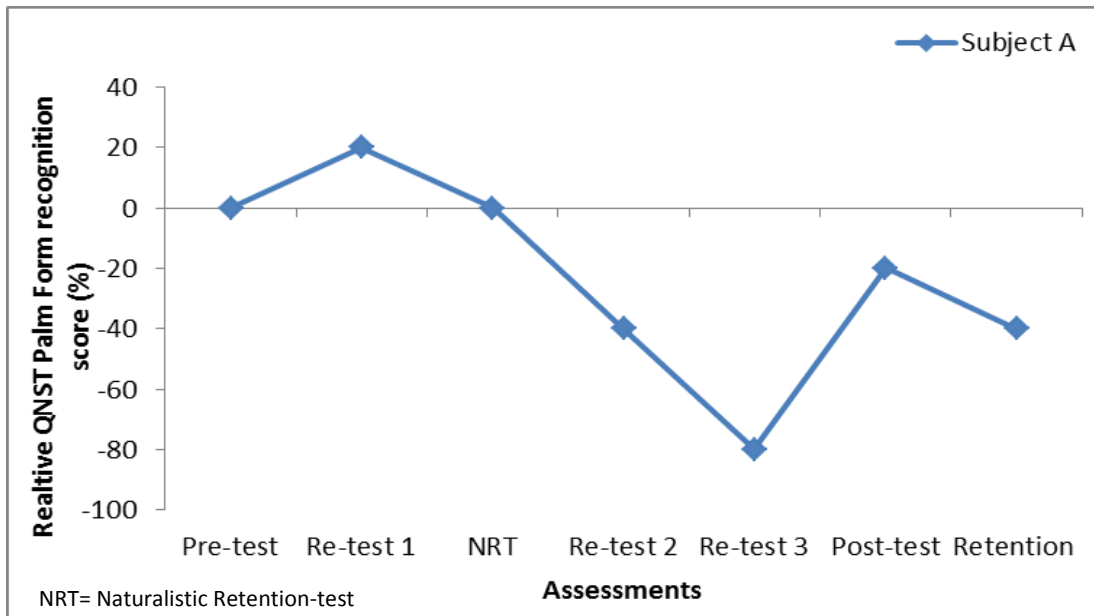
Subject G has circumscribed interests (Table 4.2). He revealed interest in specific 'Disney' characters. According to the ADI-R Summary, Subject G was unable to reciprocate social interaction. With this information in mind and to receive a response from him, the SMI programme made use of his circumscribed interest to direct his attention to the activity and to performing basic movements.

In the study of Macdonald *et al.* (2013:1385), they worked with 233 young children (14-49 months) who were divided into three groups according to their diagnosis: ASD, PDD-NOS and control group with no ASD diagnosis. Part of the findings of the study was an association between social and communication abilities in the children with ASD and their fine motor skills. This study suggests that sensory-motor skills for rehabilitation should be part of early interventions to not only enhance motor ability, but to assist children with ASD in their social and communication skills (Macdonald *et al.*, 2013:1388). Therefore, this may support this current study, in that Subject G did not receive adequate sensory stimulation in the relevant sensory systems over the natural retention period of two weeks. This also occurred during the five-week retention period, however the score did not increase to the NRT. This may suggest that sensory-motor stimulation needs to be offered more frequently.

### **Palm form recognition**

The decreased score depicts possible improvement in the subtest criteria over time and an increase in a score is an indication of number of specific errors observed during the subtest. The *X-axis* indicates the testing sessions. The data in Figure 4.3 show the relative change in the percentage of errors that Subject A made from the initial Pre-test session (baseline) over the eight-month intervention for *Palm form recognition*. Subject G was observed to being tactile defensive and therefore could not present any results for this subtest.





**Figure 4.3 SUBJECT A: PALM FORM RECOGNITION**

### **Subject A**

By observing the results between the Pre and the Post-test, there was a 20% decrease and improvement, over time. Subject A was placed in the 'no discrepancy' category at baseline (5 Au) and concluded in the same category. Re-test 1 (6 Au) (Figure 4.3) showed that the score increased by 20% which tweaked the level of severity to the 'moderate discrepancy' category. The score did not remain at that level as a gradual decline began from the NRT (5 Au) and continued on into Re-test 2 (3 Au) and Re-test 3 (1 Au). This lowered the level of severity. This illustration presents 83% decrease from Re-test 1 to Re-test 3 which is the lowest score throughout this subtest. Subject A was classified into the 'no discrepancy' category during these tests (Re-test 1, NRT, Re-test 2 and Re-test 3). This great improvement did not remain at this point in the Post-test (4 Au). After the SMI programme, the results escalated by 30% from Re-test 3 to the Post-test, but the score dropped slightly in the Retention-test (25%).

This subtest of spatial perception and numeracy involved drawing numbers on the palm of the hand. Even though Subject A revealed to know his numbers from 1- 10, in the Pre-test and Re-test 1, Subject A found it challenging to name the correct numbers or would name a shape instead of a number. According to a study conducted by van Nes and De Lange (2007:220) on four- to six-year old subjects, there was a relationship between the spatial imagery and arithmetical processes. Therefore, the inability to differentiate between

different numbers may suggest a spatial perception problem and the inability to reason and problem solve.

According to the decreasing scores from Re-test 1 to NRT, Subject A began to name some of the numbers correctly. However, he appeared to be more focused when the numbers were being traced on his right hand. He was able to name the numbers correctly, which was also confirmed in Re-test 2. This subtest has been used in another study which tested children with ASD using the QNST-II and observed their ability in tactile perception (Pfeiffer *et al.*, 2011:80) and therefore, may imply that Subject A may have a problem in receiving and interpreting information from the tactile system (Tomchek & Dunn, 2007:196; Marco *et al.*, 2012:8). It was reported and discussed further in the 'Behavioural irregularities' (Figure 4.15) section regarding Subject A, who was distracted in the Post-test, which may have contributed to the score increasing. He would ask questions relating to other matters outside of the testing session. This subtest requires the full attention of the child while the eyes should be closed to eliminate distraction.

After the long five-week December holiday, Subject A was tested concluding with the Retention-test. Improvement was seen in his responsiveness in his left hand as opposed to the former tests during the intervention.

### **Subject G**

During the Pre-test, the *Palm form recognition* was first demonstrated on Subject G and he appeared to resist the instructor while she attempted to draw on the palm of his hand. The report of occupational therapist stated that he was tactile defensive when he was first diagnosed with autism at three-years old. This resistant behaviour in this current subtest could be an indication that he is still tactile defensive as he would also rub his hand on his leg after the examiner's attempt. Baranek *et al.* (1997:93) state that tactile defensiveness may be associated with autism characteristics and makes individuals appear anxious, fidgety and resistant to change. Nevertheless, this cannot be solely related to autism and sensory abnormalities, as it can also relate to the age of the individual and lack of developmental maturity.

Recent findings on sensory sensitivities in children with ASD, have shown that most sensory issues can be observed in the tactile and olfactory areas in children with a Sensory

Modulation Disorder (SMD), especially since sensation in the oral area is said to be connected to the tactile sense (Schoen *et al.*, 2009:6,8; Hilton *et al.*, 2010:942; Lane *et al.*, 2010:120). This subtest was attempted at each testing through to the Post-test but Subject G continued to refuse the procedure of this subtest. The results were excluded from the sum of the other subtests due to him not being able to perform this subtest; therefore no score from this subtest was added to the total QNST score (Figure 4.16). This also shows the SMI programme did not improve the tactile sensitivity of Subject G even though this area was not explored.

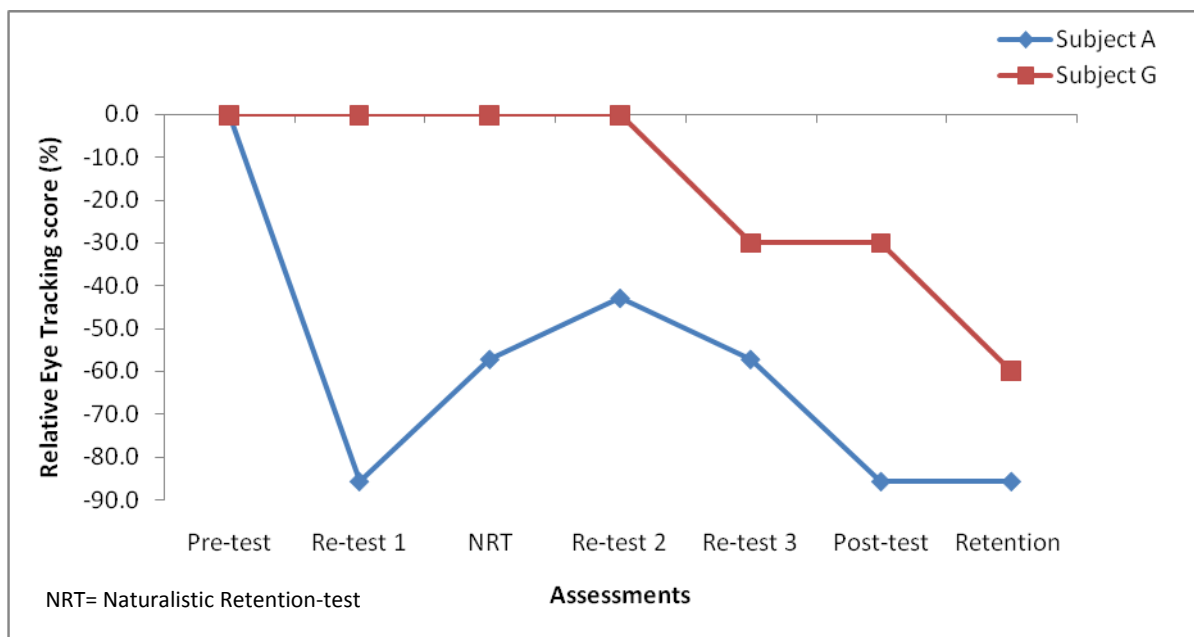
Ben-Sasson *et al.* (2009:10) and Liu (2013:204) both had similar conclusions, stating that those diagnosed with ASD had higher occurrences of abnormal sensory problems. Furthermore, the majority of the autism diagnosed subjects were more over-responsive to sensory stimulation than under-responsive. Individuals with ASD have been observed to seeking or avoiding stimuli received from the visual, tactile, auditory and oral systems, which are normal, everyday incentives to those not diagnosed with a sensory disorder. The characteristic of being over-responsive or under-responsive to sensory stimuli has been classified as a characteristic in children with ASD (Ben-Sasson *et al.*, 2009:2) and demonstrates high levels of sensory modulation disorders across ages and severity of autism. Sensory modulation disorder can intensify dysfunction and inhibit ASD children from participating in productive activities (Suarez, 2012:211), which was seen during this subtest. Subject G was observed to veer away from holding something in his hand for too long, such as his pencil during writing activities.

Supported by the Diagnostic and Statistical Manual of Mental Disorder (DSM-5) (APA, 2013:50) hypo- or hyperactivity to sensory input is experienced by individuals with ASD. Liu (2013:206) examined the occurrence of sensory and motor delays in children with ASD as compared to typical developing children. The results proposed that the fine and gross motor complications in the ASD group could be associated with their deferred sensory processing of specific stimuli (tactile, visual and movement). These findings could suggest the reason for the low scores of Subject G on manual dexterity skills (hand skills) and his intense sensitivity to tactile stimuli. If this is the case, then the limited improvement in the fine motor skills (see *Hand Skills* and *Figure form and recognition*) could mean that the SMI programme did not improve all aspects of the delayed sensory processing. As the SMI programme was not focused on inducing tactile stimulation and, therefore, was not

included unless it involved stimulating proprioception or indirectly stimulating the tactile receptors. The rainbow river stones (Appendix E) contained certain tactile patterns which were aimed at stimulating proprioception in his bare feet, while the subject had to balance on the platforms (Page, 2006:79). Subject G always resisted taking his socks off and became anxious when the instructor would assist him.

## Eye tracking

The decrease in a score over time depicts the possible improvement in the subject’s ability in the subtest along with a decrease in the level of severity of the subject. The X-axis indicates the testing sessions. Figure 4.4 shows the relative change in percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention for the *Eye tracking* subtest.



**Figure 4.4 EYE TRACKING**

### Subject A

A very high score was recorded in the Pre-test (7 Au) (Figure 4.4) which categorised Subject A at or below the 5<sup>th</sup> percentile and placed him in the ‘severe discrepancy’ category with regard to *Eye tracking* abilities. There was an extremely sharp drop (86%) in Re-test 1 (1 Au) and changed his level of severity to ‘no discrepancy’. However, the score did not remain there as the score began to increase (29%) again from re-test 1 to the NRT, followed by Re-test 2 which was 43% from baseline. A slight decline is present in Re-test 3 (3 Au). The Post-

test score returned to the score for Re-test 1 which was 86% from the baseline. This score was retained and carried through to the Retention-test. The improvement over time may have resulted from the SMI programme targeting stimulation of the vestibular system, which has been associated with the eyes.

Subject A would move his head while his eyes would attempt to track the moving pencil in the Pre-test. Other errors observed were the eyes exhibiting jerkiness and were uncoordinated both horizontally and vertically. Comments included on the QNST-III Record Form were that the subject was lifting his eye brows and opening his eyes wide while eye tracking. Mutti *et al.* (2012:99) mention in the QNST-III manual that when a subject moves his or her head during eye tracking, it is a symptom of delayed sensory-motor development. Eye movement is controlled by the Vestibulo-Ocular Reflex (VOR). If the VOR is stimulated it stabilises eye gaze (Goldberg & Wilson, 2012:4), but based on the performance of Subject A in this subtest, it could suggest that he may have a problem with the stimulation of his vestibular system and the VOR (Writer & Arora, 2012:54,55). If the head did not move, this would assist the visual system during gaze as it would exclude the need of the VOR and the gaze would be correct (Nashner, 2009:21; Schärli *et al.*, 2012:81). However, in this particular subtest, the subjects are seated, the head is restrained from moving and just the eyes are required to follow the pencil. In typical developing subjects, the VOR helps the eyes stay focused on a target (Weber *et al.*, 2008:459). The results of Subject A in the Pre-test may be a reflection of the state of his VOR, as his eyes could not follow the pencil without the head moving.

In recent research, Schärli *et al.* (2012:81) investigated how important the visual system is while children's postural control is developing. Their findings propose that five-year old subjects were unable to steady their heads during gaze and eye tracking when compared to the same standards of older children and adults. In the second week of the sessions with Subject A, eye exercises were included in the programme. Research has shown that this may stimulate the ocular muscle reflex (Goddard-Blythe, 2005:420; Niklasson *et al.*, 2009:650; Han *et al.*, 2011:192; Writer & Arora, 2012:58,60) while the eyes focus and track the moving object (Appendix D).

Subject A received a much lower score for Re-test 1 (1 Au) than during the Pre-test. However, it was still recorded that he would move his head while eye tracking, which was

also carried over into NRT and Re-test 3. In the NRT, Re-test 2 and Re-test 3, he would lose focus away from the moving pencil and his eyes would be wide open during motion. A recent study confirmed excessive associated reaction movements in children with ASD, which are minor neurological dysfunctions (De Jong *et al.*, 2011:644). Goddard-Blythe (2005:416) has mentioned that the terminology for neurological dysfunctions is the inhibited primitive reflexes which are still present in a child from six to 12 months and that a child's postural reflexes are not developed by the time they are three to four years old. Since the vestibular system drives the ocular muscle reflex by stabilising the visual alignment during movement, this also controls visual tracking (Piek, 2006:91; Callcott, 2012:139). Therefore, the programme was aimed at including eye exercises to assist in the stimulation of the vestibular system. The eyes exercises were only performed for a few minutes during a session, twice a week (Appendix D).

With the slight decrease in Re-test 3, Subject A did not reveal any eye jerkiness but was easily distracted by his hyperactive behaviour on that specific day of testing. At this point in the intervention, he was performing more ball manipulation skills. This involved the subject focusing on the object being thrown towards him, thus performing a tracking task in a larger area to track. This would also take place while he was required to remain in an upright position on a compliant surface, such as balance pods or an elevated rainbow river stone (platform) and to catch the medicine ball (Appendix D). The medicine ball made the performance of the skill a lot slower, which allowed the subject time to focus and catch the ball with both hands.

A great decrease in score is demonstrated at the Post-test (86%) as there was an improvement in his eye muscle control while moving in the horizontal and vertical planes. Despite being able to control his eyes, he would still at times move his head slightly. This was also the case in the Retention-test. Subject A would correctly follow the pathway but moved his head slightly at the beginning of the exercise. However, his tracking skills were retained over the five-week retention period, therefore the learning effect may have occurred (Vickers, 2007:164, 184) especially due to vestibular stimulation (Wrisley *et al.*, 2007:1052).

**Subject G**

Figure 4.4 indicates that there is a difference between the Pre-test (10 Au) and the Post-test scores (7 Au), but the results of both these tests still represent the same functional category ('severe discrepancy').

For the first four tests he achieved the same score throughout the first four months of testing. This was the highest score and level of severity for this subtest. Finally, Re-test 3 (7 Au) presented a 30% decrease from the high level achieved at baseline. This score continued to the Post-test, however remained in the 'severe discrepancy' category. The improvement was sustained after the retention period (4 Au) as the score reduced to a 'moderate discrepancy' category being 43% lower than the Post-test.

This subtest always seemed to be a challenge for Subject G, as his eyes would have difficulty fixating on one object. Understanding the instruction was the first requirement that needed to be established. For the Pre-test and Re-test 1, he was distracted when asked to be seated. The subtest required him to concentrate on the pencil while it moved in the horizontal plane from left to right and in the vertical plane, up and down. The inability to focus on the pencil also could be related to him not being secure in space and he constantly moved his eyes around to seek balance (Herdman, 1997:607; Nashner, 2009:21).

The ability of the eyes to stay focused on a target involved the assistance of the cerebellum (Robinson & Fuchs, 2001:982). This is also the region of the brain that helps the VOR regulate eye and head movements (Glomstad, 2004:14). If there is damage in the cerebellum, it may lead to impairments in walking and sitting and the individual may fall over regularly while walking or standing as it also affects their balancing ability (Morton & Bastian, 2004:256; Nashner, 2009:24). They may also experience problems when learning sensory-motor skills. However, it is not certain if Subject G has definite cerebellum damage, which could affect his ability to adapt to different skills.

His high score continued into the NRT (10 Au), which was conducted straight after the two-week holiday (in the 3<sup>rd</sup> month of the intervention) while being away from his normal routine of school and the SMI sessions. The high error score was also due to always moving his head, exhibiting a horizontal jerkiness during the subtest and being too distracted when asked to sit and focus on the pencil. Updated research by Niklasson (2012:266) concluded

that learning disabilities originate from an underdeveloped or delayed sensory-motor system. Formerly, Niklasson *et al.* (2009:660) carried out a study on the effects of sensory-motor therapy. The findings reported a positive increase in the subjects' physical and sensory-motor maturity after training. For example, this can be observed in an individual's inability to suppress hand movements and being distracted while performing *Eye tracking*. If there is head movement during eye-tracking, it may suggest an underdeveloped response to control different parts of the body while another area is operating (Mutti *et al.*, 2012:99).

Re-test 2 score (10 Au) remained at the level as the former three tests. Again, Subject G did not seem to understand what was required of him and could not interpret what was demonstrated. This could also be supported by his inability to correctly imitate or interpret skills (Todd, 2012:34; APA, 2013:53). In the ADI-R summary, it was also confirmed under the 'Qualitative abnormalities in communication' section (Table 4.2), that Subject G was observed to lack imitative social play. This may also have contributed to the length of time he took to respond to performing the SMI activities and the QNST-III subtests.

In Re-test 3, there was a slight shift in Subject G's ability to focus resulting in a small decline (7 Au) (30%). Even though he was slightly distracted at times during testing, he attempted to follow the pencil with his eyes. The errors noted for this test was exhibiting vertical jerkiness and coordination of the eyes when attempting to track. The child may then skip the lines or read over the same line as the eye muscles jerked the eyes to another focus area instead of to where the mind directs (Mutti *et al.*, 2012:99). This may have been the case with Subject G, as he already struggled to control his fixation skills. Fixation and the movement of the eyes across the paper involve the visual, vestibular and proprioceptive systems (Mailloux *et al.*, 2011:149; Callcott, 2012:133). When testing an eight-year-old boy with dyspraxia, Hurst *et al.* (2006:206,207), confirmed that his vestibular and proprioceptive processing abilities could have been the underlying reason for visual and sensory modulation deficits. Dyspraxia is a developmental coordination disorder (DCD), which also influences fine and gross motor skills, coordination and reading and writing skills of children (Peters *et al.*, 2001: 408-409; APA, 2013:74-75). Even though the boy in that study did not have ASD, it may still support that the poor eye tracking of Subject G is related to poor vestibular and somato-sensory (proprioception) stimulation. The results for Re-test 3 show that he may have responded to the vestibular and proprioceptive stimulation activities after 26 weeks of the intervention (16 weeks of SMI sessions).

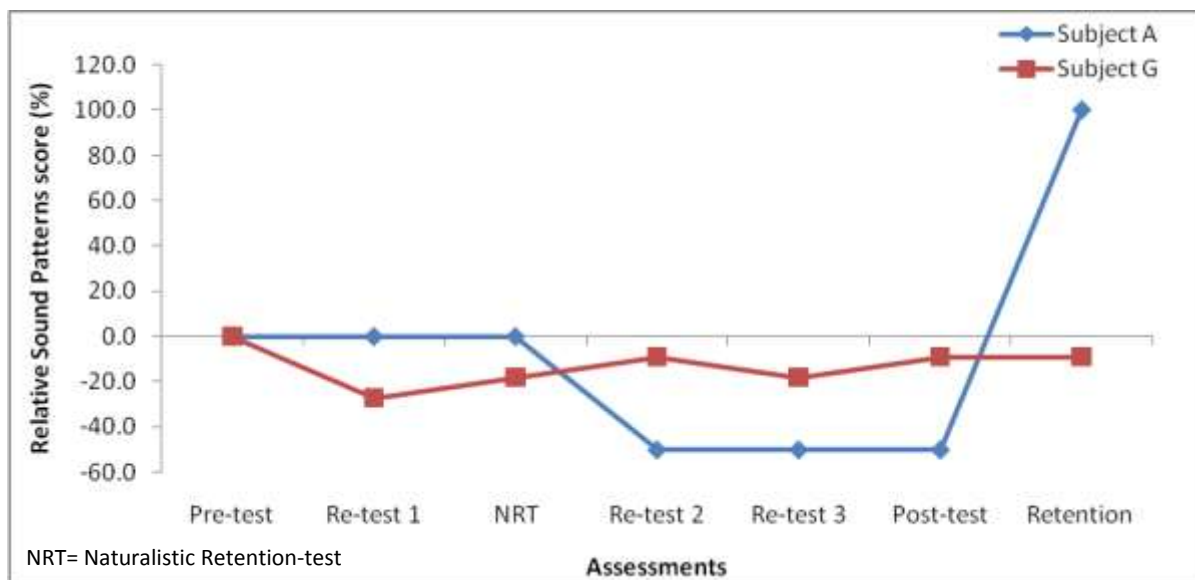


In the last few weeks of the SMI programme prior to the Post-test, Subject G's was observed to show slight improvement with how he was able to look at the object and for the first time follow it with his eyes. He would still move his head while tracking, but it was the first time he seemed to follow the correct pathway of the pencil. However, mentioned in the ADI-R summary in Table 4.2, Subject G did not seem to adhere to routines. Therefore, the improvement in his behaviour, as well as *Eye tracking*, may have resulted from the vestibular system responding to the SMI programme during Re-test 3; along with the assistance of the instructor pertaining to the subject's circumscribed interests.

As was mentioned earlier, at the Retention-test Subject G achieved a score (4 Au) that was lower than the Post-test (7 Au). There were some errors that were similar to the former test. Subject G would move his head and he was very distracted by other objects in the room. He would also rock from side to side when asked to follow the pencil which suggests his inability to control and stabilise his body while the eyes moved. However, there were moments during the test when he was able to respond and fixate on the object and follow its vertical pathway, before being distracted. This may also reflect his progressed ability to respond to instructions upon verbal cues, which was a target right from the start of the intervention; along with eye exercises and the stimulation of the vestibular system, which assisted in improved eye movements (Appendix E) (Hurst *et al.*, 2006:206; Herdman *et al.*, 2007:385; Hillier & McDonnell, 2010:5).

### **Sound patterns**

The decrease in a score over time depicts possible improvement in his ability to repeat the patterns, along with a decrease in the level of severity of the subject. The *X-axis* indicates the testing sessions. The data in Figure 4.5 show the relative change in the percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention for *Sound patterns*.



**Figure 4.5 SOUND PATTERNS**

The motor task required both of the boys to tap the rhythm on the table but they struggled to perform the task in that manner. The QNST-III manual provides an alternate option of attempting to clap the rhythm with both their hands. A second part to the subtest was the oral sequences which the instructor gave and the subject was required to orally repeat them (Mutti *et al.*, 2012:32,33).

### **Subject A**

Subject A generally performed this subtest well and was placed directly in the 'no discrepancy' category with the scores being depicted at a steady level. The first three tests (the Pre-test, Re-test 1 and the NRT) received the same score (2 Au) and a 50% decrease and improvement was achieved in Re-test 2 (1 Au) (Figure 4.5). From this point, the score continued to plateau all the way to the Post-test (1 Au), however these results were not maintained after the five week December holidays. There was an unexpected 100% surge in the Retention showing a huge contrast between the Pre and the Retention-test (4 Au).

Subject A paid attention to instructions and seemed to enjoy the tasks. In the Pre-test, speech irregularities were detected during the oral section. He would also miss any one of the sequences given to him, which are errors recorded on the Record Form. In the oral section of Re-test 1, there were some notable problems with sequencing. In addition, he was delayed in the clapping tasks and would clap in a loud and rigid manner depicting a lack on motor control. At times he would also reverse one of the sequences. Over time (despite the two-week holiday) the results in the NRT for the clapping task revealed a very good

performance. However, he still found the oral repetitions of the sequences challenging. If a child excels in one modality (motor) and the other (oral) presents a poor performance, the auditory reception may still be intact (Mutti *et al.*, 2012:101), as the child is still responding correctly to the sequences. A study conducted on high-functioning children with autism and with no speech impairment, showed that they had no problems with the sensory-sound processing or even perceiving different pitches (Ceponiene *et al.*, 2003:5570).

The auditory system was not included in the SMI programme for Subject A. Even though there was verbal communication between the subject and the instructor, no specific auditory-based exercises were provided. Despite the organs of the auditory system being situated near the vestibular receptors (Strominger *et al.*, 2012:277), the auditory system was not included in this study. Children with autism have been described to learn through visual aid (Rao & Gagie, 2006:26). However, during the sessions, he was instructed to react to visual or verbal instruction instead of 'jumping' ahead of the instructor (Tissot & Evans, 2003:428).

Along with a lowered score (50%) in Re-test 2, the only errors were when he missed one motor sequence and one oral sequence. This was also the case with Re-test 3 and the Post-test. Mutti *et al.*, (2012:101) state in the latest QNST-III manual, that a child may find it challenging to memorise the sequences, especially if the sequences were long, which made them even more difficult to remember and to repeat. The Retention-test produced the highest score (4 Au) in comparison to all the tests conducted over the eight-month period.

Music therapy has been utilised to improve and rehabilitate cognitive function and social skills in children with ASD (Kern & Aldridge, 2006:277; Thaut, 2010:282; Kern & Humpal, 2012:164). The warm-up at the start of each session involved the subject bouncing on a ball while music played. Over time the subject learnt that when the music stopped, he knew he had to stop bouncing (Appendix D). This may have assisted in the improvement of the *Sound patterns* subtest, from only after the NRT. This was 10 weeks into the intervention of performing this warm-up accompanied by music and having to respond and maintain muscle control all the way through the intervention.

**Subject G**

The highest score was achieved in the Pre-test (11 Au) (Figure 4.5). There was a 9% difference between the Pre-test and the Post-test and the scores fell in the 'severe discrepancy' category. There was a 27% improvement after the Pre-test, leaving Re-test 1 with the lowest score (8 Au) in comparison to all the other tests as a whole. Over time, a gradual rise took place from Re-test 1 to the NRT and the score in Re-test 2 was just below that baseline (starting point). There was a slight decline (10%) in Re-test 3 (9 Au) but the score increased in the Post-test and the score and level was maintained into the Retention-test.

As a whole, the scores seemed inconsistent, yet they all remained in a close range of each other. In the Pre-test, Subject G did not understand the instructions communicated to him. The instructor asked him to repeat the sequence only after it was clapped or provided orally. Once he clapped or repeated with the 'dot' word, the sequencing of the patterns were incorrect. One of the diagnostic features for individuals with ASD is the inability to respond in a mutual manner with another individual during social communication and interaction (APA, 2013:53). This explains his response to these verbal instructions to repeat patterns or sequences if he could not even relate to the instructor socially.

The fascination with objects, colours or sounds and spinning has been confirmed as an ASD diagnostic feature in the DSM-5 (APA, 2013:54). He had a fascination with any object or association with the 'Toy story' movie and characters along with shiny or spinning objects. This may indicate that Subject G craved sensory stimulation (hypo-responsiveness) (Ausderau *et al.*, 2014:940). Therefore, the instructor needed to include demonstrations that were visually attractive to try and captivate the subject's attention to the task.

Represented by a decreased score in Re-test 1 (8 Au), Subject G was a lot more responsive to the exercise, despite missing the given sequences and patterns. It was easier for him to depict the pattern orally compared to clapping them with his hands. The increase of errors in the NRT score was due to his inability to perform both the motor and the oral patterns and his distraction away from the task. He was observed to have speech challenges and did not have the ability to express himself with the correct words. This contributed to the score in Re-test 2 (10 Au) (Figure 4.5), especially since he was anxious and unsettled on the day of

testing and during the subtests. Subject G would also just clap or orally repeat his own pattern instead of waiting for the instructor to complete the original pattern.

According to the results of Re-test 3 (9 Au), there was a small shift in the oral section as he could repeat the words but was still unable to appropriately repeat the motor and the oral patterns. This presented a 10% decrease and an improvement from Re-test 2. Once again, the results reverted to the former score of Re-test 2 and increased slightly (10%) in the Post-test (10 Au) due to persevering and missing more than two patterns for the oral and motor production sections. These are errors which are scored with the highest rating in terms of most severe symptoms indicated in the *Sound Patterns* subtest.

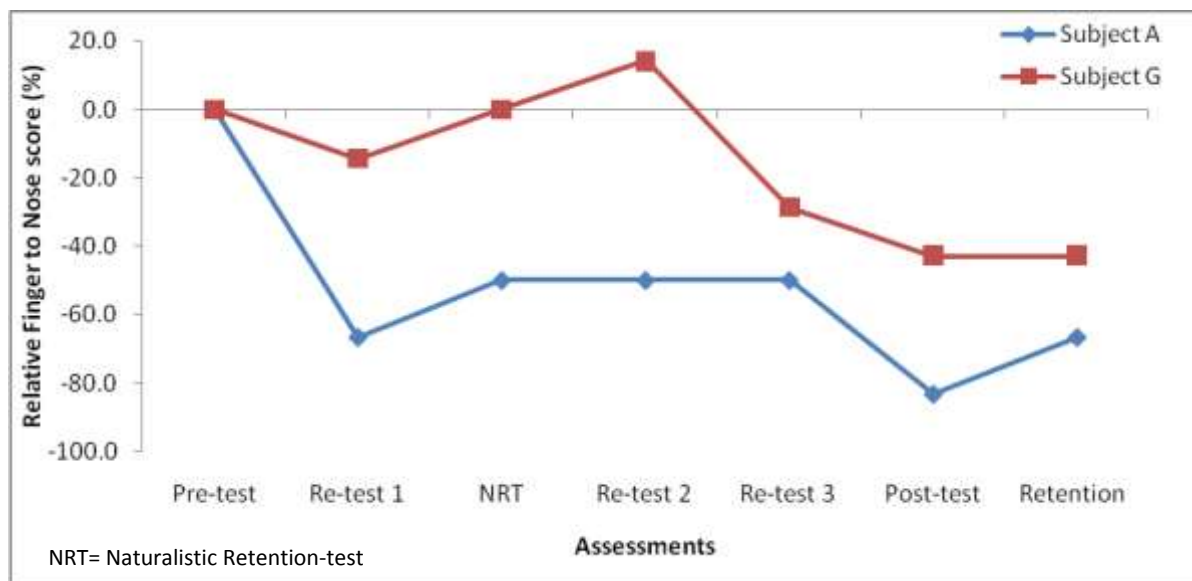
After the five weeks of having no contact with Subject G, the Retention-test scores indicated that he had begun to understand that he must first wait for the examiner to complete the pattern before he repeats it. This relates to his inability to reciprocate and therefore initiate what was demonstrated to him (Table 4.2). He would wait and then replicate his interpretation of the pattern. However, he could not repeat the motor and oral productions correctly and would still continue clapping and/or saying “dot-dot-dot” for a longer period of time than required of him (persevering). Despite the severe errors being observed once again, positive descriptive feedback was given, noting that he would at least wait for his chance to imitate the patterns when asked to do so.

In all of the tests from the Pre-test to the Post-test, Subject G was not able to close his eyes and perform the motor and oral patterns which were the instructions indicated in the manual. Mutti *et al.* (2012:100) mention their observations in clinical settings of an individual not being able to keep their eyes closed while attempting to produce the sound patterns. They suggest that this is due to their environments only being visually interpreted for them, therefore being more challenging to function at ease without visual aid (Rao & Gagie, 2006:31). This may also show that Subject G relies on visual feedback.

### **Finger to nose**

The decrease in a score over time from baseline depicts possible improvement in the subject’s ability in the subtest and a decrease in the level of severity of the subject. The X-axis indicates the testing sessions. The data in Figure 4.6 show the relative change in the

percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention for *Finger to nose*.



**Figure 4.6 FINGER TO NOSE**

### **Subject A**

As displayed in Figure 4.6, Subject A achieved a high score in the Pre-test (6 Au), which is in contrast to all the other testing periods in *Finger to Nose* subtest and was instantly classified into the 'severe discrepancy' category. A positive 83% difference was calculated between the Pre and the Post-test where improvement was evident over time. The level of severity was reduced by 67% from baseline to Re-test 1 (2 Au), which immediately altered the category to 'moderate discrepancy'. Another rise occurred by the NRT (3 Au), when the score was 5% above the Re-test 1 score. From this point, a plateau occurred by the score remaining similar to Re-test 2 and Re-test 3. A greater decline occurred in the Post-test (1 Au) which shows an optimistic 67% improvement from Re-test 3. However, the score increased slightly in the Retention-test (2 Au), placing Subject A in the 'no discrepancy' category for this subtest.

The high score achieved by Subject A in the Pre-test was due to the rapid manner in which he would execute the task. Other errors he made included moving his hand consistently to the right or left of the target on the palm of the instructor's hand and missing the tip of his nose by more than 2.5 centimetres. It has been suggested that if an individual performs the 'Finger-to-Nose' task with a slow or rapid speed (Feys *et al.*, 2003:79), it could be that they

compensate for motor planning and motor control problems (MacNeil & Mostofsky, 2012:168). Information received from the proprioceptors in the limbs plays a role in the smooth initiation of movements as the joints need to 'sense' where they are in relation to each other or the target (Riemann & Lephart, 2002:76). This also includes spatial orientation and the subject navigating his hand and index finger to the target (Petrarca *et al.*, 2013:494).

Re-test 1 indicated a sudden improvement after five weeks of the SMI programme. The comment recorded supporting the great progression was that Subject A was slower in moving his hand from the instructor's hand to his nose and back again, which the instructor had informed him to do before the task was executed. However, when he placed his index finger on the palm of the instructor's hand, he would veer more to the left of the target. To begin this particular subtest, the instructor observed that he was using his left hand which was also confirmed in the 'Hand skill' where he was left hand dominant.

Subject A swapped hands while attempting to do the finger-to-nose-to-hand routine in the NRT. He would begin with his left hand then change over to his right hand. Left-hand dominance has been reported in individuals with ASD (Dane & Balci, 2007:225; Marco *et al.*, 2012:9). In addition, he would shift his finger more to the left of the target on the instructor's hand and execute the task at a rapid pace as was observed in the Pre-test. This pace continued to be noticed in Re-test 2 including the attempt of the hands alternating and sharing the task. He was adamant to swap his hands while performing this task. Positively, he would touch the correct places and targets when his eyes were open as he understood the instructions, until he was asked to close his eyes and then he would miss the tip of his nose by 2 centimetres.

The rapid pace of execution was also observed in Re-test 3 as Subject A would rush the task and not move his hand at the instructor's command. An interesting observation was made with regard to hand dominance. Up to this point, he used his left hand in all of the tests until Re-test 3, where he began to perform the task with his right hand but did not alternate his hands as he did in the former tests. While the right hand was in action and performing the task, the left hand was observed to create small movements in the fingers which can be called associated reactions. De Jong *et al.* (2011:643) found that 40 to 45% of their ASD participants had an excess of associated movements which affected posture, motor coordination, muscle tone and the functioning of their sensory systems.

The Post-test displayed some improvement in how Subject A responded to the relevant instructions. At the instructor's command he would move his index finger from the examiner's hand, to his nose and as a result he was not initiating the task at the usual rapid pace. He would also touch the correct place on his nose but would still miss the palm or target of the examiner's hand. Overall, Subject A seemed a lot more steady and patient while performing the task.

After the five-week retention period in December and being placed in a home-school environment, the Retention-test revealed that Subject A would mirror the examiner with his hand which was scored as an error. 'Mirroring' is considered an 'overflow' of movements, along with movement occurring voluntarily on the opposite side of the body. Research has related it to developmental disorders as well as problems in the CNS which can affect motor development (Mostkofsky *et al.*, 2003:1327; Cole *et al.*, 2008:1517-1518). Subject A was observed to miss the tip of nose and would consistently move his hand to the top of the target in space.

There has been research on the presence of mirroring in children who are hyperactive and inattentive (MacNeil *et al.*, 2011:626) and has also featured amongst children with High Functioning Autism (HFA) (Jansiewicz *et al.*, 2006:619). Subject A was hyperactive and as former reports have mentioned, the subject has shown characteristics of ADHD. When movements become more complicated for subjects, it may encourage mirror movements (Verstynen & Ivry, 2011:2479), which may have been the case in this subtest. The complexity of this subtest may suggest that the amount and level of proprioception activities in the SMI programme may not have been sufficient or frequent enough for him to improve in this subtest. The protocol of having to close his eyes during the task may also be an indication that Subject A relies more on his visual input than proprioception. Visual input has been observed to provide even more reliable and regular information to a child's brain than the vestibular and somato-sensory systems (Petrarca *et al.*, 2013:498)

### **Subject G**

To have a general look at the difference between the Pre-test and the Post-test for Subject G, a 43% decrease signifies the improvement from the Pre-test (7 Au) (Figure 4.6). Overtime, advancement in the level of severity decreases positively from the 'severe discrepancy' category (Pre-test) to the 'no discrepancy' category (Post-test). The slight regression begins



in Re-test 1 but does not last long as the NRT score (7 Au) increased once again. Re-test 2 displays the highest score, 'peaking' a 14% difference in comparison to the baseline score. A sharp drop in the results was expressed in Re-test 3 and a greater decrease indicated by the Post-test. The results and score for this subtest are maintained in the Retention-test which concludes the final results of Subject G.

The *Finger to nose* subtest had to be explained visually to the subject along with cue words, as he did not understand the instructions during the Pre-test. There was a slight decrease in the scores as Subject G showed signs of slowly being able to grasp the instructions communicated to him for this subtest, as he also seemed to be more at ease with the instructor.

However, over time with the two-week holiday in the third month of the intervention (NRT), the increase in errors began once again and continued onto Re-test 2. Also observed from the former fine motor skills subtests mentioned, he had poor proprioception, which may have contributed to his many errors in this subtest. Research has shown that children with ASD rely more on proprioceptive feedback when visual information is absent. This has led to influencing their ability to imitate, poor social interaction skills and poor motor planning (Haswell *et al.*, 2009:972; MacNeil & Mostofsky, 2012:168,169). This subtest requires the subject to imitate the instructor. Table 4.2 confirms that Subject G would struggle to reciprocate and imitate actions. The errors committed in this subtest confirm his poor proprioception. Therefore, similar activities to SMI programme of Subject A were introduced into that of Subject G where visual aid was used (Rao & Gagie, 2006:31).

In Re-test 1, Subject G swapped his hands while touching the instructor's hand with one finger (his right hand) and then his own nose with the index finger of the opposite hand (his left hand). Escalante-Mead *et al.* (2003:541,542) were interested in autistic individuals who had problems with lateral preference and had a history of language challenges when they were younger. This group was compared to another group of autistic individuals who developed normal language abilities. According to the results, the autistic group with language problems struggled to develop lateral preference. In the psychiatrist's report (in the current study) from the ADI-R interview, Subject G appeared to have language impairment. His parents had indicated he lost all verbal expression at 18 months of age. However, a study in 2008 confirms that unusual lateralisation and left-handedness does not

lead to delayed language development in adults with autism (Whitehouse & Bishop, 2008:3199). In this case, Subject G showed slight improvement in Re-test 1 that may have been due to the improved communication between him and the instructor.

The following score (7 Au) increased due to the additional error of the subject showing unsteady control of movement in the NRT, as he would miss the tip of his nose more than 2.5 centimetres. He was also very distracted during testing and did not want sit down. With the highest peak in this subtest, Re-test 2 (8 Au) was supported by him returning to not being able to understand and interpret the task and, therefore would continue to miss the target. Children diagnosed with ASD may achieve poor scores in motor skill tests due to their inability to understand instructions and follow through with the actions (Green *et al.*, 2009:315).

During Re-test 3, Subject G would initiate the task, however he would still swop his hands while performing the task at a rapid pace. This could suggest that he lacks motor control and motor planning (praxis) before and during the initiation of the task (Dowell *et al.*, 2009:563), which leads back to poor proprioception. Especially when he was asked to close his eyes for the second part of this subtest, his hand would almost totally wonder off and he would lose focus.

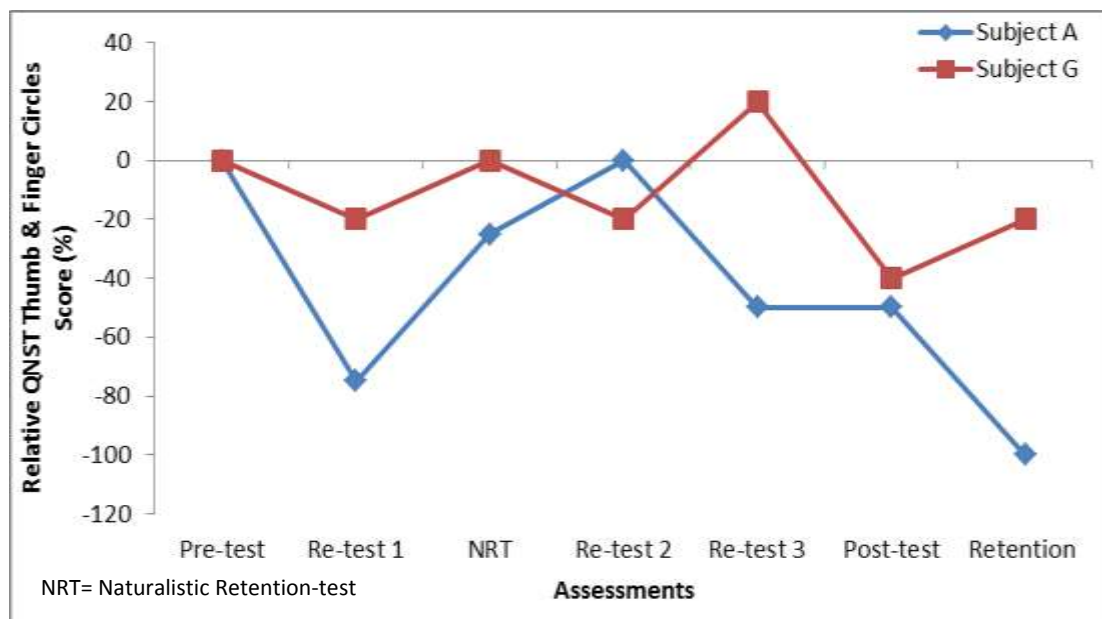
In the Post-test, Subject G improved by using one hand (right hand) to perform the task and not to alternate with his left hand. He was still unable to perform the task slowly with his eyes closed, but was able to place his index finger in the correct place on the instructor's hand and then return it to the tip of his own nose. This may be similar to Subject A, as Subject G has poor proprioception and therefore, when visual input was absent, his proprioceptors were unable to sense where his hand was in space in relation to his nose and the hand of the instructor. Therefore, this may suggest that even though there was an improvement in the Post-test, the SMI programme may not have provided sufficient proprioception stimulation for more complicated activities involving the absence of visual input.

The Retention-test follows a similar pattern in the mentioned subtests, along with the Post-test. Subject G did not mirror the examiner and was more responsive to the instructions even though he had to remain seated. However, he did swop his hands again and found the

task more challenging after closing his eyes. He performed the first part correctly while his eyes were open. Nonetheless, in the second half of the task when the eyes were supposed to be closed, the subject would lose the target on examiner’s hand. Despite the programme during the intervention, Subject G continued to struggle to find and plot targets in space without visual information being received. Therefore, the stimulation of proprioception in the SMI programme was not retained over the five-week retention period.

### Thumb and finger circles

The decrease in a score over time from baseline is a depiction of the possible improvement in the subject’s ability in the subtest along with a decrease in the level of severity of the subject. The X-axis indicates the testing sessions. The data in Figure 4.7 show the relative change in the percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention for *Thumb and finger circles*.



**Figure 4.7 THUMB AND FINGER CIRCLES**

#### Subject A

As shown in Figure 4.7, it is evident that a 50% improvement between the Pre-test and the Post-test occurred. The Pre-test results (4 Au) are in the ‘severe discrepancy’ category but a sudden drop in Re-test 1 (1 Au) represents a decreased level of severity by 75% from the baseline. The positive improvement does not continue, as there is an increase in the NRT (3 Au), which continues on in Re-test 2, returning back into the same Pre-test category. From

this high point in Re-test 2, a 50% drop from baseline occurs in Re-test 3 (2 Au), almost following the same pattern as the Pre-test and Re-test 1. However, this time the score is not as low as the former scores and evens out at the Post-test (2 Au). Instead of the score possibly rising again, it decreases even more in the Retention-test. In comparison with the Pre-test score, there is a 100% improvement.

The high score presented in the Pre-test was due to two errors observed in Subject A. While performing the task with the left-hand preference, he exhibited an overflow or slight movement in the fingers of the opposite hand. The second error, which received a high rating, was him registering excessive body movement on the opposite side, as he was fidgeting during the subtest. The information provided can reveal signs of underlying challenges in his brain's behaviour, which can be reflected through 'mirroring' as mentioned in the former test (Mostkofsky *et al.*, 2003:1327; Cole *et al.*, 2008:1517,1518). The subject is required to produce smooth movement of the one hand which is independent from other parts of his body. However, this subtest seemed to be quite complicated for him (Verstynen & Ivry, 2011:2479; Mutti *et al.*, 2012:103).

The sudden drop in the results of Re-test 1 was due to Subject A gaining more control over the opposite side of his body with no sign of the overflow of movements. As mentioned previously, proprioception and fine motor skills were not solely focused on during the start of the intervention. However, Subject A did reverse the pattern of the fingers instead of going from the little finger towards the index finger and he also mirrored the instructor by lifting up the hand directly opposite to the instructor instead of first starting with his dominant hand (left). Mutti *et al.* (2012:103) mentioned in the QNST-III manual, that if a child reverses the initial pattern that is demonstrated to them or appears to be confused of which finger is next, it can be connected to complications with their ordering and sequencing skills.

After the two weeks natural retention (third month) away from the school routine and SMI sessions, the relevant errors committed during the NRT were recorded. Once again, Subject A showed an overflow of movement of the opposite hand and was confused with the finger pattern. This continued at Re-test 2 (4 Au) producing the same errors as the NRT; however the hands indicated a flat-circle finger formation when attempting to create a circle with a finger and the thumb. If one is unable to perform this task without creating the correct

structure and form of the circle with the fingers, this may suggest a lack in the capacity to direct the muscles of the fingers during the motor activity (Mutti *et al.*, 2012:103).

Even though subject A had an overflow of movement in the opposite hand and would sometimes portray an incomplete circle with the fingers, his fingers did manage to attain the correct pattern and sequence. This may be a sign of an associated reaction occurring due to the a bilateral movement of the one hand not being able to remain still while the other hand performs finger circles (Cheatum & Hammond, 2000:77).

In Re-test 3, the score decreased by 50% (2 Au). Even though Subject A was distracted on the day of testing, he was a lot calmer with this particular activity and he seemed to enjoy it. The examiner would call the task another name which would automatically attract his attention, such as 'Spider-fingers'. The SMI programme for Subject A introduced specific hand activity using 'Squeezers' (Appendix D) a week before Re-test 3. This may only have been a short period of time before the Re-test. Nevertheless, this activity required him to concentrate, as his eyes had to be closed while applying pressure to the 'squeezers'. Therefore, this may have taught Subject A to direct his attention to his hands and each finger. The other fine motor skill subtests (*Hand skill* and *Figure recognition and production*) did not improve in Re-test 3; however writing skills may seem more complicated and require more practice as opposed to finger circles.

The Post-test (2 Au) received the same results as the former test; however one of the errors did differ. Subject A would turn his one hand towards himself when performing the task and would look at it intently. The pattern for the finger was correctly performed and the right hand showed better results than the left hand. Hand-preference will be discussed later in the *Left-right discrimination* subtest.

The Retention-test revealed the greatest improvement as the score lowered by 100% (0 Au) after the five-week retention period.

### **Subject G**

The results of Subject G portrayed a 'zig-zag' pattern from baseline to retention (Figure 4.7). There was a positive 40% decrease from the Pre- to the Post-test. In the Pre-test he

accomplished a score (5 Au) in the 'moderate discrepancy' category and positively decreased to a score in the 'no discrepancy' category in Re-test 1 (4 Au). However, very soon thereafter, the score returned to the 'moderate discrepancy' category in the NRT as the score rose back to the original baseline-score. In Re-test 2, the score was lowered again (4 Au) to the 'no discrepancy' category but did not remain there for long. An interesting sharp increase spiked to the highest score out of all of the four tests in Re-test 3 (6 Au), which was instantly categorised in the 'severe discrepancy' category. At this point, Subject G was placed below the 5<sup>th</sup> percentile. However, at the Post-test there was a greater decrease (3 Au) at the end of the intervention, which placed him below the 25<sup>th</sup> percentile for this subtest. The Retention-test presented a 10% rise from the Post-test returning to the 'no discrepancy' (4 Au).

The zig-zag pattern reveals the inconsistency of the ordering and sequencing skills by Subject G. There were a variety of errors observed at the Pre-test. He seemed to be confused with regard to which finger was next. He skipped fingers at least twice instead of following the sequence, displayed an overflow or slight movement in fingers of the opposite hand and would reverse the finger-pattern instead of doing it serially. According to Mutti *et al.* (2012:103), when an individual is unable to produce suitable circles with their thumb and finger, it indicates a poor capacity in muscle-directing. This contributes to other fine-motor skills (drawing and writing), which correlates with his high scores in the *Hand skill* and *Figure recognition and production* subtests. Subject G had problems with the sequencing and ordering of his fingers, which is related to verbal fluency or being unable to recall the order of the letters in a word. Included in the provided information, it is suggested that children with ADHD are more prone to find this task challenging than children who are not diagnosed with ADHD. He experienced speech challenges and has been diagnosed with ADHD.

There was a slight improvement in Re-test 1 as Subject G began to understand what was required of him when demonstrating the instructions. With the two-week holiday in the third month, there was an increase in severity depicted in the results of NRT. The errors recorded included creating incomplete circles with his fingers and he also seemed to be confused about which finger is next by looking at his fingers intensely. Re-test 2 revealed another decrease as he began to grasp the concept again.

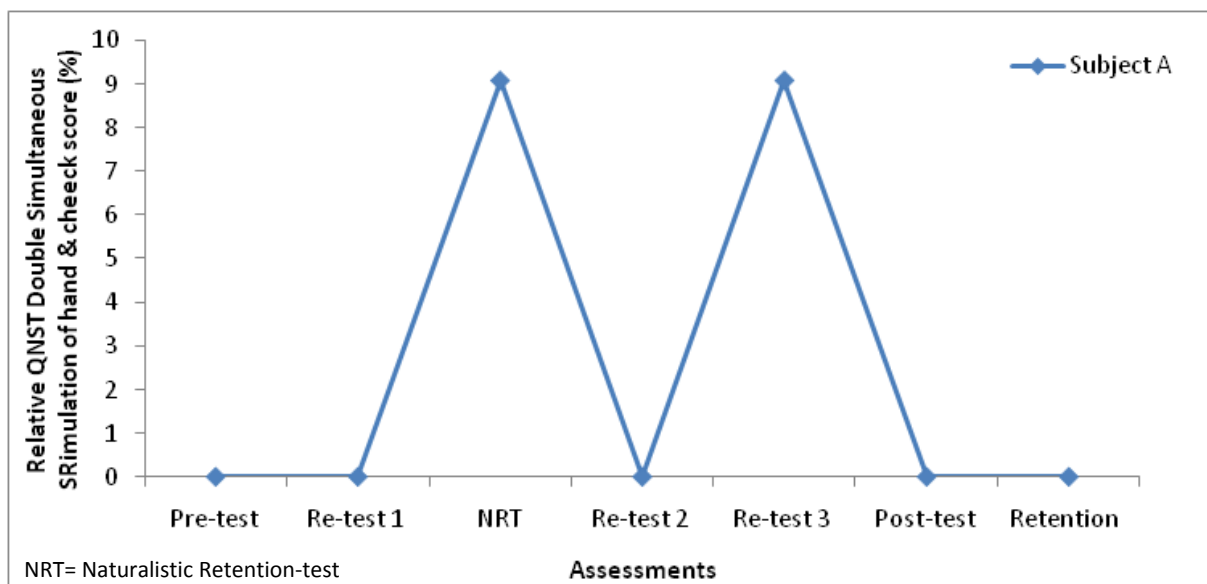
Re-test 3 reached the highest score for this subtest by having the following errors. He would turn the hand (performing the task) towards himself to look at his fingers. He was confused as to which finger would follow in the sequence. The performance of the finger circles was incomplete and he would show slight movement in the fingers of his opposite hand.

Minor errors were scored in the Post-test with the incomplete circles not being as regular as usual. Subject G would still turn his hand around to intently watch his fingers and he would reverse the pattern demonstrated to him. A positive behaviour was that he did not mirror the instructor.

In the Retention-test the fingers created complete circles but the fingers were making flat circles even though the right hand repeated the sequence correctly. The left hand was responsible for the error, attaining one of the highest scores allocated for this subtest. His left hand still manifested a misconception of which finger was next and he skipped fingers more than twice. In comparison to the previous two fine motor skill subtests for the retention period, both *Hand skill* and *Figure recognition and production* scores returned to the score at baseline. Although this current subtest score regressed by 33%, the score did not return to the baseline score. The SMI programme included the 'pumping action' activity right from third month of the intervention until the last month before the Post-test (Appendix E). This may suggest that this activity assisted in the slight improvement; however he was not able to retain his proprioception ability for more complex activities.

### **Double simultaneous stimulation of hand and cheek**

The decrease in a score over time depicts possible improvement in the child's ability in the subtest along with a decrease in the level of severity of the subject. The X-axis indicates the testing sessions. The data in Figure 4.8 show the relative change in percentage errors that the Subject A made from the initial Pre-test session over the eight-month intervention for *Double simultaneous stimulation of hand and cheek*. Subject G was unable to perform this subtest correctly as he was tactile defensive and also could not communicate what was required in the instructions. This correlates with the *Palm Form Recognition subtest* (Figure 4.3).



**Figure 4.8 SUBJECT A: DOUBLE SIMULTANEOUS STIMULATION OF HAND AND CHEEK**

### **Subject A**

According to the requirements for this particular subtest, Subject A generally performed at an acceptable standard ('no discrepancy' category). Portrayed in Figure 4.8, the scores are comparable from the Pre to the Post-test providing a 'zig-zag' pattern. Starting with zero at baseline, there is a slight increase in scores producing the upward surge from Re-test 1 to the NRT (1 Au). The zig-zag is initiated with Re-test 2 where the score decreases back down to baseline level again (0 Au), and then escalates up again in Re-test 3 (1 Au). The score evens out from the Post-test and carried over into the Retention-test.

Subject A was attentive in this subtest and responded to instruction as if it was a 'guessing game'. He was asked to close his eyes and would have to try and sense or feel where he felt the instructor's pencil or finger (left or right cheek and/or left or right hand). No errors were detected in the Pre and Re-test 1. In the NRT, he did not give the right answer for one of the body parts. This was also the case in Re-test 3, when he did not name the correct cheek because he was struggling to distinguish between the right and left side of his body. At the Post-test and the Retention-test he produced positive scores because he displayed the ability to differentiate between his right and left side of his body.

### **Subject G**

This was another task that Subject G struggled to perform, due to his lack of understanding the demonstration and his inability to interpret complex instructions. This subtest requires a

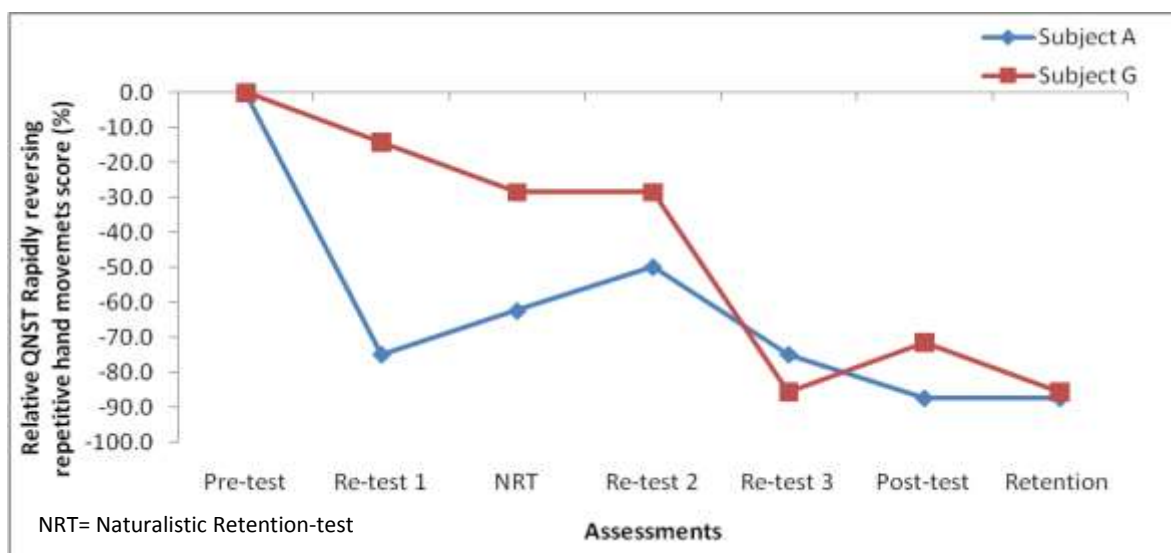


verbal answer and he struggled to express himself verbally by using the correct words. According to the psychiatrist's report and the ADI-R score from the section, "qualitative abnormalities in communication", he was over the cut-off and was scored as 'non-verbal'. He was also classified according to the Diagnostic and Statistical Manual of Mental Disorders, 5<sup>th</sup> Edition (DSM-5), with language impairment along with an intellectual impairment, which can also be associated with it being a challenge for the subject to adapt to functional skills (APA, 2013:55). In addition, this may also correlate with the *Palm form recognition* subtest (Figure 4.3) as Subject G appeared to be tactile defensive.

Noterdaeme *et al.* (2002:223) tested children with high functioning autism and speech impairments with regard to their gross and fine motor skills, coordination, balance skills and their oral abilities. Their findings concluded that the children diagnosed with autism and speech problems had highly distinct dysfunctions in their movements. Nonetheless, research has not yet confirmed the level to which the motor symptoms are precisely applicable to children with ASD (Ming *et al.*, 2007:566). The results regarding the gross motor skills of Subject G may be associated to his language and intellectual impairment and an indication how the different subtests (fine and gross motor skills) are a reflection of his lack of understanding instructions and the movement.

### **Rapidly reversing repetitive hand movements**

The decrease in a score over time depicts possible improvement in the subject's ability in the subtest along with a decrease in the level of severity of the subject. The *X-axis* indicates the testing sessions. The data in Figure 4.9 show the relative change in the percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention for *Rapidly reversing repetitive hand movements*.



**Figure 4.9 RAPIDLY REVERSING REPETITIVE HAND MOVEMENTS**

### **Subject A**

The Pre-test presents the highest score (8 Au) out of all the tests in this subtest and there is a 88% difference between the Pre- and Post-test. The high score at baseline, instantly categorised Subject A in the 'severe discrepancy' classification. There is an interesting 75% decrease for Re-test 1 (2 Au). This sudden drop shifted the level of severity to a classification for him of the 'moderate discrepancy' category for Re-test 1. However, in the NRT the score increased gradually (3 Au) creating a 10% interval which led to Re-test 2. The score did not maintain this increase as the score in Re-test 3 decreased (2 Au) to a lower level and did not stop at this point. Once again, it finally dropped to an even lower score than before in the Post-test (1 Au) and was measured to be retained in the Retention-test. The final result of the level of severity for this subtest was the 'no discrepancy' category.

There were a variety of errors observed in the Pre-test performance of Subject A. When reversing his hands, he rotated his hands in a manner which was floppy and clumsy. Mutti *et al.* (2012:105) and Kurtz (2008:73) suggest that when floppiness and poor muscle tone are observed in young children, they will also appear to be uncoordinated during other movements and this will affect their performance in physical activities and academic performance (Taylor *et al.*, 2004:34). This could be linked to a lack of muscle tone control in the upper-limb and poor proprioception. In addition, Subject A also did not follow the speed and time of the examiner. This involved rhythm which has a role in learning to control movements. The timing of his movement was also important for maintaining muscle control. He executed the exercise at the incorrect rate with uneven rhythm, which could

indicate his inability to motor plan (Dewey *et al.*, 2007:253; Dziuk *et al.*, 2007:737). This also reflected his inability to imitate the instructor's speed which most children with ASD struggle to do (Dewey *et al.*, 2007:253; Todd, 2012:34-35).

Typically the most severe errors included larger than instructed and asymmetrical movements. The errors detected in the Pre-test took a turn and only two errors were recorded. Subject A continued to demonstrate a floppy rotation with his hands and would also execute the rotation at a faster pace instead of following the instructor's instructions. However, there was improvement in how the hands were symmetrical with each other as opposed to being asymmetrical. Some improvement transferred to the NRT (3 Au). Despite the 'floppiness' appearing again, he began to initiate a 'clawed hand' at times in which the fingers started to stiffen and curl. It seemed as if this was his way of trying to gain control over the clumsiness of his hands and to try stay at the pace that the instructor was performing.

Re-test 2 showed a final increase in scores (4 Au) (Figure 4.9). He improved in the execution of the rate and rhythm of his hands. His hands were still floppy, but he maintained a steady and slow rhythm. However, when the tempo of the rotation needed to increase, he lost control of the evenness of his hands and was recorded to demonstrate asymmetry.

Re-test 3 (2 Au) and the Post-test scores (1 Au) revealed improvements in the control of his hands as he began to do the rotations at a slower pace following the instructor's demonstration. The Post-test showed significant improvement in the mentioned errors and therefore, may be an indication of the improvement in his proprioception. However, he may have not recovered to the normative level for his age and development, as he continued to portray floppy hands on rotation. This one error was carried over into the Retention-test but proprioception abilities seem to have been retained slightly, as Subject A was able to control the rotation of his hands to remain symmetrical.

### **Subject G**

Figure 4.9 shows a great difference between the Pre and Post-test, which amounted to a 71% difference. Beginning with a high score (7 Au) (severe discrepancy category) and being at or below the 5<sup>th</sup> percentile, there was a steady reduction from the Pre-test to the NRT (5 Au). The results of Re-test 2 remained the same as the former results of the NRT before a

sharp fall was evident in Re-test 3 (1 Au). Up to this point, all the tests placed Subject G in the 'severe discrepancy' category but the results of Re-test 3 levelled down to the 'no discrepancy' category. There was a slight rise at the Post-test (2 Au) but it did not change the categorical level. His Retention-test produced a 10% decrease (1 Au) from the Post-test.

A steady decrease was present from the Pre-test to the NRT, as Subject G gradually began to better understand the instructions required in the subtest. No verbal imitation was required, only a motor action where the eyes to remain open. He delayed initiating the rotation of his hands and performed at a slow pace. He was tense when doing the 'double hand bounce'. As mentioned earlier, these errors can lead to the subject becoming easily prone to fatigue when performing fine motor skills (Mutti *et al.*, 2012:105). Another error observed during the NRT and Re-test 2, was his inability to increase his speed over time. Nonetheless, he was able to only maintain his hands at a constant pace for the rotation. This is also evidence of poor motor planning (Dewey *et al.*, 2007:253; Todd, 2012:34-35) and low cognitive functioning. This may differ to the results of the previous subtests involving proprioception and fine motor skills. The score in *Finger to nose* increased (did not improve) over the NRT and Re-test 2, along with *Hand skills* remaining at baseline level. There was only a decrease in score of Re-test 2 for *Figure recognition and production* and *Thumb and finger circles*. *Rapidly reversing repetitive hand movements* also involves bilateral integration and it is speculated that the subject's gross motor skills may develop faster than fine motor skills. Therefore, it does not require specific intricate control in the fingers but in synchronising the two sides of the body. The SMI programme involved 'star jumps', however over these two tests (NRT and Re-test 2) the subject was only learning how to perform the lower limbs' part (Appendix E).

Hardy and LaGasse (2013:5) motivate the importance of 'rhythm' and how it has been used to improve sensory-motor functioning in subjects with ASD. They state that rhythm may positively influence gross motor skills along with perceptual responses. Also mentioned was that interventions for subjects with ASD, which involve improving motor control, will impact motor planning problems (Hardy & LaGasse, 2013:5).

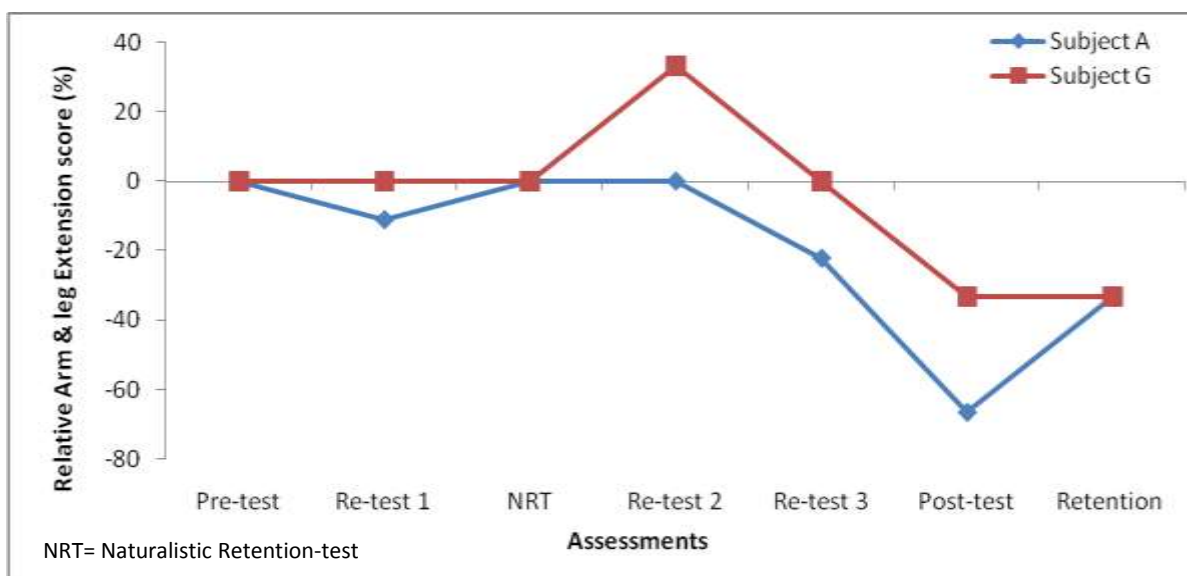
Asymmetry was visible in the Pre-test, the NRT and Re-test 2, however, it was absent in Re-test 3 and the Post-test. Therefore, his hand movement improved in symmetry in spite of the slow execution, which was still recorded as an error in the Post-test. The SMI

programme required Subject G to pass and receive a ball with both hands (tactile ball or medicine ball) (Appendix E), which may have assisted in the improvement in symmetry of the arms supporting the rotation of the hands and the gross motor muscles of the arms.

The Retention-test indicated a greater decrease than at the Post-test, due to his hands being symmetrical while rotating. This may suggest improvement in cognitive processing of Subject G and that may be due to the regular testing every four to five weeks and learning this skill (Vickers, 2007:164) through repetition. However, no improvement was observed in the control of the hands and muscle tone as they still appeared to be ‘floppy’.

### Arm and leg extension

An increase in the score indicates that there was an increase in the amount of errors. A decrease in the scores suggests that the individual is showing improvement in the variables that the subtest assesses. The X-axis indicates the testing sessions. The data in Figure 4.10 show the relative change in percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention for *Arm and leg extension*.



**Figure 4.10 ARM AND LEG EXTENSION**

#### Subject A

Prior to the intervention programme, the scores of the Pre-test (9 Au) classified Subject A in the ‘severe discrepancy’ category based on his poor muscle tone and muscle strength abilities. There was a 67% difference between the Pre- and the Post-test, indicating a great

decrease between the two tests. The score decreased slightly at the Re-test 1 by 11% (8 Au) from the Pre-test, but returned to the former score in the NRT and remained at that level until after Re-test 3. A positive decrease in the level of severity began from Re-test 3 (7 Au) and continued to regress drastically for the Post-test (3 Au). The regression did not continue into the Retention-test as the score (6 Au) increased once again to 33% from the Pre-test.

At the Pre-test, Subject A was unable to maintain the position of his lower extremities for 30 seconds. Included in the observed irregularities, he had an unusual finger position and his wrists would dip when his arms and hands were raised and extended. The vestibular system, the somato-sensory and the visual system, play a vital role in keeping the body upright and stabilised during locomotion (Cheldavi *et al.*, 2014:9). Dysfunction in even only one of systems will influence the integration processes, which will affect the balance abilities, especially since sensory problems have been detected in children ASD (Gal *et al.*, 2010:458; Fuentes *et al.*, 2011:1359; Liu, 2013:206). Children with ASD have also been observed to have motor discrepancies involving basic muscle control, such as muscle tone, posture and balance (Dowel *et al.*, 2009:563), which was in Subject A.

Maintaining a wrist dip can contribute to incomplete hand written work, tiring easily (also observed in the hand skill subtest) and poor motor performance (Mutti *et al.*, 2012:106). Subject A was asked to lift up his arms and his legs and stretch out his fingers, but his wrists still performed this dip. As his hands were not grasping anything, it may have caused the dip. In addition, poor muscle control in the upper limbs and wrists were observed at the start of the intervention.

The slight decrease in Re-test 1 (8 Au) was due to the wrists extending when Subject A was asked to do so. However, he began to show signs of fatigue towards the end of the task by dropping his upper and lower extremities and leaning backwards against the chair, which is not permitted. Once again it is related to his poor muscle control, muscle tone and core strength ability to sustain the specified position for a period of time. Research revealed that 'impersistence' (being unable to hold a constant position) occurred in scholars who find it challenging to plan and organise active motor movements (Cheatum & Hammond, 2000:204). During the subtest, the subject was asked to perform the task with eyes closed. This would have required him to rely on his somato-sensory system (Fong *et al.*, 2012:9; Gopalai *et al.*, 2011:614; MacNeil & Mostofsky, 2012:169).

A return to the original score occurred at the NRT. Subject A once again displayed all the errors indicated in at the baseline measurement. In Re-test 2, he reacted with associated movements in his hands and tongue during the subtest, while his extremities were lifted. This is again related to overflow of movements at the opposite side of the body (Mostkofsky *et al.*, 2003:1327; Cole *et al.*, 2008:1517-1518). Proprioception training progressed with the subject holding a medicine ball while having to maintain a static position (Appendix D) (Rose, 2010:155; MacNeil & Mostofsky, 2012:169).

The positive improvement in Re-test 3 (7 Au) was due to no associated movements or wrist dips being detected. Subject A was able to keep his limbs in the correct position for the entire 30 seconds, however, at 20 seconds, his upper body started to lean slightly backwards. During the SMI sessions, he was asked to stand in a static position on a stable surface, which aimed at encouraging spatial awareness and muscle control while activating the proprioceptors (Lackner & Dizio, 2005:126) and may have assisted him in the subtest when seated.

Even though vestibular and proprioception exercises were initiated (Appendix D) after the Pre-test, improvement was not observed straight away. Over time as the exercises continued and progress took place, the Post-test showed a positive improvement in muscle control and strength. Subject A was able to hold the arm and leg extension for the required duration (30 seconds) and no hand and tongue movements were observed. The only negative item was that he exhibited a slight tremor in his legs in the last 10 seconds as he tried to maintain the position for the full 30 seconds. For the Retention-test, the strength of his lower limbs was not retained, as he would start to lean his back backwards at 20 seconds and the legs would lower slowly.

### **Subject G**

There was a 33% difference between the results of the Pre-test and the Post-test (Figure 4.10). Prior to the intervention, Subject G was in the 'severe discrepancy' category and remained at this level for the first three tests (9 Au), which created a steady plateau. A high rising peak broke the plateau in the results by a 33% increase (12 Au), towering above all the other results. At Re-test 3 there was a decline from this point, and returned to the previous baseline score. The decline continued at the Post-test producing the lowest score (6 Au) (33% from baseline) and was classified into a lower severity, the 'moderate discrepancy'

category. The results of the Retention-test show that a permanent change in behaviour occurred. Hence Subject G improved and could now be classified with a 'moderate discrepancy'.

Right from the Pre-test, Subject G had difficulty in maintaining the position for longer than two seconds, as opposed to 30 seconds. He was unable to stay upright, the lower extremities failing to be lifted and his wrists were not secure when the arms were lifted. Hypotonic muscle tone was observed in Subject G when he attempted to hold the required core stabilising position. This may suggest that he tires easily when performing physical motor activities. He also displayed an under-stimulated vestibular and somato-sensory system, which contributes to weak core strength and fatigue (Schoen *et al.*, 2009:8).

'Hypotonia' is a term that is used to describe a muscle which has decreased strength and irregularly low muscle tone (Sanger *et al.*, 2003:89; Ming *et al.*, 2007:567). Indications of hypotonic muscle tone, is that the muscles are 'soft' or 'flabby' and the child will experience fatigue quite easily when trying to hold a stable and balanced position (Mutti *et al.*, 2012:40). This is a motor disorder that occurs due to damage of or impairment in the pathways of the basal ganglia, cerebellum, the cortex, the brainstem or spinal cord (Sanger *et al.*, 2003:89). Research has confirmed hypotonia to be prevalent in children with ASD (Mari *et al.*, 2003:393; Ming *et al.*, 2007:567). The results for this subtest motivated specific vestibular and balance activities to be incorporated in the programme of Subject G, to improve his muscle tone.

In Re-test 1, he was able to hold the position for five seconds but an incorrect posture was still present. Despite a 2-week holiday in the third month and a disrupted routine during the NRT, Subject G was able to hold the position for 15 seconds longer, thus achieving a total of 20 seconds. Notwithstanding the increase in time to maintain this position for the first three tests of the subtest, he remained at the equivalent score due to producing the same errors. The muscle tone of the lower extremities continued to appear hypotonic and he still could not keep them lifted. During the sessions, he was still assisted while sitting on the ball for the warm up; nonetheless he was able to jump up and down on the trampoline without holding onto a stable point.



With regard to spreading out his limbs in different directions, it was related to a poor sense of space in relation to his body. Children with ASD have been found to struggle with knowing where their limbs are in space (Fuentes *et al.*, 2009:1532; Blanche *et al.* (2012:622). This subtest also gives an idea of how well the somato-sensory system integrates with the vestibular system, as the proprioceptors in the joints and muscles need to assist in successfully stabilising the position (Lackner & Dizio, 2005:126). Since the subject closes his eyes, his body will rely on the proprioceptors in the limbs (Gopalai, 2011:126). Children with ASD have been assessed to have poor proprioception and vestibular function, therefore when visual input is absent, it may influence their movements (Fluentes *et al.*, 2011:1359). Stimulating the vestibular system and the proprioceptors enhance sensory-motor development in children and adolescents, who have motor and psychological challenges (Niklasson *et al.*, 2010:328), and was thus applied in the programme of Subject G.

Over time, Subject G began to increase in his strength being able to lift his extremities and holding the position. However, in the NRT, his wrists would dip downwards, which is classified as one of the most severe errors in this subtest. As with Subject A, the *Arm and Leg extension* showed poor proprioception in the upper limbs which is associated with the wrist dip. This is supported by the report of the occupational therapist, which stated that he has poor proprioception, resulting in clumsy hands.

Therefore, progress was observed only after the NRT. This involved increasing tension or weight on the joints, muscles and tendons (Auxter *et al.*, 2010:155) which stimulates the proprioceptors. Subject G would be given different weights of balls (especially alternating between 1kg and 2kg) and at first he would just hold it while walking or standing in place. This progressed to slowly passing the ball back and forth to the instructor (Kisner & Colby, 2007:215).

The 'towering' result for Re-test 2 (12 Au) indicates that Subject G displayed random body movements during the task. In addition, his upper and lower limbs continued to spread out in different directions. This suggests that there still was no change in his proprioceptor function after five weeks of intervention.

During the subtest, Subject G would get up off his chair and attempt to sit on the instructor's lap instead of completing the instructions. In the psychiatrist's report, his

parents had mentioned he likes to 'hug' or hold onto objects or other individuals bigger than him. It has been suggested that ASD individuals have a poor sense of their surroundings in comparison to their bodies. Therefore, grabbing onto objects would help their perception (Bogdashina, 2003:26). This is associated with hypo-sensitivity in the tactile system and forms part of the somato-sensory system and the proprioceptors (Riemann & Lephart, 2002:73). Individuals with ASD have been observed to seek pressure from their surroundings (Bogdashina, 2003:59), to self-stimulate themselves for the sensation that they are lacking in their sensory system (Fertel-Daly *et al.*, 2001:630).

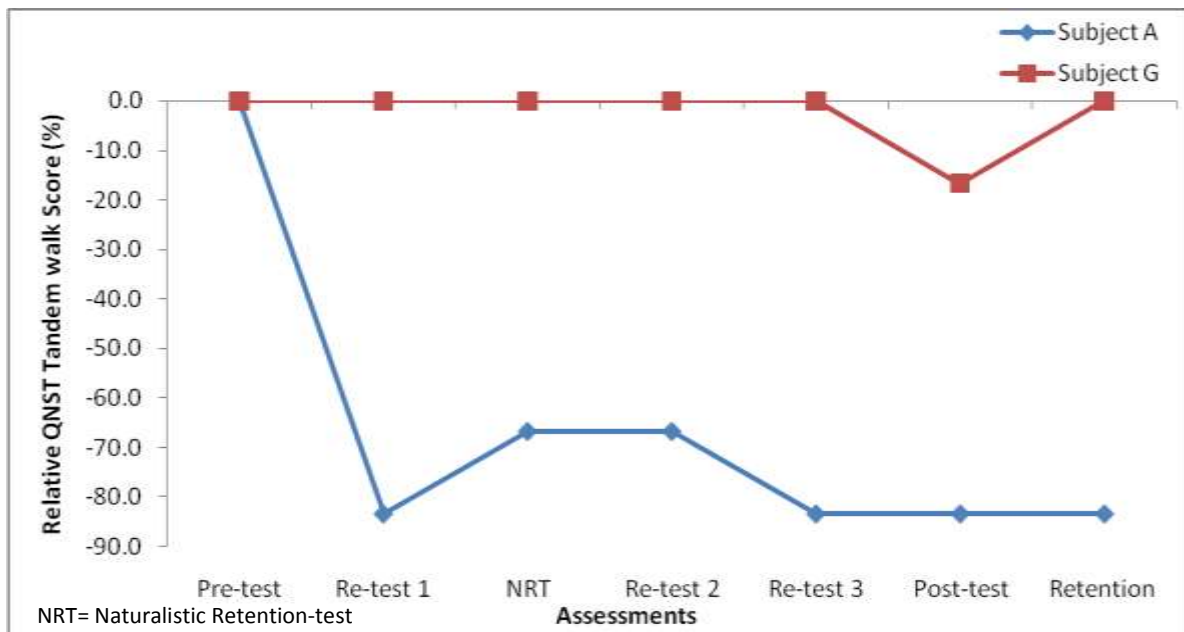
Re-test 3 shows the score improving (Figure 4.10) by causing a decrease in errors from Re-test 2. The level of proprioception exercises was increased in the third month of intervention, which followed the NRT. Therefore, he seemed to only respond 16 weeks later.

The Post-test revealed positive results with the extremities being able to remain lifted for a longer period of time. Subject G was unable to complete the required 30 seconds but could lift his extremities and imitate the task while in the seated position. It was suggested to therapists in the research by Fluentes *et al.* (2011:1359) by recommending the training of the sensory-motor areas while using proprioception. They state that it may enhance imitation skills in children with ASD.

Following the five weeks December holiday, Subject G was unable to hold up his lower extremities for the required duration. He also revealed extreme muscle tension while trying to keep the upper and lower limbs in a raised position. This implies that his strength was not retained after the holiday and that he would need constant or more regular SMI therapy, possibly three times a week for eight months.

### **Tandem walk**

When there is an increase in the score, it indicates an increased number of errors were observed. If there is a decrease, it suggests that the individual is showing improvement in the variables that the subtest assesses. The data in Figure 4.11 show the relative change in percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention for *Tandem walk*. The *X-axis* indicates the testing sessions.



**Figure 4.11 TANDEM WALK**

### **Subject A**

The subtest score for the Pre-test was categorised as ‘moderate discrepancy’, which was the highest score (6 Au) achieved by Subject A out of all the testing sessions for this subtest. There was a clear 83% improvement calculated between the Pre and the Post-test. Figure 4.11 indicates a decrease of 83% in Re-test 1 (1 Au) thus the score automatically shifts to the ‘no discrepancy’ category. From this point, the score increased slightly by 17% in the NRT and continued to Re-test 2. The lowest score is achieved again by Re-test 3 (1 Au) after which the score levels out as it is maintained in the Post-test and eventually the Retention-test as well.

The score of the Pre-test suggests that Subject A experienced balance difficulties when his eyes were closed. He was unable to understand the instructions and therefore did not imitate the action. This finding is supported by previous investigations which found that children with ASD struggle to imitate a motor action due to poor internal proprioception feedback when depending on somato-sensory information (Dziuk *et al.*, 2007:738; Haswell *et al.*, 2009:971; Todd, 2012:34). Another error recorded was irregular hand positions while he was trying to balance. Maintaining balance is a gross motor skill that develops over time and if there is a problem in this area, it will also affect other physical activities he performs (Mutti *et al.*, 2012:106). Research has associated ASD children with delayed development of postural control (Provost *et al.*, 2007:326). Balance training not only helps children, with no apparent developmental or sensory-motor delays (or problems) and children with ASD, gain

postural stability, but also leads to strengthening their legs while maintaining balance (Heitkamp *et al.*, 2001:289; Cheldavi *et al.*, 2014:12).

Recent findings of Cheldavi *et al.* (2014:12) suggest that children with ASD gain their balance ability at a later stage in comparison to typical developing children who are their age. Fournier *et al.* (2010:2,6) conducted a study with children with ASD between the ages of 8 to 16 years where they evaluated the static and dynamic impairments that they may experience. Their findings confirmed that the children struggled to balance in a static standing position and during dynamic balance tasks. They recommended that balance training be initiated at an early stage of development in the child's life to inhibit the occurrence of other deficits in their motor skills.

Re-test 1 revealed an improvement of 83%, which may speculate that Subject A could have rapidly responded to five weeks of vestibular stimulation, basic locomotor skills and gradual initiation of activating proprioception. These results confirm that of former studies conducting balance (vestibular) training (Heitkamp *et al.*, 2001:289; Fournier *et al.*, 2010:2,6; Cheldavi *et al.*, 2014:12).

After the mid-term holidays (in the third month of the intervention) the NRT was performed. Even though Subject A maintained an improved balanced stance while trying to walk heel-to-toe, he would sometimes wobble. In addition, the subtest was still challenging for him with eyes closed. When the visual system is manipulated, it forces the subject to depend only on vestibular cues (Valente, 2007:36; Rose, 2010:162).

Re-test 2 revealed similar results and Subject A was beginning to develop a habit of holding onto his pants while walking on the line. This can be related to an equilibrium reaction of trying to gain more control of his body to prevent himself from falling over or wobbling and gaining a sense of where he is in space (Fertel-Daly *et al.*, 2001:630; Bogdashina, 2003:26;).

*Substitution* was introduced into the programme, as a technique to enhance the integration of sensory inputs from the somato-sensory system to encourage Subject A to compensate for the vestibular dysfunction (Hillier & McDonnell, 2010:5). He was barefoot during the sessions to ensure that there was a maximal volume of information from the proprioceptors in the foot that would stimulate the sensory-motor system (Page, 2006:79; Gopalai *et al.*, 2011:614). The above exercises would begin with stimulating the vestibular system and

proprioception and then the subject would be directed to perform a functional motor action. Over time, he was encouraged to progress from standing on two feet to balancing 'heel-to-toe' for a set duration and then leading to closing his eyes for a limited amount of time.

The 17% decrease in Re-test 3 (1 Au) evens out in the next two successive test sessions. In the fifth month of the intervention, the instructor introduced progression into the SMI programme, to advance the stimulation of the vestibular and somato-sensory systems. During the task of standing, the aim was to reduce proprioceptor feedback in the lower limbs and increasing vestibular input by directing Subject A to stand and maintain balance on uneven surfaces, such as the mini-trampoline or the BOSU ball. This would require him to be totally reliant on the vestibular system in order to balance. This would be an indication that he was responding positively to these vestibular exercises. This is supported by recent research reporting that in the absence of visual information, the vestibular system is more sensitive and dominates over the signals and information received from the somato-sensory system (Gopalai *et al.*, 2011:614; Zanelli *et al.*, 2011:586). Manipulating visual and proprioceptor input and feedback has been used for subjects to totally rely only on vestibular signals and stimulation (Valente, 2007:36).

The Post-test score was retained in the Retention-test. This retention may have occurred due to an increase of neural pathways and the plasticity of the brain. The brain can restructure itself when regular stimulation is received (Haibach *et al.*, 2011:215) which would affect the ability of the cerebellum to adapt to learning new motor skills (Galea *et al.*, 2011:1769). This may have occurred in his case, which led to improvement and retention in his one-leg stance test.

The results in the Retention-test revealed that Subject A maintained his balance while walking forward and backwards on the line in the required manner. However, he did wobble slightly when he was asked to close his eyes. This suggests that he was still dependant on visual input to assist with balancing.

**Subject G**

According to the results represented in Figure 4.11, Subject G showed constant results from the Pre- to Re-test 3. From the Pre-test (6 Au) and over the next four tests, he was categorised as having 'moderate discrepancy'. There was a slight decline in the Post-test which shifted the level to 'no discrepancy'. Therefore, a 17% decrease separated the Post- (5 Au) from Pre-test score. The results are not maintained but return to the Pre-test score in the Retention-test.

Subject G was pigeon-toed and used wide strides when walking on the taped line. Eposito and Venuti (2008:266) conducted research on children with the possibility of being diagnosed with ASD and their findings indicated that the subjects found it challenging to perform the heel-to-toe walk. The *Tandem walk* subtest has a similar protocol. The subject is required to place their heel directly in front of the toe of the opposite foot (Mutti *et al.*, 2012:41.42). This was one of the observable errors he made as indicated on the QNST-III Record Form.

The greatest challenge for Subject G was to imitate the demonstration and understand how to execute the movement. Children learn about movement and how to carry out the action by observing others and attempting what they saw, perceived or experienced. According to Todd (2012:34-35), a child's imitation skills are vitally important during the development of their motor skills and if unable to imitate what they see, they will have a problem in performing the movement correctly.

There have been studies which observed the capabilities of autistic children and their imitation skills. Dewey *et al.* (2007:253) examined motor and gestural difficulties in children diagnosed with ASD, Developmental Coordination Disorder (DCD) and ADHD. Included in their extensive study was to examine the extent to which gesture difficulties influence motor skills and compared the severity amongst the population groups. With regard to children with ASD and the severity of their motor difficulties, the results revealed that they were significantly impaired compared to others with motor skill problems (MacNeil & Moskofsky, 2012:168). Despite ASD children having problems with imitation, gestural impairment is not due to motor coordination discrepancies. Problems with imitation for children with ASD reveal that there may be a problem in the neural processing for motor planning (Dewey *et al.*, 2007:253).

Even though this subtest involved the lower limbs, the previous subtests associated with motor planning (*Finger to nose* and *Rapidly reversing repetitive hand movements*) also showed improvement in the Post-test. The scores may have seemed inconsistent for *Thumb and finger circles* (Figure 4.7), however there was an improvement. Subject G may have found the lower limb coordination subtest slightly more difficult.

Along with imitation, Subject G seemed to be confused in understanding the concept of placing one foot in front of the other. Vestibular and proprioceptive information is vitally important for spatial orientation and navigating the body in space (Riecke *et al.*, 2002:444). This movement occurs due to sensory information being sent by vestibular system to the brainstem and the cerebellum. The cerebellum plays a role in integrating information to regulate movement, which occurs by the cerebellum receiving the information about the head position in space and communicates it to the muscles in the eyes, thus helping the body with dynamic balance (Glomstad, 2004:14; Nayate *et al.*, 2005:329; Auxter *et al.*, 2010:154).

Subject G could also not perform the activity backwards and would rather attempt the activity walking sideways along the line while shuffling his feet slowly. However, he remained on the line. When he was instructed to close his eyes, he could not respond to that command as he did not understand what the instructions meant. This observation reflects his ability to know where he was in space in relation to the line. Despite the score remaining at the same level from Re-test 2 onwards, he could walk about three steps backwards with the feet remaining on the line, but then he would return to the sideways shuffle-walk.

When a blindfold was placed on Subject G while standing on one of these tactile surfaces, he continued to take it off. Over time the subject learnt what it meant when he had to close his eyes. Upon instruction, the subject was asked to close his eyes while the instructor counted (which provided a guideline for the subject). This aspect compelled the subject to rely on the vestibular system (Rose, 2010:155).

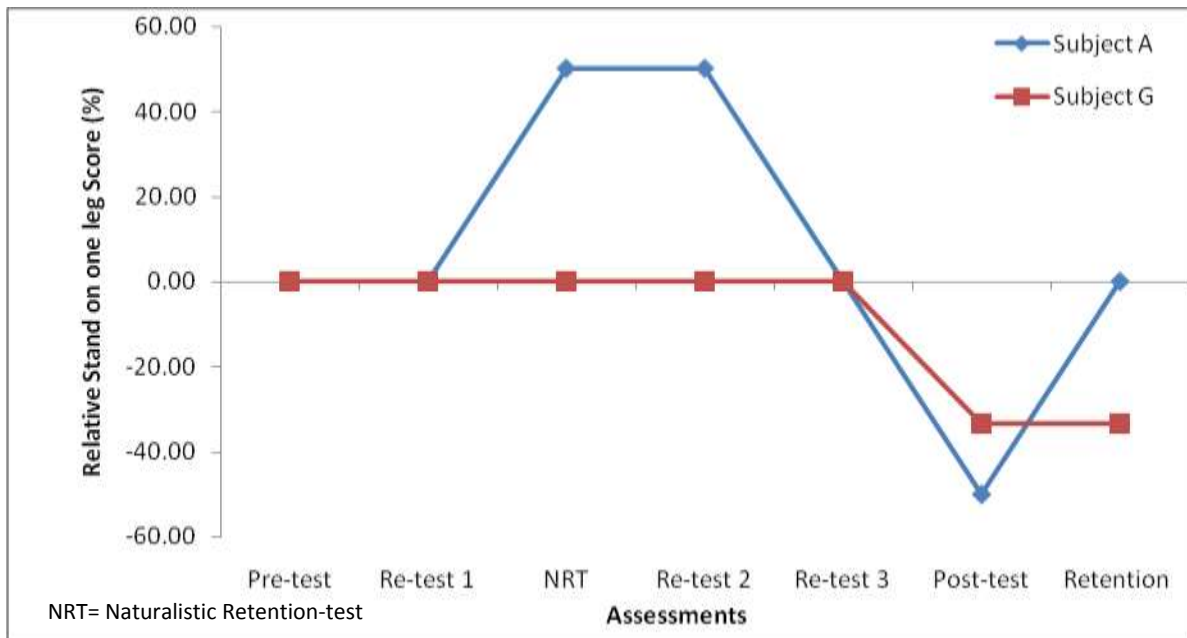
The score decreased in the Post-test by 17% (1 Au) for Subject G, as the observed errors began to improve. His balance skills while walking on the line appeared to be more secure even though he still took wide strides and walked with his feet in a pigeon-toed position.

Pigeon-toed walking has been related to gait problems in individuals with autism and gait (Eposito & Venuti, 2008:266; Fournier *et al.*, 2010:1235). Subject G struggled to keep his eyes closed for a long period of time and could still not perform this dynamic balance activity with his eyes closed.

The results in the Retention period were similar to the comments made in the former tests as the score increased once again. This may suggest that there was no relative permanent change and the activities in the SMI programme did not help with *Tandem walk*. Subject G still could not close his eyes and took wide steps when walking forward. Interesting enough when walking backwards, he did not change to walking sideways and did not take big steps but continued to walk with one foot in front of the other. The score remained the same due to the other errors mentioned that increases the score.

### Stand on one leg

The X-axis indicates the testing sessions. The data in Figure 4.12 show the relative change in percentage errors that the subjects made from the initial Pre-test session (baseline) over the eight-month intervention for *Stand on one leg*.



**Figure 4.12 STAND ON ONE LEG**

#### Subject A

Viewing the results from Pre-test to retention, Figure 4.12 shows a moderate level of discrepancy and a 50% difference between the Pre- and the Post-test. From the Pre-test, the



NRT (3 Au) and Re-test 2 presents a 50% increase in the level of severity in the middle of the intervention. A gradual decline occurred during Re-test 3 with the score (2 Au) returning to the Pre-test results. The decline continued as the Post-test score lowered and the level of severity accomplished was in the 'no discrepancy' category. This was not retained, as at the Retention-test, the score increased back to the Pre-test score again.

This subtest is another indication of the impaired balancing skills and gross motor ability and the level of functioning with regard to the vestibular system and proprioception of Subject A. While attempting to stand on one leg, during the Pre-test, the results confirmed his poor ability in maintaining balance. He found it more challenging to stand and balance on his left leg where the duration was only five seconds, in comparison to him maintaining balance for 10 seconds on his right leg. When standing on the right leg, he would hook his other leg around the right leg instead of holding the lifted leg bent at the knee at a 90 degree angle. These particular results and errors were carried over to Re-test 2. Balancing on the left leg improved slightly by two seconds, however, when he was asked to close his eyes (for both left and right legs) he struggled to maintain balance.

The NRT and Re-test 2 show a 50% increase in score, from baseline which corresponds with the previous subtest (*Tandem walk*) and both these two subtests assess the base of support of the subject. In the NRT, Subject A would make associated reactions using his hands to hold onto his pants when balancing on the left leg. Even when standing on the right leg, the left leg would try to hook around it. This may be an indication that the subject was trying secure his balance, as he may have felt like he was going to fall over. Once again, when he was asked to close his eyes, he could not maintain his balance on either leg confirming his reliance on visual input and poor proprioception. In Re-test 2, Subject A did not hook his opposite leg or foot as he usually did in the former tests. However, it was noted that his one foot would be slightly distorted when elevated. In addition, the required 10-second duration for maintaining balance was not attained with either leg.

After Re-test 2, further progression was brought into the programme for Subject A. This involved asking him to close his eyes at specific times during vestibular or proprioception exercises to increase reliance on these sensory systems (Gopalai *et al.*, 2011:614; Zanelli *et al.*, 2011:586). The 50% decline in Re-test 3 (2 Au) was due to him being able to balance on the right leg with his eyes open for the required time. However, he would start wobbling on

the left leg when the right leg was off the ground. When asked to shut his eyes, he maintained balance for seven seconds on the right leg and on the left leg he achieved four seconds. It seemed as if he was still learning to adjust to the absence of visual input to maintain balance and may suggest some improvement in proprioception. As was mentioned with *Tandem walk*, 'substitution' was introduced into the SMI programme by directing him to stand on the mini-trampoline or uneven surfaces (BOSU ball) and this was also repeated with the subject closing his eyes (Gans, 2002:154; Hillier & McDonnell, 2010:4) (Appendix D).

The Post-test had the lowest score in comparison to the other assessments. This may be as a result of the progressions experienced in the SMI programme when closing his eyes during the spinning (Niklasson *et al.*, 2009:649; Auxter *et al.*, 2010:154-155) fast, forward-backward rocking and up and down jumping to stimulate the vestibular system (Solan *et al.*, 2007:1; Angelaki & Cullen, 2008:126; Rine & Wiener-Vacher, 2013:508) along with the absence of visual input at certain times. For the Post-test, Subject A was able to maintain balance for the required duration on each the leg without the usual wobble. Nevertheless, it remained a challenge for him to close his eyes and balance, but he showed some improvement in maintaining better balance on the left leg. The score was not retained at the Retention-test but increased back to the baseline score. This may suggest that stimulating the vestibular system may need constant practice as the effects and improvements in the Post-test were not maintained over the five-week retention period.

### **Subject G**

In Figure 4.12 the scores plotted on the graph revealed that Subject G began the intervention in the 'moderate discrepancy' category. There was a 33% decrease from the Pre- (3 Au) to the Post-test. The results remained at baseline level until Re-test 3 (3 Au). The Post-test indicated an improvement in errors made. This score was retained in the Retention-test (2 Au). The results for this subtest seemed to follow a similar pattern as in his *Tandem walk* subtest and his score remained constant from Pre-test until the Re-test 3 (6 Au). The score also improved in the Post-test (5 Au). However, this current subtest score was retained whereas the score for *Tandem walk* returned back to the Pre-test's score. This may be due to the complexity of the previous subtest involving coordination, dynamic balance and motor planning as opposed solely assessing Subject G's ability to sustain a

balanced position on a reduced surface area and his level of muscle control (Cheatum & Hammond, 2000:155; Bruininks & Bruininks, 2005:6; Henderson *et al.*, 2007:34).

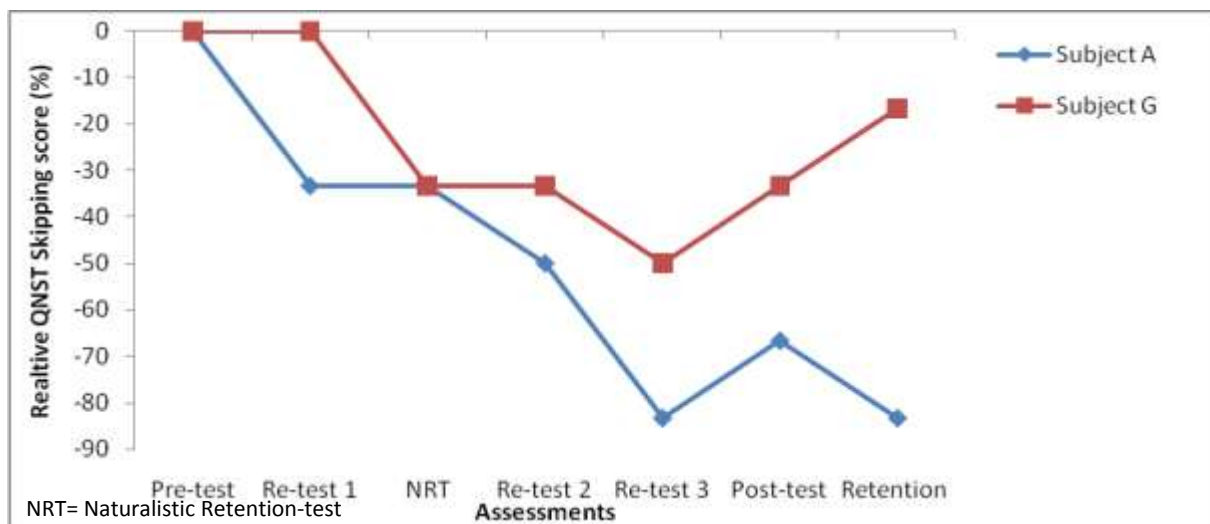
Subject G found this particular subtest quite a challenge. In the Pre-test, it was almost impossible for him to balance in a static position. There are specific requirements for this subtest and even though he attempted to stand on one leg, he could not maintain balanced for the set amount of time and would fall over. The examiner would count up to 10 with the subject to convey to him that he needed to try to stand for that amount of time. He did not understand what it meant when the examiner asked him to close his eyes. When the examiner gave the verbal instruction she would repeat the words but did not perform the task. This was recorded in the 'comments' sections for the Pre-test and the Re-tests. As mentioned in the former subtest (*Tandem walk*), Subject G did find dynamic balance challenging. Standing on one leg appeared to be even more difficult as he would cling to the instructor for support so that he would not fall over. Balance training has been reported to also enhance cognitive processing in children with ASD (Chevaldi *et al.*, 2013:12). Therefore, it was observed how the SMI programme could improve Subject G's cognitive skills socially relating to responding to instructions.

As noted in *Eye tracking* subtest, Subject G struggled to fix his eyes on one area or target. While he was trying to balance, his head and eyes were moving around, which affected his gaze and, therefore he could not stabilise himself. This was another indication of his inability to control his stance, which involves the integration of the visual, vestibular and the somato-sensory systems (Assaiante & Amblard, 1995:38; Minsheu *et al.*, 2004:2058; Hsu *et al.*, 2009:739). *Adaptation* was another rehabilitation strategy which was introduced into the SMI programme of Subject G and involved exercising the interaction with the visual and the vestibular systems (Hillier & McDonnell, 2010:5). Krakauer and Mazzoni (2011:636) define motor adaptation, as a method of learning resulting in steady and regular progression during practice and performance due to changing and improved circumstances and environments. In this particular study, adaptation for Subject G included gaze stabilising exercises, followed by eye-hand coordination skills, which also involved moving the head and eyes to exercise the VOR (Hillier & McDonnell, 2010:5).

There was a 33% decrease at the Post-test (2 Au), which was retained into the Retention-test. This could be ascribed to the adaptation progressions that were introduced in the programme. Subject G was able to maintain a stable position for the required 10 seconds on either leg, but when he closed his eyes his body would contort in order to maintain balance, which was more difficult on his left leg. The cerebellum is involved in the process of adaptation due to the cognitive strategy (Krakauer & Mazzoni, 2006:644; Criscimagna-Hemminger *et al.*, 2010:2282). As the vestibular system is connected to the cerebellum (Gans, 2002:150; Glomstad, 2004:14), recent research shows that the cerebellum plays a specific role in motor adaptation of movements such as walking, balance and manipulative skills (Bastian, 2006:648). This region of the brain has been reported to be involved in the improvement of motor adaptation along with a longer period of retention (Galea *et al.*, 2011:1767; Haibach *et al.*, 2011:215). Subject G responded to the SMI programme's balancing activities after 33 weeks of the intervention. The 'balancing on one leg skill' was able to have a lasting effect after five weeks of no vestibular or proprioception training. These results of this current study correlate with that found by Chevaldi *et al.* (2013:11-12), who investigated the benefits and influences of balance training intervention on 10 children with ASD and 10 typically developing children from seven- to 10-years of age. Comparisons with the control group revealed that the balance training enhanced the postural stability even when visual input was absent.

## **Skipping**

The decrease in a score over time depicts possible improvement in the ability of the subject and a decrease in the level of severity of the subject. The *X-axis* indicates the testing sessions. The data in Figure 4.13 show the relative change in percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention period for *Skipping*.



**Figure 4.13 SKIPPING**

### **Subject A**

There was a 67% improvement between the scores of the Pre- and the Post-test. With a high score placing him in the 'severe discrepancy' category at baseline (6 Au), Subject A was unable to perform this gross motor skill correctly. A 33% decrease lessens the score in Re-test 1 (4 Au) and it remained at that level for the NRT with a slight decrease in Re-test 2 (3 Au) as well. Improvement seemed promising as a sharp 83% drop from baseline occurred in Re-test 3 (1 Au), which altered the functional category to the 'moderate discrepancy' category. The score increased slightly in the Post-test (2 Au) but remained in the same category. Another decrease finalised the score in the Retention-test (1 Au) but the score is not lower than that of Re-test 3 (Figure 4.13).

For the Pre-test, all of the errors were circled on the Record Form. Subject A demonstrated his inability to skip and, thus being unable to perform the subtest correctly. His posture and limbs were clumsy and poor dynamic balance was once again confirmed in the Pre-test results. Due to children with ASD experiencing dysfunctional sensory processing in their vestibular system along with proprioception, which influences their capabilities to follow through in coordinated movements (Bhat *et al.*, 2011:1120,1121). This is another subtest to monitor the influence of the SMI programme and how stimulating these two sensory systems would affect this motor skill (Liu, 2013:206).

Subject A could still not skip in the Re-test 1 and the NRT but was at least able to leap from one foot to the next without falling over. At this point in the intervention, the subject had participated in vestibular activities for five weeks. Previous subtests reflecting the

combination of the vestibular and proprioception abilities was the *Arm and leg extension* and *Tandem walk*. In contrast these subtests showed an improvement in the amount of errors in Re-test 1 and this confirms the subject responding after five weeks of the SMI programme. However, these subtests were not retained in the NRT.

The score continued to gradually decrease into Re-test 2 (3 Au). Re-test 3 produced increased improvements (1 Au), as the subject was able to demonstrate changing from one foot to the next correctly. Due to *Skipping* being one of the subtests for testing, it could not be practised. The programme included activities, such as hopping on one foot around cones to retrieve an object. This may have contributed to the increased proprioception in the lower limbs and vestibular processing, in order for the one leg to support the body while in motion (Petraça *et al.*, 2013:494). When it came to the testing, he could not maintain the style of skipping for longer than a few steps before his feet would lose rhythm and synchronisation. Once again, he found it challenging to integrate all of the movements together, as this involves motor planning (Todd, 2012:33). These movements involved the cross-lateral movements of the upper limbs with the lower limbs, along with alternating from one foot to the other in a synchronised fashion while maintaining balance during this dynamic movement.

In the Post-test, Subject A understood what was asked of him but seemed very distracted while trying to skip. His posture continued to show improvement, as it was not portrayed as 'clumsy' and he had the ability to balance while one leg was lifted for a brief moment. However, the leg change was observed to being more of a 'hop and a leap' than of a 'skipping' style indicating that he was still unable to plan these movements correctly. Most children with ASD find skipping challenging to do (Rinehart *et al.*, 2001:87).

Subject A developed in his skipping skills as he was able to perform the activity, but his feet were not aligned completely with the knee when it was elevated in the air. This involved the proprioception in his lower limbs and not being able to completely imitate the demonstration of lifting the knees high enough like the instructor. He also seemed clumsy towards the end of the task. In the Retention-test, his body and posture was controlled and upright. It seemed that his vestibular function did not decrease over the retention period but even improved without the SMI sessions. This may have been due to how physically

active he was during his holiday. Despite the improvement in his posture, he could not skip and only would leap from one foot to the other.

### **Subject G**

This subtest showed a high level of severity at the Pre-test (6 Au) which continued on to Re-test 1 (Figure 4.13). There was a decline in the score, in the NRT (4 Au) which also remained constant in Re-test 2. The lowest score was achieved in Re-test 3 (3 Au), however it did not lower the level of severity. A gradual incline occurred at the Post-test (4 Au) but the score increase again in the Retention-test (5 Au). There was a 33% decrease from the Pre to the Post-test. Even though the retention score increased by 50% from the Post-test, it did not return to the Pre-test results. The level of severity remained in the 'severe discrepancy' category throughout for this subtest. The errors appeared to be inconsistent, as this was a new skill that Subject G had to learn. Learning a new motor skill can take weeks or even months (Reis *et al.*, 2009:1590). Since this motor skill involved synchronisation of the movement of limbs which was another factor he had to try and control (Savion-Lemieux & Penhune, 2005:430).

As was portrayed in the Pre and Re-test 1, Subject G received a high score at the beginning of the study. He was unable to skip and the following errors were observed and recorded: poor balance, was clumsiness during the steps, hopping uncoordinatedly from foot to foot presenting an asymmetrical style and therefore, could not perform the motor skill of skipping. The requirement for the limbs to be synchronised during the movement, was a very challenging task for him. Due to his clumsiness, he would struggle to control his movements, which involves the integration of incoming sensory information from the proprioceptors in his joints and muscles and his vestibular system. This requires regular practice in order to retain control of his limbs during the movement, which depend on sensory-motor integration (Savion-Lemieux & Penhune, 2005:430). As this was a new skill and as the former subtest confirmed, he has poor proprioception and he would struggle to imitate the demonstration by the instructor (Haswell *et al.*, 2009:3; Izawa *et al.*, 2012:10,11).

To initiate performing this coordinated movement skill, jumping on two feet from one point to another was demonstrated or jumping up and down on the trampoline during the intervention sessions. This activates the vestibular system to balance during the dynamic

movement and stimulates the receptors in the joints and muscles in order to help the body maintain an upright position.

Despite a turn of events (with his teacher leaving) and the 2-week holiday (in the 3<sup>rd</sup> month of the intervention, there was slight improvement at the NRT. It was noted that Subject G showed signs of skipping. However, he remained clumsy in the execution of the skill and would sometimes perform the steps asymmetrically. Over time, Subject G progressed to learning how to hop on one leg from one point to another or standing on a compliant surface while holding a weighted medicine ball which continued to activate vestibular function and cause compression on the joints to activate joint stability (Riemann & Lephart, 2002:81). Along with Re-test 2 receiving the equivalent score as the previous test, there was a descriptive improvement in how he remained upright and balanced while performing this subtest. At Re-test 3 Subject G performed a few steps in his attempt to skip. Despite this being the lowest score, Subject G continued to perform this skill in a clumsy and asymmetrical manner.

On the day of the Post-test, he was distracted and excited and could not perform the motor skill in the same way as he did in Re-test 3. This may have been due to his hypo-sensitivities and craving stimulation (Leekam *et al.*, 2007:907; Ben-Sasson *et al.*, 2009:8). He did not skip and all of the errors mentioned earlier returned in his performance. Improvement in balance was a positive result, as the subject attained the ability to leap from one foot to the other without falling over. However, his action was asymmetrical.

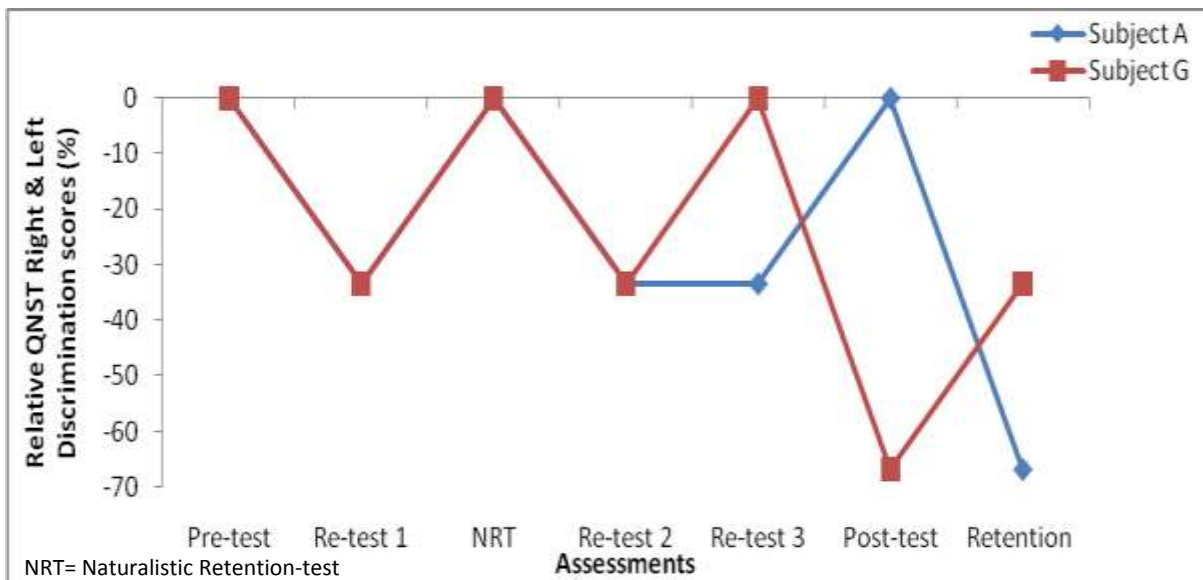
The Retention-test concluded the final results for this subtest. The escalating score after the five-week December holiday reversed improvement and clumsiness was evident along with asymmetry in leaping from one foot to the other. Therefore, without continued vestibular and proprioception-related exercises for a few weeks, his balance abilities regressed. Even if he had practised this skill, his posture may have still been incorrect and retaining balance would not have occurred. Minshew *et al.* (2004:2058-2059) conducted a study on the dysfunctions in children with ASD and how this was influenced by age. When compared to typical developing children, children with ASD were only seen to develop stable postures from 12-years old and could not develop to mature abilities of adults. The control group began developing from five-years old to 15-20 years. One could speculate that children with ASD are delayed in their motor development. Using the MABC, Liu and Breslin (2013:1247)



tested the fine and gross motor skills of 30 children with ASD and compared them to 30 typically developing children (three- to 16-years old). Their results support those of this current study relating to the finding that the children with ASD experienced motor delays.

### Left and right discrimination

The X-axis indicates the testing sessions. The data in Figure 4.14 show the relative change in percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention period for *Left and right discrimination* subtest. The decreased score over time depicts possible improvement in ability in the subtest and a decrease in the level of severity of the subject.



**Figure 4.14 LEFT AND RIGHT DISCRIMINATION**

#### Subject A

Represented in Figure 4.14, Subject A's results are aligned with Subject G's. There was no positive or negative difference was observed between the Pre - and the Post-test as they correspond with each other. A 'zig-zag' pattern following Subject G's red line, occurred for the Pre-test (3 Au) through to the NRT and the Post-test. This subtest does not have a variety of possible scores, as there are only three scores to consider. Re-test 1 showed a 33% decrease (2 Au) from the Pre-test while Re-test 2 (2 Au) and Re-test 3 produced the same score (33% from the baseline). It is interesting to note that there was a clear 67%

decrease from the post- (3 Au) to the Retention-test. The Retention-test achieved the lowest score (1 Au).

In all three of the subtests, Subject A could not distinguish between his left-and right hand. His awareness of his body is derived from his proprioceptors (Mehling *et al.*, 2009:4) and understanding the difference between the two sides of his body is derived from the sensory inputs from his vestibular and somato-sensory systems (Auxter *et al.*, 2010:157). Individuals with ASD have been reported be more prone to left-handedness which may also influence their left-right discrimination (Dane & Balci, 2007:225).

The errors for each subtest were discussed in the previous sections. In the Pre-test and the NRT, Subject A mirrored the examiner in all three subtests. However, in Re-test 1 and Re-test 2, he mirrored during the *Finger to Nose* subtest and the *Standing on one leg* but not in the *Thumb and finger circles*. In the Retention-test he only mirrored in the *Finger to nose* subtest and was able to differentiate between the left and the right sides of his body. By the end of the intervention, Subject A had a clearer understanding of which is his right or left hand, which could be an indication of the state of his proprioceptors and cognitive processing. A learning effect may have occurred due to the subtests being repeated over the duration of the intervention, along with the SMI programme involving activities for the subject to identify his right from his left side of his body. Repeating a skill over a period of time plays an important role in a child's ability to learn a skill (Sherwood & Lee, 2003:380). Subject A seemed to have remembered the subtests even after the five-week retention.

### **Subject G**

Subject G also seemed to follow a similar 'zig-zag' pattern from the Pre-test to Re-test 2. However, the 'zig-zag' pattern continues on into Re-test 3 (Figure 4.14). From the Pre-test (3 Au), there was a 33% decrease at Re-test 1 (2 Au), followed by the sharp incline in the NRT (3Au), which returned to the original score. Re-test 2 produced the same score as Re-test 1. The score returns to the former baseline score in Re-test 3. In the final stage, following the intervention, there was a great decrease and a positive 67% improvement at the Post-test revealing the lowest score (1 Au). The score was not retained at the Retention-test where the score increased and is 33% (2 Au) from baseline.

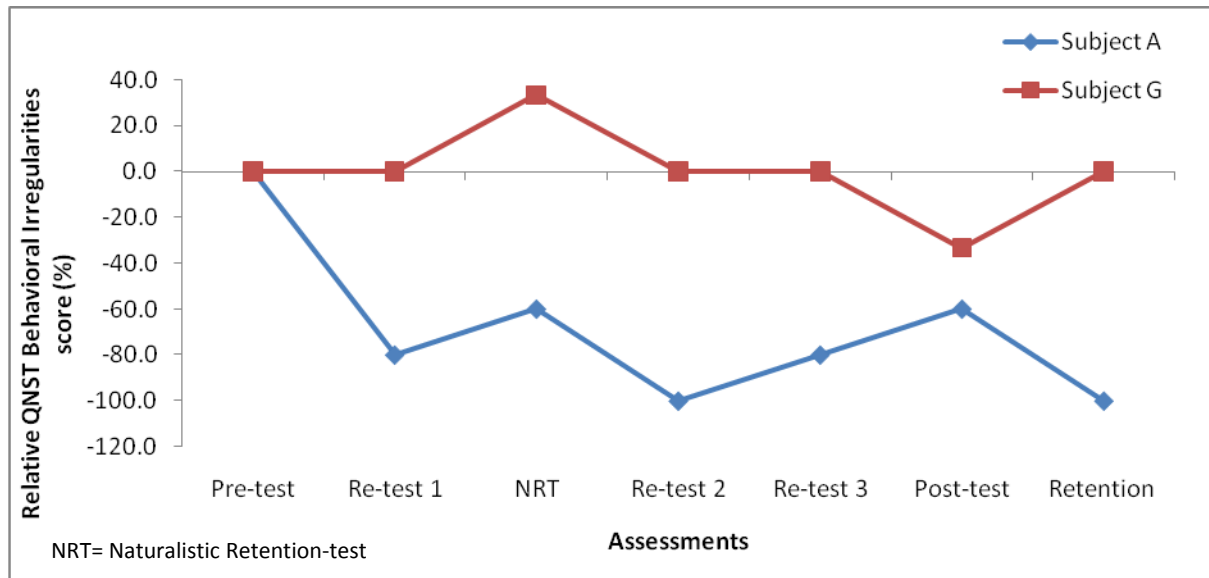
At the start of the testing period, Subject G had errors in all three of the subtests. The subject would swap his hands instead of using his dominant hand in the *Finger to nose* subtest. Supporting the high scores at the NRT and Re-test 3 of the *Thumb and finger circles* subtest, he was able to mirror the examiner during the demonstration. This was also observed in the *Eye tracking* subtest when he struggled to eye-track from left to right. Research supports that if a child does not have an internal awareness of left-right directionality it will influence their reading skills negatively due to problems with midline crossing and originating from retained reflexes (Taylor *et al.*, 2004:35; Callcott, 2012:139).

When demonstrating *Stand on one leg*, he would mirror the instructor. He struggled with his left leg for most of the tests. As he performed some of these subtests in an asymmetrical manner and with differences on the left and right sides, does not affect his academics. If a child is unusually different on one side of the body than the other, it may suggest that the maturation of their motor progression will lead to motor planning deficits and problems in sequencing and rhythm (Mutti *et al.*, 2012:108). These errors were observed during the performance of Subject G in the subtests. To support the reason behind the great improvement and decrease in the score indicated at the Post-test he did not mirror in all three subtests and even though he struggled to understand the sequence, he was a lot more responsive in executing the activity.

After the five-week December holiday, Subject G performed the Retention-test and once again mirrored the instructor in the *Thumb and finger circles* and the *Stand on one Leg* subtests. During the session of testing, he was generally quite distracted which automatically directed his attention away from initiating these tasks correctly. Even though 'mirroring' is considered an error, it is still positive to observe that Subject G would at least imitate the movement demonstrated to him, which did not occur in the Pre-test. He appeared to be more aware of the movements and responded to instruction. However, his score regressed in the retention period which may suggest that the SMI programme could have been presented over a longer period of time or attending sessions three times a week for the learning effect to be retained.

## Behavioural irregularities

The X-axis indicates the testing sessions. The data in Figure 4.15 show the relative change in percentage errors that the subjects made from the initial Pre-test session over the eight-month intervention for the *Behavioural irregularities* revealed during testing.



**Figure 4.15 BEHAVIOURAL IRREGULARITIES**

### Subject A

In Figure 4.15 the scores once again follows an 'up and down' pattern. Beginning with the Pre-test with the highest score amongst all of the tests for the study (5 Au), there was a 60% difference between the Pre and the Post-test. From the Pre-test a 80% decline occurred at Re-test 1 (1 Au), which led to a shift in the level of severity from the 'severe discrepancy' to the 'no discrepancy' category. This score did not settle here as there was an increase in the score in the NRT (2 Au) and another drop at Re-test 2 to zero errors observed according to the QNST-III Record Form. The pattern continued to head onto another rise in Re-test 3 (1 Au) with an increase at the Post-test (2 Au). The final score at the Retention-test shows a decrease and improvement of zero errors.

The Pre-test provided a typical picture of how Subject A reacts to new activities and a set routine. In the *Behavioural irregularities* section, he was observed to fidget and mumble to himself during some of the tasks. Especially when he was asked to be seated and had to concentrate on the task, such as the *Hand Skill* and *Figure Recognition and Production* subtests. He would also react in a defensive manner and was aggressive at times when there

was a change over from one subtest to another. These behaviours were witnessed in the *Palm Form Recognition* subtest as he knew when he guessed the wrong number and would want to continue the 'guessing game' until he guessed all of the numbers correctly. Subject A would also be impulsive when shown a task he needed to perform by performing it at a rapid pace before the examiner had completed the demonstration. Impulsiveness was observed in the *Sound Patterns* subtest where he needed to wait for the pattern to be completed by the instructor before he could clap the pattern. One could speculate that this may relate to Subject A's inability of 'turn-taking' and revealed his ASD-like difficulties (Table 4.1)

All these behavioural reactions seemed to tone down during Re-test 1. He was impulsive at times after a task was demonstrated to him. However, he seemed more familiar and comfortable with the routine and the instructor, after four weeks into the programme. Despite the two-week holiday half way through the second month, the behaviour in the NRT was not as excessive as the Pre-test, but Subject A remained impulsive and overly excited with some of the activities, especially during the "guessing game" or when he just wanted to finish the task quickly and move on. During the NRT, he was distracted by mumbling to himself between the subtests. Re-test 2 depicts positive results (0 Au) as no behaviour irregularities occurred on that day during the testing. He was responsive and calm and at ease even if he did not perform some of the subtests correctly.

The gradual increase in the scores of Re-test 3 (1 Au) was due him being quite distracted on the test day and he was asking the instructor questions for most of the session. These questions were related to some uncertainty about his routine and environment. His parents went through a period of deciding whether to leave him at the autistic school or take him out to be home-schooled. Therefore, Subject A went through a transition of not knowing if he would remain in his usual daily routine or leave the school, which resulted in him repeating questions his parents had been asking him.

During the Post-test, Subject A was distracted during the session and continued to ask the same questions he had been repeating over the same period of time. He was also impulsive in some of the subtests as he had heard the instructor explain it before and attempted to rush into the subtests before the instructor could stop and remind him to first listen to all the instructions.

The Retention-test was conducted in subject A's home as his parents had decided to take him out of the autistic school. During the testing session, he remained cooperative in spite of it being a new venue. There were times during the testing when he would ask to do something else or refuse to do a task. This was observed in the *Hand Skills* test which he did not want to do. Eventually, after the examiner explained it to him, he went straight into this first subtest and continued to perform all of the subtests without any resistance. This may have been influenced by a reminder of the familiarity and routine he used to have with the

### **Subject G**

The results of the Pre-test (3 Au) and Re-test 1 did not show severe behaviour from Subject G, nonetheless the score placed him in the 'moderate discrepancy' category. He remained in the equivalent category as the baseline, even though the score increased at the NRT (4 Au). Re-test 2 and Re-test 3 appearing equivalent to the Pre-test and Re-test 1. The Post-test showed improvement in his behaviour as the decline in the score (2 Au) placed him in the 'no discrepancy' category. There was 33% difference between the Pre and the Post-test thus showing a positive improvement in his behaviour overtime. However, the score increased at the Retention-test and returned to the original score (3 Au) recorded in the Pre-test.

During the testing periods of the Pre-test and Re-test 1, Subject G reacted by flapping his hands between the subtests or even during his performance (Table 4.2) (APA, 2013:54). He also was easily distracted and displayed some excessive touching of objects or himself or anything with which he came into contact. This was also confirmed in the ADI-R summary. Research provides information regarding these certain behaviours. Subject G had a poor awareness of his body in space and would often require excessive physical interaction to define himself in space.

Further interesting behaviour irregularities occurred in the NRT. Along with fidgeting, Subject G seemed extremely excited at times and in a brief moment he would shake his head rapidly. Again this confirms the ADI-R summary of the stereotyped and repetitive motor mannerism of him shaking his head (Table 4.2).

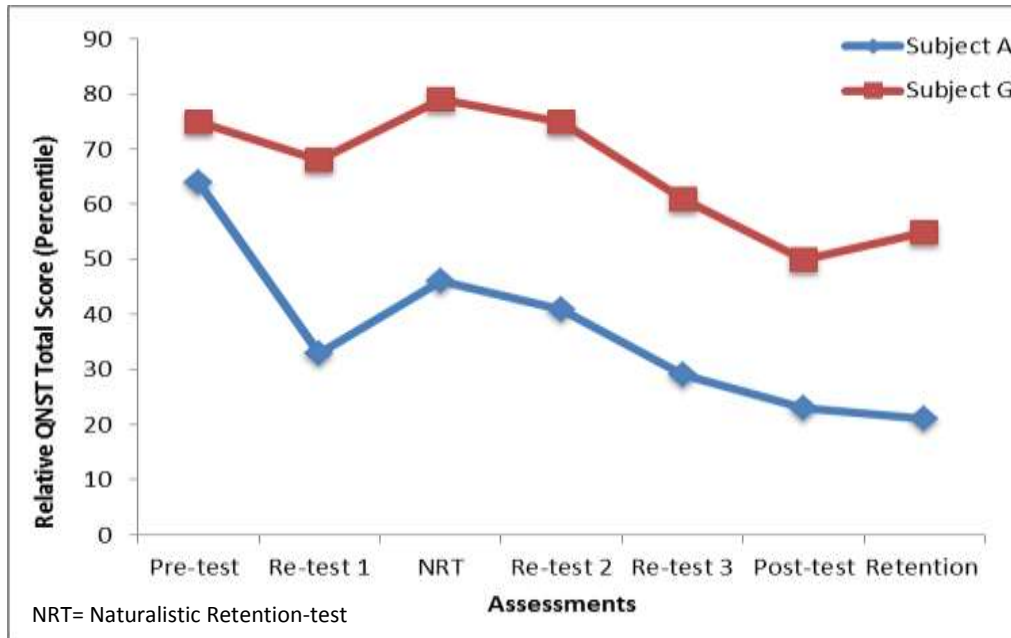
During Re-test 2, Subject G was anxious especially during the fine motor activities as was mentioned in the previous subtests (*Hand skills* and *Figure recognition and production*). He disliked the drawing activities and the 'fidgeting' and 'touching' increased, which

contributed to him being even more distracted. Studies have shown that teenagers with Asperger's Syndrome have high intensities of anxiety which corresponds with teenagers who have anxiety disorders (Farrugia & Hudson, 2006:31). However, Subject G was not diagnosed with Aspergers Syndrome. Research has confirmed that 30% to 80% of children with ASD have high levels of anxiety (Klin *et al.*, 2005:232; De Bruin *et al.*, 2007:883; Wood *et al.*, 2009:227). White *et al.* (2009:225) confirms that anxiety occurs more often in children with ASD when compared to other clinical and non-clinical populations. The anxiety could have been due to Re-test 2 being conducted in the winter and the subject having to wear his jersey. Subject G appeared to be tactile defensive as he would often tug and pull on his jersey in irritation which may be directed at his tactile defensiveness (Tomcheck & Dunn, 2007:195; Hilton *et al.*, 2010:942; Marco *et al.*, 2012:10). Re-test 3 revealed similar flapping motions of the hands and the excited behaviour, including times that he would raise his voice in outbursts of irrelevant words. The flapping of hands did not appear to lessen and therefore proprioception stimulation did not seem to assist at this point.

The Post-test seemed to show much less behaviour irregularities during the testing session. This may have occurred due to the SMI programme using the 'circumscribed interests' of Subject G (Table 4.2) to capture his attention so that he responds by performing the activity. Nonetheless, he still remained distracted at times and would reveal his unusual sensory interests and stereotyped motor mannerisms (flapping his hands or shaking his head) (Table 4.2) during activities involving walking or even sitting. The high score indicated in the Retention-test results, were due to his defensiveness, especially when he did not want to perform the *Hand skill* subtest. He was incredibly distracted and as soon as the instructor would look away, he would run off to a colourful chain on the wall to shake it. He was fidgety when seated in tasks and would throw a tantrum when he did not want to sit. Therefore, this may suggest that the SMI programme did not help him to retain his behaviour and, therefore neuroplasticity did not take place even though sensory-motor stimulation took place. This contradicts the findings of Baranek *et al.* (2013:309) which was discussed previously in the *Hand skill* section for Subject G with regard to hypo-responsiveness.

### Total score of the QNST-III

Figure 4.16 provides a plot of the total QNST score for each subtest. It provides a clear picture of the performance of each subject over the eight-month intervention period.



**Figure 4.16 TOTAL SCORE FOR QNST-III**

The two subjects are not compared with each other, as at the start Subject A was more capable of understanding instructions, whereas Subject G had an intellectual impairment and struggled with following instructions. The total score of Subject G did not include two of the subtests, namely *Palm form recognition* and *Double simultaneous stimulation of hand and cheek*.

#### **Subject A**

The total score of all the QNST-III subtests provides a picture of how severe the motor skills of Subject A were in the Pre-test (64 Au) (Figure 4.16). Table 3.2 (Chapter 3) indicates the functional categories that Subject A attained for each test over time. The Pre-test began in the 'severe discrepancy' category. The regression (48%) is present in Re-test 1 (33 Au), as the level of severity shifts to the 'moderate discrepancy' category. A 39% increase is presented at the NRT (46 Au) and returned to the 'severe discrepancy' category, however it was the start to a gradual decline over the next five months. The total score improves in Re-test 2 (41 Au) and placed in the 'moderate discrepancy' category but does not reach the same level achieved in Re-test 1. However, total test score for Re-test 3 (29 Au) continued to



decrease in the Post-test (23 Au) which achieved the 'no discrepancy' category. When comparing the Pre to the Post-test, a 64% differentiates the two tests. The final total score at the Retention-test (21 Au) evens out and is not far behind that of the Post-test.

Improvement could have occurred due to the SMI programme initiating practice (Sherwood & Lee, 2003:381) of the balance activities to enhance vestibular function (Chevaldi *et al.*, 2013:12). In addition, including progression in vestibular activities and integrating with proprioception activation, may have resulted in the lasting effect on the central nervous system, as some of the motor skills were retained over the five-weeks in the December holiday. Taubert *et al.* (2010:11674) conducted a study detecting the sensory-motor regions of the brain increasing (grey and white matter) due to six weeks of balance training for the whole body. The improvement only lasted during the training period. The improvement for Subject A may have occurred due to his cognitive skills improving, as the brain had to adapt during the relevant sensory systems being stimulation (Woo & Leon, 2013:5).

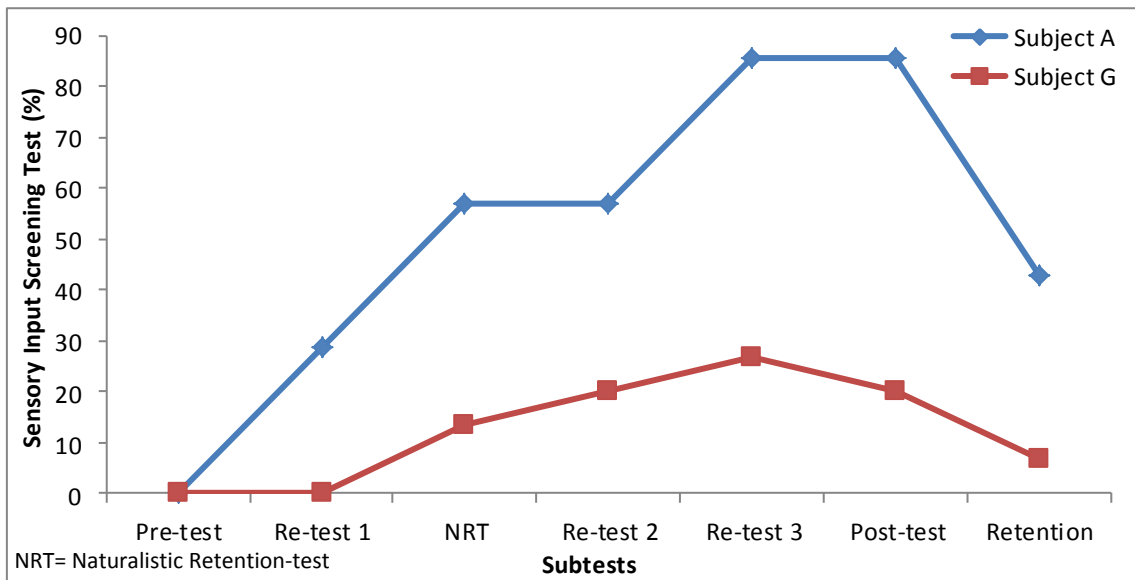
### **Subject G**

In Figure 4.16 it shows that Subject G starts at a severe level due to an extremely high total score (75 Au). A 'zig-zag' pattern begins at this point where there is a slight reduction (9%) at Re-test 1 (68 Au), but increases in the NRT by attaining an even higher score (79 Au) than in the Pre-test. Another decrease is produced for Re-test 2 by achieving a lower score (75 Au) than Re-test 1 by returning to the baseline score. The score continues to improve in Re-test 3 (61 Au), before another regression continued to the Post-test (50 Au). By the end of the study, the Retention-test score (55 Au) increased slightly.

Subject G can be placed in the 'moderate discrepancy' category in the Post-test and Retention-test for children aged six-years old. However, when the Post-test took place, Subject G was already seven years and five months old and therefore, the *Total Score* was classified according to the category for age seven-years old and remained in the 'severe discrepancy' category.

## SENSORY INPUT SYSTEMS SCREENING TEST (SISST) (PYFER)

The X-axis indicates the testing sessions. The data in Figure 4.17 shows the relative change in percentage of 'Passes' that the subjects were able to achieve from the initial Pre-test session over the eight-month intervention for the screening test.



**Figure 4.17 RESULTS OF THE SENSORY INPUT SYSTEMS SCREENING TEST**

### **Subject A**

At baseline, subject A was able to pass 7 of the 15 subtests. Illustrated in Figure 4.17, there is a gradual increase (20%) in Re-test 1 (9 passes) and the NRT improved by 22% from Re-test 1 which represents an increase in the number of subtests the subject was able to pass (11). A plateau was reached from the NRT to Re-test 2 where no change was seen. The last increase revealed another 18% improvement, which was an 86% increase from baseline. This occurred due to him achieving thirteen passes out of fifteen and remained consistent until the Post-test illustrating a second plateau. The final score of this screening test regressed in the Retention-test and settled at 43% from the Pre-test as Subject A passed 10 of the subtests.

Subject A was not able to perform the first three subtests of the Pyfer, which evaluate his reflexes, Tonic Labyrinthine Supine (TLS) and Prone (TLP) and balance skills (Positive Support reaction). As a whole, it reflects the functioning of his vestibular system. Also in this test, he was unable to hold a 'bent-knee' position for at least five seconds. The vestibular system sources the TLP, which is the reflex that responds to gravity (balance) and influences muscle

tone due to sensory information stimulation for a motor reaction (Goddard, 1996 cited in Hurst *et al.*, 2006:204; Voight *et al.*, 2011:151). The importance of the TLP reflex is to activate and strengthen the muscles when flexing. This stabilises the extensor muscles to mature such as when a baby is lying on his back. If this reflex is delayed, the child may experience problems with balancing and coordinating themselves, along with spatial orientation challenges (Cheatum & Hammond, 2000:61 cited in Hurst *et al.*, 2006:204; Goddard-Blythe, 2014:17). Children with ASD have been reported to having dysfunctions in reflexes, which can lead to developmental motor delays later on, along with problems with balancing and eye movement control during academic work (Ozonoff *et al.*, 2008:654; De Jong *et al.*, 2011:643; Goddard-Blythe, 2014:17).

The milestone of rolling over involves the baby lying on the stomach (prone) and turning onto the back (supine), which should be accomplished around four months. At five months, a baby should be able to turn back from supine to prone. This has been recorded to be one of the first milestones that revealed how reliable neuro-developmental processes of a baby are at that stage (Capute & Accardo, 1996:281). The parents of Subject A informed the psychiatrist that he never crawled as a baby which, according to Goddard (1996, cited in Hurst *et al.*, 2006:204), may be as a result of the Asymmetrical Tonic Neck Reflex (ATNR) being retained (Hurst *et al.*, 2006:204; Goddard-Blythe, 2014:13).

However, another vestibular function investigated was *Equilibrium Reactions* which was performed seated. Subject A was able to pass almost all of the tests over the eight months. He was quick to react to the examiner pushing him gently from one side to the next, as he would return back to the aligned centre of gravity without falling over. If the reflexes are functioning correctly, it would uphold postural control and therefore connecting these reflexes when maintaining balance (Goddard-Blythe, 2014:9). In this case, equilibrium control seemed to be intact, however his other reflexes were not. This seems contradictory, as recent literature reported that children with ASD find dynamic postural control to be a challenge. Fournier *et al.* (2010:5-6) investigated static positioning and postural control in typically developing children and children with ASD. They found that even during the most simple situations, both static and dynamic balance in ASD subjects were impaired. Whyatt and Craig (2012:1807) evaluated the motor skills of children with ASD between the ages of seven and ten years using the Movement Assessment Battery for Children (M-ABC2).

Interestingly, static balance had lower scores than for dynamic balance (Whyatt & Craig, 2012:1807). Due to his results, the programme of Subject A included vestibular activities.

From the fourth month of the intervention, Subject A was introduced to being rocked from side to side and back to front while in a seated, cross-legged position. Four weeks later, this activity progressed to the subject standing and the instructor would throw a ball toward him, but slightly to the side (off centre). He was encouraged to shift off centre to retrieve the ball and to return afterwards to regain balance. As the sub-tests continued, he seemed to enjoy the activity and saw it as a competition to not allow the examiner to push him over.

The *Vestibular* test was an item which evaluated the post-rotary nystagmus of the subject and over time revealed his inconsistency of vestibular function (Potter & Silverman, 1984:1074; Mailloux *et al.*, 2011:148). At baseline, Subject A achieved the required amount of seconds only for his left side, whereas the right side just missed the cut-off by one second (Auxter *et al.*, 2010:147). There was a dip in vestibular stimulation in the Re-tests 1, 2 and 3, but in the NRT he achieved the same results as that of the Pre-test.

In terms of research done on post-rotary nystagmus, Ottenbacher *et al.* (1979:1162) focused on children with learning disabilities and the duration of their post-rotary nystagmus. Those who had low levels of nystagmus (hypo-nystagmus) recorded prior to vestibular stimulation therapy, had shown an increase in their nystagmus durations over the 6-month intervention period. A more recent study conducted by Schaarf *et al.* (2012:549), recorded improvement in the duration of the low level post-rotary nystagmus of a five-year old boy who had been diagnosed with ASD and ADHD. This occurred after a 10-week intervention with the sensory integration approach.

From the start of the first session, vestibular stimulation was introduced into the SMI programme of Subject A. Table 4.3 provides the exact amount of seconds that he achieved for each test. It was interesting to note that when he was rotated to his right in Re-test 2, Re-test 3 and the Post-test, post-rotary nystagmus was achieved for the correct amount of time. However, there was a great decrease at the Retention-test achieving below seven seconds.

**Table 4.3 SUBJECT A: POST-ROTARY NYSTAGMUS RESULTS FROM THE VESTIBULAR ITEM**

| TEST                   | LEFT<br>(seconds) | RIGHT<br>(seconds) |
|------------------------|-------------------|--------------------|
| Pre-test               | <u>7</u>          | 6                  |
| Re-test 1              | 3                 | 5                  |
| Naturalistic Retention | <u>7</u>          | 6                  |
| Re-test 2              | 6                 | <u>7</u>           |
| Re-test 3              | 5                 | <u>8</u>           |
| Post-test              | 5                 | <u>9</u>           |
| Retention-test         | 4                 | 4                  |

The greatest improvement was observed in the section testing the eyes (*Fixation, Ocular alignment, Convergence-divergence ocular control and Visual tracking*). However, this was not the strongest section at baseline, which can be related to research that confirms visual tracking and eye movements are controlled by the vestibular system (Niklasson *et al.*, 2009:659; Callcott, 2012:133). Tracking the 'circle' and 'square' was easy for him, whereas while tracking the 'cross' (X) and the horizontal line, his eyes jerked or jumped. As was mentioned, if a child has retained TLR after 3½-years old, it may affect their eye control movements (Goddard-Blythe, 2014:17).

Hurst *et al.* (2006:204) studied an 8-year old boy with dyspraxia. He had visual perception problems, poor proprioception and bilateral integration. He was assigned to a programme focused on inhibiting his TLR, STNR and ATNR reflexes for three months followed by eight months of optometric vision therapy for a 30-minute session weekly. The results revealed that his oculo-motor eye control, saccadic eye movements, fixation and convergence had improved greatly. The boy's reading skills had also immensely improved by four years over the 11 months of intervention. Niklasson *et al.* (2009:659) have continually confirmed that vestibular stimulation or balance training improves eye control movements and inhibits primitive reflexes (Niklasson, 2012:257).

The development of the ability of Subject A to perform these tests was specifically prevalent in Re-test 3 and the Post-test the total score increased automatically. However, he was not able to track two of the items in the visual tracking subtests at the Retention-test, which

brought down the total score in the final stage. The two items were the 'circle' and the 'square', which he usually was able to track.

Another subtest which Subject A found challenging was the *Kinesthesia test* which is the exact same subtest as the *Finger to nose* test in the QNST-III. This was the subtest that he was unable to achieve a 'Pass' throughout the eight months of testing due to the strict requirements for the Pyfer in order to pass.

### **Subject G**

The zero scored by Subject G for the Pre-test and Re-test 1 (Figure 4.17) means that he was unable to pass any of the subtests in this screening test. In the NRT test, his performance increased by 13% (2 Passes) from baseline. From this point, a slow climb led the score to increase in Re-test 3 by 47% (4 Passes) from the baseline. The score did not continue to rise as the Post-test results returned to the Re-test 2's score (3 Passes). The regression continued as he could only complete one of the tests out of fifteen. There was a 20% difference between the Pre and the Post-test but concluded by decrease by 7%.

Subject G was unable to achieve a 'Pass' for any of the items for the Pre-test and Re-test 1. As was the case with the QNST-III, he seemed to not understand instructions and battled to imitate what was demonstrated to him. There were times when he appeared to be distracted by something when a task was demonstrated or if the task involved lying on the floor, he would try to lie on the instructor instead of the floor. In the third month of the study and just after the holiday, he was able to pass two of the tests which were the *Tonic Labyrinthine Prone* (TLP) item and the seated *Equilibrium reactions* (only for the left side). Research on reflexes has shown that if a child cannot perform the *Supine Tonic Labyrinthine reflex* (TLS), they will struggle to move against the pull of gravity and to control eye movements, such as fixating, convergence and eye tracking (Goddard-Blythe, 2014:17). In the earlier work of Goddard-Blythe (2005:416) he indicated that when primitive reflexes are not inhibited from six-12 months and a child's postural reflexes are not developed by the time they are three- to four-years old, it may be ascribed to neurological dysfunction.

Subject G could not lift his head up while lying down on the floor. This reflex must first be integrated before a baby has the ability to roll over from their back (supine) to their stomach (prone). When a child's TLP is active, they will find it challenging to lift their head or

limbs against the pull of gravity (Cheatum & Hammond, 2000:62; Goddard-Blythe, 2014:17). Over time, Subject G was monitored in these areas as he struggled with movement against gravity. He was observed to sometimes fall over randomly or hug objects or hold onto the examiner when asked to balance or perform an activity. As witnessed in the NRT test, instead of trying to lie down on the examiner, he would lie on the floor when he performed the TLP for the first time.

Despite the fact that this reflex was not included in the SISST, the QNST-III involved subtests which evaluated his fine motor skills. If the ANTR has not been retained, it can affect a child's pencil grip. The pencil grip of Subject G was clumsy and he was unable to initiate the shapes correctly. This could also be connected to influencing his hand-eye coordination skills (Goddard-Blythe, 2014:14).

For the *Equilibrium reactions* item, he was given a soft toy to hold on his lap to teach him to remain seated and stabilised. Gradually, these small alterations with objects began to help the child understand what he should do. The gradual increase in the scores of Re-test 2 was due to the improvement in both the left and the right side reacting correctly for the *Equilibrium reactions* but to partner with the TLP, there was still no sign of him being able to perform the TLS despite vestibular stimulation exercises during the sessions.

The next item, which brought the score up slightly more in Re-test 3, was Subject G being able to finally perform the *Supine Tonic Labyrinthine reflex* (TLS). At first it was difficult for him to understand how to lift up his head and touch his forehead to his knees. Throughout all the tests, the instructor had to touch his forehead to his knees and give him a slight push behind the head to feel the direction. With both the reflexes being integrated and the equilibrium reactions left and right being achieved, he could still not 'Pass' the Positive Support Reflex. When he jumped up and landed on his feet while bending his knees (which were turned inwards), he could hold the position for no longer than three seconds.

The regression at the Post-test was due to Subject G not achieving a 'Pass' for the TLS item. He was able to initiate the head lift towards the knees but could only hold that position for five seconds as opposed to ten seconds. The scores of the Retention-test after the holiday nearly took Subject G back to the baseline score. He was only able to perform the *Equilibrium reactions* but only on the right side. He was highly distracted on this day and he

did not want to remain seated. Throughout the Pyfer tests over the eight months, Subject G was not able to 'Pass' the Vestibular Item as his post-rotary nystagmus remained under seven seconds thus his vestibular function was under-stimulated. There was, however, an increase in the amount of seconds over time from Re-test 3 (three seconds left and one second right) to the Post-test (four seconds left and five seconds right) and even in the Retention-test (five seconds left and six seconds right).

Subject G was not able to pass the *Kinesthesia* test item throughout the duration of the intervention. As this is similar to the ONST-III *Finger-to-nose* subtest (Figure 4.6), this may confirm that the subject continues to struggle with coordinating his upper limbs in space while his eyes are closed (Feys *et al.*, 2003:79).



## Chapter 5

# CONCLUSION

### INTRODUCTION

This current investigation was inspired by the multifaceted approach, Sensory-Motor Integration (SMI), which involves the integration of the different sensory systems (Abbruzzese & Berardelli, 2003:232; Velasques *et al.*, 2013:4). The aim of the study was to design and implement an 8-month individualised sensory-motor integration programme for two boys (six and eight years of age) diagnosed with Autism Spectrum Disorder (ASD). This was followed by four objectives. The first was fulfilled when the two boys were diagnosed with ASD according to the Diagnostic and Statistical Manual in Mental Disorders (DSM-5). Secondly, motor delays relating the vestibular and proprioceptors in the somato-sensory systems, were identified in the two boys. Thirdly, the boys were assessed every 4-5 weeks. It was monitored that the 8-months SMI programme influenced the boys' sensory-motor skills along with their behaviour irregularities. By initiating the stimulation of the vestibular system and the proprioceptors, it would enhance the sensory-motor development in individuals (Niklasson *et al.*, 2010:328). The following sensory- motor variables were monitored: Static and dynamic balance, muscle tone, eye tracking, motor planning, body awareness, spatial orientation, laterality and object manipulation. The fourth objective was the conduct a retention period for 5 weeks.

### SUMMARY OF FINDINGS

A psychiatrist performed three diagnostic tests, namely Autism Diagnostic Interview-Revised (ADI-R), the Social Communication Questionnaire (SCQ) and Autism Diagnostic Observation Schedule-2nd Edition (ADOS-2), to evaluate their social impairments. It was confirmed that Subject A and Subject G were diagnosed with ASD according to the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders). In this study, at baseline, both boys (Subject A and Subject G) experienced poor static and dynamic balance. This is substantiated by recent research (Freitag *et al.*, 2007:956; Petraca *et al.*, 2013:494; Whyatt & Craig, 2012:1805;

Cheldavi *et al.*, 2014:12), which revealed that children with ASD are delayed and struggle in the following areas: low muscle tone (Dowel *et al.*, 2009:563), ball manipulation skills (Jasmin *et al.*, 2009:238; Pan *et al.*, 2009:1702; Staples & Reid, 2010:214), problems with motor planning (Todd, 2012:33), laterality, coordination, initiating synchronised movements (Bhat *et al.*, 2011:1120-1121; Liu, 2013:205), poor spatial awareness (Petrarca *et al.*, 2013:494) and have shown typical ASD behavioural symptoms.

Once the baseline level (Pre-test) of motor abnormalities had been determined, individualised SMI programmes were designed for each subject. Children diagnosed with ASD may achieve poor scores and results in motor skill tests due to their inability to understand instructions, imitate and follow through with the actions (Green *et al.*, 2009:315). Therefore, the instructor used the first four to five weeks of the intervention familiarising the subjects with the routine of the sessions and how they take place (APA, 2013:54, 57). This involved the basic foundations of locomotion activities (walking from one point to another, jumping up and down, open and closing legs) along with the verbal instructions and visual cues that follow. As Subject A did not have an intellectual impairment, he was more able to respond correctly to instruction after four weeks. In the case of Subject G, it took almost four months to learn simple keywords and cues to be able to respond to instructions. However, it would vary based on his irregular behaviours.

### **Stimulation of the vestibular system**

Some SMI treatments for children with ASD concentrate on the underlying sensory hypo- or hypersensitivities so that the child can receive adequate stimulation needed for reaching a sense of balance in their systems (Rodger & Brandenburg, 2009:42). It was revealed that both Subject A and Subject G had under stimulated vestibular function (hypo-vestibular). Therefore, the SMI programmes of this study included exercises directed at stimulating the hypo-sensitivity of the boys' vestibular systems and proprioception (Herdman, 2007:4), thereby developing and enriching these systems (Van Praag, 2000:194; Nithianantharajah & Hannan, 2006:698; Woo & Leon, 2013:5).

The ability to balance occurs from the driving mechanism, the vestibular system, which was a large area of focus in the SMI programmes for both subjects. Spinning (rotational), angular movements, fast rocking, jumping up and down and alternating between fast and slow speeds during locomotor activities were the stimulation techniques implemented in their

SMI programmes (Solan *et al.*, 2007:1; Angelaki & Cullen, 2008:126; Niklasson *et al.*, 2009:649; Zanelli *et al.*, 2011:586; Rine & Wiener-Vacher, 2013:508). Gradually and over time, Subject A was recorded to be a lot more attentive during the sessions.

For familiarity and routine purposes, the 'warm-up' of the intervention was the same activity for both of the subjects throughout every session. This also involved vestibular stimulation through the up and down motions, while being seated on a small pilates ball (Solan *et al.*, 2007:1; Angelaki & Cullen, 2008:126; Zanelli *et al.*, 2011:586; Rine & Wiener-Vacher, 2013:508). In order to keep the back upright while bouncing, muscle control was required as the muscles needed to support the body while in motion. According to Heitkamp *et al.* (2001:289) and Han *et al.* (2011:186), balance training or vestibular training enhanced the ability of the postural muscles to maintain a balanced position, along with improving the leg strength. Subject A did not need assistance in remaining upright on the ball but he needed to hold onto the handle which was attached to the ball. However, by the end of the intervention, Subject A was able to bounce without his hands holding onto the handle. Subject G, on the other hand, had to be assisted to remain on the ball while bouncing to music, as he could not remain upright and balance by himself. However, from the 5<sup>th</sup> month of the intervention Subject G no longer needed assistance when sitting on the ball.

Included in the basic locomotor skills was the execution of dynamic balance activities, for example when hopping from one point to another (Herdman, 2007:4). Subject A was quite competent in these dynamic activities and always could generate enough power even when jumping over objects. Subject G needed to be assisted in these activities for the first three months of the intervention, as he would lose his balance or he did not understand what was required. However, from the 5<sup>th</sup> month, he did improve in these activities as he did not need assistance while hopping from one place to another, but he would need to be guided over the elevated platforms that varied in height.

Eye exercises were also incorporated in the SMI programmes as a vestibular stimulation technique. Visual alignment while moving and visual tracking are stabilised by the Vestibulo-Ocular Reflex (VOR) driven by the vestibular system (Moussa *et al.*, 2005:9; Piek, 2006:91; Nashner, 2009:21; Han *et al.*, 2011:186; Callcott, 2012:139; Scärli *et al.*, 2012:81). These findings of vestibular improvement due to eye exercises, coincide with the findings

Herdman *et al.* (2007) and Scärli *et al.*, (2012) where vestibular rehabilitation was conducted to observe if it would help recover the visual perception of patients (Herdman *et al.*, 2007:385). Scärli *et al.* (2012) evaluated the importance of the visual system of children for postural development (2012:81). However, both studies were not based on children with ASD.

During the intervention, Subject A performed more ball manipulation skills where he would have to focus on the object being thrown towards him. This took place while he was required to remain in an upright position on a compliant surface. The medicine ball made the skill a lot slower which gave the subject time to focus and catch the ball with both hands.

Subject G could not track moving objects while his head was stationary. Therefore, the instructor attempted to first capture the subject's attention by using objects or pictures to which the subject could relate. Saccadic movements involve moving the eyes from one focal point to another (Nashner, 2009:21). The cerebellum assists the eyes in saccadic movements to ensure that the eyes are following the target accurately and remain consistent (Robinson & Fuchs, 2001:982; Glomstad, 2004:14). As the vestibular system is directly linked to the cerebellum (Glomstad, 2004:14), it also assists the cerebellum in adapting the body's posture and motor movements to the specific environment. Thus this was the system that needed stimulation to learn how to correctly integrate sensory information from other systems to assist Subject G during balance activities, postural control and controlling eye movements. This was relevant especially when he needed to orientate himself in his surroundings (Nashner, 2009:24; Writer & Arora, 2012:54).

Herdman *et al.* (2007:385) conducted vestibular rehabilitation to observe if it would help recover the visual perception of patients. Their procedure led to positive results and improvement in eye movements. This included gaze stability exercises four to five times a day for 20 to 40 minutes per day, along with balance exercises for at least 20 minutes (Herdman *et al.*, 2007:385; Han *et al.*, 2011:186). However, the duration of these exercises seemed too long for Subject A and Subject G of this study, as they would lose interest especially in eye exercises. As the sessions were only 30 minutes in duration, only a few minutes could be set aside for subjects to perform eye exercises.

## **Progression in vestibular exercises**

The progression of the SMI programmes continued with the stimulation of the vestibular system at the start of each session during the previously mentioned warm-up. While bouncing, the subject would be asked to stop, stand up and walk to a designated spot and to stand in a static position (either on two feet or heel-to-toe). The instructor applied a further progression in the programme of Subject A. This involved the subject being asked to close his eyes at specific times during vestibular or proprioception exercises to increase reliance on these sensory systems (Gopalai *et al.*, 2011:614; Zanelli *et al.*, 2011:586).

During the static balance subtests and activities, Subject G appeared to be distracted, thus the instructor had to adapt by introducing creative ideas in order to capture the subject's attention. This involved using a picture or figurine of Subject G's favourite toy or cartoon character to attract his attention and involve the fixation of his eyes. In teaching Subject G how to close his eyes upon instruction, the instructor would tactilely use her hands to cover his eyes until they closed and used a keyword every time this task was performed. Gradually and over time, he would repeat the keyword after her and close his eyes. However, this occurred for 10 seconds as Subject G could only count up to ten.

## **Stimulation of somato-sensory (proprioception) system**

For the stimulation of the somato-sensory system (proprioception) to be affective and receive as much information as possible, the subject's feet (receptors in the soles of the feet) were required to remain in contact with the floor, being a firm surface (Dietz, 2002:785; Page, 2006:79; Tossavainen *et al.*, 2006:289). With the emphasis being on familiarity and routine, the first seven weeks of the SMI programmes for Subject G did not focus on direct proprioception exercises (APA, 2013:54, 57).

Both subjects were exposed to the following five techniques for the stimulation of proprioception in the somato-sensory system, namely contraction (shortening) and stretching (lengthening) of muscles, compression (pressure) on and pulling of joints, tonic contraction of muscles around joints, increasing the power the muscles need to execute a movement and increasing the period over which a movement is performed (Cheatum & Hammond, 2000:207).

Based on the results of the relevant subtests, stimulating the proprioceptors in the limbs of Subject A and Subject G was included in their SMI programmes. This created opportunities for them to explore their bodies in space while performing simple locomotor movements followed by listening to instructions. These activities included: hopping from one point to another; orienting himself up and down balance rocks; and bouncing in place and closing his eyes when he was asked to stop. They were also exposed to alternating between balls of different weights (1kg or 2kg) or objects that would increase the force the muscles had to use in order to perform a movement. Due to the inability of Subject G to understand instructions at the start of the intervention, the instructor had to first teach the subject how to pass a tactile ball back and forth, as he did not understand the instruction at the beginning of his programme. This progressed to learning how to stand in place and throw and catch the tactile ball or walk over elevated platforms while holding the ball. This aided in activating the cerebellum and the basal ganglia to help adjust to these movement instructions. The cerebellum and the basal ganglia are connected and control and adjust movement instructions through motor commands (Riemann & Lephart, 2002:76).

### **Progression in somato-sensory (proprioception) exercises**

As the motor abnormalities of each subject was monitored and assessed frequently, the length of time a movement had to be performed was adjusted or increased. To increase the stimulation of proprioception in the upper limbs, exercises progressed to more activities involving pulling on or compressing the joints. The subject and the instructor would pull a rubber band to create a resistance in the upper arms or climb monkey bars (Riemann & Lephart, 2002:81; Kurtz, 2008:73; Auxter *et al.*, 2010:155; Fuentes & Bastian, 2010:164).

To assist Subject A and Subject G in spatial orientation tasks and body awareness (*Finger to nose* and *Arm and leg extensions* subtests), the instructor initiated exercises of locating body parts with a medicine ball. The weighted 1kg-ball would slow down the subject's movements and the sensation of the weighted ball on his joints may have contributed to stimulating the receptors in the skin, muscles and tendons surrounding the specific body parts (Riemann & Lephart, 2002:81). This required the subjects to sense where certain body parts were in space in relation to the ball, which involved stimulating the receptors as the muscles contract and stretch while moving (Fuentes & Bastian, 2010:164). The body parts that were called out during the exercises, was: the shoulder, the top of his head, left or right

knee and the chin. This also encouraged the subject to learn the difference between his right and left side of his body.

To increase proprioception in the lower limbs, the instructor designed activities involving equipment which had coarse or protruding tactile attachments (balance rocks and 'hedgehog' cushions and tactile balls of different sizes) (Auxter *et al.*, 2010:156). The subjects would be asked to walk over these tactile surfaces, to jump on and off them in order to activate the somato-sensory system (proprioceptors) in the lower extremities. In addition, when the subjects held a ball weighing 1kg or 2kg it increased the weight that the lower extremities would have to support (Rose, 2010:155).

### **Techniques to encourage the integration of the vestibular and somato-sensory (proprioception) system**

To ensure the integration of these two sensory systems, the instructor adapted the progression of functional exercises or function skills after the sensory system had been stimulated. This encouraged the sensory systems to integrate, which could influence the gross motor musculature to maintain a balanced posture or stance while performing functional movements (Velasques *et al.*, 2013:4).

The proprioception exercises, while performing functional motor actions, were initiated thus stimulating the vestibular system during the sessions. For example, after the subject had been spun around or had been jumping up and down on the trampoline, he was directed to hop from one point to another in order to retrieve a medicine ball and to hop back. The hopping activity involves dynamic balance, along with the proprioceptors in the lower legs upholding the body's position while in motion. Other functional activities included, the 'wheel barrow' or 'upside down spider-crawl', which the subjects performed on their hands. This encouraged compression on the joints (co-contraction). This was followed by the subjects climbing the 'monkey bars' and pulling on elastic bands, which continued to aid in joint traction in the upper limbs and strength in the shoulders (Cheatum & Hammond, 2000:208; Kurtz, 2008:74). The subject would then be directed to ball manipulation skills involving throwing and catching a weighted ball (1kg or 2kg).

Included in initiating integration, vestibular function along with activating proprioception were stimulated when the subjects were given compliant surfaces on which to balance (Hillier & McDonnell, 2010:4; Rajendran *et al.*, 2012:461). To increase vestibular stimulation,

they were asked to close their eyes at some points, which has been said to dominate over the required somato-sensory signals (Valente, 2007:36; Zanelli *et al.*, 2011:586; Rajendran *et al.*, 2012:461).

Table 5.1 presents an example of integrating the two sensory systems during an exercise. The example provides the relevant aims of the exercise including a creative name used as the theme for the activity. The vestibular system is stimulated through the up and down motions, along with activating the proprioceptors while holding the limbs in position.

**Table 5.1 AN EXAMPLE OF TWO SENSORY SYSTEMS INTEGRATING**

| Aim  | Activity                 | Description   |
|--|--------------------------|---|
| <ol style="list-style-type: none"> <li>1. Activating the vestibular system and proprioceptors in joints and muscles</li> <li>2. Encouraging dynamic balance</li> <li>3. Encouraging proprioceptors to stabilise an upright body alignment during locomotion</li> <li>4. Practising motor planning and spatial orientation when moving around objects</li> <li>5. Activating proprioceptors in the upper extremities through object manipulation</li> </ol> | <p>'Popping popcorn'</p> | <p>On the mini-trampoline, child jumps up &amp; down on two feet, bending knees upon landing, for a set amount of jumps (15).</p> <p>The child is asked to stop instantly, stand feet together and regain balance for a few seconds and then would be asked to close his eyes for a set amount of time (relying on vestibular cues).</p> <p>Once the time is complete the subject would be asked to open his eyes, jump off the trampoline and to hop around small cones in a zigzag manner to retrieve an object or medicine ball (1kg).</p> <p>Hop back, around the small cones, to the trampoline.</p> |

While these techniques were initiated during the SMI programmes, the subjects were tested regularly. The following section presents the overall results of the performance of Subject A and Subject G.

### **Quick Neurological Screening Test-III (QNST-III) findings**

At the start of the intervention, this screening tool determined the subject's individual level of difficulty with regard to motor planning, visual tracking, fine motor skills, spatial awareness and gross motor skills (Parush *et al.*, 2002:190; Mutti *et al.*, 2012:10; Pfeiffer *et*



*al.*, 2011:78). The findings for each boy varied for the different skills. After the Post-test was conducted, the *Total scores* for the Quick Neurological Screening Test-III (QNST-III) results revealed that Subject A's functional category improved, from 'severe discrepancy' to 'moderate discrepancy'. Subject G's category of his Total Score remained in the 'severe discrepancy' category. The Total Score results were categorised according the level of discrepancy and is presented in Table 5.2 for Subject A and Subject G.

**Table 5.2 QNST-III: INTERPRETATION OF TOTAL RAW SCORES**

| Test           | Subject A            | Subject G          |
|----------------|----------------------|--------------------|
| Pre-test       | Severe discrepancy   | Severe discrepancy |
| Re-test 1      | Moderate discrepancy | Severe discrepancy |
| NRT            | Severe discrepancy   | Severe discrepancy |
| Re-test 2      | Moderate discrepancy | Severe discrepancy |
| Re-test 3      | Moderate discrepancy | Severe discrepancy |
| Post-test      | No discrepancy       | Severe discrepancy |
| Retention-test | No discrepancy       | Severe discrepancy |

NRT = Naturalistic Retention Test

Subject A was observed to improve from the Pre-test to the Retention-test. Therefore, he improved from the 'severe discrepancy' category to 'no discrepancy' thus indicating improvement in his overall QNST-III results (Table 5.2). However, Subject G remained in the 'severe discrepancy' category which is indicated at the 5<sup>th</sup> percentile (Mutti *et al.*, 2012:53).

Due to Subject A retaining results during the retention period, it could be assumed that neuro-plasticity (Haibach *et al.*, 2011:215) took place as the programme was specifically focused on the subject's vestibular and proprioception needs (Lane & Schaaf, 2010:386). However, Subject G also had an individualised SMI programme and neuro-plasticity did not seem to have taken place after the retention period. This suggests that children with ASD accompanied by intellectual impairment should attend SMI sessions more frequently (3 to 4 times a week) and possibly for a longer period of time, such as nine months to one year.

***Improvement in the vestibular system***

Even though vestibular and proprioception exercises were included in SMI programme of Subject A, after the Pre-test, improvement was not observed straight away. However, over time as the exercises continued and progression took place, the Post-test showed a positive improvement in muscle control while performing moto skills.

Subject A showed improvement in the following vestibular activities: *Stand on one Leg* and *Tandem Walk* (static and dynamic balance). For strength and muscle tone, he did show improvement in *Arm and leg extension*. These activities shifted from 'moderate discrepancy' to the 'no discrepancy' category. Subject G found the *Stand on one leg* subtest challenging and displayed an inability to maintain the *Arm and leg extension* task. There was improvement at the end of the intervention, which was retained after the five-week December holiday (Retention-test).

With regard to the *Eye tracking* subtest, Subject A revealed jerking in his eyes at baseline measurement. However, great improvement occurred where he progressed from the 'severe discrepancy' category to the 'no discrepancy' category. At the baseline measurement Subject G could not track with his eyes, however, he was able to track an object in the final test. Therefore, gradual improvement took place over time.

***Improvement in the somato-sensory system (proprioception)***

The proprioceptor function of Subject A showed great improvement in the following subtests which changed his QNST-III category from 'severe' to the 'no discrepancy' category: *Finger to nose; Rapidly reversing repetitive hand movements; and Left and right discrimination*. The *Thumb and finger circles* subtest improved from a 'moderate' ability to the 'no discrepancy' category. These subtests specifically tested spatial awareness and laterality, which were objectives targeted by the sensory-motor programmes, as they involve proprioceptor functioning (Mehling *et al.*, 2009:4; Johnson & Soucacos, 2010:1-2).

As most of the results of Subject G started at a severe level, there was a great improvement in only one proprioceptor subtest (*Reversing repetitive hand movements*). His results went from the 'severe discrepancy' category to the 'no discrepancy' category. The *Finger to Nose* subtest changed from the 'severe' level to the 'moderate' level and the *Thumb and finger circle* subtest improved from the 'moderate' to the 'no discrepancy' category. Subject G had problems with his fine motor skills, which was evident in the *Hand skills* subtest. In addition,

the following subtests involving proprioception were also challenging for Subject G to perform: *Palm form recognition, Finger to nose, Thumb and finger circles* and *Double simultaneous stimulation of hand and cheek*. However, the final results showed improvement in only the following subtests: *Finger to nose, Rapidly reversing repetitive hand movements, Thumb and finger circles* and *Arm and Leg extension*.

It is important to take into account that the SMI programmes specifically did not focus on fine motor skills, which may have contributed to the lack of improvement in the above mentioned subtests for Subject G.

### **Sensory Input Systems Screening Test (SISST) findings**

To collate the QNST-III subtests for vestibular function, the results of the Sensory Input Systems Screening Test (SISST) were also used during the intervention. This screening test recorded results in a simpler fashion by indicating either a 'pass' or 'fail' for the subject.

Subject A progressed from a 'fail' to 'pass' after the intervention, and included the following: the Tonic Labyrinthine Supine (TLS), Tonic Labyrinthine Prone (TLP), Positive Support Reflex (PSR) and the Ocular Alignment test items along with the visual tracking of the 'X' and a horizontal line. However, the visual tracking of the square and circle went from a 'pass' to a 'fail' as the eyes jerked slightly.

The TLP has been confirmed to be 'fuelled' by the vestibular system and influences muscle tone (Goddard, 1996 cited in Hurst *et al.*, 2006:204; Voight *et al.*, 2011:151). Children with ASD have been observed to have reflexes that influence their balancing skills and eye movement (Ozonoff *et al.*, 2008:654; De Jong *et al.*, 2011:643; Goddard-Blythe, 2014:17). According to the TLP, TLS is inhibited and improvement in eye tracking may also reflect the improvement of Subject A in vestibular function through vestibular stimulation (Hurst *et al.*, 2006:208; Niklasson *et al.*, 2009:659; Niklasson, 2013:257).

The results of the *Vestibular test* items were inconsistent. In the Pre-test, Subject A appeared to be 'hypo-vestibular' (under-stimulated), as the Post-Rotary Nystagmus (PRN) score from one of the subtests in the screening test fell under seven seconds (Cheatum & Hammond, 2000:156; Auxter *et al.*, 2010:147). Throughout the entire eight months of the intervention, Subject G was not able to pass the *Vestibular test* item as his PRN remained under seven seconds, which indicated that his vestibular function was being under-

stimulated. However, there was a slight increase in the amount of seconds over time, namely from Re-test 3 (3 seconds left and 1 second right) to the Post-test (4 seconds left and 4 seconds right) and even in the Retention-test (5 seconds left and 6 seconds right).

Research conducted on children with learning disabilities (Ottenbacher *et al.*, 1979:1162) and Attention Deficit Hyperactive Disorder (ADHD) and ASD (Schaarf *et al.*, 2012:549) reported increased nystagmus after stimulation therapy. Therefore, this may contribute to vestibular exercises being initiated more frequently and for longer durations.

Overall, Subject G showed very little improvement in any of the test items for the SISST. The only positive change was a 'pass' in the *Equilibrium reactions* and he began to respond by not falling over when being pushed from side to side. However, for the last test (*Kinaesthesia*) both Subject A and Subject G remained in the 'fail' category which may indicate that low levels of proprioception and spatial orientation (when eyes are closed) were still present.

## LIMITATIONS

As the study included only two boys who were diagnosed with ASD, it was necessary to adjust to the highly restrictive characteristics of the neurological disorder, along with the high rate of sensory symptoms adding to functional deficiencies (Marco *et al.*, 2011:53). This placed a restriction on designing the specific activities. The possible limitation of this study was that it is difficult to test children with ASD due to their inability to pay attention to the task at hand for long periods of time or not being able to complete a task. Individuals diagnosed with ASD have been shown to struggle with selective attention when placed in surroundings which are very stimulating where they have more than one aspect on which to focus. It also takes them longer to process instructions (Hazen *et al.*, 2014:116-117). These are some of the main limitations which will be addressed in this section followed by possible recommendations when modifying test batteries and movement programmes accordingly.

Due to the small sample in this study, the procedures for statistical analysis were restricted. Inferential quantitative statistical analysis could not be applied; therefore the number of variables observed was increased, which is customary practice for case studies. However, it is recommended that the SMI programmes should be re-tested and applied to a larger group of children with ASD.

A great limiting factor when conducting this study was the inadequate amount of financial support. There is usually a hesitancy to provide research funds to support small case studies (Hodkinson & Hodkinson, 2001:8). There are also very few studies that have specifically focused on autism and sensory and motor skill problems (Baranek, 2002:397). Limited publications are thus available and this could have led to the conviction that research of this nature would not be a secure area to sustain with funding.

The tests used for assessment in this study, placed boundaries on the outcome of the results. There is a great need for standardised motor evaluations of children with ASD (Bhat *et al.*, 2011:1123). It was found that the QNST-III test battery appeared to be too specific when certain standards were required from the subjects. One of the examples highlighting this concern was the *Hand skills* subtest, which required the examinee to write down their name. Even if they are younger than 8 years old, they are required to print the letters. Subject G could not write his name but could draw a picture and was even able to perform the *Figure recognition and production* subtest. Future motor skill test batteries for children with ASD should provide different levels of scoring according to the child's cognitive ability and not according to their chronological age.

The screening test also contributed to the limitations with regard to the interpretation of the results. Due to the examiner only being able to delegate a 'pass', the results for this subtest of Subject G motivated specific vestibular and balance activities to be incorporated in his programme. Also the 'fail' could not provide valid information about the child's true abilities. With the administration of this screening test, subjects with ASD should be allowed more than one trial. They are accustomed to activities that are familiar and which are within their routine. Due to ASD children not being able to imitate demonstrations (Dziuk *et al.*, 2007:738; Todd, 2012:34), it was a challenge for the examiner when communicating the instructions to both of the boys. Over time, Subject A began to better understand what he had to do, which could have contributed to the improvement of his results. Subject G continued struggling to understand what was asked of him. Therefore, it is suggested that screening tests should provide more than one trial for the child to grasp the movement first before recording the results. In addition, the screening test should provide a space for the instructor to comment and describe how the child is responding to the subtests taking time into consideration.

The facilities at the school provided a limited area to work in with the boys, especially when using equipment. The room was also too light for Subject A and adjustments needed to be made constantly. This became obvious when the session had to be moved to the entrance hall due to the need for more space, but the entrance hall was too bright for him. For future studies, a wide open area should be planned in advance and the facility should be chosen according to minimal sensory stimulating distraction, such as noise and light.

Children with ASD are accustomed to their everyday set routines. This restricted the period of time required for each child to learn the movement or skill and the latter restricted the creativity of the instructor for the lessons. This is seen in the re-occurring of the warm-up activity, which had little variation throughout the entire intervention. This was adopted to create a sense of routine and familiarity for the subjects at the beginning of a session. Before progressing to the next activity, some of the activities had to be repeated more than twice. The subject had to first grasp the instructions, understand what has been asked of him and then an attempt could be made to perform the movement with the assistance of the instructor. A suggestion for future case studies is to design activities within the subject's interest right from the beginning, especially during the testing period.

With regard to the intervention outline and the study being confined to ASD children, the time frame and scheduling of the study had to be based on the school holidays. This restricted the programmes' sessions and in turn the boys' behaviour was inconsistency, which would disrupt their routine. Unfortunately, it was not required of the parents to keep a log book to record their son's activities during the holiday, and therefore it is not known what activities the subjects' performed during the holidays.

Another disruption was that the main school teacher of the two subjects went on maternity leave two months after their SMI programmes commenced. This disrupted the boys' school routine for a while, along with the addition of a new student in the class. The two subjects had to adjust to sharing individual attention and school facilities with the new student and assistant teacher.

Owing to the strict school routines and academic requirements for the subjects, the school could only offer two days a week (two sessions for each boy). The sessions were also restricted to being 30 minutes in duration. It would take the subjects a while to ease into each activity especially when changing between the activities which took up most of the

time. This also included packing out different equipment for a new activity while keeping the subject occupied so they do not run off or get distracted.

The change in medication for Subject G also disrupted his behaviour, which caused him to be even more distracted or uneasy during the testing periods. The inconsistency of Subject G taking his medication or the increase in dosage, contributed to the variation in his behaviour. Therefore, on some days he would not want to cooperate with the instructor and perform the set out activities. There were times it took the instructor even longer to calm Subject G down before he would participate and sometimes he would only perform two of the activities instead of the entire 30 minutes of at least four activities.

## **RECOMMENDATIONS**

Based on these occurrences, it is recommended that future studies secure an hour for a SMI session for an individual. This is based on taking into account the time it takes to settle the child, take their shoes off, setting up new stations while keeping the subject occupied, along with observing and making notes about the subject's progress. However, in order for the activities to be even more effective, sufficient time is needed for each activity. This would also depend on the child's level of functioning and cognitive ability.

The QNST-III has many aspects to it and provides a checklist which is descriptive. However, some of the subtests (Sound Patterns, Palm form, Double simultaneous stimulation of hand and check) were not understandable for Subject G, who had an intellectual and verbal impairment. Therefore, further research should look at adapting another version of the QNST-III, specifically for individuals with ASD who may not be able to speak or interpret instructions.

Another suggestion is directed towards the SISST. Even though it is a screening tool, more studies should invest in the reliability and validity of the tool, and especially screening other special population.

In conclusion, it is recommended that there should be an increase in the frequency of SMI programmes. Future studies should conduct individualised programmes for children with ASD at least three- to four-times a week instead of twice a week. It should be a continual movement programme and be integrated in their school routines and especially first thing in the morning.

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# **APPENDIX A**

Permission from School

Consent Form

Assent forms



[info@thedreamtreeschool.co.za](mailto:info@thedreamtreeschool.co.za)

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To Whom it may concern

Carla-Rae Hagemann approached our school in 2012 to request permission to study two of our learners as part of her research for her Msc in Sport Science.

We would be happy for her to come to our school and work with our learners after receiving permission from their parents of course.

We have a very good working relationship with Carla-Rae and her students as they came to do Kinderkinetics activities with our learners once a week in 2012. We are very pleased with the way she approaches our learners and adapt her activities to accommodate and further develop their skills.

We understand that the topic of her study involves: Designing a sensory-motor training programme for Autistic boys- two case studies. This is a very relevant topic for our learners.

She has requested to do the study on two of our male students and would like to begin with the Evaluation process and intervention in March 2013 and continue until September 2013. We will discuss the times she will work with the two boys so that it is least disruptive for our programme.

We trust that all the correct ethical procedures will be followed to ensure and respect the confidentiality of information regarding the learners and the school.

We will expect her to read through relevant policy documents relating to involvement with the learners in our school as a non-staff member.

You are welcome to contact me if you have any further questions or need more information regarding The DreamTree School.

Best regards  
Janet du Bois

Director  
The DreamTree School  
021 8422883



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## STELLENBOSCH UNIVERSITY CONSENT TO PARTICIPATE IN RESEARCH

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### Parents

#### **A sensory-motor training programme for Autistic boys: Two case studies**

As a parent of \_\_\_\_\_ [*the child's name*] it has been requested that you allow your child to participate in a research study conducted by Carla-Rae Hagemann (Masters Student) under the supervision of *DR E. AFRICA & DR K. WELMAN* from the *DEPARTMENT OF SPORT SCIENCE at STELLENBOSCH UNIVERSITY*. The results will contribute to a Master's thesis and a research article. Your child has been selected as a possible participant because they show Autistic symptoms and attend the school where the study will take place.

#### **1. PURPOSE OF THE STUDY**

Studies have been done on the prevalence of sensory and motor abnormalities in children. Although these abnormalities are not specific to Autism, literature proposes that, the occurrence of these defects is relatively high due to Autistic children's irregular responses to sensory stimuli (Fertel-Daly *et al.*, 2001:603). Children with Autism that have impaired sensory processing, will show signs of arousal dysfunctions, problems with interacting with others, delayed learning of motor skills, coordination and the process of motor planning such as peddling on a tricycle.

The aim of this study would be to evaluate and determine the level of the selected boys' motor capabilities. Motor planning, bilateral integration, laterality, body awareness, balance and muscle tone will be the areas of focus that will be specifically assessed. A sensory-motor training programme will be designed and implemented as the intervention. The study is limited to focusing on paying individual attention to only two selected boys. The aim of the intervention will be to try and improve their motor capabilities and level of functioning so that they may experience the long term effects in everyday life.

#### **2. PROCEDURES**

##### **Parent**

If you allow your child participate in this study, we would ask your child to perform the following:

- Two Motor skill tests that are designed to detect sensory motor delays. These tests will be used to evaluate your child's motor skill level involving the planning of motor processes and balance. Another test to assess your child's balance will be with a non-invasive accelerometer. Included in the evaluation process, Prof De Vries, a Psychiatrist from the University of Cape Town and an internationally accredited trainer for the ADI-R ADOS tests, will perform three of these psychiatric tests for scientific diagnostic confirmation of your child. The tests will be performed prior to the intervention and you are welcome to be present for the tests. To monitor any physical changes, the motor skill tests will be conducted every four weeks. Following the programme a post-test

will be conducted on your child to observe and record any notable improvements. There will be two weeks retention period after the post testing has been completed.

The selected tests are explained below:

- **Quick-neurological screening test-3:** This is an individually-administrated, empirically-based assessment of the development of motor coordination and sensory integration. It measures the level of difficulty a person may have with planning and/or execution of motor movements. (Appendix E).
- **The Pyfer test:** This is an informal screening test that can be used to identify sensory input delays. It tests the reflexes, primitives and equilibrium reflexes, the vestibular, visual, kinaesthetic and tactile system (Appendix E).
- **Balance and Postural Sway assessment:** is a test for anterior-posterior (AP) and medial-lateral (ML) postural sway and will be completed by using a wireless tri-axial accelerometer (ISWAY, APDM, INC. USA). the ISWAY is non-invasive method to assess postural sway (balance) (Appendix E).
- **The Sensory Integration and Praxis Test:** This is a test which gives detailed information on the examinee's sensory processing and practice abilities. It tests bilateral motor coordination, standing and walking balance, motor accuracy, kinesthesia and postrotary nystagmus. If the study cannot obtain an Occupational Therapist to perform the test on the two boys, the test will not be used.
- **Autism Diagnostic Interview-Revised (ADI-R)** (Lord, Rutter & Le Couteur, 1994) is a standardised, semi-structured investigator-based interview for caregivers of children and adults who may have Autism or an autism spectrum disorder (ASD). The time duration required for the interview is typically about an hour and a half.
- **Social Communication Questionnaire (SCQ)** is a parent-based questionnaire consisting of 40-items used to identify children with possible Autism Spectrum Disorder (ASD) (Snow & Lecavalier, 2008:630). The SCQ is a valid screening tool for children who are 4 years and older (Wiggin *et al.*, 2007, 34).
- **ADOS-2 (Autism Diagnostic Observation Schedule-2<sup>nd</sup> Edition)** (Lord, *et al.*, 2000) is a standardised, semi-structured play-based assessment for children and adults who may have an autism spectrum disorder (ASD). It consists of five modules selected based on age and expressive language level. An assessment typically takes 45-60 minutes. Clinical information, ADI-R and ADOS-2 data are combined by an expert clinician to determine an overall diagnosis.

Your child would be asked to participate from March 2013 until November 2013. After the first pre-test has been completed, the intervention programme will be conducted for 6 months, three times a week for 30-40 minutes per session. Both the testing procedures and intervention and retention period will take place at the school at which your child attends.

### 3. POTENTIAL RISKS AND DISCOMFORTS

All evaluations and participation in this study contains no invasive techniques, therefore minimal risk is expected. The tests (QNST-3, Pyfer & Sensory Integration and Praxis Test) and participation in the intervention programme presents no danger to your child, but if your child may begin to feel uncomfortable, he will not be forced to complete the activity. What will be required from the child during the intervention programme, will not be strenuous or harmful to their body, yet they may experience slight discomfort in the form of perspiration. If your child

complains that they are feeling pain or seems to be tired, uncomfortable and not concentrating, I will immediately discontinue all exercise. The foundation of what I do is created to accommodate children and for them to enjoy playing and developing in a variety of ways.

#### **4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

If your child participates in the sensory training programme, the only direct and immediate benefits they may experience will be the fun factor and the stimulation of their thought processes. Since sensory and motor deficits are closely linked, after the sensory-motor training programme has been implemented and the two selected boys have performed the post test, the following results and long term benefits are aiming to be achieved:

- Stimulation of the child's sensory systems
- Improvement of sensory processing and motor skill development
- Enhancement of the boys' quality of movement and accomplishment of motor capabilities, motor planning and performance
- Improvement of motor planning, laterality, bilateral integration and body awareness
- Improvement of vestibular and proprioceptor function that will help the boys control their posture during activities and remain in an upright seated position (static and dynamic balance) Improve academic and motor results

#### **5. PAYMENT FOR PARTICIPATION**

You or your child will not receive payment for participating in this study.

#### **6. CONFIDENTIALITY**

Any information that is obtained in connection with this study and that can be identified with the two boys will remain confidential and will be disclosed only with parental permission or as required by law. Confidentiality will be maintained by the boy's name being substituted with a code. For example: 2013- A or 2013- B. Files containing the boys' information and results will be saved under a password-based computer filing system and hard copies can also be kept in the Department of Sport Science's motor learning lab which has a filing room. Access to the files will only be given to Carla-Rae Hagemann (principle investigator and Masters student), Dr Africa, Dr Welman and Prof de Vries (supervisor and co-supervisors) of this study. The statistician (Prof M Kidd) of this study who will be analyzing the data, will also have access to the results. It will be your choice if they would like the school to also know your child's results, otherwise children's results will not be given to the school. The names of the two boys will not be revealed in the thesis and future publications.

If the study is published, the child's name will not appear in the publication and therefore personal information about the child will not be exposed.

#### **7. PARTICIPATION AND WITHDRAWAL**

You can choose whether you would like your child to participate in this study or not. If you allow your child to be in this study, you may withdraw him at any time without consequences of any kind. You may also refuse to answer any questions you do not want to answer and your child may still remain in the study. The investigator may withdraw your child from this research if circumstances arise which warrant doing so. Your child will not participate in this study if you do not provide your consent. If your child attains an illness for a long period of time or you withdraw

your child from the school due to personal reasons, your child will not continue his participation in this study.

## 8. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact:

Dr Eileen Africa: 021 808 4591, [africa@sun.ac.za](mailto:africa@sun.ac.za).

Dr Karen Welman: 021 808 4733, [welman@sun.ac.za](mailto:welman@sun.ac.za)

Prof Petrus de Vries: 021 685 4103, [petrus.devries@uct.ac.za](mailto:petrus.devries@uct.ac.za)

Carla-Rae Hagemann: 079 109 1681, [carlaraehagemann1@gmail.com](mailto:carlaraehagemann1@gmail.com).

Department of Sport Science  
Stellenbosch University  
Matieland, 7602

## 9. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [[mfouche@sun.ac.za](mailto:mfouche@sun.ac.za); 021 808 4622] at the Division for Research Development.

### SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to me by Carla-Rae Hagemann in English and the requirements of my consent was clearly translated to me. I was given the opportunity to ask questions and these questions were answered to my satisfaction.

I hereby consent voluntarily to allow my child to participate in this study. I have been given a copy of this form.

\_\_\_\_\_  
**Name of Subject/Participant**

\_\_\_\_\_  
**Name of Legal Representative (if applicable)**

**Signature of Subject/Participant or Legal Representative**

**Date**

**SIGNATURE OF INVESTIGATOR**

I declare that I explained the information given in this document to \_\_\_\_\_ [*name of the subject/participant*] and/or his parents representative \_\_\_\_\_ [*name of the representative*]. [*He/she*] was encouraged and given ample time to ask me any questions. This conversation was conducted in *English* and [*no translator was used/this conversation was translated into* \_\_\_\_\_ by \_\_\_\_\_]

\_\_\_\_\_  
**Signature of Investigator**

\_\_\_\_\_  
**Date**





STELLENBOSCH UNIVERSITY

## PARTICIPANT INFORMATION LEAFLET AND ASSENT FORM



### TITLE OF THE RESEARCH PROJECT

A sensory-motor integration programme boys with Autism Spectrum Disorder: Two case studies

Do you like to play or exercise?



**RESEARCHERS NAME(S):** Carla-Rae Hagemann

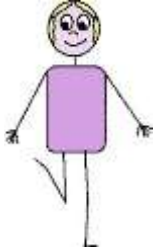














**ADDRESS:** Department of Sport Science  
Stellenbosch  
Matieland, 7600

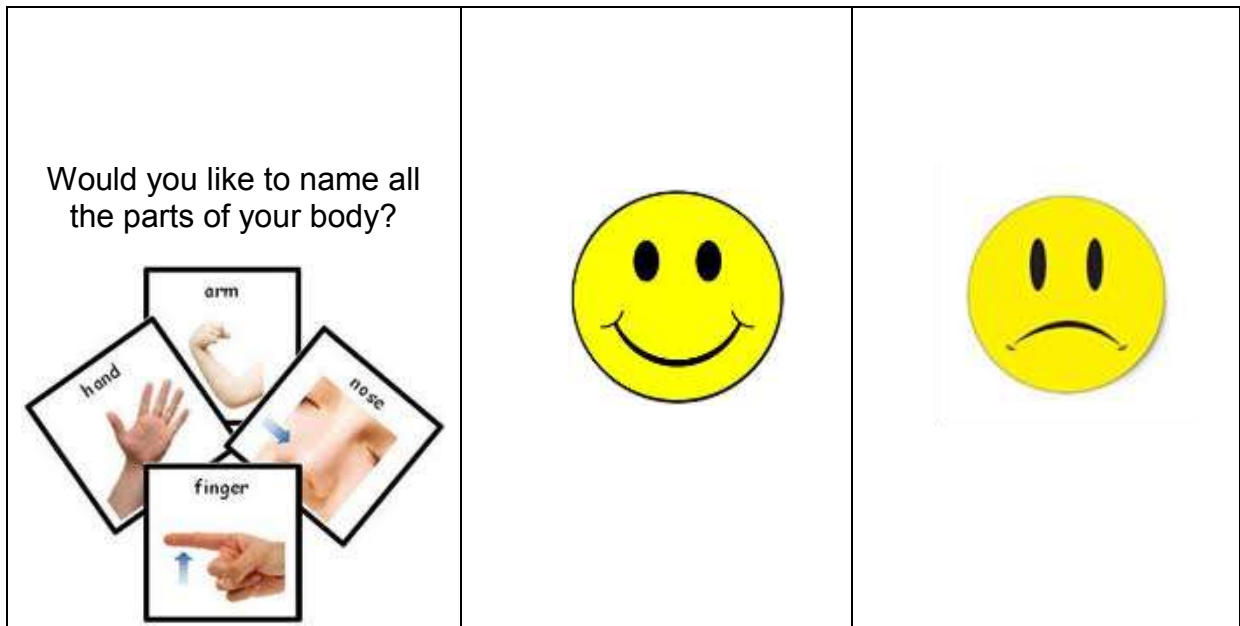
**CONTACT NUMBER:** 079 109 1681

### What is RESEARCH?

Research is something we do to find new knowledge about the way people work. We use research projects to help us find out more about delays in physical development. Research also helps us to find better ways of helping children who may have problems.

**Some questions just for you:**

| Question  | Yes   | No  |
|---|---|---|
| <p>Can you stand on one leg?</p>                                     |    |    |
| <p>Do you like to kick a ball?</p>                                  |   |   |
| <p>Would you like to sit up straight in your chair at school?</p>  |  |  |
| <p>And hold a pencil to be able draw?</p>                          |  |  |
| <p>Do you know how to make star jumps? Can I teach you?</p>        |  |  |
|   | <p>190</p>  |   |



**What is this research project all about?**

To help children to learn new things and to move better so that they can enjoy themselves even more.

**Why have I been invited to take part in this research project?**

You have been invited because you special and I think you enjoy playing in some activities I will make for you. Also, I want you to have fun.

**Who is doing the research?**

My name is Carla-Rae and you know that I like to come and play with you.

**What will happen to me in this study?**

I will make sure nothing bad will happen to you. I will tell you and show you everything you need to know. You are going to have fun and learn new things

**Can anything bad happen to me?**

Nothing bad will happen to you. You might sweat if it is hot outside. If you get tired when playing we can stop whenever you like.

**Can anything good happen to me?**

You will feel better about yourself and you will move better every time. You will be able to sit up straight in a chair when drawing and be able to kick or throw a ball to a friend. I want to help you so you do not fall over or trip over your feet when running or hopping on one leg.

**Will anyone know I am in the study?**

No, only myself and my teachers will know you will be doing activities with me. Your mom, dad and your teachers will also know that you are doing these special activities with me. Your name will be kept a secret. No one except me and my teachers will have access to your performance scores.



**Who can I talk to about the study?**

At any time you can ask me questions and tell me how you feel about the activities. Here is my number if you need it.

Carla-Rae: 079 109 1681

**What if I do not want to do this?**

You will not be forced to do any activities you do not want to do. If you decide that you do not feel comfortable with participating in this study,

you have every right to refuse. You may also withdraw at anytime during the study if you no longer wish to continue. You will not get into any kind of trouble even if you initially decided to participate. It is always your choice.

**Important things to know:**

- You get to decide if you want to take part.
- You can say 'No' or you can say 'Yes'.
- No one will be upset if you say 'No'.
- If you say 'Yes', you can always say 'No' later.
- You can say 'No' at anytime.
- I would still play with you when I visit the school on other days, no matter what you decide.

Do you understand this research and are you willing to take part in it?



Have I (Carla-Rae) answered all your questions?



Do you understand that you do not have to take part if you do not want to?



\_\_\_\_\_  
Signature of Child

\_\_\_\_\_  
Date

# **APPENDIX B**

## Medical forms



---

**REMEDIAL EVALUATION PERSONAL INFORMATION:**

Name of client \_\_\_\_\_

Initials and surname of parent/s \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

Telephone (h) \_\_\_\_\_ Cell \_\_\_\_\_ (w) \_\_\_\_\_

E-mail address \_\_\_\_\_

Test date \_\_\_\_\_

Date of birth \_\_\_\_\_

Age \_\_\_\_\_ Sex \_\_\_\_\_

School \_\_\_\_\_ Grade \_\_\_\_\_

**MEDICAL/NEUROLOGICAL BACKGROUND:**

MILESTONE DEVELOPMENT:

Crawling \_\_\_\_\_

Walking \_\_\_\_\_

Talking (starting, any problems, therapy) \_\_\_\_\_

Cycling: Tricycle \_\_\_\_\_ Bicycle: \_\_\_\_\_

Skipping \_\_\_\_\_

Jumping Jacks \_\_\_\_\_





---

**BIRTH TRAUMA:**

Prenatal (mother severely overweight, small birth canal, health habits (smoking, alcohol use, any medication, drug use before & during pregnancy), any other relevant information).

---

Birth self (normal or Caesarian, long labour (>12 hours), overexposure to anaesthetic, low birth weight (<2,3 kg), breech baby, rhesus factor, premature baby (indicate birth weight and how premature), one in multiple birth, rubella, metabolic dysfunction, diabetes, placental abnormalities, foetal oxygen shortage, excessive radioactivity, venereal disease, any other relevant information).

---

Birth weight, circumference of head, apgar score

---

Postnatal (e.g. injured in a fall, exposure to toxic gases, high fever).

---

---

**DISEASES:**

(e.g. anaemia, asthma, allergies, diabetes, ear, nose and throat infections, epilepsy, meningitis. Indicate acute or chronic).

---

Medication

---

**ANY OTHER RELEVANT INFORMATION:**

(e.g. mentally retarded, auditory/visual disabilities, emotional problems, hyperactivity, learning disability, loss of perceptual ability, psychological adaptability, physical abnormalities (postural problems, flat feet, abnormal curvature of the spine, etc.), spasticity, syndromes).

---

Medication

---



**REFERRAL:**

By \_\_\_\_\_

Reason \_\_\_\_\_

**If possible, attach previous evaluation reports.**

**INFORMED CONSENT:**

I, \_\_\_\_\_ the undersigned, hereby declare that I have read and fully understand the detailed information. I have had the opportunity to ask relevant questions with regard to the evaluation, and allow my child at my own risk to participate in the evaluation and the subsequent exercise programme.

**Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**1. GENERAL: (This section is completed by the Kinderkineticist during the evaluation process)**

1. **BODY COMPOSITION:**

|                    |       |                    |       |
|--------------------|-------|--------------------|-------|
| Body mass (kg)     | _____ | Body length (cm)   | _____ |
| Calf skinfold (mm) | _____ | Subscapular (mm)   | _____ |
| Triceps (mm)       | _____ | Fat percentage (%) | _____ |

2. **DOMINANCE:**

|      |       |   |                |
|------|-------|---|----------------|
| Hand | L / R | / | Uncertain/Both |
| Foot | L / R | / | Uncertain/Both |
| Eye  | L / R | / | Uncertain/Both |
| Ear  | L / R | / | Uncertain/Both |





# **APPENDIX C**

## **Descriptions of Subtests:**

Quick-Neurological Screening Test –III

Sensory Input System Screening Test

## QUICK-NEUROLOGICAL SCREENING TEST- 3<sup>rd</sup> Edition

### 1. Hand Skill

It examines the child's hand preference, fine motor skill, overflow movements, the occurrence of a tremor and motor planning (Fuentes *et al.*, 2009:1536; Mutti *et al.*, 2012:95).

### 2. Figure recognition and production

The test items were limited to five figures being the circle, square, rectangle, triangle and the diamond. Investigators agree that most neurologically unimpaired children should be competent to complete all of the five figures by the age of six (Mutti *et al.*, 2012:96). While testing fine motor skills, other areas and skills can also be observed as follow: motor output, imagery, memory, perceptual and verbal skills (Toomela, 2002:244; Fuentes *et al.*, 2009:1536).

### 3. Palm form recognition

The following subtest assists examiners to understand a child's developmental readiness to numbers and arithmetic. If there is a delay or the child is slow in naming the shapes, this could propose that he or she may have a problem with timing. Included in this subtest, is the child's ability to imagine the numbers when they are drawn on the palm of the hand. This could suggest a spatial perception problem if the child mentions the incorrect number. The sense of touch may be misleading and incorrect or a tactile deficit may be aligned with learning problems (Cheatum & Hammond, 2000:237; Mutti *et al.*, 2012:98).

### 4. Eye tracking:

The eyes are connected to coordinated and synchronised movements. The eyes provide visual information to the other systems with regard to the body's whereabouts and actions that take place, as well as assist in balance (Molloy *et al.*, 2003:648).

### 5. Sound patterns

The requirements of the Sound Patterns subtest involve a motor exercise of the child repeating a pattern which must be tapped on a table and then repeated orally. This enables the examiner to observe the child's rhythm, rate, sequencing and discrimination during the subtest (Mutti *et al.*, 2012:100).

## **6. Finger to Nose**

The examiner assessed the rate, rhythm, accuracy, smoothness of execution, symmetry, posturing and tremor in this subtest. It is possible for unimpaired children from the age of six years old to execute the pathway of the finger from the nose to hand in a smooth manner (Mutti *et al.*, 2012:102). It is also used to assess upper-limb coordination (Feys *et al.*, 2003:79).

## **7. Thumb and finger circles**

This test measures the ability in ordering and sequencing. In addition the examiner observes if the opposite hand (which is not performing the task) mirrors the other hand (Mutti *et al.*, 2012:103).

## **8. Double simultaneous stimulation of hand and cheek**

This subtest reveals if an individual has a poor sense of his body outline and a poor self-concept. If the child shows signs of problems with motor planning and poor body awareness, there may also be problems with the sense of self and the ability to perform movements skilfully. This can also be associated with poor body proprioception (Mehling *et al.*, 2009:2; Mutti *et al.*, 2012:104).

## **9. Rapidly reversing repetitive hand movements**

In the subtest, rate, rhythm, symmetry and accuracy are the variables observed (Mutti *et al.*, 2012:104).

## **10. Arm and leg extension**

This subtest observes the muscle tone, motor planning and muscle strength and if there is a difference between the right and left sides of their bodies in terms of gross and fine motor control (Peters *et al.*, 1975 cited in Mutti *et al.*, 2012:105).

## **11. Tandem walk**

Activities which involve walking heel-to-toe with eyes open and then closed are often included in some screening tests and neurological examinations (Mutti *et al.*, 2012:106). This subtest involves gross motor skills especially requiring balance, which is associated with

vestibular, visual and somatosensory input for balance or postural control, along with auditory-perceptual skills. It also includes variables, such as body symmetry, sequencing, motor planning and being aware of oneself in space (Sterling & Sterling, 1977 cited in Mutti *et al.*, 2012:106).

### **12. Stand on one leg**

This subtest reveals an individual's ability to sustain a balanced position on a reduced surface area and stabilise muscle control (Lackner & Dizio, 2005:126).

### **13. Skipping**

Skipping is a skill that is impossible for a child to do if they cannot stand on one leg, as it involves one foot being on the floor and the other leg lifted off the ground during the hop phase, while the body is attempting to move forward. This is another subtest which is present in screening and diagnostic neurological examinations for testing dynamic balance, coordination, synchronisation and cross-lateral motor movements (Mutti *et al.*, 2012:107).

### **14. Left and right Discrimination**

This area is assessed by three subtests in the QNST-III: Finger to Nose, Thumb and Finger Circles and Standing on one leg. Laterality, dominance and preference in hands, feet and eyes are observed (Mutti *et al.*, 2012).

### **15. Behavioural irregularities**

This final subtest aids the instructor to observe any unusual behaviour of the subject and how it may affect his/ her performance of motor skills (Baranek *et al.*, 2013:317).

## **SENSORY INPUT SYSTEMS SCREENING TEST (SISST):**

The following 15 items that make up the SISST are described below:

### **Tonic labyrinthine supine (TLS) & Tonic labyrinthine prone (TLP):**

This is a primitive reflex which assists in maintaining trunk extension when a child is in supine position (lying on their back) or to ensure trunk flexion is maintain while in prone position (lying with stomach on floor) (Cheatum & Hammond, 2000:61,62; Auxter *et al.*, 2010:151). This has been recorded to be one of the first milestones that revealed how reliable neuro-developmental processes of a baby are at that stage (Caputez & Accardo, 1996:281).

### **Positive support reaction (PSR):**

This test item reflects the functioning of the vestibular system and the subject's ability to maintain balance (Voight *et al.*, 2011:151).

### **Equilibrium reactions**

This item assesses the subject's ability to return back to centre of gravity when surface area is disturbed or manipulated, therefore assessing vestibular function (Voight *et al.*, 2011:151).

### **Vestibular test item**

The rotating chair has been used traditionally for testing the Vestibular-Ocular Reflex (VOR) function. It is also known as the 'Post Rotary Nystagmus test; (PNR) (Cheatum & Hammond, 2000:156).

The following items test the visual system and the subject performs all the items seated:

- Fixation
- Ocular Alignment
- Convergence-Divergence Ocular Control
- Visual Tracking

## **Kinesthesia**


It evaluates the subject's ability to coordinate his upper limbs in space while his / her eyes are closed and may indicate the subject's proprioception and spatial orientation skills (Auxter *et al.*, 2010:155).

# **APPENDIX D**

## **Sensory-motor integration Programmes**

### **SUBJECT A**

| SUBJECT A  | MAY  | WEEK 1: 30 minutes x2   |
|--|--|---|
| <b>General Aim:</b> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> </ul> |  |   |
| <b>Specific Aim:</b> <ul style="list-style-type: none"> <li>• Focus on bilateral coordination</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> </ul>                                    | <b>Equipment:</b> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Plastic coloured tape</li> <li>• Small hulla hoop (1)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• Small orange traffic cones (4)</li> <li>• Rotating office chair (1)</li> <li>• 1kg medicine ball (1)</li> <li>• Cardboard circle (1)</li> <li>• Floor mat (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES   | EXPLANATION  |
|---|--|--|
| <p style="text-align: center;"><b>Warm Up</b></p> <p><b>To:</b><br/> <i>Establish routine by introducing the same activity which starts the sessions;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions</i></p> <p style="text-align: right;">(4 minutes)</p> | <p>'Musical kangaroo'<br/>                     Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. One song has been chosen from child's CD (that the child is familiar with or has chosen himself).</p> <div style="text-align: center;">  </div> <p><b>Instructions:</b> Child is shown that they may sit on the kangaroo ball, holding the handle with both hands. When the music plays, child bounces up &amp; down in place on the kangaroo ball like a kangaroo. When the instructor pauses the music, the child must stop instantly. Pause the song for about 3 seconds before pressing play again &amp; the child may continue bouncing. Complete the song before moving onto the next activity.</p> |



|   |  |  |
|---|--|--|
| <p><i>Activate dynamic balance as the child remains in an upright, balanced position;</i></p> <p><i>Practice the communication of listening to instructions by responding to retrieve an object</i></p> <p>(4 minutes)</p>  | <p>1. Hop forwards like a bunny, to collect your “carrots”</p> | <p><b>Set-up:</b> Measure 3.5 m on the floor in a clear &amp; open space. Place the bright coloured tape on the floor, over that distance. The tape will be vertically in front of the child. Set up one traffic cone on one end of the taped line, with a small hoop alongside it (as the basket) &amp; the 3 other cones together on the other end.</p> <p><b>Instructions:</b> Child is instructed to ‘hop’ from the one cone (carrot) to the next, keeping feet together while hopping. <i>Ensure that you have informed the child &amp; demonstrated that they must bend at the knees when landing on each hop.</i> Once reaching the side where the 3 cones are placed, child picks up one cone &amp; hops back to the starting cone &amp; places their first ‘carrot’ in the small hoop. Child continues hopping along the line until all 3 cones (carrots) have been collected, one after the other. Child can rest in between retrieving each cone.</p>   |
| <p><i>Stimulate vestibular system during rotation;</i></p> <p><i>Activate proprioceptors in upper body when passing a heavy ball</i></p> <p>(8 minutes)</p>   | <p>2. Spinning on a rocket into space</p>                      | <p><b>Set-up:</b> Child sits on the office chair with his back against the back-rest of the chair “putting his seat belt on”.</p> <p><b>Instructions:</b> Instructor spins the child 10 times to the left &amp; then 10 times to the right. Spinning Rate: 1 second per 360 degree turn. Child is then passed the 1 kg medicine ball &amp; he must pass the ball back to the instructor. They pass the ball back &amp; forth with the child receiving it 10 times. Child resumes to be spun on the chair for a second time, following the same protocol as the former instructions. After being rotated &amp; ensuring child is still seated in place, pass the medicine ball back &amp; forth 10 times.</p> <p>Repeat rotation, followed by passing the ball for a third round.</p>   |
| <p><i>Practice bilateral coordination of upper &amp; lower limbs;</i></p> <p><i>Practice dynamic balance when body is upright &amp; in motion;</i></p> <p><i>Encourage cognitive &amp; listening skills when having to imitate the command</i></p> <p>(4 minutes)</p> | <p>3. Star jumps</p>   | <p><b>Set up:</b> Place a cardboard circle firmly on the floor with prestik. Child stands on the circle with feet next to each other &amp; arms along their sides. Like “a soldier”.</p> <p><b>Instructions:</b> Instructor demonstrates a movement with verbal commands: “Open the gate” &amp; “make a star”. Instructor stands in front of child. Child bends at the knees &amp; jumps up with feet going out into second position, landing with feet shoulder-width apart &amp; arms move up along the sides to clap above the head. “Close the gate” &amp; “make a soldier”: Child jumps back to the “soldier” position with feet returning to standing alongside each other. Complete the jumping “in” &amp; “out” 8 times. Instructor performs this exercise with child so that they can visually see &amp; try interpret what they need to do. Child then rests for 30 seconds (encourage the child to count up to 30 with you).</p> <p>Resume to “opening &amp; closing the gate” another 8 times.</p> <p>Repeat 3 sets of 8. Child has two rest periods, one in between each set.</p> |

|  |                             |   |
|--|-----------------------------|---|
| <p><b>Cool Down</b><br/><i>Encourage arms, neck &amp; back muscles to remain stable when upper body is elevated off the floor</i></p> <p>(4 minutes)</p> | <p>4. 'Flying superman'</p> | <p><b>Set up:</b> Place a floor mat in a clear space on the floor.</p> <p><b>Instructions:</b> Child lies on the mat, on their stomach with arms stretched out in front of them. Upon instruction, child lifts arms, head &amp; shoulders slightly off the floor. Feet may remain on the floor without lifting. Child lifts up &amp; then returns shoulders back to the ground. Child must hold for 3 seconds before resting. Repeat 3 times before resting for a 30 second period.</p> |
|--|-----------------------------|---|

| SUBJECT A  | MAY  | WEEK 2: 30 minutes x2  |
|--|--|--|
| <b>General Aim:</b> <ul style="list-style-type: none"> <li>To stimulate the vestibular system</li> <li>To activate proprioceptors in upper &amp; lower limbs</li> <li>Assist child with getting into a routine of attending the regular sessions</li> <li>Form an understanding of how to communicate verbal instruction with child</li> </ul> |  |  |
| <b>Specific Aim:</b> <ul style="list-style-type: none"> <li>Focus on coordination</li> <li>Activate muscle strength &amp; muscle control</li> <li>Practice eye tracking</li> <li>Initiate simple &amp; familiar locomotive skills</li> </ul>   | <b>Equipment:</b> <ul style="list-style-type: none"> <li>Kangaroo ball (1)</li> <li>Song on a CD with CD player</li> <li>Small traffic cones (2)</li> <li>1 kg medicine ball (1)</li> <li>2kg medicine ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>Floor mat (1)</li> <li>Measuring tape (1)</li> <li>3.5 m coloured tape</li> <li>Ink pen (1)</li> <li>Small “bug”/ insect objects (2)</li> </ul> |

|  | ACTIVITIES  | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which starts the sessions;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system during ‘up &amp; down’ motions</i></p> <p>(5 minutes)</p> | <p>‘Musical kangaroo’<br/>Bouncing on kangaroo ball</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. One song has been chosen from child’s cd (that the child is familiar with or has chosen himself).</p> <p><b>Instructions:</b> Child is shown that they may sit on the kangaroo ball, holding the handle with both hands. When the music plays, the child bounces up &amp; down in place on the kangaroo ball like a kangaroo. When the instructor ‘pauses’ the music, child must stop instantly. Pause the song for about 3 seconds before pressing play again &amp; child may continue bouncing. Complete the song before moving onto the next activity.</p> |
| <p><i>Stimulate eye muscles which assist in vestibular activities</i></p>  | <p>1. ‘Flying bugs’ eye exercises</p>                   | <p><b>Set up:</b> Place one of the bugs/insects on the pencil. Child sits on a chair with instructor sitting opposite them while holding the little ‘bug’ on a pen. Pen is held in line with the</p>   |

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| <p>(4 minutes)</p>   |  | <p>child's nose 45cm away from the face.</p> <p><b>Instructions:</b> Child must focus his eyes on the bug &amp; follow the pencil's pathway with his eyes. <i>Child must not move their head.</i> Instructor moves the pencil, creating horizontal figure of "8s" for 20 seconds. Child then stands up for a minute. During this time count with the child while he claps his hands. After a minute break child sits down &amp; instructor changes the direction of the figure of "8" to being vertical (20 seconds). During the third set of 20 seconds instructor alternates between the horizontal pathway &amp; the vertical pathway.</p>  |
| <p><i>Practice dynamic balance during jumping motion &amp; keeping body upright;</i></p> <p><i>Activate proprioceptors in lower limbs &amp; arms by increasing weight which the hands need to stabilise</i></p> <p>(5 minutes)</p> | <p>2. Hop 'forwards' like a bunny, to your "carrots"</p> | <p><b>Set-up:</b> Measure 3.5m on the floor in a clear &amp; open space. Place a bright colour tape on the floor over that distance. The tape will be vertically in front of the child. Set up one traffic cone on one end of the taped line &amp; the second cone on the other end.</p> <p><b>Instructions:</b> Child is instructed to hop from the one cone (carrot) to the next, keeping feet together while hopping. <i>Ensure that you have informed child &amp; demonstrated that they must bend at the knees when landing on each hop.</i> Child hops there &amp; back, twice before resting. Child repeats the hopping exercise but is then given a 1 kg medicine ball to hold with both hands while hopping from one cone to the next. Repeat twice.</p>  |
| <p><i>Stimulate vestibular system during rotating, along with dynamic balance while hopping;</i></p> <p><i>Activate proprioceptors in arms &amp; knees when holding a weighted ball &amp; while hopping</i></p> <p>(5 minutes)</p> | <p>3. 'Spin like a hurricane'</p>                        | <p><b>Set up:</b> Child stands in place while holding medicine ball.</p> <p><b>Instructions:</b> Instructor turns child to the progressed duration of 12 times to the left &amp; then 12 times towards the right. Turning rate: 1 second for every 360 degree turn. After being turned towards the left &amp; right directions, child is shown to hop on the spot with their two feet, 5 times. <i>Ensure that child bends at the knees especially when landing.</i> For the second set instructor turns child to the left &amp; then to the right 12 times. Upon stopping, child may hop 5 times. Instructor then swops the 1kg medicine ball for the child to hold a 2kg medicine ball. For the third &amp; final time, child is rotated again 12 times in each direction before he hops 5 times in place.</p> <p>Optional: Child is given the option to be rotated a fourth time.</p> |
| <p><i>Encourage cognitive planning as child processes the possible places to seek for ball;</i></p>  | <p>4. Hide the easter egg</p>                            | <p><b>Set-up:</b> Child is given a 1 kg medicine ball (easter egg) to hold &amp; is asked to 'hide it' or place it somewhere in the room.</p> <p><b>Instructions:</b> Instructor must close their eyes. Once it is hidden, instructor must try find it.</p>  |

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| <p><i>Maintain activation of proprioceptors in upper arms while holding weighted ball &amp; maintaining static balance</i></p> <p>(4 minutes)</p>  |                                 | <p>Play along with the child &amp; hunt for the easter egg. Once the ball is found child can hide it again. Repeat three more times while child hides the ball &amp; instructor finds it.</p> <p>For variation: Instructor may swop with child &amp; have child close their eyes while standing in place &amp; instructor hides the ball.</p>  |
| <p><b>Cool Down</b><br/><i>Activate back muscle strength &amp; maintain control when upper body is lifted off the floor</i></p> <p>(3 minutes)<br/>(rest for 1 minutes before last activity)</p>                     | <p>5. Superman flying</p>       | <p><b>Set up:</b> Place a floor mat in a clear space on the floor.</p> <p><b>Instructions:</b> Child lies down on the mat on their stomach with arms stretched out in front of them. Upon instruction child lifts arms, head &amp; shoulders slightly off the ground. Feet must try remain on the floor without lifting. Child lifts up &amp; then returns shoulders back to the floor. Child must hold for 3 seconds before resting.</p> <p>Repeat 3 times before resting for a 30 second period.</p> |
| <p><i>Activate abdominal muscles when contracting &amp; stabilising upper body off the floor while holding legs;</i></p> <p><i>Stimulate the vestibular system during the rocking motions</i></p> <p>(2 minutes)</p> | <p>6. Hugging an easter egg</p> | <p><b>Instructions:</b> Child lies on their back on a mat. Upon instruction child brings knees in towards his chest &amp; his arms grasp his legs ('hugging' them). While holding his legs child can try to slowly rock back &amp; forth 5 times before returning to a relaxed position. <i>For the first few sessions instructor may assist the child in rocking if the child may not understand how.</i></p> <p>Repeat this twice with 10 seconds rest in between.</p>                               |

| SUBJECT A   | MAY  | WEEK 3: 30 minutes x2   |
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| <b>General Aims:</b> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate proprioceptors in upper &amp; lower limbs</li> <li>• Assist child with getting into a routine of attending the regular sessions</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> </ul>  |  |   |
| <b>Specific Aim:</b> <ul style="list-style-type: none"> <li>• Focus on coordination</li> <li>• Courage the activation of muscle strength &amp; muscle control</li> <li>• Create environment for child to be aware of where his body is in space (spatial awareness)</li> <li>• Practice eye tracking</li> <li>• Initiate simple &amp; familiar locomotive skills</li> </ul> | <b>Equipment:</b> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Small traffic cones (2)</li> <li>• 1 kg medicine ball (1)</li> <li>• Rainbow river stones: (3)<br/>Heights: Red: 13.5 cm Green: 16 cm<br/>Yellow: 8.5 cm</li> </ul> | <ul style="list-style-type: none"> <li>• Floor mat (1)</li> <li>• 3.5 m coloured tape</li> <li>• Colourful toy (1)</li> <li>• Pilates ball (1)</li> <li>• Measuring tape (1)</li> </ul> |

|  | ACTIVITIES   | EXPLANATION   |
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| <p><b>Warm up:</b><br/><i>Establish routine by introducing the same activity which starts the sessions;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions &amp; head movements.</i></p> <p style="text-align: center;">(5 minutes)</p> | <p style="text-align: center;">‘Musical popping popcorn’<br/>Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child sits on kangaroo ball (popcorn). Use song that child knows and chooses.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music plays, the child bounces up &amp; down in place on the kangaroo ball, ‘like popcorn’. When the instructor pauses the music, child must stop instantly. Pause the song for about 5 seconds before pressing play again &amp; child can continue bouncing. Complete the song before moving onto the next activity.</p> |
| <p><i>Practice dynamic balance during jumping motions &amp;</i></p>  | <p>1. Hop like a bunny (Forwards)</p>  | <p><b>Set-up:</b> Measure 3.5 m on the floor in a clear &amp; open space. Place the bright coloured tape on the floor over that distance. The tape will be vertically in front of the child. Set up one traffic</p>   |

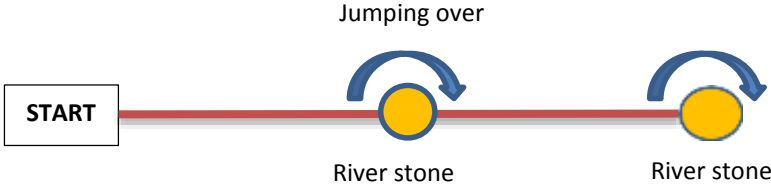
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| <p><i>maintaining body in upright position;</i></p> <p><i>Activate proprioceptors in lower limbs while the legs are upholding the body;</i></p> <p><i>Encourage 'spatial awareness', by the variation of child jumping backwards</i></p> <p>(6 minutes)</p>                         | <p>(Backwards)</p>              | <p>cone on one end of the taped line &amp; the second cone on the other end.</p> <p><b>Instructions:</b> Child 'hops' from the one cone (carrot) to the next, keeping feet together while hopping. <i>Ensure that you have informed child &amp; demonstrated that they must bend at the knees when landing on each hop.</i> Child hops there &amp; back twice before resting.</p> <p>For variation: Instruct child to hop <i>slowly</i> backwards from the starting cone to the next &amp; back again. Repeat twice</p>   |
| <p><i>Stimulate vestibular system during rotation;</i></p> <p><i>Encourage static balance when having to stand in place on an elevated platform;</i></p> <p><i>Practice listening skills &amp; motor planning when child is directed to instructed areas</i></p> <p>(8 minutes)</p> | <p>2. 'Spinning bees'</p>       | <p><b>Set-up:</b> Place 3 river stones around the room (Colours: red, green and yellow).</p> <div> </div> <p><b>Instructions:</b> Child stands in one place &amp; instructor turns child 10 times to the left &amp; then 10 times to the right. Rate of turning: one second for one 360 degree turn. After left &amp; right turns have been completed, count with the child up to 10 before telling the child to run to the red river stone. Once reaching the red river stone, child must stand on the river stone with his two feet for 10 seconds. Child climbs off river stone &amp; resumes to being rotated around by instructor. Repeat this until all 3 river stones have been balanced on.</p> |
| <p><i>Calm the vestibular system by initiating slow linear movements;</i></p>   | <p>3. 'Rocking on the moon'</p> | <p><b>Set-up:</b> Place a colourful toy on the floor. Child lies on their stomach on a pilates ball. Instructor holds &amp; stabilizes child by the knees.</p> <p><b>Instruction:</b> Child is rocked back &amp; forth on the pilates ball. When the child is rocked forwards</p>   |

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| <p><i>Activate neck muscles when upper body is lifted to touch object</i></p> <p>(6 minutes)</p>  |                              | <p>they are instructed to lift their head up &amp; put both hands out &amp; touch the toy on the floor with both hands. Child must touch the toy 10 times. Continue to rock child 10 times without them having to touch the toy, just relaxing while instructor rocks. <i>The rocking of the child should be at a slightly faster pace than a slow, gentle rock.</i> Repeat with child having to lift up &amp; touch the toy in front of them, 10 times.</p>                          |
| <p><b>Cool down</b></p> <p><i>Activate abdominal muscles when contracting &amp; stabilising upper body off the ground while holding legs;</i></p> <p><i>Stimulate the vestibular system during the rocking motions</i></p> <p>(4 minutes)</p> | <p>Hugging an easter egg</p> | <p><b>Instructions:</b> Child lies on their back on a mat. Upon instruction child bring his knees in towards his chest &amp; grasps then with his arms ('hugging' his legs). While holding their legs child can try rock back &amp; forth, slowly 5 times before returning to a relaxed position. <i>For the first few sessions instructor may assist the child during rocking if the child may not understand how.</i></p> <p>Repeat this twice with 10 seconds rest in between.</p> |



| SUBJECT A  | JUNE   | WEEK 1: 30 minutes x2  |
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| <b>General Aims:</b> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate somato-sensory system (proprioceptors) in upper &amp; lower limbs</li> <li>• Maintaining a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practicing the understanding of verbal instruction &amp; listening skills</li> </ul> |  |  |
| <b>Specific Aim:</b> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Courage the activation of muscle strength &amp; muscle control</li> <li>• Create environment for child to be aware of where his body is in space (spatial awareness)</li> <li>• Practice eye tracking</li> <li>• Initiate simple &amp; familiar locomotive skills</li> </ul>                                   | <b>Equipment:</b> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Mini trampoline (1)</li> <li>• 1 kg medicine ball (1)</li> <li>• Colourful toy (1)</li> <li>• Measuring tape (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Floor mat (1)</li> <li>• 3.5 m coloured tape</li> <li>• Rotating office chair (1)</li> <li>• Pilates ball (1)</li> <li>• Rainbow river stones: (3)<br/>Heights: Green: 16 cm (1); Yellow: 8.5 cm (2)</li> </ul> |

| SUB-AIMS  | ACTIVITIES   | EXPLANATION   |
|---|--|---|
| <p><b>Warm Up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which starts the sessions;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions</i><br/>(4 minutes)</p> | <p>'Musical popping popcorn'<br/>Bouncing on kangaroo ball</p> | <p><b>Set up:</b> Child sits on a kangaroo ball (popcorn). Use song the child knows &amp; chooses.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music plays, the child bounces up &amp; down in place on the kangaroo ball 'like popcorn'. When the instructor pauses the music, child must stop instantly. Pause the song for about 5 seconds before pressing play again &amp; child may continue bouncing. Complete the song before moving onto the next activity.</p> |
| <p><i>Activate dynamic balance as</i></p>   | <p>1. Hop &amp; jump over</p>                                  | <p><b>Set up:</b> Measure 4m of tape and tape a straight horizontal line over this distance. Place 2</p>  |

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| <p><i>the body needs to stay upright while hopping;</i></p> <p><i>Encourage spatial awareness as child needs to hop over river stones;</i></p> <p><i>Activate strength in leg muscles as child needs to initiate greater force in the lower limbs when jumping higher &amp; landing in a stable position</i></p> <p>(6 minutes)</p> | <p>the mountain</p>                     | <p>yellow river stones on the horizontal line. The first river stone is 2 meters from the start of the line &amp; second river stone is at the end of the line (4m from starting point).</p> <p><b>Instructions:</b> Child hops on two feet on the line. When he comes across the first river stone, he is instructed to jump over it &amp; to continue hopping until the second river stone, which he can also jump over. Repeat this twice. <i>First demonstrate the activity to the child before they perform it.</i> Child repeats this exercise twice followed by a 30 second rest. Child may execute this activity for a third time.</p>  |
| <p><i>Stimulate vestibular system during rotation, encourage static balance when standing on a elevated surface;</i></p> <p><i>Activate proprioceptors in upper limbs' by increasing weight on the joints</i></p> <p>(8 minutes)</p>  | <p>2. 'Spinning rocket to a planet'</p> | <p><b>Set up:</b> Place a green river stone next to office chair.</p> <p><b>Instructions:</b> Child sits on office chair with his back against the back-rest of the chair. Child is spun 12 times to the left and 12 times to the right. After rotation help child off the office chair, &amp; child steps onto the river stone. Child is then passed the 1 kg medicine ball &amp; he must pass the ball back to the instructor. They pass the ball back &amp; forth with the child receiving it 10 times. Child resumes to being spun on the chair once again before standing on the river stone &amp; being passed the medicine ball.</p>  |
| <p><i>Continue stimulating the vestibular system during linear movements;</i></p> <p><i>Stimulate proprioceptors in lower limbs during jumping</i></p> <p>(6 minutes)</p>   | <p>3. 'Jumping jelly beans'</p>         | <p><b>Set up:</b> Set a mini trampoline in a safe space in the room, with a high enough ceiling for safety precautions.</p> <p><b>Instructions:</b> Child jumps up &amp; down on the small trampoline. Ensure that child is bending at the knees when landing. When instructor says "stop" child must stop jumping &amp; balance while standing with their two feet next to each other. Allow child to jump 8 times before standing still. Repeat this exercise for 3-4 minutes. <i>Take child's reaction and fatigue levels into account. Rest with 1 minute intervals</i></p>  |
| <p><b>Cool down</b><br/><i>Calm the vestibular system</i></p>   | <p>4. 'Rocking superman'</p>            | <p><b>Set-up:</b> Place a colourful toy on the floor. Child lies on their stomach on a pilates ball. Instructor holds &amp; stabilizes child by the knees.</p>   |

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| <p><i>by during the slow linear movements;</i></p> <p><i>Activate neck muscles when upper body lifts up to touch object</i></p> |  | <p><b>Instruction:</b> Child is rocked back &amp; forth on the pilates ball. When child is rocked forward they are instructed to lift up their head &amp; place both hands out to touch the toy on the floor. Child must touch the toy 10 times. Continue to rock child 10 times without them having to touch the toy, as they just need to relax while instructor rocks. <i>The rocking should be at a slightly faster pace than a slow gentle rock.</i> Repeat with child having to lift up &amp; touch the toy in front of them 10 times.</p> |
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| SUBJECT A  | JUNE   | WEEK 2: 30 minutes x2   |
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| <b>General Aims:</b> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate somato-sensory system (proprioceptors) in upper &amp; lower limbs</li> <li>• Maintaining a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practicing the understanding of verbal instruction &amp; listening skills</li> </ul> |  |   |
| <b>Specific Aim:</b> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Courage the activation of muscle strength &amp; muscle control</li> <li>• Encourage spatial awareness</li> <li>• Practice eye tracking</li> <li>• Stimulate abdominal strength</li> </ul>  | <b>Equipment:</b> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Mini trampoline (1)</li> <li>• 1 kg medicine ball (1)</li> <li>• Coloured card board circles (4)</li> <li>• Cartoon pictures (5)</li> <li>• Measuring tape (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Floor mat (1)</li> <li>• 3.5 m colour tape</li> <li>• Cones (5)</li> <li>• Rainbow river stones: (2)<br/>Heights: Red: 13.5 cm    Green: 16 cm (1)</li> <li>• Scooter board (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES   | EXPLANATION   |
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| <p style="text-align: center;"><b>Warm Up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which starts the sessions;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions</i></p> <p style="text-align: center;">(4 minutes)</p> | <p>'Yo-yo bouncing'</p> <p>Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child sits on a kangaroo ball (a yo-yo).</p> <p><b>Instructions:</b> Child holds the handle of the kangaroo ball with both hands. When the music plays, the child bounces up &amp; down in place, 'like a yo-yo'. When the instructor pauses the music, child must stop instantly. Pause the song for about 5 seconds before playing the music again, for child to continue bouncing. Complete the song before moving onto the next activity.</p> |

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| <p><i>Activate dynamic balance as the body needs to stay upright while hopping;</i></p> <p><i>Encourage spatial awareness as child needs to hop over river stones;</i></p> <p><i>Activate strength in leg muscles as child needs to initiate greater force in the lower limbs when jumping higher &amp; landing in a stable position</i></p> <p><i>Activate proprioceptors in upper limbs as weighted ball applies pressure to joints</i></p> <p>(6 minutes)</p> | <p>1. Hop &amp; jump over the mountain</p>  | <p><b>Set up:</b> Measure 4m of tape and tape a straight horizontal line over this distance. Place 2 yellow river stones on the horizontal line. The first river stone is 2 meters from the start of the line &amp; second river stone is at the end of the line (4m from starting point).</p> <p><b>Instructions:</b> Child hops on the line, on his two feet. When child comes across the first river stone, he must jump over the river stone &amp; continue hopping until the second river stone. Repeat this twice. <i>First demonstrate the activity to the child before they perform it.</i> Child repeats this exercise twice before a 30 second rest.</p> <p>Progression for third round: instructor can give the child a 1 kg medicine ball to hold with his two hands, while hopping &amp; jumping to and over river stones. Repeat twice.</p> <div> </div> |
| <p><i>Stimulate vestibular system during rotation;</i></p> <p><i>Encourage proprioception in upper limbs when 'compression' is applied on upper limbs &amp; child is propelling his body forwards;</i></p> <p><i>Practice listening skills when child has to respond to instructions</i></p>   | <p>2. Scooter to Sponge bob friends:<br/>(Patrick, Spongebob, Gary, Squidward &amp; Squirrel)</p> | <p><b>Set up:</b> Place 5 cartoon pictures on 5 different cones &amp; set out the cones on a clear open space on the floor.</p> <div> </div> <p><b>Instructions:</b> Child lies down on their stomach on a scooter board. Instructor spins child 10 times to the left &amp; 10 times to the right. <i>Child is encouraged to lift their head slightly when spinning.</i> While remaining on the scooter board, instructor tells child to find "Patrick". Child must use their arms to "scooter" or move forward to the cone</p>   |

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| <p>(5 minutes)</p>  |                                 | <p>with the cartoon character on. Once they have touched the cone, child is spun again 10 times to the right &amp; 10 times to the left. The next character is "Spongebob". Child is spun after reaching &amp; touching each cone.</p>   |
| <p><i>Stimulate vestibular system during up &amp; down motions, practicing static balance when standing in place;</i></p> <p><i>Practice body control stabilising during the dynamic motions</i></p> <p>(4 minutes)</p>   | <p>3. 'Jumping jelly beans'</p> | <p><b>Set up:</b> A mini trampoline is set in a safe space in a room with a high enough ceiling for safety precautions.</p> <p><b>Instructions:</b> Child jumps up &amp; down on the small trampoline. Ensure that the child is bending at the knees upon landing. When the instructor says "stop" child must stop jumping &amp; balance while standing with their two feet next to each other. Allow child to jump 8 times before standing still. <i>Take the child's reaction &amp; fatigue levels into account for the given duration of time.</i></p>  |
| <p><b>Cool down</b></p> <p><i>Stimulate abdominal strength &amp; legs' control as child has to keep legs lifted up in the air;</i></p> <p><i>Activate cognitive skills when colours are called out &amp; child has to respond to verbal instructions</i></p> <p>(2 minutes)</p> | <p>4. 'Lollipop toes'</p>       | <p><b>Set up:</b> About 15 cm off the ground, place 4 coloured cardboard circles on the wall, in a straight line. Place a floor mat at the wall.</p> <p><b>Instructions:</b> Child lies on their back, lifts feet off the ground &amp; bends at the knees (90°). Make sure there is about ½ a meter between child's feet &amp; the wall. While keeping feet together, child must touch the colour circle that is called out by the instructor. Complete all 5 colours before allowing the child to rest with feet on the floor. Repeat exercise twice.</p> |

| SUBJECT A  | JULY  | WEEK 1: 30 minutes x2  |
|--|---|--|
| <b>General Aims:</b> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate somato-sensory system (proprioceptors) in upper &amp; lower limbs</li> <li>• Maintaining a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practicing the understanding of verbal instruction &amp; listening skills</li> </ul> |   |  |
| <b>Specific Aim:</b> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice eye tracking</li> </ul>   | <b>Equipment:</b> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with laptop</li> <li>• Mini trampoline (1)</li> <li>• 1kg medicine ball (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• Colourful picture of rocket (1)</li> <li>• Pencil (1)</li> <li>• 4 meters rubber band (1)</li> <li>• Rainbow river stones: (3)<br/>Heights: Red: 13.5 cm Green: 16 cm (1)<br/>Yellow: 8.5 cm</li> </ul> |

| SUB-AIMS  | ACTIVITIES   | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when child needs to suddenly stop bouncing;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions</i></p> <p><i>Create a musical space with familiar character on screen</i></p> | <p>'Musical movies'</p> <p>Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child sits on the kangaroo ball. Laptop is placed on a table about 2 metres from the child at their head's height. Place a red river stone also about 2 meters away from the child. Play one of their Disney songs which is in on the movie.</p> <p><b>Instructions:</b> Use song child knows and chooses. Child sits on the kangaroo ball, holding the handle with both hands. When the music on the movie plays, the child bounces up &amp; down in place on the kangaroo ball like 'popcorn'. When the instructor pauses the music, child must stop instantly, and is shown to walk to the red river stone &amp; to stand in top on it for 10 seconds, feet remaining next to each other. After this static balance stance, child may return to kangaroo ball &amp; instructor presses play for music continue &amp; child to bounce. Complete the song before moving onto the next activity.</p> |

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| <p><i>which child is familiar with;</i></p> <p><i>Practice fixation of the eyes, while child focuses on computer screen</i><br/>(4 minutes)</p>   |                                       |  |
| <p><i>Activate dynamic balance when body has to stabilise while jumping;</i></p> <p><i>Encourage spatial orientation when hopping over elevated platforms;</i></p> <p><i>Activate proprioceptors in lower limbs during jumping &amp; impact of landing &amp; bending knees</i></p> <p>(6 minutes)<br/>(3 minutes x2)</p>                | <p>1. Up &amp; down the mountains</p> | <p><b>Set up:</b> Place the 3 different levelled river stones, vertically out in front of the child (according to measurements above). The river stones can be 1 metre from each other.</p> <p><b>Instructions:</b> Child stands in front of the red “volcano-mountain” (river stone) &amp; has to hop on top of the river stone &amp; then back to the ground. <i>Feet need to remain synchronized when leaving the floor &amp; when landing on the river stone. Remind child to bend at the knees.</i> Child jumps up onto the red river stone &amp; back down onto the ground, 3 times. If child can perform this easily, move to the “grassy-green mountain” (river stone). Child repeats the jump onto the river stone &amp; down onto the ground 3 times. If this is also completed with ease, child may move to the “happy-golden mountain” (river stone). <i>Child is reminded that this rock is smaller. Child is instructed to also jump 3 times on &amp; off it. It will be useful for the instructor to use movement &amp; spatial cues such as saying “up” &amp; “down” to communicate with child. Child will get accustomed to hearing, &amp; responding to the instruction, with movement.</i></p> <p>Child may rest after completing one set, before repeating the exercise.</p> |
| <p><i>Stimulate eye muscles while eyes follow object;</i></p> <p><i>Activate proprioception in upper limbs when supporting weighted ball which places pressure on joints;</i></p> <p><i>Practice static balance when body needs to maintain upright position;</i></p> <p><i>Practice listening skills when having to respond to</i></p> | <p>2. ‘Shooting rocket’</p>           | <p><b>Set up:</b> Place a coloured in picture of a rocket (or a picture of what child is interested in) on the pencil. Child sits on a chair with instructor sitting opposite him holding the rocket on the pencil. The pencil (rocket) is held in line with child’s nose 45cm away from the face.</p> <p><b>Instructions:</b> Child’s eyes must focus on the rocket &amp; follow the pathway that the rocket makes, while “lifting off”. <i>Child must not move their head as it is required to remain still when eyes follow pencil.</i> Instructor creates horizontal figure of “8s” with the rocket for the duration of 25 seconds. This is followed by child standing up &amp; is given a 1kg medicine ball to hold with both hands. Instructor gives the command “up” &amp; indicates for child to lift the ball up above his head. Instructor says “down” &amp; child brings the ball down towards his knees.</p> <p>Repeat 3 times in each direction before child can be seated (this activity is done slowly over 1 minute). For the second round, instructor changes the direction of the figure of “8” to follow a vertical pathway (for 25 seconds). The third set of 25 seconds instructor alternates between</p>   |



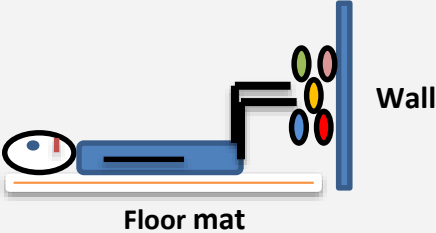
|   |                               |  |
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| <p><i>instructions</i></p> <p>(4 minutes)</p>   |                               | <p>the horizontal pathway and the vertical pathway.</p>  |
| <p><i>Stimulate vestibular system during rotation, static balance is encouraged while child maintains in the upright position on uneven surface;</i></p> <p><i>Initiate progression during balancing while decreasing surface area for child to stand on</i></p> <p>(8 minutes)</p> | <p>3. Tortoise-shell spin</p> | <p><b>Set up:</b> The rocking bowl is placed on a floor mat. Child is seated in the rocking bowl, cross-legged with hands in their lap.</p> <div> </div> <p><b>Instructions:</b> Child is spun 12 times to the left &amp; 12 times to the right. After rotation, child is assisted out of the bowl &amp; it is then turned over onto the rounded side (the tortoise). Child is instructed to climb into the rounded part of the bowl &amp; balance on two feet for 10 seconds. As this is not a flat surface instructor must be close at hand to support child if they seem unstable. After the 10 seconds, child may jump off the “tortoise” &amp; the bowl is turned over again for child to climb back inside the bowl to be seated. Instructor resumes rotating the bowl according to the above instructions. Once the spinning protocol is complete, child can stand on the tortoise again. If standing on two feet was easy, child may be asked to stand heel-to-toe for 10 seconds. This involves the left foot standing in front of the right foot, the left heel touching right foot’s toes &amp; stabilising that position. Then switch to the right foot standing in front. The rocking bowl returns to being turned over once again to be rotated a third time before he stands heel-to-toe once again on the “tortoise”.</p> |

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| <p><b>Cool down</b><br/> <i>Stimulate proprioceptors in upper limbs by creating a 'pulling' force on child's joints;</i></p> <p><i>Stimulate the action of contraction around upper limb joints when child pulls rubber band</i></p> <p>(4 minutes)</p> | <p>4. 'Stretching bubble gum'</p> | <p><b>Set up:</b> Using a thick rubber exercise band, child stands on one side of the room holding one end of the rubber band with both hands, while the instructor holds the other end of the band. An assistant or teacher may assist in demonstrating to child what to do, while the instructor is on the other end.</p> <p><b>Instructions:</b> Make sure there is enough tension so that child has to work against the pull. Child must bend arms at the elbows so that the biceps are contracting. Hold this position for 10 seconds (count with the child) before child straighten arms or instructor releases tension (not the band). Assistant demonstrates to child that he needs to stretch arms out, however, does not let go of the exercise band. Resume to contracting biceps &amp; child pulling the rubber band away from instructor who is creating tension. Hold for 10 seconds before relaxing the upper limb's muscles &amp; child extends his arms into a straightened position.</p> <p>Repeat contracted a third time.</p> |
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| SUBJECT A   | JULY  | WEEK 2: 30 minutes x2  |
|---|---|--|
| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate somato-sensory system (proprioceptors) in upper &amp; lower limbs</li> <li>• Maintaining a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practicing the understanding of verbal instruction &amp; listening skills</li> </ul> |   |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice eye tracking</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a Cd with laptop</li> <li>• Mini trampoline (1)</li> <li>• 1 kg medicine ball (1)</li> <li>• Rotating office chair (1)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• 4 meters rubber band (1)</li> <li>• Floor mat (1)</li> <li>• Colour cardboard circles (5)<br/>Colours: Yellow, red, blue, pink, green</li> <li>• Rainbow river stones: (3)<br/>Heights: Red: 13.5 cm Green: 16 cm (1)<br/>Yellow: 8.5 cm</li> </ul> |

| SUB-AIMS  | ACTIVITIES  | EXPLANATION  |
|---|---|--|
| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when child needs to suddenly stop bouncing;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions;</i></p> | <p>'Musical movies'</p> <p>Bouncing on a jumping ball</p> | <p><b>Set up:</b> Child sits on the kangaroo ball. Laptop is placed on a table about 2 metres from the child at their head's height. Place a red river stone also about 2 meters away from the child. Play one of their Disney songs which is in on the movie.</p> <p><b>Instructions:</b> Use song child knows and chooses. Child sits on the kangaroo ball, holding the handle with both hands. When the music on the movie plays, the child bounces up &amp; down in place on the kangaroo ball like 'popcorn'. When the instructor pauses the music, child must stop instantly, and is shown to walk to the red river stone &amp; to stand in top on it for 10 seconds, feet remaining next to each other. After this static balance stance, child may return to kangaroo ball &amp; instructor presses play for music continue &amp; child to bounce. Complete the song before moving onto the next activity.</p> |

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| <p><i>Create a musical space with familiar character on screen which child is familiar with;</i></p> <p><i>Practice fixation of the eyes, while child focuses on computer screen</i><br/>(4 minutes)</p>  |                                      |  |
| <p><i>Activate dynamic balance when body has to stabilise during jumping;</i></p> <p><i>Encourage spatial orientation when hopping over elevated platforms;</i></p> <p><i>Activate proprioception in lower limbs with the impact of landing &amp; bending knees</i><br/><br/>(7 minutes)<br/>(3 minutes x2)</p> | <p>1. Up and down the mountains</p>  | <p><b>Set up:</b> Place the 3 different levelled river stones vertically out in front of child (measurements indicated above). The rocks can be 1m from each other.</p> <p><b>Instructions:</b> Child stands in front of the red “volcano-mountain” &amp; has to jump on top of the river stone &amp; off back to the ground. <i>Feet need to remain synchronized when leaving the floor &amp; when landing on the river stone. Remind child to bend their knees.</i> Child jumps up onto the red river stone &amp; back down onto the ground, 3 times. If child can perform this easily, move to the “grassy-green mountain” (river stone). Child repeats the jump onto the river stone &amp; down onto the ground 3 times. If this is also completed with ease, child may move to the “happy-golden mountain”. <i>Child is reminded that this river stone is smaller. Child is instructed to also jump 3 times on &amp; off it. It will be useful for instructor to use movement &amp; spatial cues to communicate to child, such as saying “up” &amp; “down”. Child will get accustomed to hearing, &amp; responding with a motor action.</i></p>                     |
| <p><i>Stimulate vestibular system during rotation, practice static balance when standing on elevated surface;</i></p> <p><i>Stimulate proprioceptors in upper limbs when passing weighted ball, along with the proprioceptors in lower limbs during static balance when supporting the body’s posture</i></p>   | <p>2. Spinning rocket into space</p> | <p><b>Set up:</b> Place the red river stone next to the office chair with the 1kg medicine ball alongside the river stone. Child sits on office chair with his back against the back-rest of the chair.</p> <p><b>Instructions:</b> Child is spun 15 times to the left &amp; 15 times to the right. Spinning speed: 1 second per turn. After rotation help child off the office chair, &amp; instruct child to step onto the river stone. Child is then passed the 1kg medicine ball &amp; he must pass the ball back to the instructor. They pass the ball back &amp; forth with the child receiving it 10 times. Resume to being spun on the chair once again before being passed the medicine ball. Repeat 3 times of spinning &amp; 3 times of passing the medicine ball back &amp; forth but in <i>different directions</i>. Instructor lifts the ball up &amp; child extends arms up above his head to retrieve the ball, brings his arms down to waist height &amp; passes it back to instructor. Instructor bends down &amp; passes the ball at the level of child’s knees &amp; instructs child to bend down to retrieve ball, to then stand up holding the</p> |

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| <p>(6 minutes)</p>   |                                   | <p>ball &amp; then pass it back to instructor at waist level.</p> <p>Alternate between these 'up' &amp; 'down' instructions before returning child to being seated on the chair. Spin child for a third time to the left &amp; then to the right, 15 times on each side. Child is then assisted off the chair &amp; onto the river stone. Wait for child to regain balance before passing the ball back &amp; forth following the former 'up &amp; down' instructions.</p>   |
| <p><i>Stimulate proprioceptors in upper limb by causing traction, 'pulling' force on child's joints;</i></p> <p><i>Stimulate the action of contraction around upper limb joints when child pulls rubber band;</i></p> <p><i>Include progression to stimulate proprioceptors in lower limb when child is asked to bend knees</i></p> <p>(4 minutes)</p> | <p>3. 'Stretching bubble gum'</p> | <p><b>Set up:</b> Using a <i>thicker</i> rubber exercise band, child stands on one side of the room holding one end of the rubber band with both hands, while the instructor holds the other end of the band. An assistant or teacher may assist in demonstrating to child what to do while the instructor is on the other end.</p> <p><b>Instructions:</b> Make sure there is enough tension so child has to work against the pull. Child must bend arms at the elbows so that the biceps are contracting &amp; instruct child to bend his knees slightly. Hold this position for 10 seconds (count with the child) before child straightens arms &amp; legs or instructor releases tension (not the band). Assistant demonstrates to child to stretch arms out but does not let go of band. Resume to contracting biceps, to bend at the knees &amp; child pulling the rubber band away from instructor who is creating tension. Hold for 10 seconds before relaxing the upper limb's muscles &amp; leg muscles &amp; child extends his arms into a straightened position.</p> <p>Repeat contraction a third time.</p> |
| <p><b>Cool down</b></p> <p><i>Activate abdominal strength &amp; control as child has to keep legs lifted;</i></p> <p><i>Stimulate cognitive skills when colours are called out &amp; child has to respond to verbal instructions</i></p>   | <p>4. 'Lolly pop toes'</p>        | <p><b>Set up:</b> Place 5 cardboard circles on the wall about 15 cm off the ground. Place a floor mat at the wall.</p>  <p><b>Instructions:</b> Child lies on their back, lifts feet off the ground &amp; bends at the knees. Make sure there is about ½ a meter between child's feet &amp; the wall. Keeping feet together, child must touch the colour circle that called out by instructor.</p> <p>Complete all 5 colours before allowing child to rest with feet on the floor. Repeat exercise</p>   |

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| (2 minutes) |  | twice. |
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| SUBJECT A  | AUGUST   | WEEK 1: 30 minutes x2  |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate somato-sensory system (proprioceptors) in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practice the understanding of verbal instruction &amp; listening skills</li> </ul> |  |  |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice eye tracking</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with laptop</li> <li>• Balance pods (2)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• 1kg medicine ball (1)</li> <li>• Rotating office chair (1)</li> <li>• Prestik</li> <li>• 4 meters rubber band (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Floor mat (1)</li> <li>• Coloured cardboard circles (5)</li> <li>• Rainbow river stones: (3)<br/>Heights: Green: 16 cm (1) Yellow: 8.5 cm (2)</li> <li>• Multi-purpose jungle gym: wooden ramp, thick rope, secure monkey bars</li> <li>• Flash cards with pictures (10)</li> </ul> |

| SUB-AIMS  | ACTIVITIES   | EXPLANATION   |
|---|--|---|
| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> | <p>‘Musical movies’<br/>Bouncing on a jumping ball</p> | <p><b>Set up:</b> Child sits on the kangaroo ball. Laptop is placed on a table about 2m from child, level with their head. Place two balance pods (hedge-hogs) 2m away from the kangaroo ball.</p> <div> </div> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music on the movie plays, the child fixates eyes on the screen &amp; bounces up &amp; down in place,</p> |

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| <p><i>Activate vestibular system through 'up &amp; down' motions, increase stimulation by placing child on compliant surface;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on compliant surface;</i></p> <p><i>Practice fixation of the eyes, while child focuses on computer screen</i></p> <p>(5 minutes)</p> |                                     | <p>'like popcorn'. When the instructor pauses the music, child must stop instantly. Instructor indicates child to climb off the ball &amp; stand on the two 'hedge-hogs', the balance pods, with one foot on either one. Hold position &amp; balance on balance pods for 10 seconds. Child climbs off &amp; resumes to sitting on the kangaroo ball as the music begins again. Child bounces until music is paused, &amp; returns to balancing on the balance pods for 10 seconds. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music.</p>  |
| <p><i>Stimulate dynamic balance when hopping from one point to another, static balance skills when stabilising in one place;</i></p> <p><i>Spatial orientation when child needs to locate around elevated objects of different heights</i></p> <p>(3 minutes)</p>  | <p>1. 'Hopping triangle'</p>        | <p><b>Set up:</b> Using 3 river stones to create a triangle formation with 3m distance between each river stones.</p> <p><b>Instructions:</b> Child hops on two feet from one river stone to the other. Remind child to bend at the knees. Child jumps over the river stones when he reaches it. After jumping over the third river stone, child hops to the next one &amp; is told to jump onto it &amp; to remain on the river stone (balancing on two feet) for 10 seconds. Child jumps off the river stone &amp; hops on two feet to the second river stone to balance on it for another 10 seconds. Child hops to the last &amp; third river stone, completing the triangle &amp; jumps up onto it to hold a static position &amp; balance for 10 seconds.</p> |
| <p><i>Stimulate vestibular system through rotation, static balance by maintain stable body position on elevated surface;</i></p> <p><i>Stimulate proprioception</i></p>  | <p>2. 'Spinning in a fish bowl'</p> | <p><b>Set up:</b> Place the rocking bowl on a mat.</p> <p><b>Instructions:</b> Child sits upright &amp; cross-legged in the bowl. Place a colourful object in child's hands on their lap &amp; they are instructed to focus on the object while spinning. Instructor spins child 15 times to the right, stops the bowl with a firm jerk &amp; halts for a rest period for 5 seconds &amp; spins child to their left 15 times. After the second rest period, return to spinning child to the right once again &amp; then to the left, 15 times on each side. Rotation speed: fast spin</p>   |



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| <p><i>when weight &amp; pressure is applied on upper &amp; lower limbs</i></p> <p>(2 minutes- spin)<br/>         (1 minute balance exercise)<br/>         (2 minute spin)<br/>         (1 minute balance exercise)<br/>         (2 minutes spin)<br/>         (1 minute balance exercise)</p>  |                              | <p>of 1 second upon each rotation. Instructor then assists child out of the bowl &amp; turns the bowl upside down onto its rounded side. Child is then instructed to stand on top of the “tortoise” &amp; regain his balance. Progress to instructing child to stand on one leg. If they are not wobbling after a few seconds child is given a 1kg medicine ball to hold. Child may try maintain this position while holding the ball for 6 seconds. Child is then asked to return the ball to instructor &amp; to change onto the opposite leg to stand on. Once he has regained his balance on one leg, pass the 1kg medicine ball back to child to hold for 6 seconds. Instructor counts aloud to encourage child to also count. Once each foot has completed the allocated time of standing, assist child off the “tortoise” &amp; return to the spinning activity following the exact amount of spins to the right &amp; to the left with the halt after the 15 rotations. Repeat this twice &amp; return to balancing on one leg on top of the rounded side of the bowl (tortoise) while holding the medicine ball.</p> <p><i>Repeat these two activities 3 times each.</i></p>   |
| <p><i>Practice functional activity by child performing a multiple of different activities together;</i></p> <p><i>Stimulate proprioceptors in upper limbs when contraction occurs while climbing, pulling of the joints while hanging &amp; compression when body weight is supported by arms, proprioceptors in lower limbs also activated when supporting body while walking up steep ramp</i></p> | <p>3. Climbing mountains</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains monkey bars, a net, a thick rope secured to a wooden beam at the top of a 3m wooden ramp which also has support for footing. If a ramp is not accessible, use a flight of stairs as the instructor may be at the top of about 5 steps away from child and child at the bottom of the steps.</p> <div> <p>The diagram illustrates a climbing apparatus. It features a blue wooden frame with a ramp on the left side. A thick orange rope is attached to a horizontal beam at the top of the frame and runs down the ramp. To the right of the ramp, there are several horizontal bars of varying heights, labeled 'Monkey bars'. The ramp is labeled 'Ramp', the rope is labeled 'Rope', and the bars are labeled 'Monkey bars'.</p> </div> <p><b>Instructions:</b> Child steps onto the wooden ramp &amp; is shown to grasp the thick rope. Instructor is behind child to act as security for if child may let go of rope. Child begins to take steps up the ramp holding the rope &amp; climbing up with one hand being placed in front of the other. Once reaching the top, if there are monkey bars assist child to grasp the first bar &amp; hold it for 5 seconds, then lower child down to the ground. *‘Wheelbarrow’ child to the start of the ramp.</p> |

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| <p>(5 minutes)</p>  |                          | <p>Repeat this exercise 3 times of climbing up &amp; holding monkey bars for 1 second more than the last set. Therefore, reaching 7 seconds after the 3 sets.</p> <p><i>For the steps option:</i> Child holds one end of the rubber exercise band &amp; instructor holds the other end a few stairs up. An assistant is just behind the child to support &amp; act as security as a safety precaution. Child begins to climb, leans slightly back (with assistant guiding him up) &amp; takes one step at a time, while grasping the rubber band &amp; moving hands up. Once reaching the instructor, child is told to continue holding the rubber band, &amp; straighten arms, &amp; lean body backwards, trying to pull the rubber band away from instructor. Child may hold this for 5 seconds before releasing &amp; walking back down the stairs to resume to the beginning position.</p> <p>*'Wheelbarrow' child around at the bottom of the stairs before child stands up to climb up the 'mountain' again.</p> <p>Repeat these three activities three times. <i>Allow for rest period in between the sets along with child performing each activity slowly.</i></p> |
| <p><b>Cool down</b><br/> <i>Activate phasic motor control when having to hold up elevated lower limbs;</i><br/><br/> <i>Activate abdominal strength when legs are elevated in the air;</i><br/><br/> <i>Encourage cognitive skills during visual &amp; verbal instructions</i></p> <p>(2 minutes )<br/> 15 seconds rest<br/> 2 minutes<br/> 15 seconds rest</p> | <p>4. 'Picture hunt'</p> | <p><b>Set up:</b> On a clear wall, stick the 10 flash cards in place. Cards are randomly placed in no particular order. Cards are at least about 15 cm off the ground. Place a floor mat at the wall just under the flash cards.</p> <p><b>Instructions:</b> Child lies on his back, lifts feet up off the ground &amp; is shown to bend at the knees. Make sure there is about ½ a meter between child's feet &amp; the wall. While keeping feet together, child's feet are directed to the picture that is called out by instructor. Complete all 10 pictures before allowing child to rest.</p> <p>During the rest period: Indicate to child how to straighten his legs &amp; body out. Rest for 15 seconds before returning to legs being bent and lifted up. One by one, instructor calls out each picture and child touches the picture with his toes. Complete this activity twice with the rest period in between.</p>  |

\*Wheelbarrow: child is shown to lie down flat on the ground, on his stomach. Instructor will pick up child's legs and support him by the knees while child is shown to push up onto his arms. Instructor ensures that child's low back is not bent. Child is asked to 'walk forwards on his hands'.

| SUBJECT A  | AUGUST  | WEEK 2: 30 minutes x2  |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate somato-sensory system (proprioceptors) in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practicing the understanding of verbal instruction &amp; listening skills</li> </ul> |   |  |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice eye tracking</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with laptop</li> <li>• Balance pods (2)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Measuring tape (1)</li> <li>• 1 kg medicine ball (1)</li> <li>• 2 kg Medicine ball (1)</li> <li>• Mini trampoline (1)</li> <li>• Medium sized tactile ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Prestik</li> <li>• Bosu ball (1)</li> <li>• Picture of rocket coloured in (1)</li> <li>• Pencil (1)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones: (3)<br/>Heights: Green: 16 cm (1) Yellow: 8.5 cm (2)</li> <li>• Flash cards with pictures (10)</li> </ul> |

| SUB-AIMS   | ACTIVITIES   | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> <p><i>Activate vestibular system during 'up &amp; down' motions,</i></p> | <p>'Musical movies'</p> <p>Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child sits on the kangaroo ball. Laptop is placed on a table about 2 metres from child, level with head. Place two tactile-cushioned balance pods, 2 meters away from the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music on the movie plays, child bounces up &amp; down in place on the kangaroo ball like popcorn. When the instructor pauses the music, child must stop instantly. Instructor shows child to climb off the ball &amp; stand on the two balance pods, one foot on either one. Hold position &amp; balance on balance pods for 10 seconds. Child climbs off &amp; resumes to sitting on the kangaroo ball as the music begins again. Child bounces until music is paused, &amp; returns to balancing on the balance pods for 10 seconds.</p> <p>Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music.</p> |

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| <p><i>increase stimulation by placing child on compliant surface;</i></p> <p><i>Increase proprioception in lower limbs when supporting body on compliant surface;</i></p> <p><i>Practice fixation of the eyes, while child focuses on computer screen</i></p> <p>(5 minutes)</p>   |  |  |
| <p><i>Stimulate vestibular system during rotation, static balance by maintaining stable body position on elevated surface of the platforms or the compliant surface of Bosu ball;</i></p> <p><i>Stimulate proprioception when weight &amp; pressure is applied on the upper &amp; lower limbs</i></p> <p>(2 minutes- spin)<br/>         (1 minute balance exercise)<br/>         (2 minute spin)<br/>         (1 minute balance exercise)<br/>         (2 minutes spin)<br/>         (1 minute balance exercise)</p> | <p>1. 'Hurricanes &amp; mountains'</p> | <p><b>Set-up:</b> Place the solid rocking bowl on a floor mat. A few feet away in a clear space, set out 3 river stones on the horizontal line of 3 meters. Measure 1m between each river stone &amp; place a Bosu ball 1m after the third river stone.</p> <p><b>Instructions:</b> Child is seated upright &amp; cross-legged in the bowl. Place a colourful object in child's hands on their lap &amp; they are instructed to focus on the object while spinning. Instructor spins child 15 times to the right, then instructor gives a 'halt' &amp; 'jerk' to stop the bowl suddenly &amp; then to spin to their left 15 times. Repeat twice on each side. Speed of spinning: 1 second for each rotation.</p> <p>Child is asked to step out of the bowl &amp; he is assisted out in case he may lose his balance. Wait until child regains his balance. The instructor demonstrates to the child what he needs to do. Child is instructed to hop on his two feet, 'up' onto the first 'mountain' river stone &amp; back down onto the ground. At a slow pace, repeat this 'up' &amp; 'down' motion for the next two rocks &amp; ensure child is bending at his knees. When reaching the Bosu ball child will also jump onto it with his two feet (bending knees when landing) &amp; show him that he must try remain on top of Bosu ball for 3 seconds before jumping off.</p> <p>Child returns to the 'fish bowl', rocking bowl to be spun according to the same criteria mentioned earlier in the instructions. In addition, repeat the instructions for the 'mountains' river stone.</p> <p>Return to jumping on &amp; off river stones &amp; Bosu ball. Repeat these two activities 3 times each.</p> |

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| <p><i>Stimulate eye muscles when tracking moving picture &amp; during ball manipulation skills;</i></p> <p><i>Encourage stimulation of proprioceptors in upper limbs while supporting the weighted ball;</i></p> <p><i>Practice spatial orientation when child is learning how to determine the distance between his hands &amp; the ball when needing to catch &amp; throw</i></p> <p>(2 minutes)</p>   | <p>2. 'Shooting rockets'</p>                      | <p><b>Set up:</b> Place coloured-in picture of a rocket (or a picture of what the child is interested in) on the pencil. Child sits on a chair with instructor sitting opposite him, holding the rocket on a pencil. The rocket is held in line with the child's nose 45cm away from the face.</p> <p><b>Instructions:</b> Child must focus his eyes on the rocket &amp; follow with the eyes, the pathway the "rocket" moves. <i>Child must not move their head.</i> Instructor creates horizontal figure of "8s" with the rocket for 25 seconds. Child then stands up &amp; instructor stands 1.5 meters away from child &amp; with two hands throws the 1 kg medicine ball to him (under arm). Once catching the ball, child is asked to throw the ball back to instructor. Repeat this 10 times, as this activity is performed at a slow pace.</p> <p>For the second round, instructor changes the direction of the figure of "8" to follow a vertical pathway (25 seconds) in which child must follow with his eyes &amp; is asked to not moving his head. He is then asked to return to standing up &amp; instructor &amp; child throw the medicine ball back &amp; forth.</p> <p>In the third set of 25 seconds, instructor alternates between the horizontal pathway &amp; the vertical pathway with the 'shooting rocket'. When child stands up, a 2kg medicine ball is passed back &amp; forth, 10 times to the child &amp; back to the instructor.</p>  |
| <p><i>Stimulate vestibular system during 'up &amp; down' motions, increase stimulation when visual input is absent;</i></p> <p><i>Practice directionality &amp; spatial awareness when child needs to respond to different directions;</i></p> <p><i>Encourage proprioception in upper limbs when holding weighted ball, &amp; in lower limbs when compression is applied to joints upon landing, including when contraction occurs when</i></p> | <p>3. 'Bouncing bunny holding the Easter egg'</p> | <p><b>Set up:</b> Place a mini trampoline in place &amp; 1 kg &amp; 2 kg medicine balls alongside it.</p> <p><b>Instructions:</b> Child is asked to get up onto the trampoline &amp; to jump up &amp; down on two feet while also bending his knees when landing. After about 10 jumps instructor says "stop" &amp; asks the child to stand still on the uneven surface while you passing them the 1 kg medicine ball. Instructor explains to child &amp; demonstrates that they will call out 'up' or 'down' 'left' or 'right' &amp; child must move their arms in those directions. <i>Instructor must not say the direction too quickly. Allow the child time to respond to the action of extending his arms up above his head or to his left side.</i> For the 'down' direction: child bends down from the waist &amp; touches ball to his knees. After calling out the four directions child may pass the ball back to instructor &amp; return to jumping up &amp; down on the trampoline. Allow 15 jumps before stopping child once again.</p> <p>Duration: 1 minute of jumping &amp; moving the medicine ball around; Rest for 1 minute; Continue jumping &amp; moving around medicine ball; Rest for 1 minute; jumping &amp; 2 kg medicine ball; Rest. <i>During rest periods ask child to step off the trampoline &amp; to stand on the floor, on his two feet &amp; to close his eyes for 30 seconds. Then to open his eyes &amp; return to the trampoline.</i></p> <p>In the third set of holding the 'easter egg' pass the 2kg ball to child &amp; repeat the four</p> |

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| <p><i>having to stabilise the legs to support the body to balance</i></p> <p>(5 minutes)</p>  |                          | <p>directions.</p>   |
| <p><b>Cool down</b></p> <p><i>Activate phasic control when lower limbs need to be lifted up in the air;</i></p> <p><i>Activate abdominal strength which assists in elevating legs;</i></p> <p><i>Encourage cognitive skills during visual &amp; verbal instructions</i></p> <p>2 minutes- 15 seconds rest</p> <p>2 minutes- 15 seconds rest</p> | <p>4. 'Picture hunt'</p> | <p><b>Set up:</b> On a clear wall, place 10 flash cards which contain illustrated picture on. Cards are randomly placed in no particular order. Cards are at least about 15cm off the ground. Place a mat at the wall just under the flash cards.</p> <p><b>Instructions:</b> Child lies on their back, lifts feet up off the ground &amp; is shown to bend at the knees. Instructor places a <i>tactile ball</i> between his two feet &amp; asks child to hold the ball with his feet. Make sure there is about ½ a meter between child's feet &amp; the wall. While clasping the ball, child must take it to touch the picture that is called out by instructor. Complete all 10 pictures before allowing child to rest. During the rest period: Indicate to child how to straighten his legs &amp; body out. Rest for 15 seconds before returning to legs being bent &amp; lifted up while holding the tactile ball with feet. One by one, instructor calls out each picture &amp; child touches the picture with his toes. Complete this activity twice with the rest period in between.</p> |

| SUBJECT A   | AUGUST   | WEEK 3: 30 minutes x2  |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate somato-sensory (proprioceptors) in upper &amp; lower limbs</li> <li>• Maintaining balanced body positions</li> <li>• Maintaining a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practicing the understanding of verbal instruction &amp; listening skills</li> </ul> |  |  |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice eye tracking</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with laptop</li> <li>• Balance pods (2)</li> <li>• Scooter board (1)</li> <li>• 1 kg medicine ball (1)</li> <li>• 2 kg Medicine ball (1)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• Multi-purpose jungle gym: wooden ramp, thick rope, secure monkey bars</li> <li>• Rainbow river stones: (3)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1)<br/>Yellow: 8.5 cm (1)</li> <li>• Flash cards with pictures (10)</li> <li>• Pilates ball (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES   | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> <p><i>Activate vestibular system during 'up &amp; down' motions, increase stimulation by</i></p> | <p>'Musical movies'</p> <p>Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Laptop is placed on a table about 2m from child, level with their head. Place two balance pods 2m away from the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music on the movie plays, child bounces, up &amp; down, in place on the kangaroo ball 'like popcorn'. When the instructor pauses the music, child must stop instantly, instructor asks him to stand on the two 'hedge-hogs' with one foot on either one. Child holds the position &amp; balances on balance pods for 12 seconds. Child climbs off &amp; resumes to sitting on the kangaroo ball as the music begins again. Child bounces until music is paused, &amp; returns to balancing on the balance pods for 12 seconds. Alternate between 15 seconds and 25 seconds of child bouncing on the ball before pausing the music.</p> |

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| <p><i>placing child on compliant surface;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on compliant surface;</i></p> <p><i>Practice fixation of the eyes, while child focuses on computer screen</i><br/>(5 minutes)</p>   |                               |  |
| <p><i>To create a functional task of stimulating the vestibular system &amp; activating dynamic balance during ‘up &amp; down’ motions &amp; having to stabilise during jumping</i></p> <p><i>Encourage spatial orientation while jumping onto elevated platforms which are at different heights;</i></p> <p><i>Activate proprioception in lower limbs when bending knees &amp; supporting the body’s dynamic position</i></p> <p><i>Stimulate proprioceptors in upper limbs when needing to support increased weight</i><br/>(7 minutes)</p> | <p>1. ‘Treasure mountain’</p> | <p><b>Set up:</b> Place the 3 different levelled river stones vertically out in front of the child. The river stones can be 1m from each other. Place 1kg medicine ball alongside the river stones.</p> <p><b>Instructions:</b> Child is asked to pick up his ‘treasure’, the 1kg medicine ball &amp; must hold it. Instructor demonstrates to the child how he will jump up onto the “volcano-mountain”, river stone, with his two feet &amp; then must jump back down to the floor while holding the ball (his little treasure). He must jump up onto the river stone &amp; back down onto the ground 3 times. Instructor may assist the child with the counting. <i>Feet need to remain synchronized when leaving the floor &amp; when landing on the river stone. Remind child to bend at the knees.</i> Child jumps up onto the red river stone &amp; back down onto the ground, 3 times. If child can perform this easily, move to the “grassy-green mountain” (river stone). Child repeats the jump onto the river stone &amp; down onto the floor 3 times. If this is also completed with ease, child may move to the “happy-golden mountain”. <i>Child is reminded that this river stone is smaller. Child is instructed to also jump 3 times on &amp; off it. It will be useful for instructor to use movement &amp; spatial cues to communicate with child, such as repeating ‘up’ &amp; ‘down’.</i> Child will get accustomed to hearing, &amp; responding with a motor action.</p> <p><b>Note:</b> <i>Observe child’s posture when landing on the river stone &amp; the ground. Child must not bend his back &amp; body forwards. Instructor may help child by holding his upper body upright, to ensure child will now land in the incorrect manner.</i></p> |



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| <p><i>Stimulate vestibular system during rotation &amp; quick change in direction;</i></p> <p><i>Practice static balance by decreasing surface area;</i></p> <p><i>Stimulate proprioceptors in upper limbs: compression on joints when hands are turning body in rotation, Contraction: increase in weight with medicine ball;</i></p> <p><i>To activate muscle control in the arms, neck, back (extensor muscles) while lifting up during rotation.</i></p> <p style="text-align: center;">(2 minutes)<br/>(20 seconds rest)<br/>(2 minutes)<br/>(20 seconds rest)<br/>(2 minutes)<br/>(20 seconds rest)<br/>= 7 minutes</p> | <p>2. 'Rockets landing on the moon'</p>  | <p><b>Set up:</b> Place the scooter board in a clear open space away from obstructions (should not a carpeted area). Place the red river stone close at hand with the 1kg &amp; 2kg medicine balls next to it.</p> <p><b>Instructions:</b> Child is assisted to lie down on his stomach on the scooter board, lift his feet up off the ground by bending at the knees &amp; hands resting on the floor &amp; head looking straight ahead. Instructor turns child to the right while child may use his hands to also help with rotation. Instructor turns child 15 times to the right, stops the scooter board &amp; child with a 'stop' &amp; changes direction to turn child to their left 15 times. Child may rest for a few seconds lying on the scooter board &amp; return to turning the child to the right once again and then to the left, 15 times on each side. Speed of turning: fast turn of 1 second upon each rotation. Instructor then assists child off the scooter &amp; directs him to stand on the red river stone. Child is then instructed to stand on top of the red river stone standing heel-to-toe with right foot in front of the left. Child may attempt to hold this position for 10 seconds. Count aloud to encourage child to count with you. Child then returns to the scooter board to lie own on his stomach &amp; be rotated to the right &amp; to the left. Follow the same procedure mentioned above.</p> <p>In the second set, when reaching the red river stone, if child is competent enough while standing heel-to-toe &amp; does not wobble too much, instructor may pass the 1kg medicine ball to him to hold for the duration of the 10 seconds. When swopping to put the left foot in front instructor asks for the 1kg back &amp; passes the 2kg ball to the child to hold.</p> <p><i>Alternate between the scooter board &amp; the river stone 3 times each.</i> Balance activity is performed slowly and remind child to count slow &amp; take his time.</p> |
| <p><i>Practice functional movements by child performing a multiple of different activities together; Stimulate proprioceptors in upper limbs by contraction while climbing, pulling of the joints while hanging &amp; compression when body weight is supported by arms,</i></p>  | <p>3. 'Climbing the mountain slopes'</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains monkey bars, a net, a thick rope secured to a beam at the top of a 3m wooden ramp which also has support for footing. If a ramp is not accessible, use a flight of stairs as the instructor may be at the top of about 5 stairs away from child, child being at the bottom of the steps.</p> <p><b>Instructions:</b> Child steps up onto the wooden ramp &amp; grasps the thick rope. Instructor is just behind child to just act as security for if child may let go of rope. Child begins to take steps up the ramp holding the rope &amp; climbing up with one hand being placed in front of the other. Once reaching the top, if there are monkey bars, assist child to grasp the first bar &amp; to try move &amp; grab hold of the second monkey bar &amp; to hold onto it for 3 seconds. Instructor may hold child by the legs if he struggles. Once complete, lower child down to the ground.</p>   |

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| <p><i>lower limb proprioceptors also activated when support body while walking up steep ramp</i></p> <p>(5 minutes)</p>   |                                 | <p>*‘Wheelbarrow’ child to the start of the ramp. Repeat this exercise 3 times of climbing up &amp; holding monkey bars for 1 second more than the last set. Therefore, reaching 7 seconds after the 3 sets.</p> <p><i>For the steps option:</i> Child holds one end of the rubber exercise band &amp; instructor holds the other end a few steps away. An assistant is just behind the child to support him &amp; act as security for as a safety precaution. Child begins to climb, leans slightly back (with assistant guiding him up) &amp; takes one step at a time while grasping the rubber band &amp; climbing up with hands. Once reaching the instructor, child is told to continue holding the rubber band, &amp; straighten arms, &amp; lean body backwards, trying to pull the rubber band away from instructor. Child may hold this for 5 seconds before releasing &amp; walking back down the steps to resume to the beginning position. *‘Wheelbarrow’ child around at the bottom of the stairs before child stands up to climb up the ‘mountain’ again.</p> <p>Repeat these three activities three times. <i>Allow for rest period in between the sets.</i></p> |
| <p><b>Cool down</b></p> <p><i>Stimulate proprioceptors in the upper limbs by applying compression on the joints when walking forwards &amp; backwards to touch each picture;</i></p> <p><i>Stimulate back strength &amp; neck muscles while lifting up;</i></p> <p><i>Encourage cognitive &amp; listening skills when learning to respond correctly to instructions.</i></p> <p>2 minutes<br/>15 seconds rest<br/>2 minutes</p> | <p>4. ‘Rolling on a planet’</p> | <p><b>Set up:</b> Place 10 flash cards with pictures on the wall &amp; a small mat just alongside the wall with a pilates ball resting on it.</p> <p><b>Instructions:</b> Roll the ball slightly away from the wall &amp; demonstrate to child that he can lie on the ball on his stomach with arms stretched out in front of him. Child lies on a pilates ball on their stomach &amp; hands flat on the floor. Position the ball &amp; child in a way that they are ½ their body’s length away from the pictures on the wall. Instructor holds child by the knees. Child is instructed to walk forward on hands &amp; touch the picture that is called out. <i>Ensure that child’s lower back is not bending but must be supported or flat “like a table”.</i> Once touching the picture child walks back to starting position with stomach completely on the pilates ball. After touching 5 pictures child may get up off the ball &amp; stand for a few seconds before returning to lying on the pilates ball &amp; completing the next 5 pictures.</p>   |

\*Wheelbarrow: child is shown to lie down flat on the ground, on his stomach. Instructor will pick up child’s legs and support him by the knees while child is shown to push up onto his arms. Instructor ensures that child’s low back is not bent. Child is asked to ‘walk forwards on his hands’.

| SUBJECT A  | SEPTEMBER  | WEEK 1: 30 minutes x2  |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate proprioceptors in upper &amp; lower limbs</li> <li>• Maintaining balanced body positions</li> <li>• Maintaining a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practicing the understanding of verbal instruction &amp; listening skills</li> </ul> |  |  |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with laptop</li> <li>• Balance pods (2)</li> <li>• Picture of a rocket (1)</li> <li>• Pencil (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg Medicine ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Prestik</li> <li>• Mini trampoline (1)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones: (3)<br/>Heights: Red: 13.5 cm (2) Green: 16 cm (1)</li> <li>• Cardboard letters of child's name (each cut out individually)</li> <li>• Pilates ball (1)</li> </ul> |

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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> <p><i>Activate vestibular system through 'up &amp; down'</i></p> | <p>'Musical movies'</p> <p>Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Laptop is placed on a table about 2 metres from the child, level with their head. Place one tactile-cushioned balance pod 2 meters away from the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music on the movie plays, the child bounces up &amp; down in place on the kangaroo ball 'like popcorn'. When the instructor pauses the music, child must stop instantly, instructor shows him to climb off the ball &amp; stand with his two feet on the balance pod. Hold position &amp; balance on the 'balance pod for 5-6 seconds. Child climbs off &amp; resumes to sitting on the kangaroo ball as the music begins again. Child bounces until music is paused, &amp; returns to balancing on the balance pod for 5-6 seconds. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music.</p> |

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| <p><i>motions, increase stimulation by placing child on compliant surface;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on compliant surface;</i></p> <p><i>Practicing fixation of the eyes, while child focuses on computer screen</i><br/>(5 minutes)</p>  |                              |  |
| <p><i>Stimulate the eyes' muscles tracking the picture &amp; while passing the ball;</i></p> <p><i>Encourage stimulation of proprioceptors in upper limbs while supporting the weighted ball;</i></p> <p><i>Enhance spatial orientation when child needs to notice the distance between the ball &amp; his hands, in order to catch it</i></p> <p>(4 minutes)</p> | <p>1. 'Shooting rockets'</p> | <p><b>Set up:</b> Place a green river stone, as 'the planet', 1m away from a small suitable chair for the child. Place a coloured-in picture of a rocket (or a picture child is familiar with) on the pencil. Child sits on a chair with instructor sitting opposite them holding the 'rocket' which is about to launch. The 'rocket' on a pencil is held in line with the child's nose 45cm away from the face.</p> <p><b>Instructions:</b> Child must focus his eyes on the picture 'rocket' &amp; follow the pathway the rocket moves, with the eye. <i>Child must not move his head while tracking. If necessary, remind child during the task.</i> Instructor creates horizontal figure of "8s" with the rocket on the pencil for 25 seconds. Instructor then asks the child to go stand on the 'green planet' river stone. Child stands up &amp; walks to the river stone to stand on it. Instructor stands 1.5m away from child &amp; with two hands throws (under arm) the 1kg medicine ball to him. Once catching the ball the child is asked to throw the ball back to instructor. Repeat this 10 times. <i>Activity should be performed slowly.</i></p> <p>For the second round, instructor changes the direction of the figure of "8" to follow a vertical pathway (25 seconds) in which child must follow with his eyes &amp; is <i>not moving his head</i>. He is then asked to return to standing up &amp; instructor &amp; child throw the medicine ball back &amp; forth.</p> <p>In the third set of 25 seconds, instructor alternates between the horizontal pathway &amp; the vertical pathway with the 'shooting rocket'. When balancing on the 'green planet' a 2kg medicine ball is passed back &amp; forth, 10 times to the child &amp; back to the instructor.</p> |

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| <p><i>Increase stimulation of vestibular system during rapid spins &amp; sudden stops when changing direction of spinning;</i></p> <p><i>Practice static balance while body maintains position on decreased surface area;</i></p> <p><i>Practicing object manipulation skills by throwing &amp; catching a ball;</i></p> <p><i>Stimulate proprioceptors in the arms through contraction when supporting weighted ball, &amp; legs supporting the body's static posture</i></p> <p>(2 minutes- spin)<br/>(1 minute balance)<br/>(2 minute spin)<br/>(1 minute balance)<br/>(2 minutes spin)<br/>(1 minute balance)</p> <p>(=9 minutes)</p> | <p>2. 'Orbiting around Jupiter'</p>  | <p><b>Set up:</b> Place the round, rocking bowl on a floor mat.</p> <p><b>Instructions:</b> Child sits upright &amp; cross-legged in the bowl. Place a colourful object in child's hands on their lap &amp; they are instructed to focus on the object while spinning. Instructor spins child 15 times to the right, stops the bowl with a firm jerk &amp; halt for a rest period for 5 seconds &amp; spins child to their left 15 times. After the second rest period, return to spinning the child to the right once again &amp; then to the left, 15 times on each side. Speed of spinning: fast spin of 1 second upon each rotation. Instructor then assists child out of the bowl &amp; turns the bowl upside down onto it's rounded side. Child is then instructed to stand on top of the "planet Jupiter" &amp; regain his balance.</p> <p>Progress to instructing child to stand on one leg. If he is not wobbling after a few seconds child is given a 1kg medicine ball to hold. Child may try maintain this position for 8 seconds, while holding the ball. Child is then asked to return the ball &amp; to change to stand &amp; balance on the opposite leg. Once he has regained his balance on one leg, pass the 1kg medicine ball back to the child to hold for 8 seconds. Count aloud to encourage child to count with you. Once each foot has completed its time assist child off the "tortoise" &amp; return to the spinning activity following the exact amount of spins to the right &amp; then to left with the halt after the 15 rotations.</p> <p>Repeat this twice &amp; return to balancing on one leg on top of the "tortoise" while holding the medicine ball. <i>Repeat these two activities 3 times each.</i></p> |
| <p><i>Increase vestibular stimulation when child closes his eyes while performing a static position;</i></p> <p><i>Encourage child to practice sensing where he is in space</i></p>   | <p>3. 'Jumping on mountain tops'</p> | <p><b>Set up:</b> Place a mini-trampoline securely in an open space. Set down one red river stone, 1m away from trampoline, the second red river stone 1m away from the first one. The green river stone is secured on top of second red river stone, therefore increasing the height &amp; creating a small tower with the height of 19.5cm.</p> <p><b>Instructions:</b> Child is asked to get onto the trampoline &amp; to jump up &amp; down, while bending his knees during take-off &amp; landing. After about 15 jumps (for the first round) instructor asks child to stop on his two feet, regain balance &amp; to close his eyes. Instructor counts 5 seconds before</p>  |

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| <p><i>while eyes are closed (body awareness);</i></p> <p><i>Develop spatial orientation when having to determine how high child must jump to land on two feet on the elevated platforms</i></p> <p>(5 minutes)</p>   |                               | <p>child can open his eyes. Repeat this task twice (15 jumps &amp; stopping to regain static balance followed by closing his eyes for 5 seconds).</p> <p>Child is directed to jump off the trampoline &amp; to jump up onto the first red mountain (river stone). When at the top he must close his eyes. After 5 seconds child may open eyes &amp; jump down off the mountain. Repeat 3 times. Child is then directed to the taller mountain with the green on top of the red river stone. Child needs to jump up onto the taller river stone &amp; back down, 3 times. On the third time landing on top of the mountain, instructor asks child to close eyes &amp; to slowly count up to 5. Child then opens his eyes &amp; may jump down. Repeat this twice &amp; then return back to the trampoline activity.</p> <p><i>Repeat the trampoline instructions for a second round along with the 'jumping on mountains' following afterwards.</i></p>   |
| <p><b>Cool down</b></p> <p><i>Stimulating proprioceptors in the upper limbs by applying compression on the joints when walking forwards &amp; backwards to touch each picture;</i></p> <p><i>Stimulate back strength &amp; neck muscles while lifting up;</i></p> <p><i>To calm the vestibular system in slow linear-forwards, backwards motion;</i></p> <p><i>Encouraging cognitive &amp; listening skills when learning to respond correctly to instructions.</i></p> <p>2 minutes<br/>15 seconds rest<br/>2 minutes</p> | <p>4. 'Rock to your name'</p> | <p><b>Set up:</b> Place the letters of child's name on the wall, e.g. Dale. The letters are separate to each other &amp; secured with prestik in a horizontal line, about 15cm off the ground. Place a floor mat at the wall just under the letters with the pilates ball alongside it.</p> <p><b>Instructions:</b> Rolling the ball slightly away from the wall demonstrate that child may lie on his stomach on the ball with arms stretched out in front of him. Child lies on a pilates ball on their stomach &amp; hands are flat on the floor. Position the ball &amp; child in a way that they are ½ their body's length away from the pictures on the wall. Instructor holds child by the waist to support child on the ball. Instructor will perform a fast rock of the ball &amp; child, 10 times forwards &amp; backwards.</p> <p>Instructor may then ask child to walk forwards on hands &amp; touch the first letter of their name ie. "D" &amp; walk backwards on hands, which will roll the ball backwards. <i>When child walks forwards to touch letter, instructor will only hold child by the knees.</i> Instructor resumes to supporting child &amp; rocks them back &amp; forth 10 times. Continue this task until child has finished touching all the letters of their name. Instructor must be clear in saying, "Touch the second or third letter of your name". <i>Ensure that child's lower back is not bending when they have walked forwards, rolling the ball to touch the letter, but must be supported or flat "like a table".</i></p> |

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| 15 seconds rest<br>2 minutes |  |  |
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| SUBJECT A  | SEPTEMBER  | WEEK 2: 30 minutes x2  |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate proprioceptors in upper &amp; lower limbs</li> <li>• Maintaining balanced body positions</li> <li>• Maintaining a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practicing the understanding of verbal instruction &amp; listening skills</li> </ul> |  |  |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with cd player</li> <li>• Balance pod (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Bosu ball (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg Medicine ball (1)</li> <li>• A suitable chair for child's feet to touch floor (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Prestik</li> <li>• Mini trampoline (1)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones (6)<br/>Heights: Red: 13.5 cm (2) Green: 16 cm (2)<br/>Yellow: 8.5 cm (2)</li> <li>• Cardboard letters of child's name (each cut out individually)</li> <li>• Pilates ball (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES  | EXPLANATION   |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> | <p>'Musical movies'<br/>Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Laptop is placed on a table about 2m from child, level with their head's height. Place one balance pod, 2m away from the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music on the movie plays, the child bounces up &amp; down in place 'like popcorn'. When the instructor pauses the music, child must stop instantly, get off the kangaroo ball to stand on the one balance pod with his two feet. Hold position &amp; balance on the balance pod for 6-8 seconds. Child climbs off &amp; resumes to sitting on the kangaroo ball as the music begins again. Child bounces until music is paused, &amp; returns to balancing on the balance pod for 6-8 seconds. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music.</p> |



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| <p><i>Activate vestibular system during 'up &amp; down' motions, as well as increasing stimulation by placing child on compliant surface along with decreasing the surface area;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on compliant surface;</i></p> <p><i>Practice fixation of the eyes, while child focuses on computer screen</i></p> <p>(5 minutes)</p> |                          |   |
| <p><i>Stimulate vestibular system during rocking at a moderate-fast speed in different directions encouraging equilibrium reactions to occur;</i></p> <p><i>Practice equilibrium control while having to compensate on the compliant surface;</i></p> <p><i>Encourage the activation of proprioceptors in upper limbs through contraction around joints while holding weighted ball</i></p>           | <p>1. 'Rocking boat'</p> | <p><b>Set up:</b> Place the rounded, solid rocking bowl on a floor mat with a Bosu ball about 1m away from the bowl. In addition, have a 1kg medicine ball alongside the bowl.</p> <p><b>Instructions:</b> Child sits upright &amp; cross-legged in the bowl &amp; may hold on the sides of the bowl. Child is asked to <i>close his eyes</i> as the instructor will rock him back &amp; forth. Instructor may sing or say the rhyme "Rock, rock, rock your boat, gently down the stream. Merrily, merrily, merrily, merrily, life is but a dream". After saying this once, instructor changes the direction of rocking from side to side &amp; may repeat the song. Rocking speed: moderate-fast rate &amp; can be in time with the words of the song. <i>When child is being rocked, the instructor asks them to try to stay upright (to come back to their center).</i> Child is then asked to open his eyes &amp; to step out of the bowl &amp; to get up onto 'his island' the Bosu ball. Child must try maintain balance on the Bosu ball on his two feet. Once maintaining balance for at least 5 seconds before stepping off &amp; returning to his 'rocking boat'. Instructor follows the former instructions of the rocking procedure while child's eyes are closed (rocking forwards &amp; backwards; side-to-side).</p> <p>On the second round of standing &amp; balancing on the Bosu ball, child must maintain balancing for 5 seconds before instructor may hand him the 1kg medicine ball to hold out in front of his</p> |

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| <p>(4 minutes)</p>  |                               | <p>body, slightly extending at the elbows. Child holds the ball &amp; maintains balance at least 5 seconds before passing the ball back to instructor &amp; stepping off his 'island' &amp; back into his 'boat to rock home'.</p> <p>Repeat the former instructions for the third round of this exercise with the addition of the 1kg medicine ball.</p>   |
| <p><i>Maintain the stimulation of vestibular system with 'up &amp; down' motions, including directional change through quickly changing directions;</i></p> <p><i>Activate static balance when stopping on two feet &amp; closing eyes;</i></p> <p><i>Enhance spatial orientation when running around obstacles</i></p> <p>(2 minutes- spin)<br/>         (1 minute balance exercise)<br/>         (2 minute spin)<br/>         (1 minute balance exercise)<br/>         (2 minutes spin)<br/>         (1 minute balance exercise)</p> <p>(9 minutes)</p> | <p>2. 'A bouncing snake'</p>  | <p><b>Set up:</b> Securely place a mini-trampoline in an open space. Set down 6 river stones in a horizontal line in this particular order: red, green, yellow, red, green and yellow, 1m in between each rock.</p> <p><b>Instructions:</b> Child is asked to get onto the trampoline, 'the snakes nest' &amp; to jump up &amp; down, while bending at the knees during take-off &amp; landing. For the first round, after about 15 jumps instructor asks child to stop on his two feet, regain balance &amp; to <i>close his eyes</i>. Instructor counts 6 seconds before child can open his eyes. Repeat this task twice (15 jumps &amp; stopping to balance &amp; close eyes for 6 seconds).</p> <p>Child is directed to jump off the trampoline &amp; instructor demonstrates that child must weave in &amp; out, in between the river stone 'like a snake'. Child weaves in &amp; out, around all 6 river stones. When reaching the last yellow river stone, to turn around &amp; weaves back to 'his nest' the trampoline by running around the river stones, in &amp; out of the spaces. Child may then get back onto 'his nest' &amp; resume to jumping up &amp; down.</p> <p><i>Repeat these two tasks three times as was mention above.</i></p> |
| <p><i>Stimulate vestibular system during rocking motion;</i></p> <p><i>Stimulate proprioceptors in arms &amp; hands with child placing pressure on joints</i></p>   | <p>3. 'Rock to your name'</p> | <p><b>Set up:</b> Place the letters of child's name on the wall, e.g. Frank. The letters are separate to each other &amp; placed with prestik in a horizontal line, about 15cm off the ground. Place a floor mat at the wall just under the letters with the pilates ball alongside it.</p> <p><b>Instructions:</b> Roll the ball slightly away from the wall to demonstrate to child that he can lie on his stomach on the ball with arms stretched out in front of him. Child lies on a pilates ball on</p>   |

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| <p><i>during the activity;</i></p> <p><i>Activate core strength when child are not supported by the ball;</i></p> <p><i>Practice cognitive skills of understanding what is the first / second letter of their name; &amp; to respond to instructions</i></p> <p>(2 minutes)</p> |                            | <p>their stomach &amp; hands are flat on the floor. Position the ball &amp; child in a way that they are ½ their body’s length away from the pictures on the wall. Instructor holds child by the waist to support child on the ball. Instructor will perform a fast rock of the ball and child, 10 times forwards and backwards.</p> <p>The instructor may then ask child to walk forwards on hands &amp; touch the first letter of their name i.e. “F” &amp; walk backwards on hands rolling ball backwards. <i>When child walks forwards to touch letter, instructor will only hold by the knees.</i> Instructor resumes to supporting child &amp; rocks them back &amp; forth, 10 times. Continue this task until child has finished touching all the letters of their name. Instructor must be clear in saying, “Touch the second or third letter of your name,”. <i>Ensure that child’s lower back is not bending when they have walked forwards, rolling the ball to touch the letter, but must be supported or flat “like a table”.</i></p> |
| <p><b>Cool down</b></p> <p><i>Stimulate proprioceptors in the joints through quick ‘compression &amp; release’ actions</i></p>  | <p>‘Press and release’</p> | <p><b>Set up:</b> Seat child on a secure chair &amp; instructor is seated directly opposite child.</p> <p><b>Instructions:</b> Instructor places pressure on child’s head &amp; then releases. Repeat this 10 times of compression &amp; release on child’s head. Move down to both <i>shoulders</i>: Instructor places both hands on <i>shoulders</i> &amp; firmly presses down &amp; releases, 10 times. The next joint is child’s <i>elbows</i>: place your other hand where the humerus &amp; shoulder joint are. Perform the ‘pumping’ action by pushing the <i>elbow</i> joints &amp; <i>shoulder</i> joints towards each other &amp; release. Perform the same action between the <i>elbow</i> &amp; <i>wrist</i> joints, then work down to compressing &amp; releasing (pumping) each finger on the hand. Each joint is pumped 10 times.</p>   |

| SUBJECT A  | SEPTEMBER  | WEEK 3: 30 minutes x2  |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate proprioceptors in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practice the understanding of verbal instruction &amp; listening skills</li> </ul> |  |  |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with cd player</li> <li>• Tilt board (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Colourful object (1)</li> <li>• Bosu ball (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg Medicine ball (1)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• Mini trampoline (1)</li> <li>• Multi-purpose jungle gym: wooden ramp, thick rope, secure monkey bars</li> <li>• Flight of stairs (Alternative to jungle gym)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones: (3)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1)<br/>Yellow: 8.5 cm (1)</li> <li>• Pilates ball (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES  | EXPLANATION   |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i><br/><i>Activate vestibular system during 'up &amp; down' motions,</i></p> | <p>'Musical movies'<br/>Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Laptop is placed on a table about 2m from the child, level with their head's height. Place a wooden tilt board 2m away from the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music on the movie plays, the child bounces up &amp; down in place 'like popcorn'. When the instructor pauses the music, child must stop instantly, get off the kangaroo ball &amp; instructor directs him to the tilt board. Instructor assists child onto tilt board to stand on his two feet &amp; maintains for 6-8 seconds. Child climbs off &amp; resumes to sitting on the kangaroo ball as the music begins again. Child bounces until music is paused, &amp; returns to the wooden tilt board for 6-8 seconds. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music.</p> |

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| <p><i>as well as increasing stimulation by placing child on tilted surface area;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on tilted surface;</i></p> <p><i>Practicing fixation of the eyes, while child focuses on computer screen</i><br/>(5 minutes)</p>  |                            |  |
| <p><i>Stimulate vestibular system through spinning and different amount of rotation and increasing balance focus when child closes his eyes;</i></p> <p><i>Practice dynamic balance &amp; equilibrium control while jumping into on a slightly slanted surface or decreased surface area;</i></p> <p><i>Activating upper limb proprioceptors through contraction: increasing weight on limbs with different weights of medicine ball;</i></p> <p><i>Motivate spatial orientation to determine the distance in which to catch &amp; throw the ball.</i></p> | <p>1. 'Tornado towers'</p> | <p><b>Set up:</b> Place the rocking bowl on a floor mat with the 1kg medicine ball alongside the bowl. Set 3 of the river stones in a horizontal line, with 1m in between each other in this order: red, green and yellow.</p> <p><b>Instructions:</b> Child sits upright &amp; cross-legged in the bowl. Place a colourful object in child's hands on their lap &amp; they are instructed to focus on the object while spinning. Instructor spins child 10 times to the right, stops the bowl with a firm jerk &amp; halt &amp; spins child to their left 10 times. After the second rest period, return to spinning child to the right once again but just 5 times &amp; then to the left, 5 times. Speed of spinning: fast spin of 1 second upon each rotation. Instructor then assists child out of the bowl &amp; gives the 1kg medicine ball for the child to hold. Direct child to the first river stone &amp; ask him to bend his knees &amp; jump up onto the red river stone &amp; then jump down on to the other side. Child can then jump onto the second river stone, green, &amp; jump down followed by the yellow river stone. Child continues to hold the medicine ball the entire time of jump up &amp; down. Once landing on top of the yellow river stone (which is smaller in diameter) child is asked to close his eyes while the instructor counts. Allow child to attempt closing eyes for 6 seconds &amp; balance on the river stone. <i>Instructor is close at hand for in case child loses his balance.</i> After completing all 3 river stones child may return to the rocking bowl, placing 1kg down, &amp; climbing back in his 'tornado'.</p> <p>Repeat these two task 3 times each. On the third set of jumping up and down on the 'towers', child is given the 2kg to hold. <i>A reminder that child closes his eyes when on the yellow river stone.</i></p> |

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| (5 minutes)  |                                  |   |
| <p><i>Maintain stimulation of vestibular system during up &amp; down motions, including directional change when changing directions quickly;</i></p> <p><i>Activating static balance when stopping on two feet &amp; closing eyes;</i></p> <p><i>Enhance spatial orientation through being aware of running around obstacles</i></p> <p>(2 minutes- spin)<br/>         (1 minute balance exercise)<br/>         (2 minute spin)<br/>         (1 minute balance exercise)<br/>         (2 minutes spin)<br/>         (1 minute balance exercise)</p> <p>(9 minutes)</p> | <p>2. 'A bouncing journey'</p>   | <p><b>Set up:</b> Place a mini-trampoline securely in an open space. Set down 2 river stones on top of each other &amp; 1 meter away place down the yellow river stone. The green river stone must be on top of the red river stone. Have the 1 kg &amp; the 2 kg medicine ball close at hand.</p> <p><b>Instructions:</b> Child is asked to get onto the trampoline &amp; to jump up &amp; down. <i>Ensure child is bending at the knees.</i> After about 15 jumps instruct child to stop &amp; stand heel-to-toe with the right foot in front. After gaining their balance for 3 seconds, ask child to close his eyes. Instructor counts 3-4 seconds before asking child to open eyes &amp; resume to jumping. After another 15 jumps ask child to stop &amp; stand heel-to-toe with the left foot in front. After the 3-4 seconds of closing his eyes direct child to jump off trampoline. Pass the 1kg to child &amp; he must try jump up onto the green/red river stone 'tower'. Standing on two feet ask child to close his eyes &amp; count slowly up to 8. Open eyes &amp; jump off the two river stones &amp; onto the yellow river stone. Close eyes once again for 5 seconds/counts. Once child can open his eyes ask child to throw the 1kg ball to you. Instructor &amp; child throw &amp; catch the ball to each other 10 times before child jumps off the yellow river stone, onto the ground &amp; onto the green-red river stone, returning to the trampoline. Child does not need the ball for the 'trip' back.</p> <p><i>Repeat this activity three times with the trampoline &amp; river stones, following the above mentioned instructions.</i> On the third round give the child the 2kg medicine ball to hold while jumping on the river stones &amp; throwing &amp; catching.</p> |
| <p><i>Practice functional movements when child performing a multiple of combined activities;</i></p> <p><i>Stimulate proprioceptors in upper limbs during contraction while climbing, pulling of the joints while hanging &amp; compression when body weight is</i></p>  | <p>3. 'Tarzan in the jungle'</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains monkey bars, a net, a thick rope secured to a beam at the top of a 3 meter wooden ramp which also has support for footing. If a ramp is not accessible, use a flight of stairs as the instructor may be at the top of about 5 stairs away from child &amp; child at the bottom of the steps.</p> <p><b>Instructions:</b> Child steps onto the wooden ramp &amp; grasps the thick rope attached onto a secure railing on the jungle gym. Instructor is just behind child to act as security for if child may let go of rope. Child begins to take steps up the ramp holding the rope &amp; climbing up with one hand being placed in front of the other. Once reaching the top, if there are monkey bars assist child to grasp the first bar &amp; try move onto the second then the third bar. If the child feels confident enough, allow him to try do as many as he can. But the instructor needs to be below him to show that he/she is there to catch him. Assist in lowering the child back to the ground.</p>  |

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| <p><i>supported by arms, lower limb proprioceptors also activated when support body while walking up steep ramp</i></p> <p>(5 minutes)</p>  |  | <p>*Wheelbarrow' child to the start of the ramp. Repeat this exercise 3 times climbing up &amp; grasping &amp; moving across at least 3 monkey bars each time.</p> <p><i>For the steps option:</i> Child holds one end of the rubber exercise band &amp; instructor holds the other end a few steps away. An assistant is just behind the child to support &amp; act as security for safety precautions. Child begins to climb, leans slightly back (with assistant guiding him up) &amp; takes one step at a time while grasping the rubber band &amp; moving hands up. Once reaching the instructor, child is told to continue holding the rubber band, straighten arms, &amp; lean body backwards, trying to pull the rubber band away from instructor (<i>ensure that the child's weight is leaning backwards creating a pull on his elbow &amp; shoulder joints</i>). Child may hold this for 7 seconds before releasing &amp; walking back down the stairs to resume to the beginning position.</p> <p>*'Wheelbarrow' child around at the bottom of the stairs before child stands up to climb up the 'mountain' again.</p> <p>Repeat these three activities three times. <i>Allow for rest period in between the sets.</i></p> |
| <p><b>Cool down</b><br/> <i>Activate core muscle strength in abdominals (holding up legs), legs (kicking) &amp; arms (supporting position);</i></p> <p><i>Practice reaction time &amp; motor planning when having to react to a moving object</i></p> | <p>4. 'Kicking a flying meteorite'</p> | <p><b>Set up:</b> Place a floor mat on the floor in a clear open space. Instructor will have a pilates ball ready.</p> <p><b>Instructions:</b> Child is shown to sit on the floor mat, lean back onto his hands, bending at the elbows &amp; to try lift up is legs, bending at the knees &amp; feet facing the instructor. Instructor rolls the pilates ball &amp; child must try kick the 'flying meteorite' away with his feet. Child's legs may drop after kicking. Ask child to lift up his legs again after kicking. Repeat this exercise slowly until child understands the concept. Try at least 5 times. Instructor may have to try correct child's position on the floor of bending at the elbows &amp; lifting the legs up &amp; bending at the knees.</p>   |

\*Wheelbarrow: child is shown to lie down flat on the ground, on his stomach. Instructor will pick up child's legs and support him by the knees while child is shown to push up onto his arms. Instructor ensures that child's low back is not bent. Child is asked to 'walk forwards on his hands'.

| SUBJECT A  | SEPTEMBER   | WEEK 4: 30 minutes x2   |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate proprioceptors in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practice the understanding of verbal instruction &amp; listening skills</li> </ul>     |   |   |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> <li>• Practicing the integration of functional tasks</li> <li>• Teaching the body how to return to center of gravity</li> </ul> | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Balance pod (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Picture of the rocket (1)</li> <li>• Pencil (1)</li> <li>• Medium sized tactile ball (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg Medicine ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Prestik</li> <li>• Mini trampoline (1)</li> <li>• Multi-purpose jungle gym: wooden ramp, thick rope, secure monkey bars</li> <li>• Flight of stairs (alternative to jungle gym)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones: (4)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1)<br/>Yellow: 8.5 cm (2)</li> <li>• Pilates ball (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES              | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> | <p>‘Musical movies’</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Laptop is placed on a table about 2m from the child, level with the height of their head. Place one ‘balance pod, 2m away from the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music on the movie plays, the child bounces, up &amp; down in place ‘like popcorn’. When the instructor pauses the music, child must stop instantly, get off the kangaroo ball &amp; walk over to the balance pod to stand on it with his two feet &amp; maintain balance for 6-8 seconds. Child climbs off &amp; resumes to sitting on the kangaroo ball as the music begins again. Child bounces until music is paused, &amp; returns to the balance pod for 6-8 seconds. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music.</p> |



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| <p><i>Activate vestibular system through 'up &amp; down' motions, as well as increasing stimulation by child trying to balance both feet on a smaller surface area;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on smaller, compliant surface</i><br/>(5 minutes)</p>   |                      |   |
| <p><i>Stimulate eye muscle in different directions following a pathway;</i></p> <p><i>Practice object manipulation skills when throwing &amp; catching ball;</i></p> <p><i>Stimulate vestibular system when child is on an uneven surface, encourage habituation while throwing the ball just off centre as child needs to shift the middle of his body to adjust &amp; catch the ball.</i></p> | <p>1. "Lift off"</p> | <p><b>Set up:</b> Taking a picture of a rocket which is coloured in &amp; cut out to be secured on the pencil. Set up the red river stone a few steps away from the chair &amp; a medium-sized tactile ball next to it. Child sits on a chair with instructor sitting opposite them holding the little 'rocket' on the pencil. The pencil is held in line with the child's nose 45cm away from the face.</p> <p>Instructions: Child must focus his eyes on the rocket &amp; follow with his eyes, the pathway the 'rocket' moves. <i>Child must not move their head.</i> Instructor creates horizontal figure of "8s" with the rocket for 25 seconds. Child is then instructed to stand up &amp; walk to the red river stone &amp; stand on it. The instructor stands 1.5m away from child on the river stone &amp; with two hands throws (underarm throw) the tactile ball to the child &amp; if child catches it child is asked to throw it back with two hands. Repeat this 10 times (this activity is performed slowly).</p> <p>For the second round, instructor changes the direction of the figure of "8" to follow a vertical pathway (25 seconds) in which the child must follow with his eyes &amp; not moving his head. He is then asked to return to standing up &amp; balancing on the red river stone &amp; instructor throws the tactile ball back &amp; forth to child. If child catches each time &amp; throws correctly, then instructor may throw the ball slightly off center to see if child can respond by shifting his weight to one side to receive the ball, return to standing equally on both feet &amp; to throw the ball back to instructor. The instructor can shift slightly from left to right. If child does not respond correctly return to throwing to his midline.</p> |

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| <p>(4 minutes)</p>   |                                | <p>In the third set, child returns to the chair to “follow the rocket”. After the third set of 25 seconds, instructor alternates between the horizontal pathway &amp; the vertical pathway of the ‘lifting off rocket’. Return to the river stone to throw &amp; catch the ball.</p>   |
| <p><i>Stimulate vestibular system during spinning &amp; encourage greater stimulation while closing the eyes;</i></p> <p><i>Target spatial orientation by child having to move through &amp; around obstructions;</i></p> <p><i>Activating upper limb proprioceptors, to encourage contraction while weight is placed on the limbs.</i></p> <p>(6 minutes)</p> | <p>2. ‘Twisting Tornadoes’</p> | <p><b>Set up:</b> Place the rocking bowl on a floor mat with the 2kg medicine ball alongside the bowl. Set 4 of the river stones in a horizontal line, with 1m in between each other in the following order: red, green &amp; yellow &amp; the second yellow river stone.</p> <p><b>Instructions:</b> Child sits upright &amp; cross-legged in the bowl &amp; is told they may hold onto the sides of the bowl. Child is asked to close their eyes during the spinning. Instructor spins child 10 times to the right, stops the bowl with a firm jerk &amp; spins child to their left, 10 times. After the second rest period, return to spinning the child to the right once again but just 5 times &amp; then to the left, 5 times. Speed of spinning: fast spin of 1 second upon each rotation. After the spinning procedure, child may open their eyes, instructor then assists child out of the bowl &amp; gives the 2kg medicine ball for the child to hold. Direct child to the first river stone &amp; ask him to run in between the river stones, twisting in &amp; out. Child continues to hold the medicine ball the entire time of running in &amp; around the river stones. Once reaching the last yellow river stone child is shown to turn around &amp; run back in-out &amp; around the river stones. Once reaching the bowl again, child may put the 2kg medicine ball down &amp; climb back into the bowl. Resume to the former procedure of spinning the child while their eyes are closed.</p> <p>Repeat these two tasks, 3 times each. <i>Instructor needs to ensure the child is not ‘dizzy’ after the spinning task before running in-out &amp; around the rocks.</i></p> |
| <p><i>Maintaining the stimulation of vestibular system with up &amp; down motions, along with the sudden ‘stops’ to adjust &amp; balance in place;</i></p> <p><i>Enhance increased vestibular stimulation when visual input is absent;</i></p> <p><i>Activating static balance when stopping on two feet &amp; closing eyes;</i></p>                           | <p>2. ‘A bouncing journey’</p> | <p><b>Set up:</b> Place a mini-trampoline securely in an open space. Set down 2 river stones on top of each other &amp; 1m away place down the yellow river stone. The green river stone must be on top of the red river stone. Have the 1kg &amp; the 2kg medicine ball close at hand.</p> <p><b>Instructions:</b> Child is asked to get onto the trampoline, &amp; to jump up &amp; down. <i>Ensure child is bending his knees.</i> After about 15 jumps instruct child to stop &amp; stand heel-to-toe with the right foot in front. Instructor times 6 seconds before asking child to close their eyes for another 6 seconds. Child may open their eyes &amp; resume to jumping. After another 15 jumps ask child to stop &amp; stand heel-to-toe with the left foot in front, for 6 seconds. After the 6 seconds of closing his eyes direct child to jump off trampoline. Pass the 1kg to child &amp; he must try jump up onto the green/red river stone ‘tower’. Standing on two feet ask child to close his eyes &amp; count slowly up to 8. Open eyes &amp; jump off the two river stone &amp; onto the yellow river stone. Close eyes once again for 8 seconds/ counts. Once child can open his eyes ask child to throw the 1kg</p>   |

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| <p><i>Motivate spatial orientation when child has to run around obstacles</i></p> <p>(7 minutes)</p>  |                                  | <p>ball to you. Instructor &amp; child throw &amp; catch the ball to each other, 10 times before child jumps off the yellow river stone, onto the ground &amp; onto the green-red river stone, returning to the trampoline. Child does not need the ball for the 'trip' back.</p> <p><i>Repeat this activity three times with the trampoline &amp; river stones following the above mentioned instructions. On the third round give the child the 2kg medicine ball to hold while jumping on the river stones &amp; during throwing &amp; catching.</i></p>  |
| <p><i>Practice functional movements when child performs a multiple of combined activities;</i></p> <p><i>Stimulate proprioceptors in upper limbs during contraction while climbing, pulling of the joints while hanging &amp; compression when body weight is supported by arms, lower limb proprioceptors also activated when support body while walking up steep ramp</i></p> <p><i>Increase upper body strength when including the elevated river stones that child needs to climb up onto</i></p> | <p>3. 'Tarzan in the jungle'</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains monkey bars, a net, a thick rope secured to a beam at the top of a 3m wooden ramp which also has support for footing. Alongside the jungle gym place out 2 river stones (yellow, red) with a meter in between each river stone. If a ramp is not accessible, use a flight of stairs as the instructor may be at the top of about 5 stairs away from child &amp; child at the bottom of the stairs.</p> <p><b>Instructions:</b> Child steps onto the wooden ramp &amp; grasps the thick rope attached onto a secure railing on the jungle gym. Instructor is behind child to act as security for if he may let go of rope. Child begins to take steps up the ramp, holding the rope &amp; climbing up with one hand being placed in front of the other. Once reaching the top, if there are monkey bars assist child to grasp the first bar &amp; try move onto the second then the third bar, then the fourth. If the child feels confident enough allow him to try do as many as he can. But the instructor needs to be just below child in order to indicate that he/she is there to catch him. Assist in lowering the child back to the ground. *'Wheelbarrow' child to the start of the ramp. When reaching the yellow river stone, tell child to climb up onto it with one hand then the other &amp; then moving forwards, step down off it onto the other side, one hand at a time. Repeat this up down action with the hands onto the red river stone. Then child may stand up (instructor placing their legs down on ground) &amp; child walks to the ramp again. Repeat this exercise 3 times climbing up, grasping &amp; moving across at least 3 monkey bars each time.</p> <p><i>For the steps option:</i> Set up the two river stones at the bottom of the stairs. Child holds one end of the rubber exercise band &amp; instructor holds the other end a few stairs away. An assistant is behind child to support act as security for safety precautions. Child begins to climb, leans slightly back (with assistant guiding him up) &amp; takes one step at a time while grasping the rubber band &amp; moving hands up. Once reaching the instructor, child is told to continue holding the rubber band, &amp; straighten arms &amp; leans body backwards, trying to pull the rubber band away from instructor (<i>ensure that child's weight is leaning backwards creating a pull on his elbows &amp; shoulder joints</i>). Child may hold this for 8 seconds before releasing &amp; walking back down the steps to resume to the beginning position. *'Wheelbarrow' child around at the</p> |

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| <p>(5 minutes)</p>  |  | <p>bottom of the stairs &amp; once reaching the bottom 'wheelbarrow' towards the yellow river stone, to climb up onto with his hands (as is indicated above) followed by the red river stone. After 'wheel barrowing' off red river stone, child stands up to climb up the 'mountain' again.</p> <p>Repeat these three activities three times. <i>Allow for rest period in between the sets.</i></p>  |
| <p><b>Cool down</b></p> <p><i>Activate core muscle strength in abdominals (holding up legs), legs (kicking) &amp; arms (supporting position);</i></p> <p><i>Practice reaction time &amp; motor planning when having to react to a moving object</i></p> | <p>4. 'Kicking a flying meteorite'</p> | <p><b>Set up:</b> Place a floor mat on the floor in a clear open space. Instructor will have a pilates ball ready.</p> <p><b>Instructions:</b> Child is shown to sit on the mat, lean back onto his hands, bending at the elbows &amp; is asked to lift up his legs, bending at the knees &amp; feet facing the instructor. Instructor rolls the pilates ball &amp; child must try kick the 'flying meteorite' away with his feet. Child's legs may drop after kicking. Ask child to lift up his legs again after kicking. Repeat this exercise slowly until child understands the concept.</p> <p>Try at least 5 times. Instructor may have to correct child's position on the floor while he is bending at the elbows &amp; lifting the legs up &amp; bending at the knees.</p> |

\*Wheelbarrow: child is shown to lie down flat on the ground, on his stomach. Instructor will pick up child's legs and support him by the knees while child is shown to push up onto his arms. Instructor ensures that child's low back is not bent. Child is asked to 'walk forwards on his hands'.

| SUBJECT A  | OCTOBER   | WEEK 1: 30 minutes x2   |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate &amp; stimulate proprioceptors in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practice the understanding of verbal instruction &amp; listening skills</li> </ul> |   |   |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> <li>• Teaching the body how to return to center of gravity</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD on CD player</li> <li>• Balance pods (2)</li> <li>• Square- shaped tilt board (1)</li> <li>• Small traffic cones (4)</li> <li>• Medium sized tactile ball (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg Medicine ball (1)</li> <li>• Mini trampoline (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Bosu ball (1)</li> <li>• Stop watch (1)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones: (3)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1)<br/>Yellow: 8.5 cm (1)</li> <li>• Medium sized rubber ball with attached handle (1)</li> <li>• 1 meter thin rope (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES              | EXPLANATION   |
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| <p><b>Warm up</b></p> <p><b>To:</b></p> <p><i>Maintain routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> | <p>‘Bouncing blind’</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Instructor has the relevant CD &amp; song in the CD player. Place two balance pods 2m away from the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music plays, the child bounces up &amp; down in place &amp; is asked to close their eyes while bouncing. When the instructor pauses the music, child must stop instantly, &amp; is asked to open their eyes, get off the kangaroo ball &amp; walk over to the balance pods. Child places one foot on each cushion to maintain his balance &amp; then close his eyes for 6-8 seconds. After this set time child opens his eyes, climbs off &amp; resumes to sitting on the kangaroo ball as the music begin to play again &amp; child closes his eyes while bouncing. Child bounces until music is paused, opens his eyes &amp; returns to the balance pods to balance on &amp; close his eyes for 6-8 seconds. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music &amp; practicing to maintain balance while eyes are closed.</p> |

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| <p><i>Activate vestibular system through 'up &amp; down' motions, as well as increasing stimulation by child trying to balance both feet on a smaller surface area;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on smaller, compliant surface</i></p> <p>(5 minutes)</p>   |                            |  |
| <p><i>Stimulate visual system by practicing gaze stability;</i></p> <p><i>Practice object manipulation using throwing &amp; catching skills;</i></p> <p><i>Stimulate vestibular system when on a uneven surface &amp; encourage habituation when throwing the ball just off centre, for child to retrieve it &amp; regain balance;</i></p> <p><i>Gain muscle control when holding heavy object &amp; remaining upright while moving the ball from side-to-side;</i></p> <p>(4 minutes)</p> | <p>1. 'Tilting bridge'</p> | <p><b>Set up:</b> Place the square-shaped tilt board in a clear space on the floor. Have the 1kg &amp; the 2kg medicine ball alongside it.</p> <p><b>Instructions:</b> Ask the child to stand up onto the tilt &amp; board gain balance. Instructor times 5 seconds once child has maintained a balanced position. Instructor throws a 1kg ball to child for him to catch. Child holds the ball while the instructor asks the child to move the ball to the "left" then to the "right" side of his body (this action should be performed at a slow pace). Observe to see that the child keeps their body upright with just the upper limbs moving the ball from left to right. Repeat this twice before asking child to throw ball back to instructor again. <i>If child loses his balance during this activity allow child to get off and then to step back onto the tilt board without the 1kg ball &amp; for them to also regain their balance for a at least 5 seconds before holding the ball.</i></p> <p><b>Second set:</b> Child maintains his balance for another 5 seconds. Instructor may throw 2kg ball to child. Repeat the same instructions of asking the child to move the ball from "left" to "right", back to the "left" &amp; across to the "right" on the instructor's command &amp; to throw the ball back to the instructor.</p> <p><b>Third Set:</b> Child maintains his balance for another 5 seconds. Instructor uses the 1kg to throw to the child. The procedure is repeated for the last round.</p> |
| <p><i>Stimulate vestibular system when running through cones &amp; child needs to change direction;</i></p>  | <p>2. 'Weaving snake'</p>  | <p><b>Set up:</b> Set 4 cones out in a vertical line, 1m apart. Place a medium sized tactile ball, a 1kg medicine ball &amp; a 2kg ball medicine ball at the starting cone on one end.</p> <p><b>Instructions:</b> Instructor demonstrates to the child that he must pick up the 'spikey' ball</p>   |

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| <p><i>Target spatial orientation by carefully moving through &amp; around obstructions;</i></p> <p><i>Activate proprioceptors in upper limbs as contraction needs to occur around the joints to be able to support the weighted ball</i></p> <p>(5 minutes)</p>  |                                | <p>(tactile ball) &amp; must run in between the cones, without touching the cones, creating a 'weaving' action. When reaching the fourth cone at the end of the line, turn the last cone around &amp; run back in between the cones. Child repeats this demonstration &amp; instructs child that the cones are like 'hot volcanoes' or could 'blow up' &amp; must not touch the cones when running around them. Once reaching the last cone, child places down the tactile ball &amp; picks up the 1kg. Child repeats the weaving action through the cones. Progress to the 2kg ball &amp; repeat the weaving in &amp; out of the cones. The weaving action does not need to be fast but rather gives child time to learn how to correctly place his feet around the cones.</p>   |
| <p><i>Maintain the stimulation of vestibular system during up &amp; down motions;</i></p> <p><i>Activate static balance when stopping on heel-to-toe (smaller surface area) &amp; closing eyes;</i></p> <p><i>Enhance spatial orientation when child jumps up onto river stones;</i></p> <p><i>Stabilise proprioceptors in upper limbs while holding the medicine balls, &amp; lower limbs having to maintain the support of body during the jumping</i></p> | <p>3. ' Bouncing on jelly'</p> | <p><b>Set up:</b> Place a mini-trampoline securely in an open space. Set down 3 river stones in a horizontal line from the trampoline (red, green, yellow) &amp; a Bosu ball at the end, after the yellow river stone. Make sure there is about 50cm in between the river stones &amp; the Bosu ball.</p> <p><b>Instructions:</b> Child is asked to get onto the trampoline &amp; to jump up &amp; down. <i>Ensure child is bending his knees.</i> After about 15 jumps, instruct child to stop &amp; stand heel-to-toe with the right foot in front. Once child has regained balance, ask the child to close his eyes &amp; instructor times 8 seconds before asking child to open his eyes and resume to jumping on two feet. After another 15 jumps ask child to stop &amp; stand heel-to-toe with the left foot in front &amp; to close his eyes for another 8 seconds &amp; balance. After the 8 seconds of closing his eyes, ask child to open his eyes &amp; direct child to jump off trampoline. Pass the 1kg to child &amp; he must try jump up onto the red river stone &amp; back down onto the ground. Repeat the jump up &amp; jump down on the green &amp; yellow river stones as well as the Bosu ball. Once reaching the Bosu ball, child is asked to throw the 1kg ball back to instructor, regain his balance &amp; to close his eyes for 8 seconds while standing on his two feet. After the 8 seconds child may open his eyes turn around on the Bosu ball to face the yellow river stone again. Instructor throws the 1kg ball back to him. Child catches it &amp; jumps off Bosu ball &amp; onto the yellow river stone. Repeat the jumping action over the other two river stones &amp; back onto the trampoline, to throw the ball back to instructor.</p> <p><b>Second set:</b> Repeat the above trampoline procedures. Repeat the river stones &amp; Bosu ball action but instead of the 1kg ball - give child a 2kg ball after the trampoline.</p> <p><i>Repeat this activity three times with the trampoline &amp; river stones &amp; the Bosu ball</i></p> |

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| <p>(8 minutes)</p>   |  | <p><i>following the above mentioned instructions.</i> On the third round give child the 1kg medicine ball to hold while jumping on the river stones.</p>   |
| <p><b>Cool down</b></p> <p><i>Activate core muscle strength in abdominals (holding up legs) &amp; legs performing the kicking action;</i></p> <p><i>Practice reaction time &amp; motor planning when having to react to a moving object;</i></p> <p><i>Stimulated of eye muscles as the eyes have to track the moving ball from a distance &amp; to judge how close it is in order for legs to kick</i></p> <p>(8 minutes)</p> | <p>4. 'The Sun kicking away Pluto'</p> | <p><b>Set up:</b> Place a floor mat on the floor &amp; attach a medium sized rubber ball (with small handle attached to it) to a long rubber band or thin rope.</p> <p><b>Instructions:</b> Child is shown to lie down on the mat &amp; to lift his legs up in the air. Instructor holds the rope with the ball attached to it, a few centimetres away from child's feet. Child must try kick the ball (Pluto) away with his feet. The ball will automatically begin a swinging momentum &amp; child must try kick the ball away from his legs each time it swings towards him. <i>Child must keep his feet together when kicking the ball.</i> Ask child to kick the ball at least 8 times before he can rest for 30 seconds.</p> <p>Second set: repeat this exercise for 10 kicks before another 30 seconds rest. The third set will also be 10 kicks.</p> |



| SUBJECT A  | OCTOBER  | WEEK 2: 30 minutes x2  |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate &amp; stimulate proprioceptors in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practice the understanding of verbal instruction &amp; listening skills</li> </ul> |  |  |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> <li>• Teaching the body how to return to center of gravity</li> <li>• Practicing motor planning</li> </ul>                                  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD &amp; CD player</li> <li>• Balance pods (2)</li> <li>• Picture of a planet (1)</li> <li>• Pencil (1)</li> <li>• Small traffic cones (5)</li> <li>• Medium sized tactile ball (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg Medicine ball (1)</li> <li>• Colourful book (1)</li> <li>• Rocking bowl (spinning) (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Mini trampoline (1)</li> <li>• Coloured cardboard circle (3)</li> <li>• Numbered mats (6)</li> <li>• Stop watch (1)</li> <li>• Floor mat (1)</li> <li>• Green rainbow river stone: Height 16 cm (1)</li> <li>• Medium sized rubber ball with attached handle (1)</li> <li>• 1m thin rope (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES              | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b></p> <p><i>Maintain routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to</i></p> | <p>'Bouncing blind'</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Instructor has the relevant CD &amp; song in the CD player. Place the balance pods cushion 2m away from the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music plays, child bounces up &amp; down in place &amp; is asked to close their eyes while bouncing. When the instructor 'pauses' the music, child must instantly stop, &amp; is asked to open their eyes, get off the kangaroo ball &amp; walk over to the balance pods. Child places one foot on each balance pod to maintain his balance &amp; then close his eyes for 8-10 seconds. After this set time child opens his eyes, climbs off &amp; resumes to sitting on the kangaroo ball as the music begins to play again &amp; child closes his eyes while bouncing. Child bounces until music is paused, opens his eyes and returns to the 'hedge-hogs' to balance on and close his eyes for 8-10 seconds. Alternate between 15 seconds and 25 seconds of child bouncing on the ball before pausing the music and practicing to maintain balance while eyes are closed.</p> |

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| <p><i>suddenly stop bouncing;</i></p> <p><i>Activate vestibular system during 'up &amp; down' motions, as well as increase stimulation when child to balances on both feet on a smaller surface area;</i></p> <p><i>Increase vestibular stimulation due to the absence of visual input;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on smaller, compliant surface</i></p> <p>(5 minutes)</p> |                                |  |
| <p><i>Stimulate visual system by practicing gaze stability &amp; tracking a moving picture's pathway;</i></p> <p><i>Practice object manipulation skills (throwing &amp; catching);</i></p> <p><i>Stimulate vestibular system when standing on a uneven elevated surface;</i></p> <p><i>Enhance muscle control when holding a heavy object &amp; remaining upright while having to move slightly off centre to catch ball</i></p> | <p>1. 'Following a planet'</p> | <p><b>Set up:</b> Place the green river stone on the floor. Place a picture of a planet to a pencil (or a relevant picture in which the child is familiar with).</p> <p><b>Instructions:</b> Child is directed to stand on the green river stone, on both his feet. The instructor holds the pencil 45cm away from the face &amp; in line with child's nose. Child must focus his eyes on the planet while he follows the 'planet's' pathway. <i>Child must not move his head while tracking the picture.</i> Instructor creates a horizontal figure of "8" with the planet-pencil which continues for 25 seconds. The instructor then stands 1.5m away from the child &amp; throws the 1kg medicine ball to the child &amp; the child is instructed to catch it with two hands &amp; to throw it back once catching. Repeat this 12 times (this activity is perform at a slow pace).</p> <p><b>Second set:</b> Instructor changes the direction of the figure of "8" to follow a vertical pathway (25 seconds) in which the child must follow with his eyes &amp; not move his head (child continues to stand and balance on the green rock). Repeat the throwing and catching exercise with the 1kg medicine ball.</p> |

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| <p>(4 minutes)</p>   |   | <p><b>Third Set:</b> Child continues to stand on the river stone. After the third set of the 25 seconds the instructor alternates between the horizontal pathway &amp; the vertical pathway with the planet-pencil. Repeat the throwing &amp; catching exercise. If child catches each time &amp; throws it correctly then the instructor may throw the ball slightly off centre to see if child can respond by shifting his weight to one side to receive the ball, return to standing equally on both feet (returning to the centre of gravity) &amp; throw the ball back. The instructor can slightly shift from left to right. If child does not respond correctly return to just throwing towards his midline.</p>   |
| <p><i>Stimulate vestibular system through rotational movements, along with the quick changes of directions while running through cones, increased stimulation of reducing visual input during spinning;</i></p> <p><i>Targeting spatial orientation by the child's legs &amp; feet making his way through and around obstructions, without touching; Create a functional task of instructing child to obtain objects, one at a time;</i></p> <p><i>Activate proprioceptors in upper limbs which sense the difference between the different weights, sizes &amp; textures of the objects &amp; how to support them once they have been retrieved</i></p> <p>(5 minutes)</p> | <p>2. 'Riding in a spinning space ship'</p> | <p><b>Set up:</b> Place rocking bowl on a floor mat. Set out 5 medium sized cones 1m away. The 5 cones are placed out in a vertical line, about 50cm apart from each other. Place 1 colourful medium-sized tactile ball, a 1kg medicine ball &amp; an interesting book on 'planets', at the fifth cone which is the furthest cones from the bowl.</p> <p><b>Instructions:</b> Instructor demonstrates to child that he must run around the cones, weaving in &amp; out like a 'fast space ship' to fetch the 'treasure' or one of the objects at the end of the cones &amp; run back in &amp; out of the cones to get back in his 'spinning space ship'. Instructor asks child to sit up straight inside the bowl &amp; spins child according to the following instructions: Child is asked to close his eyes during the spinning. Instructor spins child 10 times to the right, stops the bowl with a firm jerk &amp; spins the child to their left 10 times. After the second rest period, return to spinning the child to the right once again but just 10 times &amp; to the left, 10 times. Speed of spinning: fast spin of 1 second upon each rotation. After being spun wait about 5 seconds or until the child can respond to saying he is not dizzy &amp; can stand up. Child runs in &amp; around the cones to pick up one of 3 subjects &amp; returns back to the bowl weaving in &amp; out of the cones. Child is asked to sit back inside of his 'spinning space ship'.</p> <p>Repeat both tasks two more times follow the above procedure. In the third set: Instructor spins the child 5 times to the right, stops the bowl suddenly, with a firm jerk &amp; spins the child to their left 5 times. After the seconds rest period, return to spinning child to the right once again but just for 5 times &amp; then to the left.</p> |

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| <p><i>Maintain the stimulation of vestibular system during fast up &amp; down motions, along with encouraging dynamic balance with hopping on one leg;</i></p> <p><i>Maintain stimulation of proprioceptors in the lower limbs while jumping, along with the one leg having to support the body in the upright position;</i></p> <p><i>Enhance spatial orientation with child having to perceive the allocated target that he needs to jump onto</i></p> <p>(6 minutes)</p>        | <p>3. 'Jumping on an alien planet'</p> | <p><b>Set up:</b> Place a mini-trampoline securely in an open space. Set down 3 cardboard circles on the floor in a horizontal line from the trampoline, 15-20cm apart.</p> <p><b>Instructions:</b> Child is asked to get onto the trampoline &amp; to jump up &amp; down. <i>Ensure child is bending his knees upon landing &amp; on taking off.</i> After about 15 jumps, instruct child to stop &amp; stand heel-to-toe with the right foot in front. Once child has regained balance, ask the child to close his eyes &amp; instructor times 10 seconds before asking child to open his eyes &amp; resume to jumping on two feet. After another 15 jumps ask child to stop &amp; stand heel-to-toe with the left foot in front &amp; to close his eyes for another 10 seconds &amp; balance. After the 10 seconds of closing his eyes, ask child to open his eyes &amp; direct child to jump off trampoline. Child is shown to hop on one leg from one circle to the next. <i>Ensure he stays on the same leg for all three cardboard circles.</i> Once hopping out of the third circle show the child that he must swop his legs &amp; to return back through circle but hopping on the opposite leg. <i>The hopping action may be done slowly as long as child lands with his foot on each circle.</i></p> <p><i>Repeat this activity three times with the trampoline &amp; hopping with one leg on each circle.</i></p> |
| <p><i>Practice bilateral integration of child learning to control upper limbs, separately from the lower limbs;</i></p> <p><i>Practice listening skills &amp; following instructions upon verbal cues;</i></p> <p><i>Encourage body awareness when child needs to respond to the body parts that are called out;</i></p> <p><i>Activate core strength while the body, limbs &amp; muscles have to hold a specific position;</i></p> <p><i>Activate proprioceptors in upper</i></p> | <p>4. 'Upside down aliens'</p>         | <p><b>Set up:</b> In a wide open space, place out 6 numbered mats. Depending on the child's height, the mats are measured to half of the child's length in a horizontal line.</p> <p><b>Instructions:</b> Instructor first demonstrates the actions to child &amp; will then perform each step with child using verbal cues. Child goes down on his haunches on the first mat with his arms alongside their legs &amp; hand just in front of the feet. Upon the instructor saying "hands, hands, hands," child walks forward to the second mat, using just his hands &amp; feet remaining on the first mat. Hands walk forward until the body is elongated, creating a 'bridge' or an 'upside down spider'. Once their hands have reached the mat the instructor says, "feet, feet, feet", &amp; the feet take small steps, one after the other, towards the second mat to meet up with the hands. Returning to child being on his haunches, before instructor gives the "hands, hands, hands" cue indicating that child walks forward again, repeating the 'caterpillar/upside down spider' movement from one mat to the other.</p> <p>Once reaching the sixth mat, child may stand upright, stretch his arms upwards, above his head &amp; then bring them down again to relax then alongside his body. Child then returns back to his haunches to perform the 'caterpillar' movement again from one mat to the</p>          |


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| <p><i>&amp; lower limbs when pressure being applied to them;</i></p> <p><i>Maintain body in equilibrium even though the body is in a different position</i><br/>(4 minutes)</p>  |  | <p>next, back to the first mat.</p> <p>This task can just be performed once, with child going from one side &amp; back again.</p>   |
| <p><b>Cool down</b></p> <p><i>Activate core muscle strength in abdominals (holding up legs) legs (kicking);</i></p> <p><i>Encourage legs to control position of holding lifted position in air &amp; to return to starting position once they have kicked the ball;</i></p> <p><i>Practice reaction time &amp; motor planning when having to react to a moving object</i></p> <p>(4 minutes)</p> | <p>5. 'the Sun is hitting away a planet'</p> | <p><b>Set up:</b> Place a mat on the floor &amp; attach a medium sized rubber ball (with small handle in it) to a long rubber band or thin rope. Have a medium sized tactile ball close at hand.</p> <p><b>Instructions:</b> Child is shown to lie down on the mat &amp; to lift his legs up in the air. Instructor holds the rope with the ball attached to it a few centimetres away from child's feet. Child must try kick the ball (Pluto) away with his feet. The ball will automatically begin a swinging momentum &amp; child must kick the ball away from his legs, each time it swings towards him. <i>Child must keep his feet together when kicking the ball.</i> Ask child to kick the ball at least 8 times before he can gently place his legs back to the ground (<i>instructor may assist in holding child's legs &amp; bringing them slowly down to show him how to try control the movement</i>). Child is handed the tactile ball to hold with both hands &amp; asked to extend his arms. Instructor stands behind the child's head holding the ball just above the child's extended arms holding the tactile ball. Child is asked to touch the 'planet' /hanging ball with the tactile ball. The movement's action: Lift the shoulders just off the floor &amp; touch the ball once &amp; come return to the floor (the lift is only about 6-7 cm off the floor). This is repeated 6 times &amp; then child may relax &amp; place the tactile ball down.</p> <p>Resume to asking child to lift the legs up, bend at the knees &amp; the instructor holds the hanging ball a few centimetres away from the feet. Child is asked to kick the 'planet' again with both of his feet 'stuck' together with 'alien glue'. Child performs 8 kicks before he may lower his legs &amp; hold the tactile ball. Repeat the task of the shoulders lifting up off the floor to touch the tactile ball to the hanging ball 6 times.</p> <p>Repeat a third set of both activities.</p> |

| SUBJECT A  | OCTOBER   | WEEK 3: 30 minutes x2   |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate &amp; stimulate proprioceptors in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practicing the understanding of verbal instruction &amp; listening skills</li> </ul> |   |   |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> <li>• Teaching the body how to return to center of gravity</li> <li>• Practice motor planning</li> </ul>                                      | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with laptop</li> <li>• Balance pods (2)</li> <li>• Small traffic cones (5)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Squeezers (3)</li> <li>• Medium sized tactile ball (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg Medicine ball (1)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• Colourful book (1)</li> <li>• Mini trampoline (1)</li> <li>• Coloured cardboard circles (3)</li> <li>• Numbered mats (6)</li> <li>• Stop watch (1)</li> <li>• Floor mat (1)</li> <li>• Green rainbow river stone: Height 16 cm (1)</li> <li>• Rubber-tactile hands (2) &amp; feet (2)</li> <li>• Green flash card (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES              | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/> <i>Maintain routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> | <p>‘Blind Kangaroo’</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Instructor has the relevant CD &amp; song in the CD player. Place the two balance pods upside down so that the rounded sides are on the floor &amp; the flat part is facing upwards (2 meters away from the kangaroo ball).</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, his hands along his sides. When the music plays, child bounces up &amp; down in place &amp; is asked to close their eyes while bouncing. When the instructor pauses the music, child must instantly stop, &amp; is asked to open their eyes, get off the kangaroo ball &amp; walk over to the upside down balance pods. Child places both feet on the balance pods (instructor may assist the child onto the cushions), maintains his balance &amp; then closes his eyes for 8 seconds. After this set time child opens his eyes, climbs off (one foot at a time) &amp; resumes to sitting on the kangaroo ball as the</p> |

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| <p><i>Activate vestibular system through 'up &amp; down' motions, as well as increasing stimulation by child trying to balance both feet on a smaller surface area;</i></p> <p><i>Increase vestibular stimulation due to the absence of visual input at certain points;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on smaller, compliant surface</i></p> <p>(5 minutes)</p>   |   | <p>music begins to play again &amp; child closes his eyes while bouncing. Child bounces until music is paused, opens his eyes &amp; returns to the balance pods to balance &amp; close his eyes for 10 seconds. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music &amp; practicing to maintain balance while eyes are closed. For the third pause: increase closing eyes duration on balance pods: 12 seconds. Fourth pause: 14 seconds.</p>   |
| <p><i>Stimulate vestibular system during rotational movements, along with the quick changes of directions while running through cones, increase stimulation when reducing visual input during spinning;</i></p> <p><i>Target spatial orientation by the child's legs &amp; feet making his way through &amp; around obstructions, without touching;</i></p> <p><i>Create a functional task of instructing child to obtain objects, one at a time;</i></p> <p><i>Activate proprioceptors in upper limbs which need to sense the</i></p> | <p>1. 'Spin &amp; get the treasure'</p> | <p><b>Set up:</b> Place the rocking bowl on a mat. Set out 5 medium sized cones, 1m away. The 5 cones are placed out in a vertical line, about 50cm apart from each other. Place 1 colourful medium sized tactile ball, a 1kg medicine ball &amp; an interesting book on planets at the fifth cone which is the furthest cones from the bowl.</p> <p><b>Instructions:</b> Instructor demonstrates to child that he must run around the cones, weaving in &amp; out like a 'fast space ship' to fetch the 'treasure' or one of the objects at the end of the cones &amp; run back in &amp; out of the cones to get back into his 'spinning space ship'. Instructor asks child to sit up straight inside the bowl &amp; spins child according to the following instructions: Child is asked to close his eyes during the spinning. Instructor spins child 10 times to the right, stops the bowl with a firm jerk &amp; spins the child to their left 10 times. After the second rest period, return to spinning the child to the right once again but just 10 times &amp; then to the left, 10 times. Speed of spinning: fast spin of 1 second upon each rotation. After being spun wait about 5 seconds or until the child can respond to saying he is not dizzy &amp; he may stand up. Child runs in &amp; around the cones to pick up one of 3 subjects &amp; returns back to the bowl weaving in &amp; out of the cones. Child is asked to sit back inside of his 'spinning space ship'.</p> <p>Repeat both tasks two more times following the above procedure. In the third set:</p> |



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| <p><i>difference between the different weights, sizes &amp; textures of the objects &amp; how to support them once they have been retrieved (5 minutes)</i></p>   |                              | <p>Instructor spins the child 5 times to the right, stops the bowl suddenly, with a firm jerk &amp; spins child to their left 5 times. After the seconds rest period, return to spinning child to the right once again but just for 5 times &amp; then to the left.</p>  |
| <p><i>Activate vestibular system &amp; proprioceptors in lower limbs during static balance while on the elevated, uneven surface;</i></p> <p><i>Activate proprioceptors in the hands while compressing the objects according to how hard or soft they are;</i></p> <p><i>Activate somatosensory system by stimulating hands with tactile objects which can be squeezed, increasing or decreasing the amount of pressure needed.</i></p> | <p>2. 'Squeezing donuts'</p> | <p><b>Set up:</b> Place a green river stone in an open space. Have the 3 different sets of tactile squeezers close at hand. The squeezers are made out of rubber &amp; the different colours represent how hard the child must squeeze the circles. Yellow: soft rubber, Green: medium requirement of pressure needed; Blue: the highest amount of pressure.</p>  <p><b>Instructions:</b> Ask child to get up onto the green river stone &amp; stand on it with both feet. Give child the two yellow squeezers to hold with one in each hand. Ask child to squeeze the 'donuts': Squeeze &amp; release, squeeze &amp; release a few times. Then give him the green set of squeezers to hold, one in each hand: squeeze &amp; release a few times. Lastly, take away the green set &amp; give child the blue set of squeezers to hold with one in each hand. <i>(This is the hardest set &amp; requires child to apply more pressure on the small rings with both hands separately. If child struggles to squeeze either circle refrain from using that level until another session when child has reached progression).</i></p> <p>After taking the blue squeezers out of child's hands, ask them to close their eyes while continuing to standing on the green river stone. While child's eyes remain closed, place one yellow squeezer in each of the child's hands. Child must squeeze &amp; to release at least 5 times. Ask child which colour 'donut' they are squeezing. Even if child guesses incorrectly they may open their eyes to check which colour squeezers are in their hands. Child is asked to close their eyes again &amp; instructor places the green set in the child's hands. Child squeezes the rings 5 times each. Once this is complete, child is asked to guess the colour of</p> |



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| <p>(4 minutes)</p>  |  | <p>the 'donuts'. After this set child keeps eyes closed &amp; is given the blue set to squeeze &amp; release 5 times before being asked the colour.</p>  |
| <p><i>Maintain the stimulation of vestibular system with fast 'up' &amp; 'down' motions, along with encouraging dynamic balance when hopping on one leg;</i></p> <p><i>Maintain stimulation of proprioceptors in the lower limbs during jumping, along with the one leg having to support the body in the upright position;</i></p> <p><i>Enhance spatial orientation while having to perceive the allocated target that he needs to jump onto</i></p> <p>(6 minutes)</p> | <p>3. 'Jumping on an alien planet'</p> | <p><b>Set up:</b> Place a mini-trampoline securely in an open space. Set down 3 coloured cardboard circles on the floor in a horizontal line from the trampoline, 15-20cm apart.</p> <p><b>Instructions:</b> Child is asked to step onto the trampoline &amp; to jump up &amp; down. <i>Ensure child is bending at the knees, upon landing &amp; while taking off.</i> After about 15 jumps instruct child to stop &amp; stand heel-to-toe with the right foot in front. Once child has regained balance, ask child to close his eyes &amp; instructor times 10 seconds before asking child to open his eyes &amp; resume to jumping on two feet. After another 15 jumps ask child to stop &amp; stand heel-to-toe with the left foot in front &amp; to close his eyes for another 10 seconds while balancing. After the 10 seconds of closing his eyes, ask child to open his eyes &amp; direct child to jump off trampoline. Child is shown to hop on one leg from one circle to the next. <i>Ensure he stays on the same leg for all three cardboard circles.</i> Once hopping out of the third circle show child that he must swop his legs &amp; return, hopping on the opposite leg, back through the circles. <i>The hopping action may be performed slowly, as long as child lands with his foot on each circle.</i></p> <p><i>Repeat this activity three times with the trampoline &amp; hopping with one leg on each circle.</i></p> |
| <p><i>Practice a bilateral integration as child learning to control upper limbs, separately from the lower limbs;</i></p> <p><i>Practice listening skills &amp; following instructions when verbal cues are given;</i></p> <p><i>Encourage body awareness as child needs to respond to the body parts that are called out;</i></p> <p><i>Activate core strength while the body, limbs &amp; muscles have to hold a specific, stabilised</i></p>                           | <p>4. 'Upside down spider'</p>         | <p><b>Set up:</b> In a wide open space, place out 6 numbered mats. Depending on child's height, the mats are measured to half of the child's length, in a horizontal line.</p> <p><b>Instructions:</b> Firstly, instructor demonstrates the actions to child &amp; will then perform each step with child while using verbal cues. Child goes down on his haunches, onto the first mat with his arms alongside his legs &amp; hands just in front of the feet. Upon the instructor repeating "hands, hands, hands," child walks forward to the second mat, using just his hands, while his feet remain on the first mat. Hands walk forward until the body is elongated, creating a 'bridge' or an 'upside down spider'. Once the hands have reached the mat the instructor says, "feet, feet, feet", &amp; the feet take small steps, one after the other, towards the second mat to meet up with the hands. Child is back on his haunches before the instructor gives the "hands, hands, hands" cue again, indicating child to walk forward, repeating the 'caterpillar/upside down spider' movement from one mat to the other.</p> <p>Once reaching the sixth mat, child may stand upright, stretch his arms upwards, above his</p>   |

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| <p><i>position;</i></p> <p><i>Activate proprioceptors in upper &amp; lower limbs when compression is applied to joints;</i></p> <p>(4 minutes)</p>  |                         | <p>head &amp; then bring them down again to relax them alongside his body. Child then returns back to his haunches to perform the ‘caterpillar’ movement from one mat to the next, returning to the first mat.</p> <p>This task can just be performed once, with child going from one side &amp; back again.</p>  |
| <p><b>Cool down</b></p> <p><i>Motivate the practice of spatial awareness &amp; motor planning for the arm to make its way in space, sensing where it is in space, while eyes are closed;</i></p> <p><i>Promote listening skills &amp; following instructions</i></p> <p>(3 minutes)</p> | <p>5. ‘Magic touch’</p> | <p><b>Set up:</b> Place a green flash card on the wall with prestik, which is level with child’s nose.</p> <p><b>Instructions:</b> Child stands 30cm from the wall. He is shown he must take his index finger &amp; touch the green card &amp; then touch the body part which the instructor calls out. The body parts include the following: stomach, chin, right/left shoulder, right/left leg. Child touches the body part &amp; must return finger to the green card. Instructor says the above body parts. Then child is asked to close his eyes, while keeping his index finger on the card. Instructor says a body part in which child must touch, while his eyes are close, &amp; returns his finger to the green card. <i>Instructor says each body part slowly. Child must perform task at a slow pace.</i></p> |

| SUBJECT A  | NOVEMBER  | WEEK 1: 30 minutes x2   |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate &amp; stimulate proprioceptors in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practice the understanding of verbal instruction &amp; listening skills</li> </ul> |   |   |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> <li>• Teaching the body how to return to center of gravity</li> <li>• Practicing motor planning</li> </ul>                                  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Balance pods (2)</li> <li>• Small traffic cones (3)</li> <li>• Rocking bowl (spinning)</li> <li>• Picture of a planet (1)</li> <li>• Pencil (1)</li> <li>• Squeezers (3)</li> <li>• Alphabet cards (10)</li> <li>• Coloured in picture- "Hercules" (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Mini trampoline (1)</li> <li>• Stop watch (1)</li> <li>• Floor mat (1)</li> <li>• Green rainbow river stone: Height 16 cm (1)</li> <li>• Prestik</li> <li>• Pilates ball (1)</li> <li>• Medium-sized tactile ball (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg Medicine ball (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES               | EXPLANATION   |
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| <p><b>Warm up</b></p> <p><b>To:</b></p> <p><i>Maintain routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to</i></p> | <p>'Musical bounces'</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Instructor has the relevant CD &amp; song in the CD player. Place one balance pod, upside down (on its rounded side) 2m away from the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle. When the music plays, child bounces up &amp; down in place &amp; is asked to close their eyes while bouncing. Ensure child is pushing up from their knees &amp; thighs. When the instructor pauses the music, child must instantly stop, &amp; is asked to open their eyes, get off the jumping ball &amp; to walk over to the upside down balanced pod. Child places one foot on the cushion &amp; then the other foot to maintain his balance. Instructor may assist child onto the balance pod, however child will maintain balance by themselves once standing on the pod. Child is then asked to close his eyes for 10 seconds. After this set time, child opens his eyes, climbs off the</p> |

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| <p><i>suddenly stop bouncing;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions, as well as increasing stimulation by child trying to balance both feet on a smaller surface area;</i></p> <p><i>Increase vestibular stimulation due to the absence of visual input at certain points;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on smaller, compliant surface</i></p> <p>(5 minutes)</p> |                                | <p>balance pod &amp; resumes to sitting on the kangaroo ball as the music begins to play again &amp; child closes his eyes while bouncing. Child bounces until music is paused, opens his eyes &amp; returns to the balance pods to balance on &amp; close his eyes for 12 seconds. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music &amp; practicing to maintain balance while eyes are closed.</p> <p>For every time the music stops, increase the time of balancing on the balance pods &amp; closing eyes, by 2 seconds.</p>  |
| <p><i>Stimulate the eye muscles when tracking a moving picture's pathway;</i></p> <p><i>Practice object manipulation skills (throwing &amp; catching);</i></p> <p><i>Stimulate vestibular system when standing on a uneven elevated surface;</i></p> <p><i>Encourage muscle control of holding heavy object &amp; remaining upright while having to move slightly off centre to catch ball.</i></p>  | <p>1. 'Following a planet'</p> | <p><b>Set up:</b> Place the green river stone on the floor with a 1kg &amp; 2kg ball alongside it. Place a picture of a planet to a pencil (or a relevant picture in which the child is familiar with).</p> <p><b>Instructions:</b> Child is directed to the green river stone &amp; is asked to stand on it with his two feet. The instructor holds the pencil 45cm away from his face &amp; in line with child's nose. Child must focus his eyes on the planet while he follows the 'planet's' pathway. <i>Child must not move his head while tracking the picture.</i> Instructor creates a horizontal figure of "8" with the planet-pencil which continues for 25 seconds. The instructor then stands 1.5m away from child &amp; throws the 1kg medicine ball to child &amp; child is instructed to catch it with two hands &amp; to throw it back, when catching it. Repeat this 12 times (this activity is perform at a slow pace).</p> <p><b>Second set:</b> Instructor changes the direction of the figure of "8" to follow a vertical pathway (25 seconds) in which child must follow with his eyes &amp; not moving his head (child continues to stand &amp; balance on the green river stone). Repeat the throwing &amp; catching exercise with the 2kg medicine ball.</p> <p>Third Set: Child continues to stand on the river stone. After the third set of the 25 seconds the instructor alternates between the horizontal pathway &amp; the vertical pathway with the</p> |

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| <p>(4 minutes)</p>  |                                   | <p>planet-pencil. Repeat the throwing &amp; catching exercise with the 1kg ball. If child catches each time &amp; throws it correctly then the instructor may throw the ball slightly off centre to see if child can respond by shifting his weight to one side to receive the ball, return to standing equally on both feet (returning to the centre of gravity) &amp; throws the ball back. The instructor can slightly shift from left to right. If child does not respond correctly return to just throwing towards his midline.</p>  |
| <p><i>Activate vestibular system &amp; proprioceptors in lower limbs during vigorous 'up &amp; down' motions &amp; during static balance on the compliant surface of trampoline;</i></p> <p><i>Activate the proprioceptors in the hands, to compress the objects according to how hard or soft the squeezers are;</i></p> <p><i>Activate somatosensory system by stimulating hands with tactile objects which can be squeezed, increasing or decreasing the amount of pressure needed.</i></p> <p>(4 minutes)</p> | <p>2. Jumping in 'Donut Land'</p> | <p><b>Set up:</b> Place a mini-trampoline securely in an open space. Have the three sets of squeezers, 'mini donuts' at hand. Yellow: soft rubber; Green: medium requirement of pressure needed; Blue: the highest amount of pressure.</p> <p><b>Instructions:</b> Child is asked to get onto the trampoline &amp; to jump up &amp; down. <i>Ensure child is bending at the knees upon landing &amp; taking off.</i> After about 15 jumps instruct child to stop, &amp; while standing, he must keep his knees bended (<i>Observe child's posture. He must not be bending forwards. Instructor may help child into an upright position</i>).</p> <p>Instructor asks child to close his eyes. While child's eyes remain closed, place one yellow squeezer in each of the child's hands. Child must squeeze the squeezer-rings hard &amp; to release at least 5 times. Child is asked to open their eyes &amp; resume to jumping up &amp; down on the trampoline. After about 15 jumps, instructor asks child to stop, &amp; stand on his two feet with bent knees. <i>Correct child's posture to remain upright.</i> Child is asked to close their eyes again &amp; instructor places the green set in child's hands. Child squeezes the rings 5 times each, while bending at the knees, balancing &amp; closing his eyes.</p> <p>For third set, child jumps up &amp; down 15 times. When the instructor says stop, child stops jumps &amp; remains standing &amp; bending his knees &amp; closes his eyes. Instructor places the blue set in child's hands, to squeeze &amp; release 5 times before he may open his eyes again.</p> |
| <p><i>Activate core strength when the body, limbs &amp; muscles have to support the body;</i></p> <p><i>Practice listening skills &amp; following instructions when using verbal cues,</i></p>  | <p>3. 'Spiderman'</p>             | <p><b>Set up:</b> In a wide open space, place out 10 alphabet cards with letters &amp; pictures on. Place them out in a 'zig-zag' pattern. Depending on child's height &amp; length of limbs, allow enough space between each card. At the end of the cards, place 3 small cones in a vertical line from the cards. Measure about ½ a meter between each cone.</p> <p><b>Instructions:</b> Instructor first demonstrates the actions to child &amp; will then perform each step with child, while using verbal cues. Child goes down on his haunches &amp; places one hand on the first card &amp; reaches forward for the other hand to rest on the next card.</p>   |

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| <p><i>Activate proprioceptors in upper &amp; lower limbs when is pressure is applied to joints;</i></p> <p><i>Maintain body in equilibrium even though the body is in a different position.</i></p> <p><i>Activate dynamic balance when jumping &amp; landing ;</i></p> <p><i>Encourage spatial orientation when having to figure out how high to jump when jumping over the cones</i></p> <p>(5 minutes)</p>  |                              | <p><i>Instruct child to either say the letter that is printed on the card or what the picture is, when reaching one card at a time. Child ‘climbs’ from one car to the next with feet following, until reaching the cones.</i></p> <p>When reaching the last card, child may stand, &amp; is shown to jump with two feet over the cones, one after the other. <i>Ensure the child bends their knees upon landing.</i> After the third cone, child may walk back to the start of the cards.</p> <p>Repeat this exercise 3 times.</p>   |
| <p><b>Cool down</b></p> <p><i>Stimulate the vestibular system during linear directions of movement (forwards &amp; backwards);</i></p> <p><i>Stimulate proprioceptors in the upper limbs by applying compression to the joints when walking forwards &amp; backwards to touch the picture;</i></p> <p><i>Stimulate back strength &amp; neck muscles while lifting up;</i></p> <p><i>Focus on left-right discrimination by calling out what hand child must use to touch the picture;</i></p> | <p>‘Rocking to Hercules’</p> | <p><b>Set up:</b> Place a coloured in picture of a character that child can identify with (e.g. Hercules) on a clear wall, about ½ meter off the ground. Place a small pilates ball about half the length of the child, away from the wall.</p> <p><b>Instructions:</b> Child is asked to lie on his stomach on the ball &amp; his hands rest on the floor. Instructor may hold the child by the knees to ensure he does not fall off when walking forward. Instructor asks the child to show him/ her which is his left hand &amp; which is his right. <i>If he indicates the wrong answer, place a sticker on his left hand to help him remember.</i> Instructor then rocks child on the ball, forwards &amp; backwards at a medium pace, for 30 seconds. Once the rocking is complete, child is shown to walk forwards towards Hercules, on the palms of his hands (while the ball rolls under him) &amp; to touch the picture with his left hand. He is then asked to walk backwards. Then child is asked to walk forwards to touch Hercules with his right hand &amp; then to walk backwards again. Complete at least 6 times with child walking forwards to touch Hercules/or the picture, while the pilates ball is rolling them.</p> <p>Repeat this exercise another two more times. Begin with the 30 seconds rock, forwards &amp; backs, followed by child walking forwards to touch the picture.</p> |

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| <p><i>Encourage cognitive &amp; listening skills when learning to respond correctly to instructions</i></p> <p>(4 minutes)</p> |  |  |
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| SUBJECT A  | NOVEMBER  | WEEK 2: 30 minutes x2   |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate &amp; stimulate proprioceptors in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practice the understanding of verbal instruction &amp; listening skills</li> </ul> |   |   |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> <li>• Practicing motor planning</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Balance pod (1)</li> <li>• Medium sized cones (5)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg medicine ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Mini trampoline (1)</li> <li>• Multi-purpose jungle gym: wooden ramp, thick rope, secure monkey bars</li> <li>• Alternative: A flight of stairs</li> <li>• Stop watch (1)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones: (3)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1)<br/>Yellow: 8.5 cm (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES                | EXPLANATION   |
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| <p><b>Warm up</b></p> <p><b>To:</b></p> <p><i>Maintain routine by introducing the same activity which begins the routine;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> <p><i>Activate vestibular system</i></p> | <p>‘ Musical bounces’</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Instructor has the relevant CD and song in the CD player. Place one ‘hedge-hog’ cushion, upside down (on its rounded side) 2m away from the kangaroo ball. Place a 1kg medicine ball alongside it.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle. When the music plays, child bounces up &amp; down in place &amp; is asked to close their eyes while bouncing. Ensure child is pushing up from their knees &amp; thighs. When instructor pauses the music, child must instantly stop &amp; is asked to open their eyes, get off the kangaroo ball &amp; walk over to the upside down balance pod. Child places one foot on the balance pod &amp; then the other foot to maintain his balance. Instructor may assist child onto the balance pod. Once child has regained their balance, instructor gives a 1kg ball to child to hold while balancing. Child is then asked to close his eyes for 10 seconds. After this set time, child opens his eyes, climbs off the balance pod, gives the ball back to the instructor &amp; resumes to sitting on the kangaroo ball as music begins to play again &amp; child closes his eyes while bouncing. Child</p> |



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| <p><i>through 'up &amp; down' motions, as well as increasing stimulation by child trying to balance both feet on a smaller surface area;</i></p> <p><i>Increase vestibular stimulation due to the absence of visual input at certain points;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on smaller, compliant surface</i></p> <p>(5 minutes)</p>  |                                    | <p>bounces until music is paused, opens his eyes &amp; returns to the balance pod, to stand &amp; and regain his balance. Instructor gives him the 1kg ball to hold &amp; then to close his eyes for 12 seconds. He may then return to the bouncing ball. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music &amp; practicing to maintain balance while eyes are closed.</p> <p>For every time the music stops, increase the time of balancing on the balance pod &amp; closing eyes, by 2 seconds.</p>  |
| <p><i>Activating dynamic balance by jumping up &amp; down, along with activating static balance by standing on a compliant surface;</i></p> <p><i>Activate proprioception in upper limbs by throwing &amp; catching different weights of balls &amp; in the lower limbs when jumping up &amp; down &amp; having to stabilise a position;</i></p> <p><i>Practice motor planning &amp; spatial awareness (figure-ground) by having to process the change in height that child must jump;</i></p> <p><i>Practice ball manipulation skills while throwing &amp; catching with the hands</i></p> <p>(6 minutes)</p> | <p>1. 'Reaching mountain tops'</p> | <p><b>Set up:</b> Place out 3 river stones, in a vertical line (red, green &amp; yellow) with the one balance pod 2 feet away from the yellow river stone.</p> <p><b>Instructions:</b> Child is asked to jump with two feet onto the red river stone &amp; to jump back down. This is followed by, jumping up onto the green river stone &amp; then back down. Continue this action onto the yellow river stone. After jumping off the yellow river stone, child may climb into the balance pod to maintain his balance. Instructor throws a 1kg ball to child for him to catch. Throw &amp; catch 10 times, then child may climb off the balance pod &amp; return to repeat this activity again.</p> <p><b>Progression:</b></p> <p><b>Set up:</b> Leaving the red, the yellow river stone &amp; the balance pod in place, use the second red river stone to be as a base for the green river stone. Therefore, place the green river stone on to the red river stone which will slightly increase the jumping height.</p> <p><b>Instructions:</b> Child repeats the jumping action onto &amp; off the river stones. Remind him to bend deeper with his knees so he can jump higher onto the red-green river stones. Once reaching the balance the instructor throws the 1kg ball to him.</p> <p>Repeat this set for a second time. Upon reaching the balance pod, instructor throws the 2kg medicine ball to the child. Throw &amp; catch 10 times.</p> |
| <p><i>Stimulate vestibular system</i></p>  | <p>2. 'Riding in a spinning</p>    | <p><b>Set up:</b> Place the rounded, rocking bowl on a floor mat. Set out 5 medium-sized cones 1m</p>  |

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| <p><i>during rotation, along with the change of direction while running through cones;</i></p> <p><i>Target spatial orientation by moving through &amp; around obstructions;</i></p> <p><i>Create a functional task as child is instructed to retrieve an object by making his way through obstacles;</i></p> <p><i>Activate proprioceptors in upper limbs', enabling contraction to occur while retrieving &amp; grasping the weighted balls</i></p> <p>(7 minutes)</p> | <p>space ship'</p>               | <p>away. The 5 cones are placed out in a vertical line, about 50 cm apart from each other. Place a 1kg &amp; a 2kg medicine ball next to the bowl.</p> <p><b>Instructions:</b> Instructor asks child to sit up straight inside the bowl &amp; spins child according to the following instructions: Child is asked to close his eyes during the spinning. Instructor spins child 10 times to the right, stops the bowl with a firm jerk &amp; spins child to their left 10 times. After the second rest period, return to spinning child to the right once again but just 10 times &amp; then to the left 10 times. Speed of spinning: fast spin of 1 second upon each rotation. After being spun wait, about 5 seconds or until child can respond to saying he is not dizzy &amp; then he may stand up. Child runs in &amp; around the cones to pick up one of 3 subjects &amp; returns back to the bowl weaving in &amp; out of the cones. Child is asked to sit back inside of his 'spinning space ship'.</p> <p>Instructor demonstrates to child that he must run around the cones, weaving in &amp; out like a 'fast space ship' while holding one of the 'planets' (medicine balls). Once reaching the last cone he must turn around &amp; run back in between all the cones, back to the space ship. Rather let child walk through the cones to get the correct motion, before he progresses to running.</p> <p>Repeat both tasks two more times, following the above procedure. First round: child holds the 1kg when running through the cones, second round, holding the 2kg ball. In the third set: Instructor spins the child 5 times to the right, stops the bowl suddenly &amp; with a firm jerk, spins child to their left, 5 times. After the second rest period, return to spinning the child to the right once again but just for 5 times &amp; then to the left. Child holds the 1kg when running through the cones.</p> |
| <p><b>Cool down</b></p> <p><i>Practice functional movements when child performs a multiple of different activities together;</i></p> <p><i>Stimulate proprioceptors in upper limbs during contraction while climbing, pulling of the joints while hanging &amp; compression</i></p>  | <p>3. 'Tarzan in the jungle'</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains a swing, monkey bars, a net, a thick rope secured to a beam at the top of a 3m wooden ramp which also has support for footing. Alongside the jungle gym place out 2 river stones (yellow, red) with a meter in between each river stone. Followed by 3 small cones, with a meter in between. <i>If a ramp/jungle gym is not accessible:</i> use a flight of stairs as the instructor may be at the top of about 5 stairs away from child, while child is at the bottom of the stairs.</p> <p><b>Instructions:</b> Child steps onto the wooden ramp &amp; grasps the thick rope attached onto a secure railing on the jungle gym. Instructor is just behind child to act as support for if child may let go of rope. Child begins to take steps up the ramp holding the rope &amp; climbs up</p>   |

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| <p><i>when body weight is supported by arms, lower limb proprioceptors are also activated when supporting body while walking up steep ramp</i></p> <p>(5 minutes)<br/>Rest- 30 seconds<br/>(4 minutes)</p> |  | <p>with one hand being placed in front of the other. Once reaching the top, if there are monkey bars, assist child in grasping the first bar &amp; try move onto the second then the third bar, then the fourth. If the child feels confident enough allow him to do as many as he can. But the instructor needs to be just below him to show that he/she is there to catch him. Assist in lowering the child back to the ground. *'Wheelbarrow' child to the yellow river stone. When reaching the yellow river stone, tell child to climb up onto it with one hand then the other &amp; then moving forwards step down off it onto the other side, one hand at a time. Repeat this up- down action with the hands, onto the red river stone. Then child may stand up (instructor placing their legs down on ground) &amp; hop with his two feet over the 3 cones until he reaches the ramp. Repeat this exercise 5 times climbing up &amp; grasping &amp; moving across at least 3 monkey bars each time.</p> <p><i>For the steps option:</i> Set up the two river stones at the bottom of the stairs. Child holds one end of the rubber exercise band &amp; instructor holds the other end a few steps away. An assistant is just behind the child to support &amp; act as security for safety precautions. Child begins to climb, leans slightly back (with assistant guiding him up) &amp; takes one step at a time while grasping the rubber band &amp; moving hands up. Once reaching the instructor, child is told to continue holding the rubber band, straighten arms, &amp; lean body backwards, trying to pull the rubber band away from instructor (<i>ensure that child's weight is leaning backwards creating a pull on his elbow &amp; shoulder joints</i>). Child may hold this for 10 seconds before releasing &amp; walking back down the stairs to resume to the beginning position. *'Wheelbarrow' child around at the bottom of the stairs &amp; once reaching the bottom, 'wheelbarrow' towards the yellow river stone, to climb up onto with his hands (as is indicated above) followed by the red river stone. After 'wheel barrowing' off red river stone, child stands up to hop on two feet over the 3 cones. Child climbs up the 'mountain' again. Repeat these three activities three times. <i>Allow for rest period in between the sets.</i></p> |
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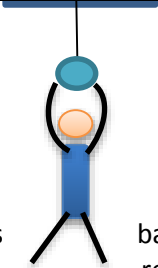
\*'wheelbarrow': child is shown to lie down flat on the ground, on his stomach. Instructor will pick up child's legs and support him by the knees while child is shown to push up onto his arms. Instructor ensures that child's low back is not bent. Child is asked to 'walk forwards on his hands'.

| SUBJECT A  | NOVEMBER  | WEEK 3: 30 minutes x2   |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate &amp; stimulate proprioceptors in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practice the understanding of verbal instruction &amp; listening skills</li> </ul> |   |   |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> <li>• Practicing motor planning</li> <li>• Bilateral integration</li> <li>• Cognitive thought processing</li> </ul>                         | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Balance pod (1)</li> <li>• Coloured cardboard circles (4)</li> <li>• Medium-sized cones (4)</li> <li>• Picture of Hercules (1)</li> <li>• Small tactile balls (6)</li> <li>• Small basket (1)</li> <li>• Scooter board (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Picture of familiar cartoon characters (5)</li> <li>• Mini trampoline (1)</li> <li>• 1 meter rope (1)</li> <li>• Prestik</li> <li>• Medium-sized rubble ball with handle (1)</li> <li>• Secured monkey bars / rail</li> <li>• Pilates ball / peanut ball(1)</li> <li>• Stop watch (1)</li> <li>• Foam mats-numbered 1-7 (7)</li> </ul> |

| SUB-AIMS  | ACTIVITIES               | EXPLANATION   |
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| <p><b>Warm up</b></p> <p><b>To:</b></p> <p><i>Maintain routine by introducing the same activity which begins the routine;</i></p> <p><i>Initiate progression of including more dynamic bouncing, moving from one target to the next;</i></p> <p><i>Activate muscle in the lower</i></p> | <p>‘Musical bounces’</p> | <p><b>Set up:</b> Place out the 4 different coloured cardboard circles, in a square. Measure 1.5m between each circle &amp; set them down with prestik, to secure them to the floor. Child sits on a kangaroo ball on the red circle. Instructor has the relevant CD &amp; song in the CD player. Place one balance pod, upside down (on its rounded side) 2m away from the set up square of circles.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle. When the music plays, the child is shown to bounce from the red circle to the blue circle, then yellow then green and back to the red circle. Continue this pattern while the music plays. When music stops, child must stop bouncing &amp; gets off the kangaroo ball &amp; walks over to the upside down balance pod. Child places one foot on the pod &amp; then the other foot to maintain his balance. Once child has regained their balance, child is then asked to close his eyes for 14 seconds. After this set time, child opens his eyes, climbs off the balance pod &amp; resumes to sitting on the</p> |

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| <p><i>limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> <p><i>Activate vestibular system during 'up &amp; down' motions, as well as increasing stimulation when child maintains balance with both feet on a smaller surface area;</i></p> <p><i>Increase vestibular stimulation due to the absence of visual input at certain points;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on smaller, compliant surface</i></p> <p>(5 minutes)</p> |                                  | <p>kangaroo ball, which has been set on the red circle, as the music begins to play again &amp; child bounces to each circle, making the square. Child bounces until music is paused, opens his eyes &amp; returns to the balance pods to stand on &amp; regain his balance &amp; to close his eyes for 14-16 seconds. Then to return to the bouncing ball. Alternate between 15 seconds &amp; 25 seconds of child bouncing on the ball before pausing the music &amp; practicing to maintain balance while eyes are closed.</p> <p>For every time the music stops, increase the time of balancing on the balance pod, by 2 seconds, along with closing eyes. <i>Initiate this only if child is able to retain their balance.</i></p>  |
| <p><i>Continue stimulating vestibular function by maintaining dynamic balance on one leg, which may also contribute to activate muscles in lower limbs while hopping;</i></p> <p><i>Practice ball manipulation skills</i></p> <p><i>Stimulate proprioception in limbs: legs having to support the body while balancing;</i></p> <p><i>Motivate motor planning when child has to make his way from</i></p>   | <p>1. 'Hercules' fire balls'</p> | <p><b>Set up:</b> Place one small cone in an open space with a basket next to it. Measure 3m vertically from the first cone &amp; set down the second small cone. Place a picture of Hercules on the second cone with 6 tactile balls next to 'Hercules' Tower'.</p> <p><b>Instructions:</b> Child is shown to hop on one leg (of own preference) to Hercules, pick up 1 tactile ball ('fire ball') &amp; to hop back to the first cone &amp; place the ball inside the basket. Child may swop legs when hopping back to the first cone. Child may then hop back on one leg to retrieve another tactile ball ('fire ball'). <i>Encourage child to alternate between legs on each trip to the 'Hercules' Tower'.</i> Child may rest after retrieving 3 balls, before claiming the next 3 balls.</p> |

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| <p><i>one to the next to retrieve the balls</i></p> <p>(5 minutes)</p>   |                                  |  |
| <p><i>Activate proprioceptors in the upper limbs when compression is applied on the joints while child rotates themselves;</i></p> <p><i>Stimulate vestibular system when body is rotated, along with a quick change in direction;</i></p> <p><i>Encourage cognitive processing while the child has to remember how many times to rotate himself, along with correctly responding the verbal instruction</i></p> <p>(5 minutes )</p>                                     | <p>2. 'Spinning to cartoons'</p> | <p><b>Set up:</b> In a scattered manner, Place 4 cones apart from each other, in an open space (hallway/room). Secure pictures that are relevant to child, onto the cones (e.g. characters from Hercules). Have the scooter board, with wheels, ready for the child.</p> <p><b>Instructions:</b> Child is asked to lie down on his stomach, on the scooter board, with his arms out in front of him, legs bent at the knees which should keep feet off the floor. Assist child in showing them how to spin himself, turning the scooter board around, using his arms. While using his arms, child is shown to turn 5 times to the left, &amp; 5 times to the right. Instructor calls out the cartoon's name, &amp; child must try 'scooter' (walking on the palms of their hands &amp; pulling on the ground with arms) themselves forward towards the cone with the cartoon it. Once reaching &amp; touching the cartoon, child is asked again to spin to the left 5 times &amp; then spin to the right. <i>Instructor may assist child in propelling forwards towards the cones, in order to get the motion correct.</i></p> <p>Alternate between child turning themselves &amp; moving forward to touch a cone.</p> |
| <p><i>Stimulate vestibular system during jumping, along with activating dynamic balance of holding the body upright while the limbs moving, bilaterally;</i></p> <p><i>Activate proprioceptors in arms &amp; hands to function as they need to sense where they are in relation to the hanging ball above the child's head;</i></p> <p><i>Practice bilateral integration as both sides of the body need to be coordinated together when performing jumping jacks</i></p> | <p>3. 'Bouncing soldier'</p>     | <p><b>Set up:</b> Place the mini-trampoline outside, alongside the jungle gym which has monkey bars. Attach the 1m cord or rope to the ball with a small handle on it. Place the rope onto monkey bars or on a secure rail. Ensure the ball is above child's head by asking child to lift up both of his arms above his head, extending at the elbows to touch the ball. Child should be able to clap both hands over the ball while standing on two feet &amp; not having to go on their 'tippy toes' to reach for the ball. It should be at a comfortable level.</p> <p><b>Instructions:</b> Child is asked to jump up &amp; down on the mini trampoline, 15 times &amp; bending at the knees, upon landing. Child is then told to step off the trampoline &amp; to stand under the hanging ball on the rope, with his arms along his sides 'like a soldier' &amp; feet are standing together. <b>Monkey bar</b> Child is shown to jump up, with feet stepping out at shoulder-width apart, while both of his arms come up along his sides &amp; extend up above his head to touch the hanging ball with both hands.</p>   |

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| <p>(6 minutes)</p>   |                                 |  <p>Child is then told to bring his arms back in to stand alongside each other, back down to his sides as his feet jump returning to the 'soldier' stance. Repeat this 5 times at a slow pace ensuring child gets the movement &amp; body position correct. Return to jumping on the trampoline.</p> <p><i>Repeat these two activities, three times.</i></p>  |
| <p><b>Cool down</b></p> <p><i>Stimulate vestibular system during forward-backward motions of rocking;</i></p> <p><i>Stimulate proprioceptors in arms &amp; hands while compression is applied on joints when walking out to touch numbers;</i></p> <p><i>Stabilise core strength when body position is elongated &amp; walking out to touch numbers or in</i></p> <p>(7 minutes)</p> | <p>4. 'Rocking caterpillar'</p> | <p><b>Set up:</b> Have a pilates ball or peanut ball for the rocking process. Place out 7 foam mats in a semi-circle. Each mat is numbered from 1-7.</p> <p><b>Instructions:</b> Indicate to child to lie down on the pilates ball, on his stomach as the instructor will support his body while rocking. Rock child forwards &amp; backwards, 10 times at a medium pace. Once halting the rocking motion, ask child to stand up &amp; walk to numbered mats. Instructor demonstrates to child that he may go down onto his haunches in the middle of the semi-circle. Instructor will call out a number &amp; child must walk on his hands, forwards towards the number, to touch the number. Child's body position must be in an elongated position, with the feet remaining in place &amp; the hands on the foam number. Once touching the number, child may walk back on his hands towards his feet, back to the starting position of being on his haunches. Instructor calls out another number &amp; child repeats the 'walking-out-into-a-bridge' movement. Call out 5 numbers before asking child to stand up &amp; return to the pilates ball, to be rocked.</p> <p><i>Repeat these two activities three times. If child is seems tired and the instructor can see that child's attention span is starting to drift, only repeat twice.</i></p> |



| SUBJECT A  | NOVEMBER   | WEEK 4: 30 minutes x2  |
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| <p><b>General Aims:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• To activate &amp; stimulate proprioceptors in upper &amp; lower limbs</li> <li>• Maintain balanced body positions</li> <li>• Maintain a routine for child</li> <li>• Create a structured &amp; familiar environment to help the child feel secure in the sessions</li> <li>• Practice the understanding of verbal instruction &amp; listening skills</li> </ul> |  |  |
| <p><b>Specific Aims:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordinating body over &amp; around objects</li> <li>• Encourage the activation of muscle strength &amp; muscle control</li> <li>• Motivate spatial awareness</li> <li>• Practice simple ball manipulation skills</li> <li>• Practice eye tracking</li> <li>• Practicing motor planning</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Coloured cardboard circles</li> <li>• 1 kg medicine ball (1)</li> <li>• 2kg medicine ball (1)</li> <li>• Medium-sized cones (5)</li> <li>• Picture of Hercules</li> <li>• Small tactile balls (6)</li> <li>• Small basket (1)</li> <li>• Picture of familiar cartoon characters (5)</li> </ul> | <ul style="list-style-type: none"> <li>• Scooter board (1)</li> <li>• Mini trampoline (1)</li> <li>• 1 meter rope (1)</li> <li>• Prestik</li> <li>• Medium-sized rubble ball with handle (1)</li> <li>• Secured monkey bars / rail</li> <li>• Pilates ball / peanut ball(1)</li> <li>• Stop watch (1)</li> <li>• Foam mats-numbered 1-8 (8)</li> </ul> |

| SUB-AIMS  | ACTIVITIES               | EXPLANATION   |
|---|--------------------------|---|
| <p><b>Warm up</b></p> <p><b>To:</b></p> <p><i>Maintain routine by introducing the same activity which begins the routine;</i></p> <p><i>To initiate progression of including more dynamic bouncing, moving from one</i></p> | <p>‘Musical bounces’</p> | <p><b>Set up:</b> Place out the 4 different coloured cardboard circles, in a square. Measure 1.5m between each circle &amp; set them down with prestik securing them to the floor. Child sits on a kangaroo ball which is placed on the red circle. Instructor has the relevant CD &amp; song in the CD player.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle. When the music plays, child is shown to bounce, from the red circle to the blue circle, then yellow then green &amp; back to the red circle. To continue this pattern while the music plays. When music stops, child must stop bouncing &amp; get off the kangaroo ball &amp; is told to stand on one leg, along with holding the 2kg medicine ball &amp; to close his eyes to maintain balance for 10 seconds. After the one-leg balance, child is asked to open his eyes, swop to the other leg &amp; to</p> |



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| <p><i>target to the next;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilise the body on the ball &amp; learning to control body when they need to suddenly stop bouncing;</i></p> <p><i>Activate vestibular system during 'up &amp; down' motions, as well as increasing stimulation by child trying to balance both feet on a smaller surface area;</i></p> <p><i>Increase vestibular stimulation due to the absence of visual input at certain points;</i></p> <p><i>Increase proprioception in lower limbs to help support body while on smaller, compliant surface</i></p> <p>(5 minutes)</p> |                                  | <p>resume to closing his eyes again for 10 seconds. When this allocated time is complete child may open his eyes, place the 2kg ball down &amp; return to the kangaroo ball which has been set in place on the red circle. As the music begins to play again, child bounces to each circle which makes up the square. Child bounces until music is paused &amp; stands up to balance on one leg again while holding the 2kg ball. Alternate between the two legs. In terms of bouncing on the ball, following the square formation, alternate between 15 seconds &amp; 25 seconds before pausing the music &amp; practicing to maintain balance while eyes are closed.</p>  |
| <p><i>Continue stimulating vestibular function by maintaining dynamic balance on one leg, which may also contribute to activate muscles in lower limbs while hopping;</i></p> <p><i>Practice ball manipulation skills</i></p> <p><i>Stimulate proprioception in limbs: legs having to support the body while balancing;</i></p>   | <p>2. 'Hercules' fire balls'</p> | <p><b>Set up:</b> Place one small cone in an open space with a basket next to it. Measure 3m vertically from the first cone &amp; set down the second small cone. Place a picture of Hercules on the second cone with 6 tactile balls next to 'Hercules' Tower'.</p> <p><b>Instructions:</b> Child is shown to hop on one leg (of own preference) to Hercules, pick up 1 tactile ball, 'fire ball' &amp; to hop back to the first cone &amp; place the ball inside the basket. Child may swap legs when hopping back to the first cone. Child may then hop back on one leg to retrieve another 'fire ball' (tactile ball). <i>Encourage child to alternate between legs on each trip to the 'Hercules' Tower'.</i> Child may rest after retrieving 3 balls, before claiming the next 3 balls.</p> |

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| <p><i>Motivate motor planning when child has to make his way from one to the next to retrieve the balls</i></p> <p>(5 minutes)</p>   |                                  |  |
| <p><i>Initiate progression as another cone is added, therefore increasing the amount of work child will perform;</i></p> <p><i>Activating proprioceptors in the upper limbs by increasing compression on the joints which need to rotate the scooter board in different directions;</i></p> <p><i>Stimulating the vestibular system by the body being rotate, along with the quick change in direction.</i></p> <p><i>Encouraging cognitive processing while the child has to remember how many times to rotate himself, along with correctly responding the verbal instruction</i></p> <p>(5 minutes)</p> | <p>3. 'Spinning to cartoons'</p> | <p><b>Set up:</b> Place out 5 cones apart from each other in a scattered manner, in an open space (hallway/room). Stick on pictures relevant to child on the cones (e.g. characters from Hercules). Have the scooter board, with wheels, ready for child.</p> <p><b>Instructions:</b> Child is asked to lie down on their stomach, on the scooter board, with their arms out in front of them, legs bent at the knees to keep feet off the ground. Assist child in showing them how to spin themselves, rotating the scooter board around, using their arms. Tell child to turn 5 times to the left, using their arms, &amp; 5 times to the right. Instructor says the cartoon's name, &amp; child must try 'scooter' (walking on the palms of their hands &amp; pulling on the ground with arms) themselves forward towards the cone with the cartoon it. Once reaching &amp; touching the cartoon, child is asked again to spin to the left 5 times &amp; then spin to the right. <i>Instructor may assist child in propelling forwards towards the cones, in order to get the motion correct.</i></p> <p>Alternate between child turning themselves &amp; moving forward to touch a cone.</p> |

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| <p><i>Initiate progression with increasing the amount of star jumps child needs to perform;</i></p> <p><i>Stimulate vestibular system during jumping, along with activating dynamic balance of holding the body upright while the limbs moving, bilaterally;</i></p> <p><i>Activate proprioceptors in arms &amp; hands to function as they need to sense where they are in relation to the hanging ball above the child's head;</i></p> <p><i>Practice bilateral integration as both sides of the body need to be coordinated together when doing star jumps</i><br/>(6 minutes)</p> | <p>5. 'Bouncing soldier'</p>    | <p><b>Set up:</b> Place the mini-trampoline outside alongside the jungle gym which has monkey bars. Attach the 1m cord or rope to the ball with a small handle on it. Place the rope onto monkey bars or onto a secure rail. Ensure the ball is above child's head by asking child to lift up both of their arms above their head, extending at the elbows, in order to touch the ball. Child should be able to clap both hands over the ball while standing on two feet &amp; not having to go on their 'tippy toes' to reach for the ball. It should be at a comfortable level.</p> <p><b>Instructions:</b> Child is asked to jump up &amp; down on the mini trampoline, 15 times &amp; bending at the knees, when landing. Child is then told to step off the trampoline &amp; to stand under the hanging ball on the rope, with his arms along his sides 'like a soldier' &amp; feet together. Child is shown to jump up, with feet stepping out to shoulder-width apart, while both of his arms come up along his sides &amp; extend up above his head to touch the hanging ball with both hands. Child is then told to bring his arms back down to his sides as his feet jump back in, to stand alongside each other, returning to the 'soldier' stance.</p> <p>Repeat this 7 times at a slow pace ensuring the child performs the movement correctly &amp; body position is upright. Return to jump on the trampoline.</p> <p><i>Repeat these two activities, three times.</i></p> |
| <p><b>Cool down</b></p> <p><i>Stimulate vestibular system during forward-backward motions of rocking;</i></p> <p><i>Stimulate proprioceptors in arms &amp; hands while compression is applied on joints when walking out to touch numbers;</i></p> <p><i>Stabilise core strength when body position is elongated &amp; walking out to touch numbers or in</i></p>  | <p>6. 'Rocking caterpillar'</p> | <p><b>Set up:</b> Have a pilates ball or peanut ball for the rocking process. Set down 8 foam mats in a semi-circle on the floor. Each mat is numbered from 1-8.</p> <p><b>Instructions:</b> Instruct child to lie down, on his stomach, on the pilates ball as the instructor will support his body while rocking. Rock child forwards &amp; backwards, 10 times, at a medium pace. Once halting the rocking, demonstrate to child to go down on his haunches in the middle of the semi-circle. Instructor will call out a number &amp; child must walk forwards towards the number, with his hands, to touch the number. Child's body position must be in an elongated position, with the feet remaining in place &amp; the hands on the foam number. Once touching the number, child may walk back on his hands towards his feet, back to the starting position of being on his haunches. Instructor calls out another number &amp; child repeats the 'walking-out-into-a-bridge' movement. Call out 5 numbers before asking child to stand up &amp; return to the pilates ball to be rocked.</p>  |


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| (7 minutes) |  | <i>Repeat these two activities three times. If child is seemingly tired &amp; the instructor can see that child's attention span is starting to drift only repeat twice.</i> |
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# **APPENDIX E**

## **Sensory-motor integration Programmes**

**SUBJECT G**

| SUBJECT G   | MAY   | WEEK 1: 30 minutes x2  |
|---|---|--|
| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• Activate lower limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Helping child understand instructions (keywords) &amp; respond with the required action</li> </ul> |   |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Teaching simple ball skills</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Song on a CD with CD player</li> <li>• Measuring tape (1)</li> <li>• Mini-trampoline (1)</li> <li>• Colour cardboard circles (4)<br/>(Colours: green, red, yellow, blue;<br/>Diameter: 12 cm)</li> </ul> | <ul style="list-style-type: none"> <li>• Prestik</li> <li>• Rotating office chair (1)</li> <li>• Medium sized tactile ball (1)</li> <li>• Pilates ball (1)</li> <li>• Picture of 'Buzz Light-Year' (1)</li> <li>• Floor mat (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES  | EXPLANATION  |
|--|---|--|
| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions</i></p> | <p>'Bouncing toys'</p> <p>Bouncing on a kangaroo ball</p> | <p><b>Set up:</b> Child is directed to sit on kangaroo ball. One song has been chosen from child's CD (that the child is familiar with or self-chosen).</p> <div style="text-align: center;">  </div> <p><b>Instructions:</b> Instruct child to sit on the kangaroo ball, holding the handle with both hands. Instructor may need to support child from behind his back to help him maintain an upright posture while bouncing &amp; therefore placing slight pressure on his shoulders. When the music</p> |

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| <p>(4 minutes)</p>  |   | <p>plays, child bounces up &amp; down in place on the kangaroo ball 'like a bouncing toy'. <i>The instructor can gently push the child's shoulders 'down' &amp; help bend their knees to indicate the sensation of 'bouncing' and the 'up &amp; down' motion.</i> When instructor pauses music, child must stop instantly. Instructor can stop pushing on child's shoulders (for the first few times, child may need to be firmly held by the shoulders when indicated to stop). Pause the song for about 5 seconds before pressing play again &amp; child may continue bouncing (release child's shoulders). Complete the song before moving onto the next activity.</p>  |
| <p><i>Continue with vestibular stimulation through vigorous up &amp; down motions;</i></p> <p><i>Introduce spatial orientation using visual targets which child must hop to (indicating structured boundaries);</i></p> <p><i>Activate proprioception in lower limbs through joint compression &amp; traction during hopping &amp; jumping</i></p> <p>(4 minutes)</p> | <p>1. 'Hopping bunny'</p>                   | <p><b>Set-up:</b> Place a mini-trampoline securely on the floor. A few steps away, in a clear space measure out 2m on the floor with a measuring tape. Place 4 bright coloured cardboard circles in a vertical row on the floor over that distance, one after the other.</p> <p><b>Measurements:</b> 4 circles over 2m with 30cm in between each other. The row will be vertically in front of child.</p> <p><b>Instructions:</b> Child is instructed to hop from the one circle to the next, keeping feet together while hopping. <i>Ensure that you have informed &amp; demonstrated that he must bend his knees when landing on each hop.</i> Upon completing one row of hopping child may turn around &amp; hop back to the starting circle &amp; climb onto trampoline. Child is instructed to jump up &amp; down on trampoline. Count with child up to 10. Ensure that child is bending his knees when jumping. Once the 10 jumps are complete, stop &amp; assist him off the trampoline &amp; onto the first circle, to resume to hopping from circle to circle. Child may repeat these two activities twice. Increase 10 jumps to 15 when on trampoline.</p> |
| <p><i>Stimulate vestibular system through rotating motion;</i></p> <p><i>Stimulate visual system while having to focus on passing a ball;</i></p> <p><i>Teach ball manipulation skills;</i></p> <p><i>Respond to verbal instruction by using cue words to assist in understanding how to</i></p>  | <p>2. 'Spinning on a rocket into space'</p> | <p><b>Set-up:</b> Child sits on office chair with his back against the back-rest of chair (putting his seat belt on). Assistant may be needed.</p> <p><b>Instructions:</b> Instructor spins child 12 times to the left &amp; then 12 times to the right. Spinning Rate: 1 second per 360 degree turn. Child is then passed the medium-sized tactile ball &amp; is told to pass ball back to the instructor. They pass the ball back &amp; forth with child receiving it 10 times (verbally count with the child). Resume to spin the child for a second round, followed by passing tactile ball back &amp; forth 10 times.</p>   |

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| <p><i>passing the ball back &amp; forth</i></p> <p>(4 minutes)</p>   |  |   |
| <p><i>Introduce the learning steps to performing 'star jumps';</i></p> <p><i>Teach simple lower limb-coordination through 'out &amp; in' feet positions;</i></p> <p><i>Initiate simple dynamic balance during jumping</i></p> <p>(4 minutes)</p>                 | <p>3. 'Open &amp; close the gate'</p>  | <p><b>Set up:</b> Place one cardboard circle firmly on the floor with prestick. Child stands on the circle with legs and feet next to each other &amp; arms along their sides. Like a "soldier". <i>Instructor may need to physically place child in this position.</i></p> <p><b>Instructions:</b> "Open the gate": child bends knees &amp; jumps up with feet going out into second position. Feet land shoulder-width apart. Instructor shows child how to stand with legs open. <i>May need to physically assist child into this position.</i> "Close the gate": child jumps back to the "soldier" position with feet returning to standing next to each other. Complete the jumping "in" &amp; "out" 8 times. Instructor performs this exercise with child so that they can visually see &amp; try interpret what they need to do. Child then rests for 30 seconds (encourage child to count to 30 with you). Resume to "opening &amp; closing the gate" another 8 times. Repeat 3 sets of 8. Therefore child has two rest periods in between.</p> |
| <p><b>Cool Down</b></p> <p><i>Activate back &amp; neck muscles through having to lift upper body up;</i></p> <p><i>Activate muscle control of upper body to control that position;</i></p> <p><i>Learn keywords of 'up' &amp; 'down'.</i></p> <p>(3 minutes)</p> | <p>4. Flying to catch 'Buzz-Light year' (child's favourite Disney character)</p> | <p><b>Set up:</b> Place a pilates ball on the floor in front of a wall &amp; a picture i.e. 'Buzz-Light Year' as a focal point for child.</p> <p><b>Instructions:</b> Child lies with their stomach on the pilates ball, an arms-length away from the wall. <i>Instructor helps child remain on the ball to not roll off.</i> Instruct child to stretch their arms out in front of them. Upon instruction of "touch Buzz": child's arms, head &amp; shoulders are slightly lifted off the pilates ball. Feet remain on the floor without lifting. Child lifts up to "touch Buzz" &amp; then returns shoulders &amp; stretched arms back to the ground. Repeat 3 times before resting for a 30 second period.</p>  |



| SUBJECT G   | MAY   | WEEK 2: 30 minutes x2  |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• Activate lower limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Helping child understand instructions (keywords) &amp; respond with the required action</li> </ul> |   |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Practice simple eye fixation</li> <li>• Teaching simple ball passing skills</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story song on a CD with CD player</li> <li>• Measuring tape (1)</li> <li>• Cardboard circles (5)<br/>(Colours: green, red, yellow, blue, black;<br/>Diameter: 12 cm)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• Basket (1)</li> <li>• Colourful Disney toys (3)</li> <li>• Rotating office chair (1)</li> <li>• Medium sized tactile ball (1)</li> <li>• Pilates ball (1)</li> <li>• Picture of 'Buzz Light-Year' (1)</li> <li>• Floor mat (1)</li> </ul> |

| SUB-AIMS:  | ACTIVITIES             | EXPLANATION  |
|--|------------------------|--|
| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright; Activate vestibular system through 'up &amp; down' motions</i></p> | <p>'Bouncing toys'</p> | <p><b>Set up:</b> Child is directed to sit on a kangaroo ball. One song has been chosen from child's CD (that the child is familiar with or self-chosen).</p> <p><b>Instructions:</b> Child is told to sit on kangaroo ball, holding handle with both hands. <i>Instructor may need to support child from behind his back to help him maintain an upright posture while bouncing.</i> When music plays, child bounces up &amp; down in place on the kangaroo ball 'like a bouncing toy'. <i>Instructor can gently push child's shoulders 'down' &amp; help bend their knees to indicate the sensation of 'bouncing' &amp; the 'up and down' motion.</i> When instructor pauses music, child must stop instantly. Instructor can stop pushing down on child's shoulders (for the first couple of times, child may need to be firmly held by the shoulders when indicated to stop). Pause song for about 5 seconds before pressing play again. Count aloud up to 5 so that child may hear the counts. Child may continue bouncing (release child's shoulders) when song plays. Complete the song before moving onto the next activity.</p> |

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| (4 minutes)  |   |  |
| <p><i>Continue with vestibular stimulation through up &amp; down motions;</i></p> <p><i>Initiate specific visual boundaries for child in order to teach spatial orientation by using colourful targets child must hop to;</i></p> <p><i>Activate proprioception in lower limbs through joint compression &amp; traction during hopping</i></p> | <p>1. Hop forward to collect Toys</p>       | <p><b>Set-up:</b> Measure out 3.5m on the floor in a clear &amp; open space. Over the measured distance, place the 5 coloured cardboard circles in a vertical row, one after the other in no particular order of colour (30cm between each other). The row will be vertically in front of child. At the starting circle, position a small basket alongside it. At the last circle, place down 3 “toys” or interesting objects.</p> <p><b>Instructions:</b> Child is instructed to hop from the one circle to the next, keeping feet together while hopping. <i>Ensure that you have informed &amp; demonstrated that they must bend their knees when landing on each hop. Instructor may need to physically show the child how to bend knees.</i> Once child gets to fifth circle, he collects one toy or object &amp; hops back on each circle, to reach the basket &amp; place objects inside. Child may continue hopping from each circle until all 3 toys have been collected &amp; placed in the basket. If instructor observes child is getting tired, child may rest for a few seconds before continuing.</p> |
| (4 minutes)  |   |  |
| <p><i>Practice fixation by attempting to get child to look at objects which he enjoys, such as his favourite Disney characters</i></p>   | <p>2. ‘Look at Toy/ Buzz Light-Year’</p>    | <p><b>Set up:</b> Seat child on a chair with his feet firmly positioned on the floor and have 3 different colourful &amp; interesting toys or pictures e.g. Toy Story characters.</p> <p><b>Instructions:</b> Hold up one character/picture &amp; tell child to look at the picture. Try encourage child to fix their gaze at the picture for at least 3 seconds. Then take another picture for child to gaze at. Go through all 3 pictures once for 3 seconds each.</p>   |
| (2 minutes)  |   |  |
| <p><i>Stimulate vestibular system through rotating motion;</i></p> <p><i>Activate static balance when instructed to stand &amp; remain in one place;</i></p>   | <p>3. ‘Spinning on a rocket into space’</p> | <p><b>Set-up:</b> Child sits on a rotating office chair with his back against the back-rest of the chair “putting his seat belt on”. Place a coloured cardboard circle just alongside the chair. Assistant may be needed.</p> <p><b>Instructions:</b> Instructor spins child 15 times to the left &amp; then 15 times to the right. Spinning Rate: 1 second per 360 degree turn. Child is assisted off chair &amp; directed to stand on two feet on circle. While standing, child is then passed the medium-sized tactile ball &amp; must pass the</p>   |

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| <p><i>Stimulate visual system while having to focus on passing a ball;</i></p> <p><i>Teach ball manipulation skills;</i></p> <p><i>Respond to verbal instruction by using cue words to assist in understanding how to passing the ball back &amp; forth</i></p> <p>(5 minutes)</p>         |   | <p>ball back to instructor. <i>Child may need to learn the skill of passing through verbal &amp; visual instruction. Therefore, instructor uses cue words “give ball” &amp; child must give ball to instructor. An assistant may be needed to physically help child to pass ball to instructor. They pass the ball back &amp; forth with child receiving it 10 times (verbally instruct child through task).</i></p> <p>Resume to spinning the child on the chair for a second round. Child is then instructed to stand on the circle, to repeat instruction when passing the tactile ball back &amp; forth (10 times).</p> <p>Repeat spinning for a third time, followed by standing in place &amp; passing ball.</p>  |
| <p><i>Practice the steps to performing ‘star jumps’;</i></p> <p><i>Teach simple lower limb-coordination through ‘out &amp; in’ feet position,</i></p> <p><i>Initiate simple dynamic balance during jumping, along with activating proprioception in lower limbs</i></p> <p>(4 minutes)</p> | <p>4. Open &amp; close the gate</p>         | <p><b>Set up:</b> Firmly place a cardboard circle on the floor with prestik. Child stands on circle with legs and feet next to each other &amp; arms along his sides, like a “soldier”.</p> <p><b>Instructions:</b> “Open the gate”: child bends at the knees and jumps up with feet going out into second position, landing with feet, shoulder-width apart. “Close the gate”: child jumps back to the “soldier” position with feet returning to standing next to each other. Complete the jumping “in” &amp; “out” 8 times. Instructor performs this exercise with child so that they can visually see &amp; try interpret what they need to do. Child then rests for 30 seconds (encourage the child to count to 30 with you). Resume to “opening &amp; closing the gate” another 8 times. <i>Count aloud so that child hears the verbal counts &amp; indications.</i> Repeat 4 sets of 8. Therefore child has three rest periods in between &amp; <i>child performs each jump at a slow pace.</i></p> |
| <p><b>Cool Down</b></p> <p><i>Activate back &amp; neck muscles through having to lift upper body up;</i></p> <p><i>Activate muscle control of upper body to control that position;</i></p> <p><i>Learn keywords of ‘up’ &amp;</i></p>  | <p>5. Flying to catch ‘Buzz-Light year’</p> | <p><b>Set up:</b> Place a pilates ball on the floor in front of a wall &amp; a picture e.g. ‘Buzz-Light Year’ as a focal point for child. Place floor mat just between pilates ball &amp; wall.</p> <p><b>Instructions:</b> Child lies with their stomach on pilates ball, an arm-length away from the wall. Instructor assists in helping child remain on the ball &amp; not roll off. Instruct child to stretch their arms out in front of them. Upon the verbal instruction of “Touch Buzz!”, child’s arms, head &amp; shoulders are slightly lifted off pilates ball &amp; feet remain on the floor without lifting. <i>If feet lift up (as child may struggle with muscle control) instructor may gently hold child’s legs towards the floor.</i> Child lifts up to ‘touch Buzz’ &amp; then returns shoulders &amp; stretched arms back to the</p>   |

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| <p>'down'.<br/><br/>(3 minutes)</p> |  | <p>ground. Repeat 3 times before resting for a 30 second period.</p> |
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| SUBJECT G   | MAY   | WEEK 3: 30 minutes x2  |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• Activate lower limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Helping child understand instructions (keywords) &amp; respond with the required action</li> </ul> |   |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple and familiar locomotive skills</li> <li>• Practice simple eye fixation</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story song on a CD with CD player</li> <li>• Measuring tape (1)</li> <li>• Cardboard circles (6)<br/>(Colours: green, red, yellow, blue, black, pink; Diameter: 12 cm)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• Small hoop (1)</li> <li>• Colourful Disney toys (4)</li> <li>• Rainbow river stones (3)<br/>Heights: Red: 13.5 cm Green: 16 cm Yellow: 8.5 cm</li> <li>• Pilates ball (1)</li> <li>• Medium sized tactile ball (1)</li> <li>• 'Buzz Light-Year' toy (1)</li> <li>• Floor mat (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES                    | EXPLANATION   |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions</i></p> | <p>'Musical jumping bean'</p> | <p><b>Set up:</b> Child sits on the kangaroo ball (jumping bean). Use a song child knows and chooses.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music plays, child bounces up &amp; down in place on the kangaroo ball like a 'jumping bean'. When the instructor pauses the music, child must stop instantly. Pause song for about 5 seconds before pressing play again &amp; child can continue bouncing. Complete the song before moving onto the next activity.</p> |

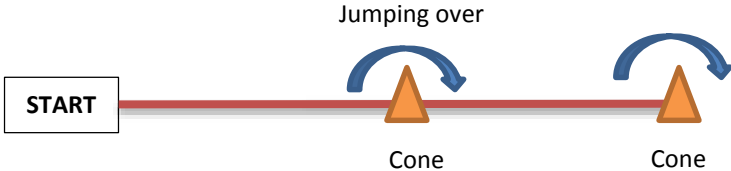
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| <p>(4 minutes)</p>   |                              |   |
| <p><i>Continue with vestibular stimulation through 'up &amp; down' motions;</i></p> <p><i>Initiate specific visual boundaries for child in order to teach spatial orientation by using colourful targets child must hop to;</i></p> <p><i>Activate proprioception in lower limbs during joint compression &amp; traction from hopping</i></p> <p>(5 minutes)</p> | <p>1. 'Hopping toys'</p>     | <p><b>Set-up:</b> Measure out 3.5m on the floor in a clear space. Place 6 coloured cardboard circles in a horizontal row on the floor over that distance, one after the other. The row will be vertically in front of child. At the starting circle place a small hoop. At the last circle place down 4 toys or interesting objects.</p> <p><b>Instructions:</b> Child is instructed to hop from the one circle to the next, keeping feet together while hopping. <i>Ensure that you have informed &amp; demonstrated that they must bend their knees when landing on each hop.</i> Once child gets to the sixth circle child collects one toy or object &amp; hops back on each circle to place in the small hoop. Child may continue hopping from each circle until all 4 toys have been collected &amp; placed inside the small hoop. If instructor observes child is getting tired, child may rest for a few seconds before continuing.</p> |
| <p><i>Stimulate vestibular system during rotation motion, along with activating dynamic balance while walking to target;</i></p> <p><i>Static balance is initiated while having to stand on an elevated surface;</i></p> <p><i>Practice listening skills when having to respond to instructions</i></p> <p>(5 minutes)</p>                                       | <p>2. 'Spinning frizbee'</p> | <p><b>Set-up:</b> Place 3 river stones around the room.</p> <div> </div> <p><b>Instructions:</b> Child stands in one place &amp; instructor turns them 12 times in the left direction &amp; then 12 times in the right direction. Rate of turning: 1 second for 1 360 degree turn. After left &amp; right have been completed, count with child up to 10 before telling child to run to the colour of a river stone. Once reaching the "red" river stone child must stand on two feet for 10 seconds. Child climbs off river stone and goes back to being turned around by instructor.</p>  |

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|  |                            | Repeat this until all 3 rocks have been balanced on.  |
| <p><i>Stimulate the vestibular system during forward &amp; backwards motions;</i></p> <p><i>Activate muscles control of upper body (neck muscles);</i></p> <p><i>Learn to respond to a simple instruction of touching an object</i></p> <p>(3 minutes)</p>                     | 3. 'Rocking on the moon'   | <p><b>Set-up:</b> Place a 'Buzz-Lightyear' toy on the floor. Child lies on their stomach on a pilates ball. Instructor holds &amp; stabilizes child by the knees.</p> <p><b>Instruction:</b> Child is rocked back &amp; forth on pilates ball. When child is rocked forward they are instructed to lift head up &amp; put both hands out and touch the toy on the floor with both hands. Child must touch the toy 10 times. Continue to rock child 10 times without them having to touch the toy, just relaxing while instructor rocks. <i>The rocking should be a slightly faster pace than a slow gentle rock.</i> Repeat with child having to lift up &amp; touch the toy in front of them 10 times.</p> |
| <p><b>Cool down</b></p> <p><i>Activate abdominal muscles when legs are tucked in, contracting abdominal wall;</i></p> <p><i>Attempting to integrate the tonic labyrinthine reflex supine;</i></p> <p><i>Understand instruction during demonstration</i></p> <p>(3 minutes)</p> | 4. 'Hugging an easter egg' | <p><b>Set up:</b> Set down a floor mat with a tactile ball beside it.</p> <p><b>Instructions:</b> Child lies with their back on a mat. Instructor places the tactile ball on child's stomach &amp; supports ball on stomach during exercise. Instruct child to hug the ball with legs &amp; arms. Physically help child during demonstration to bring in their knees towards the ball &amp; their chest &amp; 'hugs' legs with arms grasping them &amp; the ball. Repeat this three times with 5 second's rest in between.</p>  |

| SUBJECT G   | JUNE   | WEEK 1: 30 minutes x2   |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To stimulate the vestibular system</li> <li>• Activate lower limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Helping child understand instructions (keywords) &amp; respond with the required action</li> </ul> |  |   |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Practice simple eye fixation</li> <li>• Body awareness &amp; spatial orientation</li> <li>• Cognitive skills</li> </ul>                              | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story song on a CD with CD player</li> <li>• Measuring tape (1)</li> <li>• 4m floor tape</li> <li>• Small cones (2)</li> <li>• Rainbow river stones (4)<br/>Heights: Red: 13.5cm (1) Green: 16cm (2) Yellow: 8.5cm (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Rotating office chair (1)</li> <li>• Pilates ball (1)</li> <li>• Colour cards (6)<br/>red, blue, yellow, green, black, orange</li> <li>• Colour cardboard circle (1)<br/>Diameter: 12cm</li> <li>• Prestik</li> <li>• Floor mat (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES              | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions;</i></p> | <p>'Musical bounce'</p> | <p><b>Set up:</b> Child sits on kangaroo ball. Use a song child knows &amp; feels familiar with.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding handle with both hands. When music plays, child is indicated to bounce in place, up &amp; down on the kangaroo ball. When the instructor pauses the music, child must stop instantly. Pause song for about 3 seconds before pressing play again &amp; child may continue bouncing. Complete the song before moving onto next activity.</p> |



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| <p><i>Practice listening skills with simple indications of pausing music</i></p> <p>(4 minutes)</p>  |   |  |
| <p><i>Activate dynamic balance by hopping &amp; jumping;</i></p> <p><i>Encourage spatial awareness by jumping over a target, having to learn how high to jump along with bending knees;</i></p> <p><i>Activate proprioception in lower limbs during hopping</i></p> <p>(4 minutes)</p> | <p>1. Hop &amp; jump over the mountain peak</p> | <p><b>Set up:</b> Measure 3m &amp; tape down a straight horizontal line over this distance. Place 2 small cones on the horizontal line, however, place one small cone 1.5m from the start of the line &amp; the other cone 1.5m from the first cone (3m from starting point).</p>  <p><b>Instructions:</b> Child hops on two feet on the line. When he comes across the first cone, he must jump over the 'mountain peak' (cone) &amp; continue hopping until the next 'mountain peak'. Repeat this twice. <i>First demonstrate the activity to child before they perform it. However, instructor may need to guide child through each step.</i> Child repeats this exercise twice before a 30 second rest &amp; then for a third time to complete the activity.</p>  |
| <p><i>Stimulate vestibular system through rotating motion;</i></p> <p><i>Respond to simple instructions involving colours &amp; movement</i></p> <p>(8 minutes)</p>  | <p>2. Twirling tornadoes</p>                    | <p><b>Set up:</b> Randomly place 3 different sized river stones in a clear open space. Place the fourth river stone (which has a slight uneven surface) next to the office chair.</p> <p><b>Instructions:</b> Child sits on office chair with his back against the back rest. Child is spun 12 times to the left &amp; 12 times to the right. Wait for a few seconds &amp; tell child to count up to 5 with the instructor. Thereafter, tell child to walk to the red river stone &amp; to stand on top of it. (<i>Gently assist child off the office chair if their feet are not able to reach the ground</i>). Once child has climbed onto the river stone, count up to 10 with the child before they return to the rotating chair. Child is then spun on the chair with the instructor using the same amount of rotations mentioned above. When rotations on both sides have been completed &amp; instructor &amp; child have rested &amp; counted to 5, instructor tells child to walk to green river stone. Child stands on river stone for 10 counts &amp; then returns to chair for the third round which will be followed by standing on yellow river stone.</p> |

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| <p><i>Stimulate vestibular system during rocking motion and firm stops;</i></p> <p><i>Practice static balance</i></p> <p><i>Encourage listening skills &amp; motor planning of directing himself to the target;</i></p> <p>(6 minutes)</p>   | <p>3. 'Rocking Ball'</p> | <p><b>Set up:</b> Instruct child to lie with his stomach on a pilates ball while instructor will assist by holding child by the knees or supporting his back with his/her hand (depending on child's height as their feet might be able to reach the floor). Place a small mat or coloured circle 3m away from where child &amp; pilates ball is. <i>Make sure child's head is away from any objects, walls or furniture that he might bump into.</i></p> <p><b>Instructions:</b> Instructor will rock child forwards and backwards on pilates ball, 10 times. Stop rocking for 5 seconds, then instruct child to stand up and walk to circle or mat and stand on it for 8 counts. Child may then be guided back to the pilates ball. <i>Instructor may need to physically take child to the circle and indicate to stand still by counting with child.</i> Continue to rock forwards and backwards once again before halting and child walking to the circle. Repeat exercise 3 times. Rocking speed: at medium pace (not a slow gentle rock), with a slight jerk and force when rocking forwards. The halt should be a firm stop. Repeat this exercise for 3-4 minutes. <i>Take child's reaction and fatigue levels into account.</i></p> |
| <p><b>Cool down</b></p> <p><i>Encourage body awareness as child learns to direct his feet in relation to a target;</i></p> <p><i>Activate abdominal muscle &amp; phasic control while elevating legs;</i></p> <p><i>Target cognitive &amp; listening skills as child is required to respond to instructions regarding colours</i></p> <p>(4 minutes)</p> | <p>4. 'Tummy-toes'</p>   | <p><b>Set up:</b> Place a floor mat next to the wall &amp; 6 colour cards along the wall, just off the floor. Cards are placed with 3 cards as the first layer closer to the floor (about 20cm from the floor- depending on the child's length) &amp; the other 3 colour cards about 8-10cm above them.</p> <p><b>Instructions:</b> Child is directed to lie down on the floor mat on his back with his feet facing the wall where the cards are placed. Child's legs are lifted, bent at the knees creating a 90 degree angle from the wall. The instructor calls out a colour and child must touch the colour with both of his feet. Legs remain lifted for at least all 6 colours before child can rest &amp; place legs flat on the ground. Repeat this exercise twice.</p>   |

| SUBJECT G   | JUNE   | WEEK 2: 30 minutes x2  |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide a environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Helping child understand instructions (keywords) and respond with the required action</li> </ul> |  |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Body awareness &amp; spatial orientation</li> <li>• Initiating simple ball manipulation skills</li> <li>• Cognitive skills</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story song on a CD with CD player</li> <li>• Measuring tape (1)</li> <li>• 4m of floor tape</li> <li>• Mini-trampoline (1)</li> <li>• 1kg medicine ball (1)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• Rainbow river stones (3)<br/>Heights: Red: 13.5cm (1) Green: 16cm (1) Yellow: 8.5cm (1)</li> <li>• Rocking bowl (spinning bowl) (1)</li> <li>• Colour cards (6)<br/>red, blue, yellow, green, black, orange</li> <li>• Coloured cardboard circle (1)<br/>Diameter: 12cm</li> <li>• Floor mat (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES              | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down'</i></p> | <p>'Musical bounce'</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Use a song child knows and feels familiar with.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When music plays, the child is instructed to bounce up &amp; down in place on kangaroo ball. When instructor pauses the music, child must stop instantly. Pause song for about 3 seconds before pressing play again &amp; child may continue bouncing. Complete song before moving onto the next activity.</p> |

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| <p><i>motions;</i></p> <p><i>Practice listening skills with simple indications of pausing music</i></p> <p>(4 minutes)</p>  |                          |   |
| <p><i>Activate dynamic balance while hopping from one place to another, along with maintaining upright position when on trampoline, practice static balance when standing on compliant surface;</i></p> <p><i>Proprioception in lower limbs during hopping along with supporting body when on compliant surface;</i></p> <p><i>Understand the instruction of jumping onto a target;</i></p> <p><i>Learn how to adapt to changes when having to jump up &amp; off different heights</i></p> <p>(7 minutes)</p> | <p>1. Kangaroo-mania</p> | <p><b>Set up:</b> Measure 4m &amp; tape a straight horizontal line over this distance. Place a trampoline at the end of the line &amp; a colour cardboard circle between the line &amp; trampoline.</p> <p><b>Instructions:</b> Child hops on two feet on the line towards trampoline. When he has reached it, child is instructed to bend his knees again &amp; make a big jump onto trampoline. <i>The height of the trampoline may not be correctly perceived by the child, but instructor may show child that they must see or feel how high it is. Even before jumping, when child has stopped, instructor may hold child's hand &amp; help child onto the trampoline.</i> When child has landed on the trampoline, tell him to stop &amp; balance (or count up to 5) &amp; then he may continue to jump up &amp; down on the 'bouncy' surface for another 5 seconds. After these few jumps, child is instructed to jump off trampoline &amp; onto the floor. Instructor may point to the ground or place a colour cardboard circle on the ground on the line as an indicator for child where he must aim to land. Once landing, child may stop, position feet next to each other &amp; count to 5 once again before hopping back to the start, along the line. <i>First demonstrate the activity to child before they perform it.</i> Child repeats this exercise twice before a 20 second rest &amp; then for a third time, to complete the activity. During the rest time, you can ask child to close their eyes &amp; count with you up to 30 or if child cannot understand what it means to close eyes, visually show the child on his fingers how to count up to 10 or 20.</p> |

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| <p><i>Stimulate vestibular system during rotation;</i></p> <p><i>Enhance static balance when standing in place while on uneven surface;</i></p> <p><i>Stimulate proprioception in upper limbs when having to hold a weighted ball;</i></p> <p><i>Initiate simple ball manipulation skills of passing and receiving;</i></p> <p><i>Learn to respond to simple instruction involving colours &amp; movement</i></p> <p>(8 minutes)</p> | <p>2. 'Spinning bowl'</p>      | <p><b>Set up:</b> Child gets into the rocking bowl, sits upright &amp; cross-legged. Place a river stone (which has a slightly uneven surface) next to the office chair.</p> <div> </div> <p><b>Instructions:</b> Instructor spins the child 12 times to the left, gives a firm stop &amp; then spins bowl 12 times to the right with a firm stop afterwards. After rotation, wait up to 10 seconds before child is instructed to step out of the bowl &amp; walk to the rock. Child is directed to stand on top of it &amp; asked to balance on it with two feet. Child is then passed the 1kg medicine ball &amp; must pass ball back to the instructor. They pass ball back &amp; forth with child receiving it 10 times. Child is then once again spun in the bowl before standing on the balance rock &amp; being passed the medicine ball. Repeat this activity 3 consecutive times.</p> |
| <p><i>Stimulate vestibular system while jumping up &amp; down;</i></p> <p><i>Encourage static balance when having to stand still;</i></p> <p><i>Activate proprioception in lower limbs while jumping &amp; having to stop abruptly;</i></p> <p><i>Initiate simple motor planning situations which direct child to make his way</i></p>   | <p>3. Popcorn &amp; towers</p> | <p><b>Set up:</b> Place trampoline in an open space with 3 river stones around trampoline.</p> <p><b>Instructions:</b> Child jumps up &amp; down on trampoline. <i>Ensure that child is bending their knees when landing.</i> When the instructor says, "Stop! Jump on green stone", child must stop, jump off the trampoline onto the ground, landing on two feet &amp; jump onto the river stone that was called out. <i>Child may need to have his hand held by instructor in order to direct him off &amp; on the apparatus.</i> Child must stand straight, like a "tower". After a few seconds child may return to the trampoline to resume jumping. Allow child to jump 10 times before jumping off trampoline. Call out all three river stones.</p>  |

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| <p><i>to the target;</i></p> <p><i>Correctly respond to instructions</i></p> <p>(6 minutes)</p>  |                        |   |
| <p><b>Cool down</b></p> <p><i>Encourage body awareness as child learns to direct his feet in relation to a target;</i></p> <p><i>Activate abdominal muscle &amp; phasic control while elevating legs,</i></p> <p><i>Target cognitive and listening skills as child needs to respond to instructions relating to colours</i></p> <p>(4 minutes)</p> | <p>4. 'Tummy-toes'</p> | <p><b>Set up:</b> Place a floor mat next to the wall &amp; 6 colour cards along the wall, just above floor level. Cards are placed with 3 cards as the first layer closer to the floor (about 20cm from the floor - depending on the child's leg length) &amp; the other 3 colour cards about 8-10cm above them.</p> <p><b>Instructions:</b> Child is directed to lie down on the floor mat on his back with his feet facing the wall where the cards are placed. Child's legs are lifted, bent at the knees creating a 90 degree angle from the wall. Instructor calls out a colour &amp; child must touch the colour with both of their feet. Legs remain lifted for at least 3 colours of the 6, before child can rest &amp; place legs flat on the ground. Then child may complete the next 3 colours.</p> <p>Repeat this exercise twice.</p> |

| SUBJECT G  | JULY  | WEEK 1: 30 minutes x2  |
|--|---|--|
| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Helping child understand instructions (keywords) and respond with the required action</li> </ul> |   |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple and familiar locomotive skills</li> <li>• Body awareness &amp; spatial orientation</li> <li>• Initiating simple ball manipulation skills</li> <li>• Cognitive skills</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story song on a CD with CD player</li> <li>• Measuring tape (1)</li> <li>• Rainbow river stones (3)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1) Yellow: 8.5 cm (1)</li> </ul> | <ul style="list-style-type: none"> <li>• 3m of floor tape</li> <li>• Medium tactile ball (1)</li> <li>• 3m of thick rubber exercise band (1)</li> <li>• Rocking bowl (spinning bowl) (1)</li> <li>• Floor mat (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES                  | EXPLANATION   |
|--|-----------------------------|---|
| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions;</i></p> <p><i>Practice listening skills with the</i></p> | <p>'Telly-tubby bounce'</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Use the song child knows and feels familiar with.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music plays, child is indicated to bounce up and down in place on the kangaroo ball. When the instructor pauses the music, child must stop instantly. Pause the song for about 3 seconds before pressing play again and child may continue bouncing. Complete the song before moving onto the next activity.</p> |

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| <p><i>simple indication of pausing music</i><br/>(4 minutes)</p>  |                                       |   |
| <p><i>Activate dynamic balance while jumping;</i><br/><br/><i>Encourage spatial awareness while jumping over a target, having to learn how high to jump with bending knees;</i><br/><br/><i>Activate proprioception in lower limbs while hopping</i><br/>(5 minutes)</p>  | <p>1. 'Jumping up mountain peaks'</p> | <p><b>Set up:</b> Measure 3m and tape a straight horizontal line over this distance. Place 3 river stones over the distance, allowing enough space on the floor between the rocks, for the foot placement.</p> <p><b>Instructions:</b> Child is directed to jump up onto the first river stone (red). Emphasise that he must remain on the river stone for about 2 seconds. Child is then directed to jump back down onto the floor, landing on 2 feet and bending knees. <i>Instructor may need to hold child's hand while jumping and to direct him back down onto the floor, landing on 2 feet.</i> He is then shown to jump onto the second river stone (green). Repeat the same action as the former river stone. This continues onto the third river stone (yellow). When all 3 river stones have been completed, child is directed back to the red river stone and repeats this activity 2 more times.</p>                                     |
| <p><i>Stimulate vestibular system during rotation and firm, sudden stops;</i><br/><br/><i>Enhance static balance when standing in place on uneven surface;</i><br/><br/><i>Learn simple ball manipulation skills of passing and receiving;</i><br/><br/><i>Respond to simple instructions involving colours &amp; movement</i><br/><br/>(8 minutes)</p> | <p>2. 'Washed in a tornado'</p>       | <p><b>Set up:</b> Place the big rocking bowl on a floor mat with a green river stone alongside it.</p> <p><b>Instructions:</b> Child is directed to sit inside of the bowl, cross-legged and child may hold on the sides of the bowl. Instructor spins the child 12 times to the left, gives a firm stop/halt and then spins the bowl 12 times to the right, followed by a firm halt afterwards. After rotation, wait up to 8-10 seconds before child is instructed to step out of the bowl and walk to the river stone. Child is directed to stand on top of it and asked to balance on it with two feet. Child is then passed a tactile ball to hold and is asked to pass it back to instructor. They pass the ball back and forth with the child receiving it 8 times. Child resumes to being spun in the bowl once again, before standing on the river stone and passing the tactile ball.</p> <p>Repeat both activities 3 consecutive times.</p> |
| <p><b>Cool down</b><br/><i>Initiate simple instructions &amp; motor planning of the hands,</i></p>  | <p>3. 'Pulling gummy gum'</p>         | <p><b>Set up:</b> Using a thick rubber exercise band, child stands on one side of the room with an assistant which helps him hold one end of rubber band with both hands. <i>Assistant may need to place their hands over child's hands to indicate the grip which secures the band.</i> Instructor</p>   |



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| <p><i>as they are directed to be placed one after the other;</i></p> <p><i>Activate proprioception in hands when assistant places pressure on hands</i></p> <p>(4 minutes)</p> |  | <p>holds the other end of the band.</p> <p><b>Instructions:</b> Ensure there is enough tension when the instructor pulls exercise band away from child and assistant. While instructor is securing the one end, assistant takes child's hands to move one hand at a time to 'climb' towards the instructor. Once reaching the instructor, indicate to child that he can let go of band. Then child and assistant retrieve their end of the band, to pull the band and stand in the starting position to repeat the climbing action for a second time.</p> |
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| SUBJECT G   | JULY   | WEEK 2: 30 minutes x2   |
|---|--|---|
| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somatosensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Helping child understand instructions (keywords) and respond with the required action</li> </ul> |  |   |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple and familiar locomotive skills</li> <li>• Initiating simple ball manipulation skills</li> <li>• Cognitive skills</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story song on a CD with CD player</li> <li>• 1kg medicine ball (1)</li> <li>• Rocking bowl (Spinning bowl) (1)</li> <li>• Rainbow river stones (2)</li> </ul> <p>Heights: Red: 13.5 cm (1) Green: 16 cm (1)</p> | <ul style="list-style-type: none"> <li>• 3m of thick rubber exercise band (1)</li> <li>• Mini-trampoline (1)</li> <li>• Floor mat (1)</li> <li>• Red cardboard circle (1)</li> <li>• Prestick</li> <li>• Small chair (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES              | EXPLANATION   |
|--|-------------------------|---|
| <p><b>Warm up</b></p> <p><b>To:</b><br/> <i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions;</i></p> | <p>'Musical bounce'</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Use the song child knows &amp; feels familiar with.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands. When the music plays, the child is indicated to bounce up &amp; down in place on the kangaroo ball. When the instructor pauses the music, child must stop instantly. Pause the song for about 3 seconds before pressing play again &amp; child may continue bouncing. Complete the song before moving onto the next activity.</p> |

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| <p><i>Practice listening skills with the simple indication of pausing music</i><br/>(4 minutes)</p>  |                                 |  |
| <p><i>Attain child's eye tracking ability by trying to get his attention through a familiar, attractive picture;</i></p> <p><i>Stimulate eye muscles while following the ball which is being passed back &amp; forth;</i></p> <p><i>Activate proprioception in upper limbs while weighted ball places pressure on joints;</i></p> <p><i>Practice static balance while child is standing upright in place;</i></p> <p><i>Practice to respond to a keyword</i><br/>(4 minutes)</p> | <p>1. 'Buzzing google eyes'</p> | <p><b>Set up:</b> Place an illustrated, cut out picture of a funny face with big round 'google' eyes (or a picture of what child is interested in) and secure to the pencil. Child sits on a chair with instructor sitting opposite him and holding the pencil. The pencil is held in line with child's nose 45cm away from the face. Have the 1kg ball close at hand.</p> <p><b>Instructions:</b> Child is instructed to look at the pencil and to follow its pathway when the instructor moves it. <i>Using keywords: "look" is instructed in order to direct child. It may be difficult for child not move his head as the requirements are for the head to remain still during eye exercises.</i> With the pencil, instructor creates horizontal figure of "8s" for the duration of 15-20 seconds. This is followed by child standing up and the instructor passes the 1kg medicine ball to child to hold for 3 seconds, using both of his hands. Upon the keywords, "give" child must pass it back. Repeat for 10 counts. Child then returns to being seated to perform the above-mentioned eye exercises. Instructor repeats the horizontal figure of "8"s. Repeat both activities 3 times each.</p> <p>For the third time instructor may change the picture to another colourful character.</p> |
| <p><i>Stimulating vestibular system during rotation;</i></p> <p><i>Enhance static balance when standing in place on the rounded surface of the upside-down bowl which is at a small height off the ground;</i></p>   | <p>2. Spinning tortoise</p>     | <p><b>Set up:</b> place big rocking bowl on a floor mat.</p> <p><b>Instructions:</b> Child is directed to sit inside of the bowl, cross-legged &amp; child may hold on the sides of the bowl. Instructor spins the child 15 times to the left, gives a firm stop/halt &amp; then spins the bowl 15 times to the right, followed by a firm halt afterwards. After rotation, wait up to 8 seconds before child is instructed to step out of the bowl &amp; instructor turns the bowl over, with its rounded side exposed. <i>During this waiting period, encourage child to clap his hands with instructor, counting up to 8.</i> Child is directed to stand on top of bowl (tortoise) &amp; asked to balance on it with two feet. <i>Instructor may assist child while he climbs on top &amp; may support him while he steps up onto it, in case he may fall.</i> Instructor counts with child up to 10. Then child is assisted off the 'tortoise' &amp; the bowl is resumed to be turned over on its rounded side.</p>   |

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| <p>(6 minutes)</p>  |                                    | <p>Instructor spins child, following the above-mentioned criteria. Repeat these 2 activities, 3 consecutive times each, alternating between the spinning of the bowl &amp; child standing on top of the bowl.</p>  |
| <p><i>Activate dynamic balance while jumping on trampoline &amp; on and off the rocks;</i></p> <p><i>Stimulate proprioception in lower limbs during jumping, along with proprioception in upper limbs being stimulated while passing weighted ball;</i></p> <p><i>Understand instructions as each activity involves set instructions;</i></p> <p><i>Learn how to adapt the change in the different heights child is required to jump up on to.</i></p> <p>(7 minutes)</p> | <p>3. 'Jelly beans'</p>            | <p><b>Set up:</b> A mini-trampoline in an open space with two river stones alongside it. River stones are placed vertically from trampoline, leaving an amount of space for the child's feet to jump in between the river stones.</p> <p><b>Instructions:</b> Child is directed to jump up &amp; down on the trampoline, 20 times. Child is then asked to "stop" &amp; is indicated to step off the trampoline. Instructor may assist child off trampoline. Child is shown to jump up onto the first river stone (red), wait 3 seconds on top &amp; then to jump back down onto the other side, towards the river stone. Child is shown to jump on top of the green river stone, wait 3 seconds, before jumping back down. Child is passed 1kg ball &amp; upon the keywords "give" child passes the ball back to instructor. Repeat 8 times before turning around to repeat the jumps on the river stone, back towards the trampoline. Once reaching trampoline, child is shown to step back up onto it.</p> <p>Repeat this 3 times: Jumping on trampoline, followed by jumping up &amp; down on river stones, &amp; lastly passing ball back and forth.</p> |
| <p><i>Encourage static and dynamic balance while jumping up and out, decreasing or increasing surface area as feet are changing position;</i></p> <p><i>Activate proprioception in lower limbs while jumping &amp; encouraging stability while changing positions;</i></p>  | <p>4. Star jumps (lower limbs)</p> | <p><b>Set up:</b> Secure a red cardboard circle on the floor as target (use prestik).</p> <p><b>Instructions:</b> Child is asked to stand on the red circle. Instructor may hold his hands &amp; demonstrate just the 'lower-limbs part' of the star jumps. <i>Using the keywords:</i> out &amp; in. Upon the word "out" instructor jumps up &amp; feet jump off the target, to shoulder-width apart. Upon the word: "in" instructor indicates that the feet jump back in onto the target. This may take a while for child to process this activity. Instructor may assist child by physically lifting him up (to sense the 'up-motion') &amp; place child's feet out or in. <i>Perform this slowly as child is learning new words with actions.</i></p>   |

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| <p><i>Learn to respond to keywords: "out" &amp; "in"</i></p> <p>(3 minutes)</p>  |                          |   |
| <p><b>Cool down</b><br/><i>Initiate the stimulation of proprioception in all of the joints using compression &amp; traction</i></p> <p>(3 minutes)</p> | <p>5. Pumping action</p> | <p><b>Set up:</b> Have a sturdy chair for child to sit on &amp; a floor mat alongside it. Allow a familiar song to play while activity is being performed.</p> <p><b>Instructions:</b> Seat child in secure chair. Instructor places pressure on child's head &amp; then releases, 10 times. Move down to both shoulders. Instructor places both hands on shoulders &amp; firmly presses down &amp; releases, 10 times. The next joint, hold child's elbow &amp; place your other hand where humerus &amp; shoulder joint are. Perform 'pumping' action by pushing elbow joints &amp; shoulder joints towards each other &amp; release. Perform the same action between elbow &amp; wrist joints, then each finger on the hand. Direct child to lie down on the floor. Repeat pumping action on hip joint, followed by knee joints, moving down to ankles &amp; finally each toe. Repeat this activity only once.</p> |

| SUBJECT G   | AUGUST  | WEEK 1: 30 minutes x2  |
|---|---|--|
| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) and respond with the required action</li> </ul> |   |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple and familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story song on a CD with CD player</li> <li>• Bosu ball (1)</li> <li>• 3m of thick rubber exercise band (1)</li> <li>• Floor mat (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Multi-purpose jungle gym: wooden ramp, thick rope, secure monkey bars</li> <li>• Hula hoop (1)</li> <li>• Prestick</li> <li>• Small chair (1)</li> <li>• Scooter board (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES                  | EXPLANATION  |
|---|-----------------------------|--|
| <p><b>Warm up</b></p> <p><b>To:</b><br/> <i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions, along with having to remain on complaint</i></p> | <p>'Jelly fish jumping'</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Use a song child knows and feels familiar with. Place bosu ball alongside kangaroo ball.</p> <p><b>Instructions:</b> Child sits on kangaroo ball, holding the handle with both hands. When music plays, child is indicated to bounce up and down in place on the kangaroo ball. When instructor pauses music, child must stop instantly &amp; is instructed to stand up &amp; get on top of bosu ball. Instructor may need to assist child onto this compliant surface. Count with child up to 6 before he may climb down. <i>Instructor may assist child with balancing on bosu ball.</i> Child returns to kangaroo ball to resume bouncing. Instructor puts the music back on. Repeat this exercise, alternating between kangaroo ball and bosu ball. Complete song before moving onto next activity.</p> |

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| <p>surface;</p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(4 minutes)</p>   |                                 |  |
| <p><i>Initiate the stimulation of proprioception in all of the joints using compression and traction</i></p> <p>(3 minutes)</p>  | <p>1. Pumping action</p>        | <p><b>Set up:</b> Have a sturdy chair for child to sit on and a floor mat alongside it. Allow a familiar song to play while activity is being performed.</p> <p><b>Instructions:</b> Seat child in secure chair. Instructor places pressure on child's head and then releases, 10 times. Move down to both shoulders. Instructor places both hands on shoulders and firmly presses down and releases, 10 times. For the next joint, hold child's elbow and place your other hand where the humerus and shoulder joint are. Perform 'pumping' action by pushing elbow joints and shoulder joints towards each other and release. Perform same action between elbow and wrist joints, then each finger on the hand. Direct child to lie down on the floor. Repeat pumping action on hip joint, followed by knee joints, mobbing down to ankles and finally each toe. Repeat this activity only once.</p> |
| <p><i>Stimulate vestibular system during linear motions, and quick changes in directions while being pulled;</i></p> <p><i>Activate proprioception in upper limbs, as the joints are being pulled;</i></p> <p><i>Enhance lower back and neck muscles while in a lying down position to encourage the upper body to lift up</i></p> | <p>2. Flying Buzz Lightyear</p> | <p><b>Set up:</b> Have scooter board with a hula hoop ready and ensure the area is clear.</p> <div> </div> <p><b>Instructions:</b> Child is directed to lie down with his stomach on the scooter board. He is shown to bend at the knees (contracting hamstrings) so that his feet are not dragging on the floor. Instructor gives hula hoop to child to hold the one end, while instructor holds the opposite end. Instructor pulls hula hoop to pull the child, ensuring</p>   |

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| <p>(4 minutes)</p> <p><i>Initiate simple instructions &amp; motor planning of the hands, as they are directed to be placed one after the other;</i></p> <p><i>Activate proprioception in hands while assistant applies pressure on hands</i></p> <p>(4 minutes)</p>               | <p>3. Gummy gum</p>                 | <p>that child continues to hold on. Instructor may steer to change direction.</p> <p><b>Set up:</b> Using a thick rubber exercise band, child stands on one side of room with an assistant who helps him hold one end of the rubber band, with both hands. <i>Assistant may need to place his/her hands over child's hands to indicate the grip to secure the band.</i> Instructor holds other end of band.</p> <p><b>Instructions:</b> Ensure there is enough tension when instructor pulls exercise band away from child and assistant. While instructor is securing one end, assistant takes child's hands to move one hand at a time to 'climb' towards the instructor. Once reaching instructor, ask child to let go of band. Then child and assistant retrieve their end of the band, to pull the band and stand in starting position to repeat the climbing action, for a second time.</p>  |
| <p><b>Cool Down</b></p> <p><i>Practice functional movements by integrating vestibular and proprioception activities;</i></p> <p><i>Stimulate proprioceptors in upper limbs during contraction while climbing, and pulling of the joints while hanging;</i></p> <p>(5 minutes)</p> | <p>4. 'Woody climbs up the bed'</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains monkey bars, a net and a thick rope secured to a wooden beam at the top of a 3m wooden ramp which also has support for footing. If a ramp is not accessible, use a flight of stairs as the instructor may be at the top of about 5 steps away from child and child at the bottom of the steps.</p> <p><b>Instructions:</b> Child steps onto the wooden ramp and is told to grasp thick rope. Instructor is behind child to act as security if he lets go of rope. Child is instructed to walk up ramp holding the rope by climbing up with one hand being placed in front of the other. Once reaching the top, if there are monkey bars, assist child to grasp the first bar and hold it for 5 seconds, then lower child down to the ground. Direct child to the start of the ramp to repeat this activity.</p> <p>Repeat this exercise 4 times, climbing up and holding monkey bars for 1 second more than the last set.</p> <p><i>For the steps option:</i> Child holds one end of the rubber exercise band and instructor holds other end a few stairs up. <i>An assistant is just behind the child to support and act as security for safety precautions.</i> Child begins to climb, leans back slightly (with assistant guiding him) and takes one step at a time while grasping the rubber band and moving hands up. Once reaching the instructor, child is told to continue holding the rubber band, straighten arms, lean body backwards and try to pull the rubber band away from instructor. Child may hold this for 5 seconds before releasing and walking back down the steps to resume starting position. *'Wheelbarrow' child around the bottom of the stairs before child stands up to climb up the stairs (mountain) again. Repeat these three activities three times. <i>Allow for rest period in between sets along with child performing each activity slowly.</i></p> |



\*Wheelbarrow: child is shown to lie down flat on the ground, on his stomach. Instructor will pick up child's legs and support him by the knees while child is shown to push up onto his arms. Instructor ensures that child's low back is not bent. Child is asked to 'walk forwards on his hands'.

| SUBJECT G   | AUGUST   | WEEK 2: 30 minutes x2   |
|---|--|---|
| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) and respond with the required action</li> </ul> |  |   |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple and familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> <li>• Body awareness</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story song on a CD with CD player</li> <li>• Bosu ball (1)</li> <li>• 3m of thick rubber exercise band (1)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones (2)<br/>Heights: Red: 13.5 cm (1) Yellow: 8.5 cm (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Multi-purpose jungle gym: wooden ramp, thick rope, secure monkey bars</li> <li>• Prestik</li> <li>• Small chair (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• 1kg medicine ball (1)</li> <li>• Colour flash cards (6)<br/>Red, yellow, black, blue, green, orange</li> </ul> |

| SUB-AIMS   | ACTIVITIES                  | EXPLANATION  |
|--|-----------------------------|--|
| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system</i></p> | <p>‘Jelly fish jumping’</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Use a song child knows and feels familiar with. Place bosu ball alongside the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding handle with both hands. When music plays, child is indicated to bounce up and down in place on the kangaroo ball. When instructor pauses music, child must stop instantly &amp; is instructed to stand up and get on top of bosu ball. Instructor may need to assist child onto this compliant surface. Count with child up to 6 before he may climb down. <i>Instructor may assist child to remain on bosu ball.</i> Child returns to kangaroo ball to resume bouncing. Instructor puts music on again. Repeat this exercise, alternating between kangaroo ball and bosu ball. Complete song before moving onto the next activity.</p> |

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| <p><i>through 'up &amp; down' motions, along with having to remain on complaint surface;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(4 minutes)</p>                                       |                                |  |
| <p><i>Initiate the stimulation of proprioception in all of the joints using compression and traction;</i></p> <p><i>Learn to respond to keywords;</i></p> <p><i>Practice ball manipulation skills</i></p> <p>(3 minutes)</p>                  | <p>1. Pumping action</p>       | <p><b>Set up:</b> Have a sturdy chair for child to sit on and a floor mat alongside it. Have a red river stone close by. Allow a familiar song to play while activity is being performed.</p> <p><b>Instructions:</b> Seat child on secure chair. Instructor places pressure on child's head and then releases, 10 times. Move down to both shoulders. Instructor places both hands on shoulders and firmly presses down and releases, 10 times. For the next joint, hold child's elbow and place your other hand where humerus and shoulder joint are. Perform 'pumping' action by pushing elbow joints and shoulder joints towards each other and release. Perform same action between elbow and wrist joints, then each finger on the hand. Direct child to lie down on the floor. Repeat pumping action on hip joint, followed by knee joints, moving down to ankles and finally each toe. Repeat this activity only once.</p> <p>Once instructor has completed all limbs, child is asked to stand on top of red river stone. While standing, instructor passes 1kg ball back and forth to child. Use usual keywords for this activity. When child has the ball, instructor says "Give". Pass back and forth 15 times.</p> |
| <p><i>Stimulate vestibular system during rotation;</i></p> <p><i>Enhance static balance when standing in place on uneven surface;</i></p> <p><i>Stimulate proprioception in upper limbs while arms need to control the weighted ball;</i></p> | <p>2. 'Spinning to towers'</p> | <p><b>Set up:</b> Place yellow river stone alongside the rocking bowl.</p> <p><b>Instructions:</b> Child gets into the big rocking bowl, sits upright and cross-legged. Instructor spins the child 12 times to the left, stops firmly and then spins the bowl 12 times to the right with a firm halt afterwards. After rotation, wait up to 10 seconds before child is instructed to step out of bowl and is directed to stand on river stone rock. Child is instructed to balance on it with two feet. Child is then passed the 1kg medicine ball. He is given the following instructions: "Touch head" and child must take medicine ball and touch his head. "Touch tummy" and child must touch his tummy. "Touch legs" and while holding the ball, child touches his legs. Upon the</p>   |

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| <p><i>Learn to respond to simple instructions involving body parts;</i></p> <p><i>Initiate body awareness when having to direct ball to body part</i></p> <p>(8 minutes)</p>  |                              | <p>keyword “give” he must pass the ball back to the instructor. Child is then directed to step off rock and into bowl. He is once again spun in the bowl before standing on river stone and given medicine ball. Repeat these 2 activities, 3 consecutive times.</p> <p>For the second round add a 4<sup>th</sup> body part, such as feet. And the 3<sup>rd</sup> round, add “Touch your nose”.</p>   |
| <p><i>Practice functional movements by placing locomotor (walking) skills with proprioception and vestibular activities;</i></p> <p><i>Stimulate proprioceptors in upper limbs during contraction while climbing, and pulling of the joints while hanging;</i></p> <p>(6 minutes)</p> | <p>3. ‘Climbing up toys’</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains monkey bars, a net &amp; a thick rope, which is secured to a wooden beam at the top of a 3m wooden ramp which also has support for footing. If a ramp is not accessible, use a flight of stairs as instructor may be at the top of about 5 steps away from child and child at the bottom of the steps.</p> <p><b>Instructions:</b> Child steps onto wooden ramp and is shown to grasp the thick rope. Instructor is behind child to act as security if child lets go of rope. Child is instructed to walk up the ramp holding the rope and climbing up with one hand being placed in front of the other. Once reaching the top, if there are monkey bars help child to grasp the first bar and direct him to the 2<sup>nd</sup> bar, hold it for 3 seconds, then lower child down to the ground. Direct child to the start of the ramp to repeat this activity. Repeat this exercise 4 times climbing up and climbing 2 monkey bars and holding for 3 seconds on 2<sup>nd</sup> bar.</p> |
| <p><b>Cool down</b></p> <p><i>Encourage body awareness as child learns to direct his feet in relation to a target;</i></p> <p><i>Activate abdominal muscles and phasic control while elevating legs,</i></p> <p><i>Target cognitive and listening skills as child needs</i></p>       | <p>4. ‘Tummy toes’</p>       | <p><b>Set up:</b> Place a floor mat next to the wall and 6 colour cards along the wall, just off the floor. Cards are placed with 3 cards as the first layer closer to the floor (about 20cm from the floor depending on the child’s leg length) and the other 3 colour cards about 8-10cm above them.</p> <p><b>Instructions:</b> Child is directed to lie down on the floor mat on his back, with his feet facing the wall with the cards. Child’s legs are lifted, bent at the knees creating a 90 degree angle from the wall. Instructor calls out a colour and child must touch the colour with both of their feet. Legs remain lifted for at least all 6 colours before child can rest and place legs flat on the ground. Repeat this exercise twice.</p>   |

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| <i>to respond to instructions<br/>relating to colours<br/>(4 minutes)</i> |  |  |
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| SUBJECT G   | AUGUST  | WEEK 3: 30 minutes x2  |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) and respond with the required action</li> </ul> |   |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiate static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple and familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story song on a CD with CD player</li> <li>• Bosu ball (1)</li> <li>• Picture of insect on pencil (1)</li> <li>• 2kg medicine ball (1)</li> <li>• 1kg medicine ball (1)</li> <li>• Rainbow river stones (3)<br/>Heights: Red: 13.5 cm (1) Green:16 cm (1) Yellow: 8.5 cm (1)</li> <li>• Medium tactile ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Prestik</li> <li>• Small chair (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Small orange traffic cone (1)</li> <li>• Picture of cartoon character (1)</li> <li>• Pilates ball (1)</li> <li>• Floor mat (1)</li> <li>• 3m of line of floor tape</li> <li>• Mini-trampoline (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES                  | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Establish routine by introducing the activity which will start each session for intervention;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright; Activate vestibular system through 'up &amp; down'</i></p> | <p>'Jelly baby jumping'</p> | <p><b>Set up:</b> Child sits on a kangaroo ball. Use a song child knows and feels familiar with. Place bosu ball alongside the kangaroo ball.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding handle with both hands. When music plays, child is instructed to bounce up and down in place on the kangaroo ball. When the instructor pauses the music, child must stop instantly &amp; is instructed to stand up and get on top of bosu ball. Instructor may need to assist child onto this compliant surface. Count with child up to 8 before he may climb down. <i>Instructor may assist child to remain on bosu ball.</i> Child returns to kangaroo ball to resume bouncing. Instructor puts music back on. Repeat this exercise, alternating between kangaroo ball and bosu ball. Complete the song before moving onto next activity.</p> |

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| <p><i>motions, along with having to remain on complaint surface;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(4 minutes)</p>   |                             |  |
| <p><i>Attain child's eye tracking ability by getting his attention using a familiar, attractive picture;</i></p> <p><i>Stimulate eye muscles while following the ball that is being passed back and forth;</i></p> <p><i>Activate proprioception in upper limbs by increasing the weight of the ball which places pressure on joints;</i></p> <p><i>Practice static balance while child is standing upright in place;</i></p> <p><i>Practice responding to instructions and keywords</i></p> <p>(4 minutes)</p> | <p>1. 'Buzzing wasps'</p>   | <p><b>Set up:</b> Place an illustrated, cut out picture of a colourful insect (or a picture of what the child is interested in) and secured it on the pencil. Child sits on a chair with instructor sitting opposite them holding the pencil. Pencil is held in line with the child's nose 45cm away from the face. Have the 2kg ball close at hand.</p> <p><b>Instructions:</b> Child is instructed to look at pencil and to follow its pathway when the instructor moves it. <i>Use keyword: "look" to direct child. It may be difficult for child to not move his head but it is required that the head does not move during eye exercises.</i> Instructor creates horizontal figure of "8s" with pencil for the duration of 15-20 seconds. Child then stands up and instructor passes 2kg medicine ball to child to hold with both of his hands, for 3 seconds. Upon the keyword "give": child must pass ball back. Repeat for 10 counts before child is seated to perform eye exercises. Instructor repeats the horizontal figure of "8"s. Repeat both activities 3 times each.</p> <p>For third time instructor may change picture to another colourful character.</p> |
| <p><i>Stimulate vestibular system during rotation;</i></p> <p><i>Enhance static balance when</i></p>  | <p>2. 'Twisting tables'</p> | <p><b>Set up:</b> Place the big rocking bowl on a floor mat. Measure out 3m and tape a straight horizontal line over this distance. Place 3 river stones over this distance, allowing enough space on the floor between river stones for feet placement.</p>   |

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| <p><i>standing in place on uneven surface and dynamic balance during jumping;</i></p> <p><i>Stimulate proprioception in upper limbs as the arms need to control and support a weighted ball;</i></p> <p><i>Learn to respond to simple instructions, using keywords;</i></p> <p><i>Practice ball manipulation skills</i></p> <p>(8 minutes)</p> |                                   | <p><b>Instructions:</b> Child is directed to sit cross-legged inside of bowl and child may hold on the sides of the bowl. Instructor spins child 12 times to the left, stops firmly and then spins bowl 12 times to the right, followed by a firm halt afterwards. After rotation, wait up to 8 seconds before child is instructed to step out of bowl and to walk to rock. Child is directed to first river stone (red). He is told to bend at the knees and jump up onto rock and back down onto the other side. Then he must jump up onto green river stone, back down to the ground and lastly, jump up onto the yellow river stone. Once reaching the yellow river stone, child is passed a 1kg medicine ball to hold and is asked to pass back to instructor. They pass ball back and forth with the child receiving it 10 times. Child is then spun in bowl once again before standing on river stone and being passed the tactile ball.</p> <p>Repeat both activities 3 consecutive times.</p> |
| <p><i>Activate dynamic balance while jumping on trampoline and walking on decreased surface area;</i></p> <p><i>Activate proprioception in lower limbs while jumping, along with proprioception in upper limbs being stimulated while passing weighted ball;</i></p> <p><i>Understand instructions</i></p> <p>(7 minutes)</p>                  | <p>3. 'Tippy-toes trampoline'</p> | <p><b>Set up:</b> A mini-trampoline in an open space with a 3m line that has been taped to the floor and a small orange cone at the end of the line.</p> <p><b>Instructions:</b> Child is directed to jump on top of trampoline 20 times. Child is then asked to stop and is indicated to step off trampoline. <i>Instructor may assist child off trampoline.</i> Child is shown to walk on 'tippy-toes' on the line, from trampoline towards orange cone. Instructor may need to physically lift child up to show him how to go on his 'tippy-toes'. Once reaching the cone, child is asked to walk in the same manner, back towards trampoline. Once reaching trampoline, child is shown to step back up onto it and to resume jumping.</p> <p>Repeat this 3 times: Jumping on trampoline, followed by walking on 'tippy-toes' on the line towards the cone and back again.</p>  |
| <p><b>Cool down</b></p> <p><i>Stimulate vestibular system through linear rocking motion and firm stops;</i></p>  | <p>4. 'Rocking motions'</p>       | <p><b>Set up:</b> Instruct child to lie on his stomach on a pilates ball while instructor assists by holding child by the knees or supporting his back with his/her hand (depending on child's height as their feet might be able to reach the floor). Place a picture of his favourite cartoon character on the wall, close to the floor. <i>Make sure child's head is away from any objects, walls or furniture</i></p>  |



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| <p><i>Encourage motor planning as child is required to direct himself to the allocated picture;</i></p> <p><i>Stimulate proprioception in the upper limbs as compression is applied on the joints while hands and arms walk forward;</i></p> <p><i>Encourage back and neck muscles to contract &amp; stabilise while upper body needs to lift up to touch picture</i></p> <p>(4 minutes)</p> |  | <p><i>which he might bump into.</i></p> <p><b>Instructions:</b> Instructor will rock child forwards and backwards on the pilates ball, 12 times. Child is then told to walk on his hands towards the wall to touch 'Buzz' or the picture and to walk back again. <i>Instructor continues to hold child's legs as he rolls over the ball.</i> Continue to rock forwards and backwards once again before stopping and child walking forward to touch the picture again. Repeat exercise 3 times. Rocking speed: at medium pace (not a slow gentle rock), with a slight jerk and force when rocking forwards. The halt should be a firm stop.</p> <p>Repeat this exercise for 3-4 minutes. <i>Take child's reaction and fatigue levels into account.</i></p> |
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| SUBJECT G   | SEPTEMBER   | WEEK 1: 30 minutes x2   |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) &amp; respond with the required action</li> </ul> |   |   |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> <li>• Bilateral integration</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story theme song on movie on laptop</li> <li>• Balance pods (2)</li> <li>• Picture of 'Buzz' on pencil (1)</li> <li>• 2kg medicine ball (1)</li> <li>• 1kg medicine ball (1)</li> <li>• Prestik</li> </ul> | <ul style="list-style-type: none"> <li>• Multi-purpose jungle gym: Climbing-net, monkey bars</li> <li>• Red cardboard circle (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Floor mat (1)</li> <li>• 3m of line of floor tape</li> <li>• Rainbow river stones (3)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1) Yellow: 8.5 cm (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES                   | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions, along with having</i></p> | <p>'Bouncing to Balance'</p> | <p><b>Set up:</b> Place the laptop on a table with relevant Disney movie theme -song playing. Near the kangaroo ball, place two balance pods (hedge-hog) next to each other, but upside down on the rounded side.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands &amp; <i>may need assistance to remain on the ball while bouncing</i>. When the movie-music plays, child is indicated to bounce up &amp; down in place on the kangaroo ball. Child will be watching the movie on the screen. When the instructor pauses the music, child must stop instantly &amp; is instructed to stand up &amp; is directed to the balance pods. <i>Instructor may need to assist child onto this compliant surfaces as the rounded side increases the level of difficulty</i>. Count with child up to 6 before he climbs off the balance pods. Child returns to kangaroo ball to resume bouncing. Instructor presses play for the music to continue. Repeat this exercise, alternating between the kangaroo ball &amp; the balance pods. Complete song before moving onto next activity.</p> |

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| <p><i>to remain on complaint surface;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(4 minutes)</p>   |                           |  |
| <p><i>Attain child's eye tracking ability by capturing his attention through a familiar, attractive picture;</i></p> <p><i>Stimulate eye muscles when the ball is being passed back &amp; forth &amp; eye need to follow;</i></p> <p><i>Activate proprioception in upper limbs by increasing the weight of the ball which places pressure on joints;</i></p> <p><i>Practice static balance while child is standing upright in place;</i></p> <p><i>Practice responding to instructions by using keywords</i></p> <p>(4 minutes)</p> | <p>1. 'Buzzing wasps'</p> | <p><b>Set up:</b> Place an illustrated, cut out picture of 'Buzz Lightyear' (or a picture of what child is interested in) &amp; secure it on a pencil. Place a red balance rock in a secure area. Child is directed to stand on the rock &amp; instructor stands opposite him, holding the pencil in line with child's nose 45cm away from the face. Have 2kg ball close by.</p> <p><b>Instructions:</b> Child is instructed to look at pencil &amp; to follow its pathway when the instructor moves it. <i>Using keyword: "look" to direct child's attention. It may be difficult for child to not move his head however, the requirements are for the head not to move during the eye exercises.</i> Instructor creates horizontal figure of "8"s with pencil, for the duration of 15-20 seconds. This is followed by the instructor passing the 2kg medicine ball to child to hold for 3 seconds. Upon the keyword "give", child must pass it back. Repeat for 10 counts. Child remains standing on the balance rock for entire duration of the activity. Instructor changes pencil's pathway to vertical figures of "8", for 15-20 seconds. This is followed by instructor passing 2kg ball to child.</p> <p>Repeat both activities 3 times each. For the third time instructor may change the picture to another colourful character.</p> |

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| <p><i>Stimulate vestibular system during rotation;</i></p> <p><i>Enhance static balance when standing one 1 leg, on elevated surface &amp; practicing dynamic balance during jumping;</i></p> <p><i>Stimulate proprioception in lower limbs while one leg is supporting the body &amp; maintaining balance</i></p> <p>(8 minutes)</p>   | <p>2. 'A visit in the fish bowl'</p> | <p><b>Set up:</b> Place rocking bowl on a floor mat. Place the river stones alongside the bowl. Measure 3m &amp; tape a straight horizontal line over this distance.</p> <p><b>Instructions:</b> Child is directed to sit cross-legged inside of the bowl &amp; child may hold on the sides of the bowl. Instructor spins child 15 times to the left, stops firmly &amp; then spins the bowl 15 times to the right, followed by a firm halt afterwards. After rotation, wait up to 8 seconds before child is instructed to step out of the bowl &amp; walk to the river stone. He is shown to bend his knees &amp; jump up onto the rock &amp; remain standing on it. He is shown to regain his stance &amp; to lift up one leg off the river stone. Hold this for 4 counts before attempting to stand on the opposite leg for 4 counts. Child is then shown to put his foot down &amp; to jump off the river stone &amp; back into the bowl. Child resumes to being spun in the bowl, 15 times to the left, halt &amp; the 15 times to the right. This is followed by balancing one leg on the river stone for 4 counts. Instructor may assist child in this position, in case he loses his balance and may not be able to maintain this position. Repeat both activities for a third time.</p> |
| <p><i>Activate dynamic balance while jumping on &amp; off the elevated surfaces;</i></p> <p><i>Encourage spatial orientation as child needs to judge how high to jump due to the different heights of balance rocks;</i></p> <p><i>Stimulate proprioception in lower limbs while jumping, along with stimulating upper limbs proprioception when passing weighted ball;</i></p> <p><i>Understand &amp; respond to instructions</i></p> <p>(7 minutes)</p> | <p>3. 'Telly-tubby mountains'</p>    | <p><b>Set up:</b> Measure 3m &amp; tape a straight horizontal line over this distance. Place 3 river stones over the distance, allowing enough space on the floor between the river stones, for foot placement.</p> <p><b>Instructions:</b> Child is directed to jump up onto the first river stone (red). Child is asked to remain on the river stone for about 2 seconds. Child is then directed to jump back down onto the floor, landing on 2 feet &amp; bending knees. <i>Instructor may need to hold child's hands while jumping &amp; to direct him back down onto the floor, landing on to 2 feet.</i> He is then shown to jump onto the second river stone (green). Repeat same action as former rock. This continues onto the third river stone (yellow). When balancing on the yellow river stone, child is passed 2kg ball &amp; is indicated to pass it back to the instructor. Pass &amp; receive 10 times, counting allowed for child to hear. The ball is then returned to instructor &amp; child is directed jump off the yellow river stone, onto the floor, followed by jumping up onto the green river stone. Continue until child has reached the red river stone again.</p> <p>Repeat this activity for a second time.</p>   |

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| <p><i>Encourage static &amp; dynamic balance while jumping up &amp; out, decreasing or increasing surface area as feet are changing positions;</i></p> <p><i>Activate proprioception in lower limbs while jumping &amp; &amp; encouraging stability when changing positions;</i></p> <p><i>Encourage bilateral integration as both arms move together, at the same time as the legs;</i></p> <p><i>Learn to respond to keywords “out” &amp; “in”</i></p> <p>(3 minutes)</p> | <p>4. ‘Open &amp; close Star gates’</p> | <p><b>Set up:</b> Place a red cardboard circle on the floor as target.</p> <p><b>Instructions:</b> Child is asked to stand on the red circle. Instructor may hold child’s hands &amp; demonstrate to him the ‘lower-limb part’ of the star jumps. Using the keywords: <i>out &amp; in</i>. Upon the word “out” instructor jumps up &amp; feet jump off the target, to shoulder-width apart. Upon the word: “in” instructor indicates that the feet jump back in, landing on the target. This may take a while for child to process this activity. Instructor may assist child by physically lifting him up (to sense the ‘up’ motion) &amp; place the child’s feet out or in. <i>Perform this slowly as child is learning new words with actions.</i> After the legs jumping “out” &amp; “in”, 10 times, a second round is performed. Instructor holds both of child’s hands. On the words “out”, child lifts up the child’s hands along his sides, to reach above his head (legs jump out to shoulder-width apart). Upon the words “in”, child brings legs in &amp; instructor brings child’s arms down, resuming to be along his sides. Repeat this slowly 8 times.</p> |
| <p><b>Cool down</b></p> <p><i>Practice functional movements by integrating vestibular and proprioception activities;</i></p> <p><i>Stimulate proprioceptors in upper limbs through contraction while climbing &amp; the pulling of the joints while hanging;</i></p> <p><i>Increase shoulder strength while climbing the net &amp; hanging on the monkey bars.</i></p>  | <p>5. ‘Toy Story’s spider web’</p>      | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains a small climbing-net &amp; monkey bars.</p> <p><b>Instructions:</b> Child is assisted to the net. Instructor &amp; child climb up the net to the top. Once reaching the top, child is directed to the monkey bars. Instructor may assist child by supporting his legs. Child is shown to grasp first bar &amp; then direct him to the second bar, &amp; then the third bar &amp; hold for 3 seconds. This is followed by lowering child down to the ground. Direct child to the start of the net to repeat this activity. Repeat these activities 3 times each.</p>  |

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| (6 minutes) |  |  |
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| SUBJECT G  | SEPTEMBER  | WEEK 2: 30 minutes x2  |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Integrate vestibular functions with somatosensory (proprioception) functions</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understanding instructions (keywords) &amp; respond with the required action</li> </ul> |  |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> <li>• Directionality</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story theme song on movie on laptop</li> <li>• Balance pods (2)</li> <li>• Chair (1)</li> <li>• Mini-trampoline (1)</li> <li>• 1kg medicine ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• 2kg medicine ball (1)</li> <li>• Rainbow river stones (2)<br/>Heights: Red: 13.5 cm (1) Green:16 cm (1) Yellow: 8.5 cm (1)</li> <li>• Scooter board (1)</li> <li>• Red cardboard circle (1)</li> <li>• Pilates ball (1)</li> <li>• Slow song on CD</li> </ul> |

| SUB-AIMS  | ACTIVITIES                | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions, along with having to remain on complaint</i></p> | <p>'Happy hedge-hogs'</p> | <p><b>Set up:</b> Place the laptop on a table with the relevant Disney movie and theme-song playing. Near the kangaroo ball, place two balance pods (hedge hogs) next to each other, but upside down on the rounded side.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands &amp; <i>may need assistance to remain on the ball while bouncing</i>. When the movie-music plays, child is indicated to bounce up &amp; down, in place on the kangaroo ball. Child will be watching the movie on the screen. When the instructor pauses the music, child must stop instantly, is then instructed to stand up &amp; directed to the balance pods. <i>Instructor may need to assist child onto this compliant surfaces as the rounded side increase level of difficulty</i>. Count with child up to 6 before he climbs off the balance pods (hedge hogs). Child returns to kangaroo ball to resume bouncing. Instructor presses play for the music to continue.</p> |

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| <p><i>surface;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music (4 minutes)</i></p>   |                                  | <p>Repeat this exercise, alternating between kangaroo ball &amp; the balance pods. Complete song before moving onto next activity.</p>  |
| <p><i>Initiate proprioception stimulation in all of the joints through 'pumping action'</i></p> <p>(3 minutes)</p>  | <p>1. 'Dressing up the toys'</p> | <p><b>Set up:</b> Have a sturdy chair for child to sit on &amp; a floor mat alongside it. Allow a familiar song to play while activity is being performed.</p> <p><b>Instructions:</b> Seat child in secure chair. Instructor places pressure on child's head &amp; then releases, 10 times. Move down to both shoulders. Instructor places both hands on shoulders &amp; firmly presses down &amp; releases, 10 times. The next joint: hold child's elbow &amp; place your other hand where the humerus &amp; shoulder joint are. Perform 'pumping' action by pushing the elbow joints &amp; shoulder joints towards each other &amp; release. Perform the same action between the elbow &amp; wrist joints, then each finger on the hand. Direct child to lie down on the floor. Repeat pumping action on hip joint followed by knee joints, moving down to ankles &amp; finally each toe. Repeat this activity only once.</p>  |
| <p><i>Stimulate vestibular system through rotation &amp; quick changes in direction;</i></p> <p><i>Activate proprioception in upper limbs, as the arms are assisting in rotation which applies compression to joints, followed by contraction when arms hold weighted ball</i></p> <p><i>Enhance lower back &amp; neck muscles while the upper body is required to lift up;</i></p> <p><i>Stimulate proprioception in lower limbs while jumping on rocks;</i></p> | <p>2. 'Turning tummy'</p>        | <p><b>Set up:</b> Place a scooter board in a clear open space &amp; set out 3 river stones in a vertical row, with a 1kg ball alongside it. River stones are in the following order: Red, Green, Yellow.</p> <p><b>Instructions:</b> Child is directed to lie down on the scooter, on his stomach, to bend at the knees &amp; place both hands on the floor. Rotate the child to the left 10 times, stop, &amp; 10 times to the right. If child is capable, his hands may assist in rotating the scooter board while hands are on the floor &amp; elbows are bent. Once completing rotation, wait a few seconds &amp; ask child to stand up. <i>Instructor may assist child while standing up.</i> Child is then asked to go to the red river stone. He is given the 1kg medicine ball. Child is shown to jump up, onto the red river stone &amp; then back down onto other side while holding the 1kg ball with both hands. <i>Ensure that child is bending his knees.</i> Child is then shown to repeat the same on green river stone, while holding ball. Continue jumping on &amp; off until standing on top of the yellow river stone. Child is then asked to throw 1kg ball (with his two hands) to instructor, while remaining on yellow river stone. Remember that yellow river stone is smaller in diameter compared to the other river stones. Child throws &amp;</p> |



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| <p><i>Practice dynamic balance while jumping up &amp; down, followed by static balance being encouraged when standing on decreased surface area;</i></p> <p><i>Practice ball manipulation when throwing &amp; catching is initiated</i></p> <p>(10 minutes)</p>   |                              | <p>catches 5 times &amp; is then asked to jump off &amp; back on to the green river stone. This is followed by jumping up on to the red river stone while holding the 1kg with both hands. Child places the ball down &amp; is shown to lie down on scooter board for a second time.</p> <p>Repeat these 2 activities, 3 times each: Rotation on scooter board (10 times to the left &amp; 10 times to the right) followed by jumping up &amp; down on all 3 river stones while holding the 1kg. Repeat throwing &amp; catching to child.</p>   |
| <p><i>Activate dynamic balance while jumping on trampoline, initiate static balance by standing on compliant surface;</i></p> <p><i>Stimulate proprioception in lower limbs while jumping, this includes stimulating proprioception in upper limbs while passing weighted ball &amp; increasing the weight on the joints;</i></p> <p><i>Practice directionality with the keywords the instructor says, learning the difference between ‘up’ &amp; ‘down’</i></p> <p><i>Encourage muscle contraction to occur in the obliques with moving weighted ball from side to side</i></p> <p>(1 minutes)</p> | <p>3. Jumping jelly tots</p> | <p><b>Set up:</b> Place trampoline on the floor with a 1kg &amp; 2kg ball next to it.</p> <p><b>Instructions:</b> Child is asked to stand on the trampoline &amp; to begin jumping 10 times. Instructor count out allowed along with child. When instructor says “stop”, child stops in place and regains balance. Instructor passes 1kg ball to him. Child is shown to move it from side to side while remaining in place. When instructor says “Up” child puts his arms &amp; ball up in the air. When the instructor says “Down”, child bends down with the ball. Instructor may need to physically show these actions to the child by lifting up the child’s hand or pressing on his shoulder to indicate “down”.</p> <p>Repeat 3 times for each direction: up, down, side to side. Instructor retrieves the ball from child. Child returns to jumping up &amp; down on trampoline 10 times before stopping to receive the 1kg ball. Repeat the above instructions for the ball-related activity.</p> <p>Return to jumping on trampoline for a third time, in addition give child 2kg ball to move from side to side &amp; up &amp; down.</p> |

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| <p><b>Cool down</b><br/><i>Stimulate vestibular system through rocking motion &amp; firm stops;</i></p> <p>(3 minutes)</p> | <p>4. 'Cradle rock'</p> | <p><b>Set up:</b> Instruct child to lie on his stomach on a pilates ball while a slow song plays in background.</p> <p><b>Instructions:</b> instructor gently supports child on the ball, by placing his hand on their hands on child's back to ensure child does not fall off. Instructor rocks child forwards &amp; backwards while music plays. After about a minute, pause the rocking for a few seconds before returning to rock the child &amp; ball again until the song is finished. Rocking speed: at medium pace (not a slow gentle rock), with a slight jerk &amp; force when rocking forwards. The halt should be a firm stop.</p> |
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| SUBJECT G   | SEPTEMBER  | WEEK 3: 30 minutes x2  |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Integrate vestibular functions with somatosensory (proprioception) functions</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) &amp; respond with the required action</li> </ul> |  |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> <li>• Motor planning</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story theme song on movie on laptop</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Floor mat (1)</li> <li>• Tape measure (1)</li> <li>• 3m taped line</li> </ul> | <ul style="list-style-type: none"> <li>• Mini-trampoline (1)</li> <li>• 2kg medicine ball (1)</li> <li>• Small orange cone (1)</li> <li>• Multi-purpose jungle gym: Climbing-net, monkey bars</li> <li>• Small tactile balls or colour objects (3)</li> <li>• Rainbow river stone: Green:16 cm (1)</li> <li>• Balloon (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES             | EXPLANATION  |
|---|------------------------|--|
| <p><b>Warm up</b></p> <p><b>To:</b><br/> <i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learn to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions, along with having to remain in</i></p> | <p>'Bouncing toys'</p> | <p><b>Set up:</b> Place the laptop on a table with the relevant Disney movie theme song playing. Near the kangaroo ball, place one green river stone.</p> <p><b>Instructions:</b> Child sits on kangaroo ball, holding the handle with both hands &amp; <i>may need assistance to remain on the ball while bouncing</i>. When the movie-music plays, child is indicated to bounce up &amp; down in place on kangaroo ball. Child will be watching movie on screen. When the instructor pauses the music, child must stop instantly &amp; is instructed to stand up &amp; walk to the green rock &amp; stand on top of it. Child must remain in static position for 10 counts before he may climb off the green river stone. <i>Instructor may count allowed with child</i>. Child returns to kangaroo ball &amp; resumes bouncing. Instructor presses play for the music to continue. Repeat this exercise, alternating between kangaroo ball &amp; green river stone. Complete song before moving onto next activity.</p> |

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| <p><i>static position on elevated, slanted surface;</i></p> <p><i>Stimulate proprioception in the lower limbs while bouncing &amp; encourage the support the body when having to remain upright on the river stone;</i></p> <p><i>Practice listening skills with simple indication of pausing music &amp; responding to the instructions that follow</i><br/>(4 minutes)</p> |                                   |  |
| <p><i>Increase stimulation of vestibular system during rotation &amp; increasing the number of rotation yet shortening the rotations;</i></p> <p><i>Increase static balance ability by decreasing the surface area of foot position, progressing to standing heel-to-toe instead of 2 feet next to each other;</i></p> <p>(6 minutes)</p>                                    | <p>1. 'Turning tortoises '</p>    | <p><b>Set up:</b> Place big rocking bowl on a floor mat &amp; 1kg medicine ball alongside it.</p> <p><b>Instructions:</b> Child is directed to sit cross-legged inside of the bowl &amp; child may hold on the sides of the bowl. Instructor spins the child 10 times to the left, stops firmly &amp; then spins bowl 10 times to the right; followed by spinning to the left again but only 5 times, firm stop &amp; then 5 times to right, stop. After rotation wait up to 8 seconds before child is instructed to step out of the bowl. <i>During this waiting time, encourage child to clap his hands &amp; count up to 8 with instructor.</i> Child is then asked to stand up &amp; step out of the bowl. Instructor turns bowl over, with its rounded side exposed. Child is directed to stand on top of bowl (tortoise) &amp; asked to balance on it. <i>Instructor may assist child while he climbs on top &amp; to be close to ensure he does not fall off.</i> Once reaching the top, child needs to regain balance before instructor assists him in standing heel-to-toe (one foot in front of the other). Instructor counts with child up to 8. Then child is assisted to change legs &amp; have the back leg to be in front, for 8 counts. Child is then assisted off 'tortoise' &amp; the bowl is turned over on its rounded side. Instructor spins child, following the above-mentioned criteria. Repeat these 2 activities 3 consecutive times each, alternating between the spinning &amp; child standing on top of the bowl.</p> |
| <p><i>Activate dynamic balance while jumping on trampoline &amp; walking on decreased surface</i></p>  | <p>2. 'Tippy-toes trampoline'</p> | <p><b>Set up:</b> trampoline in an open space with a 3m line that has been measured out &amp; taped to floor. Place a small orange cone at end of the line with a 2kg medicine ball next to it.</p>  |

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| <p><i>area when child is walking on the balls of his feet;</i></p> <p><i>Stimulate proprioception in lower limbs while jumping &amp; when supporting weighted ball;</i></p> <p><i>Understand instructions and respond accordingly</i></p> <p>(2 minutes)</p>  |                                     | <p><b>Instructions:</b> Child is directed to jump on top of the trampoline, 10 times, to stop &amp; stand in place with 2 feet beside each other for 8 counts before jumping up &amp; down on trampoline only 8 times. Child is the asked to instantly stop &amp; is indicated to step off trampoline. <i>Instructor may assists child off trampoline.</i> Child is instructed to walk on the balls of his feet (tippy-toes) on the line from the trampoline end towards the orange cone. Instructor may need to physically lift the child up slightly to show him how to walk on his 'tippy-toes'. Once reaching the cone, child is direct to pick up the 2kg ball off the ground with both hands &amp; to walk back (on his toes) over the line back to trampoline. Child may place ball back down on the ground when reaching the trampoline. Child is shown to step back up onto it &amp; resume jumping. <i>Instructor places 2kg ball back at cone &amp; follows the above directions for the jumping protocol. Alternating between 10 jumps-stop &amp; then 8 jumps.</i></p> <p>Repeat this 3 times: Jumping on trampoline, followed by walking on 'tippy-toes' on the line towards the cone &amp; back again.</p>                          |
| <p><i>Stimulate proprioceptors in upper limbs through contraction while climbing, pulling of the joints while hanging on monkey bars &amp; compression on joints during the wheelbarrow (child is on his hands &amp; instructor holds his legs by his knees);</i></p> <p><i>Integrate vestibular stimulation with proprioception through functional movements;</i></p> <p><i>Increase shoulder strength while climbing the net as well as support the joints while hanging on the monkey bars;</i></p> <p>(9 minutes)</p> | <p>3. 'Woody rescuing the toys'</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym that contains climbing-net, monkey bars. Place 3 colourful objects or small tactile balls on the ground next to jungle gym where they easily accessible for child.</p> <p><b>Instructions:</b> Child is assisted to the net. Instructor &amp; child climb the net, to the top. Once reaching the top, child is instructed to go to monkey bars. Instructor may assist child by supporting his legs while hanging from monkey bars. Child is shown to grasp first bar &amp; then direct him to second bar, &amp; then third bar &amp; then fourth bar, hold for 3 seconds. This is followed by lowering child down to the ground. Child is then showed to lie down on the ground &amp; to perform the *'wheelbarrow' walk. Child is asked to walk forwards on his hands to fetch one tactile ball or toy. When he reaches the balls, instructor lowers child's legs and he picks up one ball to hold &amp; take to the net. Place ball or object down &amp; begin this functional activity again. Direct child to the start of the net to repeat this activity.</p> <p>Repeat this exercise 3 times to collect all 3 tactile balls or objects after the 'wheelbarrow' walk.</p> |

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| <p><b>Cool down</b><br/> <i>Encourage motor planning as balloon creates a slow path for child to follow &amp; touch it;</i></p> <p><i>Stimulate neck muscles as child is asked to look up at balloon is floating in air</i></p> <p>(2 minutes)</p> | <p>4. 'Balloon fun'</p> | <p><b>Set up:</b> Instructor inflates one balloon. Ensure there is an area, clear of obstructions &amp; furniture.</p> <p><b>Instructions:</b> Child is instructed to hit balloon to keep it off the ground. Instructor may need to help child by physically directing child's hands to hit or touch the balloon. The balloon creates a slow enough path for the child to follow. Continue this activity for 2 minutes of teaching child to look up &amp; touch balloon.</p> |
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\*Wheelbarrow: Child is shown to lie down flat on the floor. The instructor picks up child's legs & holds by the knees as child lifts up upper body & supported by the arms. Child is shown to walk forwards on his hands. Instructor ensures that child's lower back is not bent.

| SUBJECT G   | SEPTEMBER  | WEEK 4: 30 minutes x2   |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Integrate vestibular functions with somatosensory (proprioception) functions</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) &amp; respond with the required action</li> </ul> |  |   |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Body awareness</li> <li>• Initiate functional tasks</li> <li>• Motor planning</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story theme song on laptop</li> <li>• Chair</li> <li>• 1 kg medicine ball (1)</li> <li>• 2kg medicine ball</li> </ul> | <ul style="list-style-type: none"> <li>• Rocking bowl (1)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones (4)<br/>Heights: Red: 13.5 cm (2) Green:16 cm (1) Yellow: 8.5 cm (1)</li> <li>• Balloon (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES             | EXPLANATION  |
|---|------------------------|--|
| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions, along with having to remain on</i></p> | <p>'Bouncing toys'</p> | <p><b>Set up:</b> Place the laptop on a table with the relevant Disney movie theme song playing. Near the kangaroo ball, place one green river stone.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding the handle with both hands &amp; <i>may need assistance to remain on ball while bouncing</i>. When the movie-music plays, the child is indicated to bounce up &amp; down in place on the kangaroo ball. Child will be watching the movie on the screen. When the instructor pauses music, child must stop instantly &amp; is instructed to stand up &amp; walk to the green rock &amp; stand on top of it. Child must remain in static position for 10 counts before he may climb off green river stone. <i>Instructor may count aloud with the child</i>. Child returns to kangaroo ball to resume bouncing. Instructor presses play for music to continue. Repeat this exercise, alternating between kangaroo ball &amp; green river stone. Complete song before moving onto next activity.</p> |

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| <p><i>slanted or complaint, surface;</i></p> <p><i>Stimulate proprioception in the lower limbs while bouncing &amp; encourage limbs to support the body while having to remain upright on the river stone;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(4 minutes)</p> |                                 |  |
| <p><i>Initiate stimulation of proprioceptors in all of the joints through ‘pumping action’, which applies compression &amp; release on the joints.</i></p> <p>(3 minutes)</p>  | <p>1. ‘Jumping joints’</p>      | <p><b>Set up:</b> Have a sturdy chair for child to sit on &amp; a floor mat alongside it. Play a familiar song while activity is being performed.</p> <p><b>Instructions:</b> Seat child in secure chair. Instructor places pressure on child’s head &amp; then releases, 10 times. Move down to both shoulders. Instructor places both hands on shoulders &amp; firmly presses down &amp; releases, 10 times. The next joint, hold child’s elbow &amp; place your other hand where humerus &amp; shoulder joint are. Perform ‘pumping’ action by pushing the elbow joints &amp; shoulder joints towards each other &amp; release. Perform the same action between the elbow &amp; wrist joints, then each finger on the hand. Direct child to lie down on the floor. Repeat pumping action on hip joint, followed by knee joints, moving down to ankles &amp; finally each toe. Repeat this activity only once.</p> |
| <p><i>Stimulate vestibular system through up &amp; down movements, along with dynamic balance during this action;</i></p> <p><i>Encourage proprioception in</i></p>  | <p>2. ‘Jumping on Smarties’</p> | <p><b>Set up:</b> Place 4 river stones out in a row (red, green, yellow, red) &amp; 1kg &amp; 2kg medicine ball alongside the last red river stone.</p> <p><b>Instructions:</b> Child is given 1kg medicine ball &amp; shown to jump up onto first river stone (red). Then child must jump back down onto the floor to prepare to jump onto the green river stone. This continues until the last river stone (red) where child is asked to remain standing on it.</p>  |



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| <p><i>upper limbs, during contraction while supporting weighted ball, this is followed by increasing stimulation by increasing the weight of the ball that the joints need to support;</i></p> <p><i>Practice body awareness when directed to touch weighted ball to the instructed body part</i></p> <p>(5 minutes)</p>  |                                | <p>Child is asked to pass the 1kg ball to the instructor. Instructor then passes the 2kg ball to the child &amp; he holds it with his 2 hands. Instructor repeats the following: “Touch your head”, &amp; child touches the top of his head with the 2kg ball. Instructor follows onto next instruction, “touch your legs” &amp; child is told to bring ball down to his legs. If child fails to follow this instruction, instructor may assist child in showing him where to bring the ball. Instructor gives a third instruction indicating to child to touch the ball to his stomach. Child then passes ball back to the instructor &amp; is shown to turn around &amp; jump off red river stone &amp; return to the starting river stone, by jumping on &amp; off yellow river stone, followed by green &amp; lastly the starting red river stone. Instructor meets child at this rock &amp; passes the 1kg ball to child. Child is given the same instructions to follow by using 1kg ball to touch to the body part. Once 3 instructions relating to body parts have been given &amp; followed, child gives 1kg ball back to instructor &amp; receives 2kg ball, shown to turn around &amp; jump off the red river stone &amp; to follow the routine of jump on &amp; off the relevant river stones.</p> <p>Activity is complete after jumping up &amp; down onto rocks for third round.</p> |
| <p><i>Increase stimulation of vestibular system during rotation &amp; alternating between a longer duration of spinning &amp; a shorter duration;</i></p> <p><i>Continue of stimulating the proprioceptors while passing of the weighted ball;</i></p> <p><i>Activate eye tracking as the child’s eyes need to follow the balls path into his hands</i></p> <p>( 8 minutes)</p> | <p>3. Turning to towers’</p>   | <p><b>Set up:</b> Place big rocking bowl on a floor mat with 1 red river stone &amp; 1 green river stone fitted on top of it (making a tower). Have a 1kg medicine ball alongside it.</p> <p><b>Instructions:</b> Child is directed to sit cross-legged inside of the bowl &amp; child may hold on to the sides of bowl. Instructor spins child 12 times to the left, stops firmly &amp; then spins the bowl 12 times to the right; followed by spinning to the left again but only 8 times, a firm stop &amp; then 8 times to right, then stop. After rotation, wait up to 8 seconds before child is instructed to step out of bowl. <i>During this waiting time, encourage child to clap his hands &amp; count up to 8 with instructor.</i> Child is then asked to stand up &amp; to step out of the bowl &amp; directed to stand on top of the red &amp; green river stones ‘tower’. While standing in a static position child &amp; instructor pass the 1kg ball back &amp; forth. Count only 10 passes before child is asked to climb off the 2 river stones &amp; step back into rocking bowl. Repeat spinning activity according to above instructions, followed by balancing on the 2 river stones.</p> <p>Repeat these two activities for a third time.</p>   |
| <p><b>Cool down</b><br/><i>Maintain activation of</i></p>   | <p>5. ‘Balancing balloons’</p> | <p><b>Set up:</b> Instructor inflates 1 balloon. Place yellow river stone rock in an open area. Ensure there is a space clear of obstructions &amp; furniture.</p>   |

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| <p><i>vestibular system through dynamic balance while jumping;</i></p> <p><i>Maintain stimulation of proprioceptors in lower limbs while jumping;</i></p> <p><i>Encourage motor planning as balloon creates a slow path for child to follow it &amp; make contact with it;</i></p> <p><i>Stimulate neck muscles as child is asked to look up at balloon floating in air</i></p> <p>(4 minutes)</p> |  | <p><b>Instructions:</b> Child is asked to jump up onto river stone &amp; to jump back down. Repeat 4 times &amp; then remain standing on the rock for 10 counts. Repeat this twice. Child is then shown to hit balloon to keep it off the ground when the instructor places it in the air. Instructor may need to help child by physically directing child's hands to hit or touch balloon. Balloon creates a slow enough path for child to follow it. Continue this activity for 2 minutes of teaching child to look up &amp; touch balloon. Return back to the yellow river stone &amp; repeat jumping up &amp; down onto the river stone, followed by remaining it for 10 counts.</p> <p>Repeat both activity 3 times, alternating between each other.</p> |
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| SUBJECT G   | OCTOBER   | WEEK 1: 30 minutes x2  |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) &amp; respond with the required action</li> </ul> |   |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiate static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> <li>• Motor planning</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story theme song on movie on laptop</li> <li>• Balance pods (2)</li> <li>• Picture of 'Buzz' &amp; picture of Woody (1)</li> <li>• Small traffic cones (2)</li> <li>• Scooter board (2)</li> <li>• Hula hoop (1)</li> <li>• 1kg medicine ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Prestik</li> <li>• Mini-trampoline (1)</li> <li>• Colour cardboard circles (3)<br/>Red, blue, green</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Floor mat (1)</li> <li>• Rainbow river stones (3)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1) Yellow: 8.5 cm (1)</li> <li>• Colourful balloon (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES                | EXPLANATION  |
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| <p><b>Warm up:</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the</i></p> | <p>'Happy hedge-hogs'</p> | <p><b>Set up:</b> Place laptop on a table with relevant Disney movie theme song playing. Near the kangaroo ball, place two balance pods next to each other, but upside down on the rounded side.</p> <p><b>Instructions:</b> Child sits on the kangaroo ball, holding handle with both hands &amp; <i>may need assistance to remain on the ball while bouncing</i>. When movie-music plays, child is indicated to bounce up &amp; down in place on kangaroo ball. Child will be watching movie on screen. When instructor pauses music, child must stop instantly &amp; is instructed to stand up &amp; walk to the balance pods. <i>Instructor may need to assist child onto this compliant surfaces as the rounded</i></p> |

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| <p><i>ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions, along with having to remain on slanted or complaint, surface;</i></p> <p><i>Stimulate proprioception in the lower limbs while bouncing &amp; encourage limbs to support the body while having to remain upright on the river stone;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(4 minutes)</p> |                          | <p><i>side increase level of difficulty. Count with child up to 6 before he may climb off the balance pods (hedge hogs). Child returns to kangaroo ball to resume bouncing. Instructor presses play for the music to continue. Repeat this exercise, alternating between kangaroo ball and the balance pods (hedge-hogs). Complete song before moving onto next activity.</i></p>  |
| <p><i>Initiate stimulation of the proprioceptors in upper limbs' when compression is placed on the child's joints &amp; he pulls himself forward across the floor, in addition, stimulation continues when traction occurs when child's arms are being pulled;</i></p>   | <p>1. 'Scooter pull'</p> | <p><b>Set up:</b> Set out 2 cones &amp; place 2 cartoon pictures on both cones, setting down 1 cone (Buzz Lightyear) on one side of the room and other cone (Woody) on opposite side of the room. Scooter board is placed in middle of the room and a hula hoop is ready at hand, ensuring there is clear open space.</p> <p><b>Instructions:</b> Child is directed to lie down with his stomach on the scooter board. Child is instructed to bend at the knees (contracting hamstrings) so that his feet are not dragging on the floor. Instructor calls out one of the cartoon characters' name &amp; child is shown to 'scooter' forward on hands towards the relevant cone. Then instructor calls out the other cone's</p> |

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| <p><i>Encourage vestibular stimulation to continue with acceleration and quick change in direction when on the scooter board;</i></p> <p><i>Activate muscle in back and neck as upper body needs to be lifted up while arms move forwards and while child is being pulled</i><br/>(5 minutes)</p>   |                            | <p>character &amp; child is shown to scooter forward again on his hands. <i>Instructor may assist child in the action of using his hands to move forwards.</i> Instructor then gives hula hoop to child to hold one end and instructor is on opposite end of the hula hoop. Instructor pulls hula hoop to pull child, ensuring that child continues to hold on. Instructor may steer child, or while pulling child forward, initiate a quick change in direction. Pull child around the room or open space for a 1 minute, ensuring child remains holding onto the hoop.</p> <p>Alternate between scooter forward on hands &amp; child being pulled by hula hoop, 3 times for each activity.</p>   |
| <p><i>Activate dynamic balance while jumping on trampoline, initiate static balance by standing on compliant surface and maintaining position;</i></p> <p><i>Stimulate proprioception in lower limbs while jumping as muscles contract to support jumping &amp; standing in place; along with stimulating proprioception in upper limbs when picking up the weighted ball &amp; increasing the weight on the joints;</i></p> <p><i>Encourage cognitive skills when child needs to respond to colours or object called</i></p> | <p>2. Jumping smarties</p> | <p><b>Set up:</b> Place mini-trampoline in middle of a clear open space. In 1m radius from trampoline, space out 3 river stones (red, green &amp; yellow) around the trampoline &amp; 1kg medicine ball in between the yellow and red river stones.</p> <p><b>Instructions:</b> Child is asked to step up onto trampoline and begin jumping up and down. Instructor counts up to 10 with child, then ask him to stop and stand on his 2 feet for 5 counts (5 seconds). Child is asked to resume jumping up &amp; down for 10 counts. On second stop (wait for 5 counts) instructor calls out colour of a river stone. Child must seek out in which direction the river stone is situated. Child jumps down onto ground, landing on 2 feet in front of river stone &amp; must hop forwards onto river stone (he will be facing away from trampoline). Child remains on river stone for 5 counts, turns around &amp; hops back down to the ground and back onto trampoline. Child resumes jumping up &amp; down following same instructions mentioned above: stopping &amp; starting twice before another colour river stone is called out. Instructions continue until all 3 river stones have been called out. The fourth one is the medicine ball. When instructor calls out "ball": child jumps off trampoline &amp; hops to pick up ball. He is then asked to turn around &amp; hop back to trampoline &amp; step up onto trampoline. Child resumes jumping up &amp; down for 10 counts while holding the ball. After the 10 counts child is asked to stop &amp; pass ball to instructor.</p> <p>This activity is only repeated once.</p> |

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| <p>out</p> <p>(6 minutes)</p>  |   |   |
| <p><i>Stimulate vestibular system through rocking motions of forward-backwards, &amp; side to side;</i></p> <p><i>Stimulate proprioception in lower limbs while jumping as the tendons around joints are being stretched when knees bend to that extent (while child is on his haunches)</i></p> <p><i>Encourage equilibrium reactions to occur when oblique's around abdominal area need to contract to enable child from falling over during rocking;</i></p> <p><i>Learn to respond to when keyword is given</i></p> <p>(6 minutes)</p> | <p>3. 'Rocking boat- to froggy float'</p> | <p><b>Set up:</b> Place the rocking bowl on a floor mat. Near to bowl stick down 3 coloured cardboard circles in a vertical line with ½ a meter between each circle.</p> <p><b>Instructions:</b> Child is asked to get into rocking bowl &amp; to sit cross-legged. <i>He may hold onto the sides of the bowl.</i> Instructor rocks child forwards &amp; backward 10 times. This set is followed by a sudden stop &amp; bowl is rocked from side to side, 10 times. Rocking speed: At a medium speed but ensuring that child does not completely fall over. If this is the case, start with a gentle rock. Repeat these two directions twice (forward, backwards; side to side). Child is then assisted out of bowl. He is instructed to go down on his haunches &amp; to place his two arms together in front of his body to create a 'frog-stance', preparing to leap. The first coloured circle is called out &amp; instructor imitates a forward frog jump. This entails jumping up from his bent legs, while being on his haunches &amp; landing on the coloured circle on his feet &amp; hands, returning to being on his haunches. Instructor may physically assist child to jump, by picking him up from behind to demonstrate the lift, using the keyword, "Jump". Instructor may need to assist for all 3 circles. Child is then asked to return to his 'rocking boat' bowl. Repeat rocking motion as mentioned before, followed by frog jumping to each circle.</p> <p>Repeat the 2 activities for a third time.</p> |
| <p><b>Cool down</b></p> <p><i>Teach child new keyword, "kick" &amp; the relation of it to his feet &amp; the target;</i></p> <p><i>Encourage motor planning</i></p>  | <p>4. 'Floating toes'</p>                 | <p><b>Set up:</b> Place a floor mat on the floor &amp; instructor inflates a balloon. <i>An assistant may be needed to help instructor teach child the activity.</i></p> <p><b>Instructions:</b> Child is directed to lie down on floor mat on his back, with his feet up in the air. Assistant is next to child. Instructor places the balloon in the air directly above child's feet. Child is asked to "kick" the balloon. Assistant physically takes child's legs &amp; makes contact with</p>  |

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| <p><i>as the balloon is slow enough for child to process its path;</i></p> <p><i>Activating abdominal muscles</i></p> <p>(3 minutes)</p> |  | <p>child's feet &amp; balloon, keeping in air. Assistant keeps helping child until he understands the kicking action. This may take the entire duration of the activity.</p> |
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| SUBJECT G  | OCTOBER   | WEEK 2: 30 minutes x2  |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somatosensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) &amp; respond with the required action</li> </ul> |   |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiate static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> <li>• Motor planning</li> <li>• Bilateral integration</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story theme song on movie on laptop</li> <li>• Blindfold (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Coloured cardboard circles (3)<br/>Red, blue, green</li> <li>• Small chair (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Floor mat (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg medicine ball (1)</li> <li>• Prestik</li> <li>• Mini-trampoline (1)</li> <li>• Rainbow river stones (2)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1)</li> <li>• Colourful pictures child can relate to (5)</li> <li>• Pilates ball</li> </ul> |

| SUB-AIMS  | ACTIVITIES             | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down'</i></p> | <p>'Covering eyes'</p> | <p><b>Set up:</b> Place the laptop on a table with the relevant Disney movie theme song playing. Near kangaroo ball, place one red river stone near to kangaroo ball &amp; a blindfold close at hand.</p> <p><b>Instructions:</b> Child sits on kangaroo ball, holding the handle with both hands. When the movie-music plays, child is indicated to bounce up &amp; down in place on kangaroo ball. Child will be watching movie on screen. When instructor pauses music, child must stop instantly &amp; is instructed to stand up &amp; stand on top of the red river stone, remaining in place for 5 counts. Instructor then shows child the blindfold &amp; indicates that it will be placed on his face, over his eyes. Instructor places blindfold over child's eyes &amp; counts up to 5 before blindfold is removed &amp; child is directed to resume to bouncing on ball again. Alternate between bouncing &amp; child's eyes being covered, while remaining on river stone. Continue until song is finished. <i>Instructor should be close by to assist child while his eyes are closed as this is a new instruction &amp; may cause anxiety.</i> If blindfold causes irritation, instructor may use his own hands to cover child's</p> |



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| <p><i>motions, along with having to remain on slanted or complaint, surface;</i></p> <p><i>Stimulate proprioception in the lower limbs while bouncing &amp; encourage limbs to support the body while having to remain upright on the river stone;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p><i>Increase stimulation during static stance by eliminating visual input</i></p> <p>(5 minutes)</p> |                           | <p>eyes or help child use his hands to cover his eyes.</p>  |
| <p><i>Stimulate vestibular system through rotation &amp; quick changes of direction for a certain amount of turns;</i></p> <p><i>To stimulate proprioception in lower limbs while jumping &amp; having to bend at the knees;</i></p>   | <p>1. 'Spinning boat'</p> | <p><b>Set up:</b> Place rocking bowl on a floor &amp; lay out 3 coloured cardboard circles in a vertical line, secured on the floor, ½ a meter between each other.</p> <p><b>Instructions:</b> Child steps into big rocking bowl, sits upright &amp; cross-legged. Instructor spins child 12 times to the left, stops firmly &amp; then spins the bowl 12 times to the right with a firm halt afterwards. Spinning is repeated for a second time, however only 8 rotations to the left &amp; then 8 rotations to the right. After rotation wait up to 10 seconds before child is instructed to step out of bowl &amp; is directed to go to the first circle (indicate the colour). Child is directed to go onto his haunches, by bending at the knees, sitting on his legs &amp; placing his arms in front of his</p> |

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| <p><i>Respond to keywords</i></p> <p>(7 minutes)</p>   |                            | <p>body &amp; hands on the floor. The first coloured circle is called out, followed by the keyword “jump!”. Instructor may need to remind child how to perform this activity by going behind him &amp; lifting him up while supporting him around the abdominals. Assist for first two jumps &amp; then for third circle stand back to see if child will respond without assistance. If not, instructor may assist. Child is then asked to return to rocking bowl.</p> <p>Repeat these two activities 3 consecutive times. Instructor may assist with jumping from circle to circle.</p>  |
| <p><i>Initiate activation in proprioceptors in all of the joint's by alternating between compression &amp; traction;</i></p> <p><i>Encourage body awareness as instructor names the body part that receives pressure applied to it;</i></p> <p><i>Stimulate proprioceptors when body is on an elevated, uneven surface and limbs need to support weighted ball which are alternated between 1 kg &amp; 2kg;</i></p> <p><i>Practice ball manipulation skills</i></p> <p>(6 minutes)</p> | <p>2. ‘Where are you?’</p> | <p><b>Set up:</b> Have a sturdy chair for child to sit on &amp; a floor mat alongside it. Have green river stone close by. Allow a familiar song to play while activity is being performed.</p> <p><b>Instructions:</b> Seat child in secure chair. Instructor places pressure on the child’s head &amp; then releases, 10 times. Move down to both shoulders. Instructor places both hands on shoulders &amp; firmly presses down &amp; releases, 10 times. Next joint is in the arms: hold child’s elbow &amp; place your other hand where the humerus &amp; shoulder joint are. Perform ‘pumping’ action by pushing elbow joints &amp; shoulder joints towards each other &amp; release. Perform same action between elbow &amp; wrist joints, then each finger on the hand. Direct child to lie down on the floor. Repeat pumping action on hip joint, followed by knee joints, moving down to ankles &amp; finally each toe. Repeat this activity only once, however repeat on other side of body as well. <i>For every section or area instructor applies pressure to &amp; releases, the instructor says “Hello head” or “Hello shoulders”, to assist in child being aware of the body part.</i></p> <p>Once instructor has completed this action on all limbs, child is asked to stand on top of green river stone. While standing, instructor passes 1kg ball back &amp; forth to child. Use the usual keywords for this activity. When child has the ball, instructor says “Give”. Pass back &amp; forth 15 times. Child is then given 2kg ball which will be for passed back &amp; forth him between him &amp; instructor. Return to passing 1kg ball back &amp; forth 15 times.</p> |

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| <p><i>Encourage static &amp; dynamic balance while jumping up &amp; out, alternating between the increase or decreasing surface area as feet are changing positions;</i></p> <p><i>Increase vestibular stimulation by alternating between slower jumps (star jumps ) &amp; accelerated jumps when on the trampoline;</i></p> <p><i>Activate proprioception in lower limbs while jumping &amp; encouraging stability while changing positions;</i></p> <p><i>Encourage bilateral integration as both arms &amp; legs move together, at the same time;</i></p> <p><i>Practicing to respond to keywords “out” &amp; “in”</i></p> <p>(7 minutes)</p> | <p>3. ‘Star fish Island’</p> | <p><b>Set up:</b> Place a red cardboard circle on the floor as target &amp; a trampoline nearby.</p> <p><b>Instructions:</b> Child is asked to stand on red circle, ‘his own island’. Instructor may hold his hands &amp; demonstrate to him the ‘leg-part’ of star jumps. Using the keywords: out &amp; in. Upon the word “out” instructor jumps up &amp; feet jump off the target to stand shoulder-width apart. When the word “in” is said, instructor indicates that the feet jump back in onto the target. It may take a while for child to process the activity. Instructor may assist child by physically lifting him up (to sense the ‘up’ motion) &amp; place child’s feet out or in. <i>Perform this slowly as child is learning new words along with actions.</i> After the “out” &amp; “in” jumps of the legs (10 times), child is directed to step up onto trampoline. He is asked to jump 10 times. Ask him to stop, count up to 3 &amp; resume jumping up &amp; down 10 times. This is followed by returning to red circle to repeat a second round of star-jumps. Instructor holds both of the child’s hands. On the words “out”, child lifts up their hands, to be above his head (legs jump apart). Upon the words “in”, child brings legs in &amp; instructor brings child’s arms down to be along his sides. Repeat this slowly, 8 times. Child is then directed back to trampoline. Child jumps up &amp; down 10 times, stops for 3 counts &amp; jumps another 10 times before returning to red circle (his island) for the last time. Repeat star jumps 8 times.</p> |
| <p><b>Cool down</b></p> <p><i>Stimulate vestibular system through rocking motion &amp; firm stops;</i></p> <p><i>Stimulate proprioceptors in</i></p>   | <p>4. Rocking Toy Story</p>  | <p><b>Set up:</b> Place 5 different pictures of Toy Story characters on a clear wall about ½ a meter off the floor. Place floor mat alongside the wall &amp; a pilates ball about half the child’s body length away from the wall.</p> <p><b>Instructions:</b> Instruct child to lie on his stomach on pilates ball while instructor assists child by holding him by the knees or supporting his back with his/her hand (depending on child’s height</p>   |


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| <p><i>upper limbs as compression is applied on the joints when walking forwards &amp; backwards to touch picture;</i></p> <p><i>Encourage listening skills &amp; motor planning when child needs to make his way to the target;</i></p> <p><i>Stimulate cognitive skills when child needs to identify characters.</i></p> <p>(4 minutes)</p> |  | <p>as their feet might be able to reach the floor). <i>Make sure child's head is away from any objects, walls or furniture which he might bump into.</i> Instructor will rock child forwards &amp; backwards on the pilates ball, 12 times. Pause rocking for 3 seconds &amp; resume rocking another 8 times forwards &amp; backwards. This is followed by child being asked to walk forwards on his hands to touch the Toy story character that instructor calls out. Once touching the character, child is asked to walk back. Instructor continues to hold his legs. The second character is called out &amp; child walks forward to touch it &amp; returns back as the ball rolls under him &amp; instructor holds his legs. Instructor resumes to rock child, following the above instructions. This is followed by child walking forward to touch another character. Repeat this exercise (rocking &amp; walking forwards) <i>for 3-4 minutes taking child's reaction &amp; fatigue levels into account.</i> Rocking speed: at medium pace (not a slow gentle rock), with a slight jerk &amp; force when rocking forwards. The halt should be a firm stop.</p> |
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| SUBJECT G  | OCTOBER   | WEEK 3: 30 minutes x2   |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somatosensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) &amp; respond with the required action</li> </ul> |   |   |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiate static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> <li>• Motor planning</li> <li>• Bilateral integration</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• Toy Story theme song on movie on laptop</li> <li>• Blindfold (1)</li> <li>• Buzzlight Year figurine</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Floor mat (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg medicine ball (1)</li> <li>• Stop watch (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Multi-purpose jungle gym: wooden ramp, thick rope, secure monkey bars, secured swing with supportive sides</li> <li>• Parachute (1)</li> <li>• Hula hoops (3)</li> <li>• Hula hoops stands (3)</li> <li>• Medium tactile ball (1)</li> <li>• Rainbow river stones (4)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1) Yellow: 8.5 cm (2)</li> </ul> |

| SUB-AIMS   | ACTIVITIES               | EXPLANATION   |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> | <p>‘Buzz close eyes’</p> | <p><b>Set up:</b> Place laptop on a table with relevant Disney movie theme song playing. Place one red river stone near kangaroo ball &amp; blindfold close at hand. If child is not comfortable with blindfold, use an object which child can relate to. For example a figurine of Buzz Lightyear.</p> <p><b>Instructions:</b> Child sits on kangaroo ball, holding handle with both hands. When movie-music plays, child is indicated to bounce up &amp; down in place on kangaroo ball. Child will be watching movie on screen. When instructor pauses music, child must stop instantly &amp; is instructed to stand up &amp; walk to stand on top of red river stone, remaining in place for 5 counts. Instructor then shows child the blindfold &amp; indicates that it will be on his face, over his eyes. Instructor places blindfold over child’s eyes &amp; counts up to 5 with child before blindfold is removed &amp; child is directed to resume to bouncing on kangaroo ball again. If the object/ figurine has been</p> |

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| <p><i>Activate vestibular system through 'up &amp; down' motions, along with having to remain on slanted or complaint, surface;</i></p> <p><i>Stimulate proprioception in the lower limbs while bouncing &amp; encourage limbs to support the body while having to remain upright on the river stone;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(5 minutes)</p> |                          | <p>chosen as an option: show child that "Buzz Lightyear closes his eyes" by placing your fingers over figurine's eyes. This may encourage child to close his eyes. Alternate between bouncing &amp; child's eyes being covered while remaining on the river stone. Continue until song is finished. <i>Instructor should be close by to assist child while his eyes are closed as this is a new instruction &amp; may cause anxiety.</i> If blindfold causes irritation, instructor may attempt to use their own hands to cover child's eyes or help child use his hands to cover his eyes.</p>  |
| <p><i>Stimulate vestibular system during rotation &amp; quick changes in direction;</i></p> <p><i>Stimulate proprioception in lower limbs during jumping as the tendons around joints are being stretched when knees bend to that extent (while child is on his haunches)</i></p>   | <p>1. 'Rocking bowl'</p> | <p><b>Set up:</b> Place plastic rocking bowl on the floor &amp; lay out 4 river stones in a vertical line, with ½ a meter between each other.</p> <p><b>Instructions:</b> Child gets into big rocking bowl, sits upright &amp; cross-legged. Instructor spins child 12 times to the left, stops firmly &amp; then spins the bowl 12 times to the right with a firm stop afterwards. The spinning is repeated for a second time, however only 10 rotations to the left &amp; then 10 rotations to the right. After rotation, wait up to 8 seconds before child is instructed to step out of the bowl &amp; is directed to go to the first river stone (red). Child is asked to jump up onto river stone &amp; back down on other side, facing second river stone. Child repeats jumping up &amp; down on the river stone until he reaches the fourth river stone, on which he is asked to remain standing. Child is thrown the 1kg ball &amp; he must catch it. Child is asked to throw it back</p> |

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| <p><i>Learn to respond to when keyword is given</i></p> <p>( 9 minutes)</p>  |  | <p>to instructor. Repeat 10 times. On the 10<sup>th</sup> time child keeps the ball &amp; jumps back, on the river stones ('up &amp; down'), returning to the bowl. Child is asked to place ball down next to bowl &amp; to step back into bowl.</p> <p>Repeat these two activities 3 consecutive times. On the third round, child is passed 2kg ball to hold while he jumps on &amp; off the river stones, returning to bowl.</p>   |
| <p><i>Stimulate the vestibular system during linear motions while swinging especially when visual input is eliminated;</i></p> <p><i>Initiate functional movements when vestibular &amp; proprioceptive skills are placed together;</i></p> <p><i>Stimulate proprioceptors in upper limbs through contraction while climbing the rope, pulling of the joints while hanging, &amp; compression on the upper limbs while walking forwards on hands</i></p> <p>( 7 minutes)</p> | <p>2. 'Flying Buzz &amp; climbing in the jungle'</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains a swing, monkey bars, a net &amp; a thick rope secured to a wooden beam at the top of a 3m wooden ramp which also has support for footing. If a ramp is not accessible, use a flight of stairs with instructor about 5 steps away from child and child at the bottom of the steps.</p> <p><b>Instructions:</b> Child is directed to sit on the secured swing which enables him to hold on and it supports his body. Instructor swings child and child is asked to close his eyes for 10 counts. Swing child for 20 seconds. <i>If child opens eyes during the swinging, instructor asks him to close his eyes for another 10 counts.</i> Instructor stops swinging with a firm halt. Count up to 5 with child and then he may climb out of swing. He is directed to walk to wooden ramp.</p> <p>Child steps onto wooden ramp &amp; is shown to grasp the thick rope. Instructor is behind child to act as security if child lets go of rope. Child is indicated to walk up the ramp holding the rope and climb up with one hand being placed in front of the other. Once reaching the top, if there are monkey bars, assist child to grasp the first bar, then second, followed by 3<sup>rd</sup> and then 4<sup>th</sup> bar, before instructor lowers child to the ground. Child is then *'wheel-barrowed' back to the swing area of jungle gym. Repeat the above instructions for the swing activity.</p> <p>Repeat the above mentioned activity 3 times each.</p> |
| <p><b>Cool down</b></p> <p><i>Encourage abdominal muscles to contract as the upper body lifts up to touch colours;</i></p> <p><i>Control body l as the movement needs to be</i></p>  | <p>3. 'Rainbow cave'</p>                             | <p><b>Set up:</b> 3 hoop stands with hoops secured in them &amp; positioned into a triangle surrounding a floor mat. Spread out the parachute over the 3 hoops &amp; the medium tactile ball alongside the mat.</p>  |

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| <p><i>performed slowly;</i></p> <p><i>Stimulate cognitive skills when child needs to identify colours &amp; respond to instruction</i><br/>(3 minutes)</p> |  |  <p><b>Instructions:</b> Child is shown to crawl under the parachute (into the cave) &amp; to lie down with his back on the mat, looking up at the parachute's colours which are about a meter above him. Child is given tactile ball to hold with his 2 hands. Instructor calls out a colour, "blue" &amp; child is encouraged to lift up his upper body. His arms are extended to touch the colour called out. No strain should be placed on child's neck when lifting up. It is only a small lift. Child returns back to the ground. Instructor may need to assist child by gently placing their hand under his head to indicate the "lift up". Instructor calls out another 4 colours before child may rest. Call out 2 more colours before activity is complete. This is a short activity as it is the first time child will be performing it. Therefore, only a few colours are called out.</p> |
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\*Wheelbarrow: Child is shown to lie down flat on the floor. The instructor picks up child's legs & holds by the knees as child lifts up upper body & supported by the arms. Child is shown to walk forwards on his hands. Instructor ensures that child's lower back is not bent.



| SUBJECT G  | NOVEMBER   | WEEK 1: 30 minutes x2   |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somatosensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) &amp; respond with the required action</li> </ul> |  |   |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiating static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills</li> <li>• Initiate functional tasks</li> <li>• Motor planning</li> <li>• Spatial awareness</li> </ul>   | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• CD player with relevant songs (2)</li> <li>• Picture of 'Buzz' (1) &amp; picture of Woody (1)</li> <li>• Small chair (1)</li> <li>• Floor mat (1)</li> <li>• 1kg medicine ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Rocking bowl (spinning) (1)</li> <li>• Small traffic cones (4)</li> <li>• Mini-trampoline (1)</li> <li>• Rainbow river stones (2)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (1)</li> <li>• Colourful balloon (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES                     | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions,</i></p> | <p>'Bouncing with no eyes'</p> | <p><b>Set up:</b> CD player contains relevant Disney song which child may like. Near the kangaroo ball, place one red river stone near to kangaroo ball &amp; have a blindfold close at hand. <i>If child is not comfortable with blindfold, use an object which child can relate to (e.g. Buzz Lightyear figurine).</i></p> <p><b>Instructions:</b> Child sits on kangaroo ball, holding handle with both hands. When music starts to play, child is instructed to bounce up &amp; down in place on kangaroo ball. Child is asked to close his eyes while bouncing. <i>Instructor may support child as they bounce on the ball &amp; eyes are closed.</i> When instructor pauses music, child can open his eyes, stop bouncing, &amp; is instructed to stand up &amp; walk to stand on top of red river stone, remaining in place for 5 counts. Instructor then shows child the blindfold &amp; indicates that it will be on his face, over his eyes. Instructor places blindfold over child's eyes &amp; counts up to 5 with child before blindfold is removed &amp; child is directed to resume</p> |

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| <p><i>along with having to remain on slanted or complaint, surface;</i></p> <p><i>Stimulate proprioception in the lower limbs while bouncing &amp; encourage limbs to support the body while having to remain upright on the river stone;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(5 minutes)</p> |                              | <p>bouncing on the ball again.</p> <p>If the object has been chosen as an option: show child that “Buzz Lightyear closes his eyes”, &amp; place your fingers over figurine’s eyes. This may encourage child to close his eyes. Alternate between child bouncing with eyes closed &amp; child’s eyes being covered while remaining on the river stone. Continue until song is finished. <i>Instructor should be close by to assist child while his eyes are closed as this is a new instruction &amp; may cause anxiety.</i> If blindfold causes irritation, instructor may use his own hands to cover child’s eyes or help child use his own hands to cover his eyes.</p>   |
| <p><i>Activate proprioceptors in all of the joint's by alternating between pressure being applied to joints &amp; then released;</i></p> <p><i>Encourage body awareness as instructor names the body part that has pressure applied t;</i></p> <p><i>Initiate a functional activity for proprioceptors in the limbs to support body while balancing on elevated, uneven surface &amp; supporting the weighted ball</i></p>                    | <p>1. ‘Where is your...’</p> | <p><b>Set up:</b> Have a sturdy chair for child to sit on &amp; a floor mat alongside it. Have a green river stone close by. Allow a familiar song to play while activity is being performed.</p> <p><b>Instructions:</b> Seat child in secure chair. Instructor places pressure on child’s head &amp; then releases, 10 times. Move down to both shoulders. Instructor places both hands on shoulders &amp; firmly presses down &amp; releases, 10 times. Next joint is in the arms: hold child’s elbow &amp; place your other hand where humerus &amp; shoulder joint are. Perform ‘pumping’ action by pushing elbow joints &amp; shoulder joints towards each other &amp; release. Perform same action between elbow &amp; wrist joints, then each finger on the hand. Direct child to lie down on the floor. Repeat pumping action on hip joint, followed by knee joints, moving down to ankles &amp; finally each toe. Repeat this activity only once, however repeat on the other side of the body as well. <i>For every section or area instructor applies pressure to &amp; releases, instructor says “Where is your head” or “Where are your shoulders”, to assist child in being aware of that body part.</i></p> |

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| <p>(6 minutes)</p>  |                                    | <p>Once instructor has completed all limbs, child is asked to stand on top of river stone. While standing, instructor passes 1kg ball back to child. Instructor says: "Head", &amp; child must bring ball towards his head. Instructor may assist child to show him that he must lift the ball. Other body parts: stomach, legs, nose, feet. Instructor may alternate between these different body parts.</p>  |
| <p><i>Stimulate vestibular system during rotation &amp; quick changes in direction, along with an increase in stimulation while eyes are closed;</i></p> <p><i>Practice static balance by progressing to decreasing surface area that child stands on(heel-to-toe)</i></p> <p><i>Increase proprioception in lower limbs during jumping as the tendons around joints are being stretched when knees bend to that extent (while child is on his haunches)</i></p> <p>( 9 minutes)</p> | <p>2. 'Taller than a tortoise'</p> | <p><b>Set up:</b> place big rocking bowl on a floor mat &amp; 1kg medicine ball alongside it.</p> <p><b>Instructions:</b> Child is directed to sit cross-legged inside of bowl &amp; child may hold onto the sides of the bowl. Instructor spins child 10 times to the left, stops firmly &amp; then spins the bowl 10 times to the right; followed by spinning to the left again but only 5 times then a firm stop &amp; then 5 times to right, then stop. Child is spun a third time with his eyes closed, 10 times to the left &amp; 10 times to the right. After rotation, wait up to 8 seconds before child is asked to open his eyes &amp; is instructed to step out of bowl. <i>During this waiting time, count up to 8 with child.</i> Child is then asked to stand up &amp; to step out of bowl &amp; instructor turns the bowl over, with its rounded side up. Child is directed to stand on top of bowl (tortoise) &amp; asked to balance on it. <i>Instructor may assist child while he climbs on top &amp; to ensure he does not fall off.</i> Once reaching the top, child needs to regain balance before instructor assists him in standing heel-to-toe (one foot in front of the other). Instructor counts with child up to 10. Then child is assisted to change legs to have the back leg stand in front, for 10 counts. Child is then assisted off 'tortoise' &amp; the bowl is turned over onto its rounded side. Instructor spins child, following the above-mentioned criteria.</p> <p>Repeat these 2 activities 3 consecutive times each, alternating between spinning &amp; standing on top of the bowl, heel-to-toe.</p> |
| <p><i>Activate dynamic balance while jumping on trampoline, initiate static balance by standing on compliant surface &amp; maintaining stance;</i></p> <p><i>Stimulate proprioception in lower limbs while jumping as</i></p>   | <p>3. 'Making a new pathway'</p>   | <p><b>Set up:</b> Place trampoline in middle of a clear open space &amp; about 1m away set down a vertical row of 4 small cones, 30cm between each cone.</p> <p><b>Instructions:</b> Child is asked to step up onto trampoline &amp; to begin jumping up &amp; down. Count with child up to 10, then ask him to stop &amp; stand on his 2 feet for 5 counts (5 seconds). Child is asked to resume jumping up &amp; down for 10 counts. On the second stop, child only stops for 3 seconds &amp; resumes jumping only 8 jumps. On the third stop, child is asked to step off trampoline. He is directed to the first small cone. Instructor</p>   |

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| <p><i>muscles contract to support jumping &amp; standing in place;</i></p> <p><i>Encourage spatial awareness as child needs to make his way around objects, without touching them;</i></p> <p>(6 minutes)</p>                               |                           | <p>assists child in walking in &amp; around the cones, in &amp; out. Instructor guides child all the way to 4<sup>th</sup> cone, turns around &amp; walks back, in &amp; around cones, back to trampoline. Child resumes jumping up &amp; down on trampoline. Follow same instructions as above.</p> <p>Repeat both activities 3 times. Instructor assists child through cones as it may take a while for him to grasp the movement.</p>   |
| <p><b>Cool down</b></p> <p><i>Practice keyword, “kick”;</i></p> <p><i>Encourage motor planning as the balloon is slow enough for child to track &amp; process its path;</i></p> <p><i>Activate abdominal muscles</i></p> <p>(3 minutes)</p> | <p>4. ‘Floating toes’</p> | <p><b>Set up:</b> Place a floor mat on the floor &amp; instructor inflates a balloon. <i>Assistant may be needed to help instructor teach child the activity.</i></p> <p><b>Instructions:</b> Child is directed to lie down with his back on floor mat, with his feet up in the air. Assistant is next to child. Instructor places balloon in the air directly above child’s feet. Child is asked to “kick” balloon. Assistant physically takes child’s legs &amp; makes contact between child’s feet &amp; balloon to keep balloon in air. Assistant keeps helping child until he understands what to do.</p> |

| SUBJECT G   | NOVEMBER   | WEEK 2: 30 minutes x2  |
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| <p><b>General Aim:</b></p> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somatosensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords)&amp; respond with the required action</li> </ul> |  |  |
| <p><b>Specific Aim:</b></p> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiate static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills using numbers</li> <li>• Initiate functional tasks</li> <li>• Motor planning</li> <li>• Spatial awareness</li> </ul>  | <p><b>Equipment:</b></p> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• CD player with relevant songs (2)</li> <li>• Picture of 'Buzz' (1) &amp; picture of Woody (1)</li> <li>• Small chair (1)</li> <li>• Floor mat (1)</li> <li>• Small traffic cones (5)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg medicine ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Rocking bowl (spinning) (1)</li> <li>• Cardboard numbered circles (7)</li> <li>• Mini-trampoline (1)</li> <li>• Rainbow river stones (1)<br/>Heights: Green:16 cm (1)</li> <li>• Parachute (1)</li> <li>• Hula hoops (3)</li> <li>• Hula hoops stands (3)</li> <li>• Medium tactile ball (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES               | EXPLANATION   |
|---|--------------------------|---|
| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through</i></p> | <p>'Buzz cannot see'</p> | <p><b>Set up:</b> CD player contains relevant Disney song child may like. Place one green river stone near kangaroo ball &amp; have a blindfold close at hand. <i>If child is not comfortable with a blindfold use an object which child can relate to (e.g. Buzz Lightyear figurine).</i></p> <p><b>Instructions:</b> Child sits on kangaroo ball, holding the handle with both hands. When music starts to play, child is instructed to bounce up &amp; down, in place on kangaroo ball. Child is asked to close his eyes while bouncing. <i>Instructor may support child as they bounce on ball &amp; eyes are closed or even cover child's eyes with instructor's own hands if child struggles to do it.</i> When instructor pauses music, child can open his eyes, stop bouncing &amp; is instructed to stand up &amp; walk to stand on top of green river stone remaining in place for 8 counts. Instructor then asks child to close his eyes. Child may use his hands to cover eyes &amp; to count up to 10. Alternate between child bouncing with</p> |

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| <p><i>'up &amp; down' motions, along with having to remain on slanted or compliant, surface;</i></p> <p><i>Stimulate proprioception in the lower limbs while bouncing &amp; encourage limbs to support the body while having to remain upright on the river stone;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(5 minutes)</p>                    |                                   | <p>eyes closed &amp; child's eyes being covered while remaining on river stone. Continue until song is finished.</p>   |
| <p><i>Activate dynamic balance while jumping on trampoline, initiate static balance by standing on compliant surface &amp; maintaining stance;</i></p> <p><i>Stimulate proprioception in lower limbs while jumping as muscles contract to support jumping &amp; standing in place, along with upper limbs contract to support weighted balls;</i></p> <p><i>Encourage spatial awareness &amp; motor planning as child needs to make his way around objects, without touching them</i></p> | <p>1. 'Hopping a new pathway'</p> | <p><b>Set up:</b> Set down a vertical row of 5 small cones, 30cm between each cone &amp; place a 1kg &amp; 2kg medicine ball at the fifth cone.</p> <p><b>Instructions:</b> Child is asked to step up onto trampoline &amp; begin jumping up &amp; down. Count with child up to 10 then ask him to stop &amp; stand on his 2 feet for 3 counts. Child is asked to resume jumping up &amp; down for 10 counts. On the second stop, child only stops for 5 seconds &amp; resumes jumping only 5 jumps. On the third stop, child is asked to step off trampoline. He is directed to first small cone. Instructor assists child to hop on 2 feet in &amp; around cones, performing a 'weaving action'. Child hops until fifth cone, stops &amp; is asked to pick up 1kg ball. Child hops back to trampoline, but not between cones.</p> <p>Child resumes jumping up &amp; down on trampoline. Follow same instructions as above. On the second round of hopping through cones, child retrieves 2kg medicine ball &amp; hops back to trampoline.</p> <p>Repeat both activities 3 times. On the 3<sup>rd</sup> round child picks up the 1kg ball once again at</p> |

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| <p>(6 minutes)</p> <p><i>Stimulate vestibular system during rotation &amp; quick changes in direction, in addition eliminating visual input to increase stimulation;</i></p> <p><i>Increase static balance by progressing to decreasing surface area (heel-to-toe);</i></p> <p><i>Stimulate proprioception in lower limbs during jumping as the tendons around joints are being stretched when knees bend to that extent (while child is on his haunches)</i></p> <p>(9 minutes)</p> | <p>2. Crawling insects</p>             | <p>the fifth cone.</p> <p><b>Set up:</b> Place 7 numbered cardboard circles on the floor in a vertical line with ½ meter between each one. Make sure they are secured to the floor with prestick.</p> <p><b>Instructions:</b> Child is instructed to go on his hands &amp; knees &amp; then lift his knees off the ground &amp; to walk forwards to a number that is called out. <i>For child to understand how to position his body, instructor may go behind child (while he is on his hands and knees) and hold child securely around waist &amp; lift up middle part of his body in the air.</i> Instructor says, “One” &amp; gently guides child to first numbered circle. Assess if child can uphold his own body in the air while his limbs move his body forwards.</p> <p>After completing all 7 numbers, child is guided back to beginning to repeat activity again, moving from number to number.</p>  |
| <p><i>Stimulate vestibular system during rotating motion, &amp; increasing stimulation when eyes are closed;</i></p> <p><i>Stimulate proprioceptors in upper &amp; lower limbs through compression, &amp; muscles contract to hold limbs in place as they support the body,</i></p> <p><i>Activate vestibular system to support core muscle strength in maintaining body position lifted in the air</i></p>  | <p>3. ‘Passing the spikey monster’</p> | <p><b>Set up:</b> place big rocking bowl on a floor mat &amp; tactile ball (spikey monster) alongside it. Assistant may be needed to for this exercise.</p> <p><b>Instructions:</b> Child is directed to sit cross-legged inside of bowl &amp; child may hold onto sides of the bowl. Instructor spins child 12 times to the left, stops firmly &amp; then spins the bowl 12 times to the right; followed by spinning to the left again but only 10 times, firm stop &amp; then 10 times to right, stop. Child is spun a third time, however his eyes are closed, 8 times to the left and 8 times to the right. After rotation, wait up to 8 seconds before child is asked to open his eyes &amp; is instructed to step out of bowl. <i>During this waiting time, count up to 8 with child as he is shown to clap his hands.</i></p> <p>Child is then asked to stand up, to step out of bowl &amp; sit down on the floor mat as the instructor also sits down on floor (assistant next to child). Instructor leans back on his/her hands (bending at elbows), bends knees &amp; places tactile ball (spikey monster) between their own two feet. Instructor passes ball to child, as assistant shows child to lean back, placing his hands backwards, supporting the body &amp; helps him lift his legs,</p> |

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| <p>(7 minutes)</p>   |                          | <p>bend at the knees &amp; receive ball from instructor. Child's feet might drop the ball, therefore instructor picks up the ball again with his/her feet to give to child. Attempt this activity for about a minute before returning to child being spun (following the above-mentioned spinning instructions).</p> <p>Return to passing ball with feet. Alternate between spinning &amp; 'passing ball with feet activity' for 4 consecutive times.</p>   |
| <p><b>Cool down</b><br/> <i>Stimulate proprioceptors in upper &amp; lower limbs through compression, &amp; muscles contract to hold limbs in place as they support the body,</i></p> <p><i>Activate vestibular system to support core muscle strength in maintaining body position lifted in the air.</i></p> <p>(3 minutes)</p> | <p>4. 'Rainbow cave'</p> | <p><b>Set up:</b> Place 3 hoop stands with hoops secured in them &amp; position into a triangle surrounding a floor mat. Spread out parachute over the 3 hoops &amp; place medium tactile ball alongside the mat.</p> <p><b>Instructions:</b> Child is shown to crawl under the parachute (into the cave) &amp; to lie down on his back on the mat, looking up at the parachute's colours which are about a meter above him. Child is given tactile ball to hold with his 2 hands. Instructor calls out a colour, "blue" &amp; child is encouraged to lift up his upper body, his arms are extend to be straight &amp; to touch the colour called out. No strain should be placed on child's neck when lifting up; it is only a small lift &amp; then child returns back to the ground. Instructor may need to assist child by gently placing their hand under his head to indicate the "lift up". Instructor calls out another 4 colours before child may rest. Call out 2 more colours before activity is complete. This is a short activity as it is the first time child will be performing it. Therefore, only a few colours are called out.</p> |



| SUBJECT G  |  | NOVEMBER   | WEEK 3: 30 minutes x2   |
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| <b>General Aim:</b> <ul style="list-style-type: none"> <li>To provide an environment that stimulates the vestibular system</li> <li>Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>Establish a sense of routine &amp; security for child</li> <li>Form an understanding of how to communicate verbal instruction with child</li> <li>Help child understand instructions (keywords) &amp; respond with the required action</li> </ul> |  |  |   |
| <b>Specific Aim:</b> <ul style="list-style-type: none"> <li>Focus on coordination in lower limbs</li> <li>Initiate static &amp; dynamic balance</li> <li>Activate muscle strength &amp; muscle control</li> <li>Initiate simple &amp; familiar locomotive skills</li> <li>Initiate functional tasks when integration activities</li> <li>Motor planning</li> <li>Spatial awareness</li> </ul>  |  | <b>Equipment:</b> <ul style="list-style-type: none"> <li>Kangaroo ball (1)</li> <li>CD player with relevant songs (2)</li> <li>Figurine (Buzzlight Year) (1)</li> <li>Small chair (1)</li> <li>Floor mat (1)</li> <li>1kg medicine ball (1)</li> <li>2kg medicine ball (1)</li> <li>Mini-trampoline (1)</li> </ul> | <ul style="list-style-type: none"> <li>Rocking bowl (spinning) (1)</li> <li>Small traffic cones (5)</li> <li>Rainbow river stones (5)<br/>Heights: Red: 13.5 cm (2) Green: 16 cm (2) Yellow: 8.5 cm (1)</li> <li>Multi-purpose jungle gym: wooden ramp, thick rope, secure monkey bars, secured swing with supportive sides</li> <li>Medium tactile ball (1)</li> </ul> |

| SUB-AIMS   | ACTIVITIES               | EXPLANATION  |
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| <p><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system through 'up &amp; down' motions,</i></p> | <p>'Buzz cannot see'</p> | <p><b>Set up:</b> CD player contains relevant Disney song child may like. Place one green river stone near kangaroo ball &amp; a blindfold close at hand. <i>If child is not comfortable with blindfold, instructor may encourage child to use his hands to cover his eyes.</i></p> <p><b>Instructions:</b> Child sits on kangaroo ball, holding the handle with both hands. When music starts to play, the child is instructed to bounce up &amp; down in place on the kangaroo ball. Child is asked to close his eyes while bouncing. <i>Instructor may support child as they bounce on the ball with eyes are closed or even cover child's eyes with instructor's own hands if child struggles to do it.</i> When the instructor pauses music, child can open his eyes, stop bouncing &amp; is instructed to stand up &amp; walk to stand on top of the green river stone, remaining in place for 10 counts. Instructor then asks child to close his eyes. Child may use his hands to cover eyes &amp; to count up to 10, or place blindfold over child's eyes or let child use his hands. Child then opens eyes &amp; returns to</p> |

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| <p><i>along with having to remain on slanted or complaint, surface;</i></p> <p><i>Stimulate proprioception in the lower limbs while bouncing &amp; encourage limbs to support the body while having to remain upright on the river stone;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(5 minutes)</p> |                          | <p>kangaroo ball. Alternate between child bouncing with eyes closed &amp; child's eyes being covered while remaining on the rock. Continue until song is finished.</p>   |
| <p><i>Activate dynamic balance while jumping on trampoline, initiate static balance by standing on compliant surface &amp; maintaining stance;</i></p> <p><i>Stimulate proprioception in lower limbs while jumping as muscles contract to support jumping &amp; standing in place, along with upper limbs having to support weighted balls while contracting;</i></p> <p><i>Encourage spatial awareness &amp;</i></p>                         | <p>1. Jumping higher</p> | <p><b>Set up:</b> Place trampoline in the middle of a clear open space &amp; about 1m away set down 5 river stones in a vertical row, 30cm between each rock. However, 3 river stones (red, green, yellow) are set down &amp; then the fourth river stone (red) has the second green river stones secured on top of it (making a tower). Place 1kg &amp; 2kg medicine balls next to red and green river stones that make the tower.</p> <p><b>Instructions:</b> Child is asked to step up onto trampoline &amp; begin jumping up &amp; down. Count with child up to 10 then ask him to stop &amp; stand on his 2 feet for 3 counts (3 seconds). Child is asked to resume to jumping up &amp; down for 12 counts. On the second stop, child stops for 5 seconds &amp; resumes to jumping only 8 jumps. On the third stop, child is asked to step off trampoline. He is directed to first red river stone. Child is shown to jump up onto river stone &amp; then down again, landing in front of second river stone (green). Continue to jump up &amp; down on green river stone, followed by yellow and then up onto the red-green river stone (tower). <i>Instructor shows child the red-green river stone is higher. Child may need assistance with jumping the increased height.</i></p> |

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| <p><i>motor planning as child needs to jump up the different heights of the rocks;</i></p> <p><i>Integrate the vestibular &amp; somato-sensory (proprioception) systems by combining all these activities together</i></p> <p>( 8 minutes)</p>  |                                   | <p>Child remains on top &amp; 1kg ball is passed to child. He must receive the ball with both hands &amp; is asked to pass it back to instructor. Repeat 12 times. Child may then jump off red-green river stone (tower). He is asked to hop along the floor back to trampoline.</p> <p>Child resumes jumping up &amp; down on trampoline. Follow same instructions as above. However, for this second round, child is passed 2kg ball when standing on red-green river stones.</p>  |
| <p><i>Stimulate vestibular system through rotation &amp; quick changes of direction for a certain amount of turns, &amp; increasing stimulation while eyes are closed;</i></p> <p><i>Practice dynamic balance while walking in out of cones</i></p> <p><i>Practice motor planning as child makes his way around cones</i></p> <p>( 8 minutes)</p> | <p>2. 'Turning to twisting'</p>   | <p><b>Set up:</b> Place big rocking bowl on a floor mat in an open space and about 1m away set down a vertical row of 5 small cones, 30cm between each cone.</p> <p><b>Instructions:</b> Child is directed to sit cross-legged inside of bowl &amp; may hold onto sides of the bowl. Instructor spins the child 15 times to the left, stops firmly &amp; then spins bowl 15 times to the right; followed by spinning to the left again but only 10 times, firm stop and then 10 times right, stop. Child is spun a third time, 5 times to the left &amp; 5 times to the right. However, his eyes are closed during rotation. After rotation, wait up to 8 seconds before child is asked to open his eyes &amp; is instructed to step out of bowl.</p> <p>He is directed to first small cone. Instructor instructs child to walk in &amp; out of cones. Instructor guides child all the way to the 5<sup>th</sup> cone, turns around &amp; walks back, in &amp; out of the cones back to rocking bowl. Repeat spinning according to the amount of rotations indicated above, followed by walking in &amp; out of the cones.</p> <p>Repeat these two activities 3 times.</p> |
| <p><i>Stimulate the vestibular system during linear motions while swinging especially with the elimination of visual input;</i></p>   | <p>3. 'Buzz flying off again'</p> | <p><b>Set up:</b> This may take place at a multi-purpose jungle gym which contains a swing, monkey bars, a net &amp; a thick rope secured to wooden beam at the top of 3m wooden ramp which also has support for footing.</p>  |

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| <p><i>Practice functional movements which combines vestibular activities &amp; stimulating proprioception;</i></p> <p><i>Stimulate proprioceptors in upper limbs during contraction while climbing, pulling of the joints during hanging &amp; compression on the upper limbs while walking forwards on hands</i></p> <p>( 9 minutes)</p> |  | <p><b>Instructions:</b> Child is directed to sit on secured swing which enables him to hold on &amp; the swing supports his body. Instructor swings child &amp; he is asked to close his eyes for 10 counts. When he opens his eyes, ask him to close them again for another 10 counts. Swing child for 20 seconds. Instructor stops swinging firmly. Count up to 5 with child &amp; then he may climb out of swing. He is directed to walk to wooden ramp.</p> <p>Child steps onto wooden ramp &amp; is shown to grasp the thick rope. Instructor is behind child to act as security in case child lets go of rope. Child is instructed to walk up the ramp, holding the rope &amp; climbing up with one hand being placed in front of the other. Once reaching the top, if there are monkey bars, assist child to grasp first bar, then second, followed by third, fourth &amp; then the fifth bar before instructor lowers child to the ground. Child is then *‘wheelbarrowed’ to swing area of jungle gym.</p> <p>Repeat above instructions for swing activity. Repeat above-mentioned information for each activity, 3 times each.</p> |
| <p><b>Cool down</b></p> <p><i>Encourage abdominal muscles to contract as the upper body lifts up to grasp the ball;</i></p> <p><i>Train legs muscles to maintain control as the legs need to remain lifted in air;</i></p> <p><i>Practice ball manipulation skills while passing the ball back &amp; forth</i></p> <p>(3 minutes)</p>     | <p>4. ‘Can we catch the spikey monster this time?’</p> | <p><b>Set up:</b> The floor mat is set down on the floor with tactile ball (spikey monster) alongside it. Assistant may be needed for this exercise.</p> <p><b>Instructions:</b> Child is shown to sit down on floor mat as instructor also sits down on floor (assistant next to child). Instructor leans back on his/her hands (bending at elbows), bends the knees &amp; places tactile ball (spikey monster) between their own two feet. Instructor passes ball to child as the assistant shows child to lean back, placing his hands backwards as support &amp; helps him lift his legs, bend at knees &amp; receive ball from instructor. Child’s feet might drop the ball, therefore instructor picks up the ball again with his/her feet to give to child. Continue for 1 minute, rest for 30 seconds. While child is resting he is asked to sit up. Instructor &amp; child pass tactile ball back &amp; forth. Return to leaning back &amp; passing ball with feet for another minute before resting once again.</p>   |

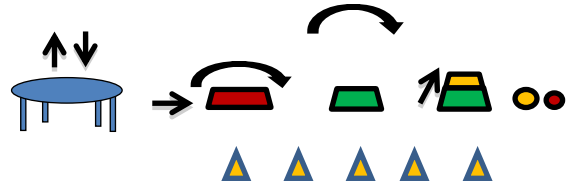
\*Wheelbarrow: Child is shown to lie down flat on the floor. The instructor picks up child’s legs & holds by the knees as child lifts up upper body & supported by the arms. Child is shown to walk forwards on his hands. Instructor ensures that child’s lower back is not bent.

| SUBJECT G  | NOVEMBER  | WEEK 4: 30 minutes x2   |
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| <b>General Aim:</b> <ul style="list-style-type: none"> <li>• To provide an environment that stimulates the vestibular system</li> <li>• Activate lower &amp; upper limbs proprioception (somato-sensory system)</li> <li>• Establish a sense of routine &amp; security for child</li> <li>• Form an understanding of how to communicate verbal instruction with child</li> <li>• Help child understand instructions (keywords) &amp; respond with the required action</li> </ul> |   |   |
| <b>Specific Aim:</b> <ul style="list-style-type: none"> <li>• Focus on coordination in lower limbs</li> <li>• Initiate static &amp; dynamic balance</li> <li>• Activate muscle strength &amp; muscle control</li> <li>• Initiate simple &amp; familiar locomotive skills</li> <li>• Cognitive skills using numbers</li> <li>• Initiate functional tasks while placing activities together</li> <li>• Motor planning</li> <li>• Spatial awareness</li> </ul>                      | <b>Equipment:</b> <ul style="list-style-type: none"> <li>• Kangaroo ball (1)</li> <li>• CD player with relevant songs (2)</li> <li>• Figurine (Buzzlight Year) (1)</li> <li>• Rocking bowl (spinning) (1)</li> <li>• Floor mat (1)</li> <li>• Cardboard circles numbered (8)</li> <li>• Cardboard circle (1)</li> <li>• 1kg medicine ball (1)</li> <li>• 2kg medicine ball (1)</li> </ul> | <ul style="list-style-type: none"> <li>• Small traffic cones (5)</li> <li>• Scooter board (1)</li> <li>• Large hula hoop (1)</li> <li>• Cartoon pictures (3)</li> <li>• Rainbow river stones (4)<br/>Heights: Red: 13.5 cm (1) Green: 16 cm (2) Yellow: 8.5 cm (1)</li> <li>• Medium tactile ball (1)</li> <li>• Mini-trampoline (1)</li> </ul> |

| SUB-AIMS  | ACTIVITIES              | EXPLANATION  |
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| <p style="text-align: center;"><b>Warm up</b></p> <p><b>To:</b><br/><i>Maintain routine by repeating the same activity which starts each session;</i></p> <p><i>Activate muscle in the lower limbs while bouncing &amp; stabilising the body on the ball, learning to sit upright;</i></p> <p><i>Activate vestibular system</i></p> | <p>‘Bouncing blues’</p> | <p><b>Set up:</b> CD player contains relevant Disney song child may like. Place one green river stone near kangaroo ball with yellow river stone on top of it. <i>If child is not comfortable with blindfold, instructor may encourage child to use his hands to cover his eyes.</i></p> <p><b>Instructions:</b> Child sits on kangaroo ball, holding the handle with both hands. When music starts to play, child is instructed to bounce up &amp; down in place on kangaroo ball. Child is asked to close his eyes while bouncing. <i>Instructor may support child as they bounce with their eyes closed or even cover child’s eyes with instructor’s own hands if child struggles to do it.</i> When instructor pauses music, child can open his eyes, stop bouncing, stand up &amp; walk to stand on top of green-yellow river stones (tower), remaining in place for 10 counts. Instructor then asks child to close his eyes. Child may use his hands to cover eyes &amp; to count up to 10 or place blindfold over child’s eyes.</p> |

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| <p><i>through 'up &amp; down' motions, along with having to remain on slanted or complaint, surface;</i></p> <p><i>Stimulate proprioception in the lower limbs while bouncing &amp; encourage limbs to support the body while having to remain upright on the river stone;</i></p> <p><i>Work on eye fixation skills as child watches the characters on screen;</i></p> <p><i>Practice listening skills with the simple indication of pausing music</i></p> <p>(5 minutes)</p> |                                | <p>Child then opens eyes &amp; returns to kangaroo ball. Alternate between child bouncing with eyes closed &amp; child's eyes being covered while remaining on the river stone. Continue until song is finished.</p>   |
| <p><i>Stimulate vestibular system during rocking motions of forward-backwards, &amp; side to side, increase vestibular stimulation when eyes are closed;</i></p> <p><i>Activate proprioception in upper limbs during compression as child walks forward on his hands &amp; arms need to be stabilised;</i></p> <p><i>Encourage equilibrium reactions when oblique's around abdominal area need to contract</i></p>   | <p>1. 'Rocking to numbers'</p> | <p><b>Set up:</b> Place the rocking bowl on a floor mat. Near to the bowl secure 8 numbered cardboard circles into a semi-circle formation &amp; the ninth circle (not numbered) place 1.5m below the semi-circle.</p> <p><b>Instructions:</b> Child is asked to get into rocking bowl &amp; to sit cross-legged. <i>He may hold onto the sides of the bowl.</i> Instructor rocks child forwards &amp; backward 10 times. This set is followed by a sudden stop &amp; then bowl is rocked from side to side 10 times. Progress to asking child to close his eyes while instructor rocks forwards &amp; backwards 10 times &amp; from side to side 10 times. Rocking speed: At a medium speed, however, observe that child does not fall over completely. If this happens, then start with a gentle rock. Child is asked to open his eyes &amp; is then assisted out of bowl. He is shown to go down on his haunches, on the unnumbered circle (below the semi-circle) &amp; to place his two arms together in front of his body to create a 'frog-stance'.</p> |

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| <p><i>to enable child from falling over during rocking;</i></p> <p><i>Motivate cognitive skills as child is asked to respond to the numbers that are called out</i></p> <p>(9 minutes)</p>  |  | <p>Instructor will call out a number &amp; child must walk forwards on his hands to touch the number called out &amp; walks back to the starting position. <i>Feet are encouraged to remain in place when hands walk forward.</i> The instructor calls out 4 numbers before child returns to rocking bowl.</p> <p>Repeat rocking motion following above-mentioned instructions. Child is then asked to return to the unnumbered circle &amp; gets into 'frog-stance' position. Instructor calls out another 4 numbers.</p> <p>Alternate between rocking child in bowl &amp; him walking to numbers in the semi-circle, 3 times each.</p>   |
| <p><i>Initiate stimulation of proprioceptors in upper limbs when compression is placed on the child's joints when pulling himself forward across the floor, in addition, the stimulation of stretching when child's arms are being pulled;</i></p> <p><i>Encourage vestibular stimulation during linear motions &amp; acceleration with quick change in direction;</i></p> <p><i>Activate neck and back muscles as upper body needs to be lifted while body moves forward &amp; while being pulled</i></p> <p>(5 minutes)</p> | <p>2. 'Find Buzz/ Woody / Mr Potato man'</p> | <p><b>Set up:</b> Set out 3 cones &amp; place 3 cartoon pictures on each cone. Set down 1 cone (Buzz Lightyear) on one side of the room, the second cone (Woody) on the opposite side of the room and the third one (Mr Potato Head) in between the other two cones, creating a triangle. The scooter board is placed in the middle of the room (in between the cones) with a hula hoop.</p> <p><b>Instructions:</b> Child is directed to lie down with his stomach, on the scooter board &amp; to bend at the knees (contracting hamstrings) so that his feet are not dragging on the floor. Instructor calls out one of the cartoon pictures &amp; child is shown to scooter forward on hands towards the cone with relevant picture on. Then instructor calls out the other cone's character &amp; child must scooter forward again on his hands. <i>Instructor may assist child in the action of using hands to move forwards.</i> Instructor then gives hula hoop for child to hold one end &amp; instructor is opposite child, holding the hula hoop. Instructor pulls the hula hoop, which should pull the child. Ensure that child holds on. Instructor may steer child, or while pulling child forward, initiate a quick change in direction or rotate child &amp; scooter board. Maintain pulling child around the room for 1 minute, ensuring child remains holding onto hoop.</p> <p>Alternate between child 'scootering' forward on hands and being pulled by hula hoop, 3 times for each activity.</p> |

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| <p><i>Activate dynamic balance while jumping on trampoline, initiate static balance by standing on compliant surface &amp; maintaining stance;</i></p> <p><i>Stimulate proprioceptors in lower limbs during jumping as muscles contract to support legs, along with upper limbs having to support weighted balls during contraction;</i></p> <p><i>Encourage spatial awareness &amp; motor planning as child needs to jump up on to the different heights of the river stones &amp; walk in between cones;</i></p> <p><i>Integrate the vestibular &amp; somato-sensory (proprioception) systems by combining all these activities together;</i></p> <p>(10 minutes)</p> | <p>3. 'Multi-movements'</p> | <p><b>Set up:</b> Place trampoline in middle of clear open space &amp; about 1m away set down 4 river stones in a vertical row, 30cm between each rock. However, set down 3 river stones (red, green) &amp; then the third river stone (yellow) is placed on top of second green river stone (making a tower). Place 1kg &amp; 2kg medicine balls next to green-yellow river stones that make the tower. Alongside the river stones' vertical line, set out 5 small cones in a vertical line, leaving enough space away from river stones (see diagram below).</p>  <p><b>Instructions:</b> Child is asked to step up onto trampoline &amp; begin jumping up &amp; down. Count up to 10 with child, followed by asking him to stop &amp; stand on his 2 feet for 5 counts (5 seconds). Child is asked to resume jumping up &amp; down for 12 counts. On the second stop, child stops for 3 seconds &amp; resumes jumping only 8 jumps. On the third stop, child is asked to step off trampoline. He is directed to first red river stone. Child is instructed to jump up onto river stone &amp; then down again, landing in front of second river stone (green). Continue to jump up &amp; down on the green river stone, followed by jumping up on to green-yellow river stones (tower). <i>Instructor shows child green-yellow river stone is higher. Child may need assistance with jumping the increased height.</i></p> <p>Child remains on top &amp; the 1kg ball is passed to child. He must receive the ball with both hands &amp; is asked to pass it back to instructor. Repeat 10 times. Child may then jump off green-yellow river stones (the tower). He is then directed to first small cone. Instructor directs child to walk in &amp; out of the cones. Instructor guides child all the way to the fifth cone which is the closest to trampoline.</p> <p>Child resumes jumping up &amp; down on trampoline. Follow same instructions as above. However for this second round, child is passed 2kg ball when standing on green-yellow river stones.</p> |
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| <p style="text-align: center;"><b>Cool down</b></p> <p><i>Stimulate child's vestibular system when he is being rotated, especially when his eyes are closed;</i></p> <p><i>Stimulate proprioceptors in upper &amp; lower limbs during compression, &amp; muscles contracting to hold limbs in place as they support the body while leaning back;</i></p> <p><i>Encourage abdominal muscles to contract as the upper body lifts up to grasp the ball;</i></p> <p><i>Train leg muscles to remain lifted &amp; controlled while managing a ball with feet;</i></p> <p><i>Practice ball manipulation skills while passing the ball back &amp; forth</i></p> <p style="text-align: center;">(4 minutes)</p> |  | <p><b>Set up:</b> Place big rocking bowl on a floor mat and tactile ball (the spikey monster) alongside it.</p> <p><b>Instructions:</b> Child is directed to sit cross-legged inside of bowl &amp; child may hold onto sides of bowl. Instructor spins child 15 times to the left, give a firm stop &amp; then spins bowl 15 times to the right; followed by spinning to the left again but only 10 times, firm stop &amp; then 10 times to right, stop. Child is spun a third time (his eyes closed) 8 times to the left &amp; 8 times to the right. After rotation, wait up to 8 seconds before child is asked to open his eyes &amp; is instructed to step out of bowl. <i>During this waiting time, count up to 8 with child.</i> Child is then asked to stand up &amp; to step out of bowl &amp; to sit down on the floor mat as the instructor also sits down on floor (assistant next to child). Instructor leans back on his/her hands (bending at the elbows), bends at the knees &amp; places tactile ball (spikey monster) between their own two feet. Instructor passes ball to child as the assistant shows child to put his hands back &amp; helps him lift his legs, bend at the knees &amp; receive ball from instructor. Child's feet might drop the ball, therefore instructor picks the ball up again with his/her feet to pass to child. Attempt this activity for about a minute before spinning child again, following the above instructions.</p> <p>Return to passing ball with feet. Alternate between spinning &amp; 'passing ball with feet activity' for 4 consecutive times.</p> |
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