A DANCE PROGRAMME TO ENHANCE GROSS MOTOR SKILLS AND BODY AWARENESS OF SELECTED CHILDREN DIAGNOSED WITH AUTISM SPECTRUM DISORDER

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Thesis presented in partial fulfilment of the requirements for the degree of Masters of Sport Science in the Faculty of Education at Stellenbosch University.

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December 2017

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ABSTRACT

Although over 7 decades of research on Autism Spectrum Disorder (ASD) have been conducted, research focusing on gross motor skills (GMS) development in these children have been neglected. However, it has been suggested that GMS may be a window for research. Recent studies indicate that creative movement is a viable form of therapy for children with ASD, as these children develop body-awareness through movement. A creative movement programme has not been conducted on South African children with ASD. Therefore, the main aim of this study was to explore the possible effect of a dance programme's on the GMS and body awareness of selected verbal children with ASD. The age ranges of the subjects were between 7 and 14 years old. The subjects (N=15) were selected from a LSEN school in Mitchells Plain, Cape Town, South Africa. They were randomly divided into an experimental (n=7) and control group (n=8). The primary data was collected using the Quick Neurological Screening Test-3 (QNST-3) and Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2), pre- and post-intervention. The experimental group participated in the intervention consisting twice per week, while the control group continued with daily activities. The duration of the intervention was 16 weeks, which was between 45 and 60 minutes. The data were analysed by means of statistical analysis that was derived from the mixed model repeated measures ANOVA. The results for the QNST-3 indicated that the experimental group improved by 50% ($p \leq 0.01$). Additional improvements were concluded from the BOT-2 where the experimental group improved by 26% ($p \leq 0.01$). Both quantitative evaluations indicated that the control group’s skills deteriorated over time. It was gratifyingly concluded that a creative movement programme is beneficial for enhancing the GMS and body awareness of verbal children with ASD. Future research is required to assess the effect of the programme on nonverbal children with ASD.

Keywords: Autism Spectrum Disorder (ASD), gross motor skills, body awareness, creative movement, lower socio-economic status community, South Africa.

OPSOMMING

Hoewel heelwat navorsing die afgelope 7 dekades oor Outismespektrum-versteuring (OSV) gedoen is, het studies oor die ontwikkeling van groot motoriese vaardighede (GMV) van Outisitiese kinders dikwels agterweë gebly. Ruimte vir navorsing oor GMV bestaan egter wel. Onlangse studies toon dat kreatiewe beweging 'n bruikbare terapievorm vir kinders met OSV is aangesien dié kinders liggaamsbewustheid deur beweging aanleer. ’n Kreatiewe bewegingsprogram is nog nie vir Suid-Afrikaanse kinders met OSV gebruik nie. Die hoofdoel van hierdie studie is gevolglik om die effek van 'n kreatiewe bewegingsprogram op die GMV en liggaamsbewustheid van (verbale) kinders met OSV te bestudeer.Die deelnemers se ouderdoms reeks was tussen 7 en 14 jaar oud. Die deelnemers (N=15) is vanuit Mitchells Plein, Kaapstad, Suid-Afrika geselekteer. Die deelnemers is op ’n lukrake wyse in 'n eksperimentele groep (n=7) en 'n kontrolegroep (n=8) verdeel. Die primêre data is voor en gedurende die intervensie deur middel van die "Quick Neurological Screening Test-3" (QNST-3) en die "Bruininks-Oseretsky Test of Motor Proficiency-2" (BOT-2) verkry. Die eksperimentele groep het twee keer per week aan die intervensie deelgeneem, terwyl die kontrolegroep aangegaan het met daaglikse aktiwiteite. Die intervensie was tussen 45 en 60 minute en het 16 weke geduur. Die statistiese ontleding is met behulp van die herhaaldemetings- ANOVA volgens ’n gemengdemodel-benadering gedoen. Die resultaat van die QNST-3 het getoon dat die eksperimentele groep met 50% ($p \leq 0.01$) verbeter het. Verder het die BOT-2 op 'n verbetering van 26% gedui ($p \leq 0.01$) vir die eksperimentele groep. Albei dié kwantitatiewe evaluasies het aangedui dat die kontrolegroep se GMV mettertyd agteruitgegaan het. Die slotsom is dat 'n kreatiewe bewegingsprogram wel tot die bevordering van OSV en liggaambewustheid van verbale kinders met OSV kan bydra. Toekomstige navorsing word benodig om te bepaal wat die effek van dié program op nie-verbale kinders met OSV sal wees.

Sleutelwoorde: Outismespektrum-versteuring (OSV), groot motoriese vaardighede, liggaamsbewustheid, kreatiewe beweging, gemeenskappe met 'n laer sosio-ekonomiese status, Suid-Afrika.

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DEDICATION

This thesis is dedicated to all the ASD children, that I have had the privilege of working with in my studies; you gave me strength.

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LIST OF ABBREVIATIONS

ABC	Autism Behaviour Checklist
ADI-R	Autism Diagnosed Interview- Revised
ADOS-2	Autism Diagnostic Observation Schedule-2
ANOVA	Analysis of variance
AOSI	Autism Observational Scale for Infants
APA	American Psychiatric Association
ASD	Autism Spectrum Disorder
ASSQ	Autism Spectrum Screening Questionnaire
BM	Board Marker
BOT-2	Bruininks-Oseretsky Test of Motor Proficiency, 2nd Edition
BRIAAC	Behaviour Rating Instrument for Autistic and Other Neurotypical Children
CARS	Childhood Autism Rating Scale
CDCP	Centres for Disease Control and Prevention
CNS	Central Nervous System
CP	Cerebral Palsy
CRT	Choice reaction time
CSBS	Communication and Symbolic Behaviour Scale
DAP-IQ	Draw-A-Person Intellectual Ability Test for Children, Adolescents, and Adults
DISCO	Diagnostic Interview for Social and Communication Disorders
DS	Down Syndrome
DSM-5	Diagnostic and Statistical Manual of Mental Disorders 5th Edition
ECD	Early childhood development

FMS	Fundamental motor skills
GARS	Gilliam Autism Rating Scale
GHDT	Goodenough-Harris Drawing Test
GMS	Gross motor skills
HIV	Human immunodeficiency virus
HTP	House-tree-person test
IA	Interoception Awareness
ICD	International Classification of Disease
IQ	Intellectual Quotient
LC-NA	Locus coeruleus-noradrenergic
LSEN	Learners with Special Educational Needs
MD	Moderate discrepancy
n	Number of subjects
N	Total number of subjects
NR	Normal range
NSS	Neurological soft signs
OCD	Obsessive-compulsive disorder
ODD	Oppositional defiant disorder
PANESS	Physical and neurological examination
PCS	Picture communication symbol
PDD	Pervasive developmental disorder
PDD-NOS	Developmental disorder not otherwise specified
PECS	Picture Exchange Communication System

QNST-3	Quick Neurological Screening Test 3rd Edition
RT	Reaction time
SAPIK	South African Professional Institute for Kinderkinetics
SCQ	Social Communication Questionnaire
SD	Severe discrepancy
SHTP	Synthetic house-tree-person
SRS	Social Responsiveness Scale
SRT	Simple reaction time
STAT	Screening Tool for Autism in Toddlers
TB	Tuberculosis
TGMD	Test for Gross Motor Development
TLR	Tonic labyrinthine
UK	United Kingdom
USA	United States of America
WCED	Western Cape Education Department
WHO	World Health Organisation

CHAPTER 1

INTRODUCTION

"Why does he never look at me in the eyes with love and affection?
Why does he laugh when I cry, instead of asking me why I am sad?
Why is he so nice to me when I have a red ribbon in my hair,
and not when I am wearing a blue one?"
(Gilberg & Peeters (1997) cited in Guolaugsdottir, 2002:10).

OVERVIEW OF CHAPTER

The research question is of vital importance because it forms the essence of a research study. The researcher considered the research journey, as well as the relevant findings and built on previous research in order to make a valuable contribution toward a specific research field. After the latter, the researcher designed the core aspects of the study, namely the problem statement and research design. The researcher then considered all relevant ethical issues, as well as statistical significance, in formulating the research plans. The researcher noted that throughout the research process, challenges raised, which formed part of the study limitations.

BACKGROUND TO THE RESEARCH QUESTION

Autism was first described less than a century ago, however, the reported prevalence in high income countries has risen markedly over the past two decades (Rice & Lee, 2017:515). The year 1943 was considered to be a noteworthy moment in the history of Autism, when Leo Kanner identified *Infantile Autism* as a unique syndrome in which the individual experiences extreme aloneness as well as predictability (Martin, 2014:546; Scharoun *et al*., 2014:209-210; Mthombeni & Nwoye, 2017:1; Postorino *et al*., 2017:1051). Since then, numerous diagnostic terms and classifications have been used to describe this disorder. The latest diagnostic criteria for Autism Spectrum Disorder (ASD) have been categorised in the most recent version of the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM- 5) (APA, 2013:50, 53-54).

Autism has undergone many variations over the past few years. After considering numerous factors, including research findings, documented characteristics and symptoms, Autism is now on a spectrum of disorders. Some characteristics that have been consistent throughout the years are: extreme aloneness; isolation from the environment and themselves; insistence on sameness; disordered personality; speech delays; ritualistic behaviours and impaired relationships. It is believed that ASD is a range of neuro-developmental disorders of which the symptoms can occur in any combination and in varying degrees of severity (Lang *et al*., 2009:566; Rutter, 2011:30; APA, 2013:58; Skewes *et al*., 2015:301; De Milander *et al*., 2016:37).

When approaching a child with ASD as a holistic being, a healthy self-esteem is one of the core essential factors to keep in mind. In turn, physical activity has the potential to facilitate a variety of improvements in various aspects of a child's life, including enhanced self-esteem (Dieringer *et al*., 2017:421). The manner in which physical activity is executed can be experienced differently by each and every child. One established fact is that children learn through developmental movement patterns, which in turn, provide them the ability to relate their bodies to the environment (Martin, 2014:546).

Children generally develop gross motor skills (GMS) through play and interaction with the environment and their peers. ASD children frequently have limited experience in this realm, as they lack social communication skills and exhibit restrictive behaviours. In addition to these limitations, ASD children display gross motor deficits, however, these deficits are not officially part of the diagnostic criteria. GMS of the ASD population are often neglected in literature, and may have significant impact on the core ASD characteristics (Provost *et al*., 2007:321; Bremer *et al*., 2015:980; Bo *et al*., 2016:51; De Milander *et al*., 2016:38; Dieringer *et al*., 2017:421; Grace *et al*., 2017:1006; Mody *et al*., 2017:156).

When considering a gross motor intervention, a researcher needs to take the strengths and weaknesses of the children into consideration. In addition, a researcher should have the ability to adapt to the child's needs and abilities. Age-appropriate activities need to be embedded in the programme, which may increase the individual's motivation to willingly engage in the activities (Lang *et al*., 2009:574; Scharoun *et al*., 2014:212, 215; Rollins *et al*., 2016:220).

Dance is a viable holistic form of therapy for individuals with ASD, because it promotes inclusivity and provides ample layers of learning that deepens a child's response to the world. It is also a creative process that involves movement of the body in a particular time and space (Scharoun *et al*., 2014:213; Devereaux, 2017:51).

PROBLEM STATEMENT

It is believed that 90% of people with ASD live in low and middle-income countries such as Africa (De Vries, 2016:130,135). It is, therefore, essential for intervention and treatment programmes to be available to everyone, including those with limited resources (Mthombeni & Nwoye, 2017:3). Additionally, it has been estimated that 21 to 100% of children diagnosed with ASD display a number of notable motor deficits (Bo *et al*., 2016:51).

Previous studies have also concluded that physical activity has the potential to facilitate a variety of improvement in multiple aspects of an ASD child's life. Of these aspects include the body awareness (self- esteem) and gross motor skills (Martin, 2014:54; Sanford & Horner, 2017:46). Gross motor skills are generally developed through interacting with the environment and their peers. Although children with ASD have limited experience in this realm as they have limited social communication skills (Bo *et al*., 2016:52).

There is a consequently a dearth of literature and findings on the benefits of interventions on the GMS and body awareness of children with ASD. From the above statements the purpose of the current study is to investigate the possible beneficial effects of a self-designed dance programme on GMS and body awareness of verbal subjects diagnosed with ASD.

RESEARCH QUESTION

With the problem statement in mind. Does a self- designed dance programme have an effect on the GMS, as well as the body awareness of the selected verbal children with ASD?

AIMS AND OBJECTIVES OF THE CURRENT STUDY BASED ON THE RESEARCH QUESTION

The main aim of the current study was to determine the effect of a self-designed dance programme, focusing specifically on gross motor skills (GMS) and body awareness of selected verbal subjects with ASD.

The first sub-aim was to identify the extent of GMS deficits of the selected verbal subjects with ASD.

The objectives were to:

- determine the level of gross motor development of each subject;
- determine any delays in motor planning and motor sequencing when performing the GMS (tasks);
- identify each subject's sense of rate and rhythm when performing gross motor movements;
- classify the spatial organisation of each subject;
- identify the subject's bilateral coordination (this requires bodily control and simultaneous coordination of upper and lower limbs);
- identify the upper body coordination of each subject, which coordinates the visual tracking with arm or hand movements;
- determine the trunk, upper and lower body strength of the subjects because this is essential for daily gross motor performance;
- determine each subject's balance and stability linked to their vestibular system;
- determine the agility of each subject.

The second sub-aim was to explore the body awareness of the selected verbal subjects with ASD.

The objectives were to:

- subjectively identify and examine their body image and the emotions accompanying this;
- subjectively identify their kinaesthetic body schema;
- subjectively examine their laterality and directionality;
- explore their midline and midline crossing.

RESEARCH DESIGN

The study employed a completely randomised control experimental design because the subjects were randomly assigned in the experimental and control groups by an independent third party. A homogenous purposive sampling method was also conducted for the specific population. Psychologists formally diagnosed the selected children with ASD. The homogenous purposive sampling and sample of convenience was selected from Learners with Special Educational Need (LSEN) School in Mitchells Plain, Western Cape Province, South Africa. The sample (N=15) was randomly divided into a control (n=8) and experimental (n=7) group. The age ranges of the sample was between 7 and 14 years.

A 16-week intervention programme was conducted semi-weekly for 45 to 60 minutes in two different locations (Department of Sport Science, Stellenbosch University and the selected school in Mitchells Plain). The intervention programme was designed to meet the specific gross motor skill- and body awareness needs of the subjects. Main gross motor skill areas that were included in the programme were locomotion, hand-eye coordination, foot-eye coordination and bilateral coordination, core strength, static and dynamic balance, spatial awareness, proprioceptive stimulation, vestibular stimulation, visual motor integration, imitation, tactile discrimination, motor planning, object manipulation and anaerobic endurance. Main body awareness areas included were: body concept; body image; laterality; directionality; body schema and spatial awareness. All the dances were accompanied by music, including folk and melody. The proprioceptive and vestibular systems of the subjects were actively stimulated between the dances.

Quantitative data were collected pre- and post- intervention using two standardised tests, namely the Quick Neurological Screening Test 3rd Edition (QNST-3) and the Bruininks-

Oseretsky Test of Motor Proficiency, 2nd Edition (BOT-2). These took 4 weeks to complete.

LIMITATIONS

A lack of motor impairments in research exists because both the DSM-4 and DSM-5's, ASD diagnostic criteria include limited evidence of these impairments (Bo et al., 2016:51). Regarding a standardised assessment, Provost et al. (2007:327) alleged that limited research on a gold standard assessment, for the motor skills of children with ASD, is available. Although there are standardised tests that can be used to assess the GMS of the ASD population, none of these tests have special adaptations for the population and requires the subjects to showcase some verbal abilities. This limited the subjects that could be included in the current study because they all had to be verbal. Furthermore, standardised assessment can

be unfeasible and unsuitable due to the noncompliance, unresponsiveness and the extensive diversity of behavioural and developmental levels of subjects with ASD.

STATISTICAL ANALYSIS

The quantitative data of the GMS and body awareness components of the standardised tests were collected by the researcher and analysed with the assistance of the Director of Statistical Consultation at Stellenbosch University, Professor Martin Kidd (mkidd@sun.ac.za). The mixed model repeated measures ANOVA was used to simultaneously compare pre- and post-measurements among the groups and the interaction effect that the intervention had over time on the experimental group. The p value of significance was set at (p=0.05). The statistician assisted with the analysis, interpretation and presentation of the results using Statistica 13, and provided graphic representations of the results of both the QNST-3 and BOT-2 for the control and experimental groups over*time.

ETHICAL ASPECTS

The Research Ethics Committee: [Human Research (Humanities) at Stellenbosch University] (SU-HSD-001759), the Western Cape Education Department (WCED), as well as the principal and governing body of participating school granted permission for the study to be conducted. Additionally, parents and/or legal guardians had to provide informed consent, whereas the subject's had to provide assent. All the data were safeguarded and kept confidential to ensure that the subjects could not be personally identified. Refer to Appendix A (A1- A5) for all relevant ethical considerations.

SUMMARY OF CHAPTERS

Chapter 1: This chapter states the problem and significance of this research. A brief description regarding the research design, limitations, statistical analysis and ethical aspects are also provided.

Chapter 2: A thorough review of literature is presented in this chapter, from the evolution of the term ASD to the increasing rate of diagnosis. The cornerstones of the disorder, such as language and social communication, restrictive and stereotypical behaviours, gross motor deficits and body awareness, and how it is related to dance as a form of therapy for ASD children, are also discussed.

Chapter 3: In this chapter, a description of the methodological procedures and the implemented research design for the current study is given. Additional aspects of research such as the research objective, research design, the sample of the study including the inclusion and exclusion criteria are discussed. The aim of the study is stated, as well as the relevant sub-aims and the complementary objectives that the intervention was based on. The collected quantitative data is discussed followed by an in-depth description of each scientific evaluation. Lastly, a brief description of the data analysis used for interpretation of data is provided and the ethical considerations related to this study are discussed.

Chapter 4: In this chapter, the researcher intends to answer the research question based on the findings. The demographics of the subjects, such as their chronological age ranges, which were relevant for the interpretation of the QNST-3 and BOT-2 scores, are discussed. The outcomes of the scientific evaluations are presented and analysed.

Chapter 5: The researcher presents the final conclusion that is in line with the answered aims of the research question that was set out for the current study. Lastly, the researcher acknowledges the limitations and recommends a few noteworthy points for future research.

The researcher made use of a modified Harvard reference method.

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CHAPTER TWO

LITERATURE REVIEW

OVERVIEW OF CHAPTER

In the previous chapter, the researcher mentioned the importance of the current research question in light of the dearth of South African research on this topic. The current study was based on specific methodological procedures, which were briefly discussed in the research design section of Chapter One. Thereafter, the statistical analysis was clarified and the research limitations were included. Lastly, the ethical considerations were elaborated on, and a brief summary of each chapter was presented. In this chapter, the literature on Autism Spectrum Disorder (ASD) will be reviewed. The term ASD has evolved over the past 70 years and a thorough analysis will be conducted on the disorder, as well as the accompanying co-morbid psychiatric disorders, and the severity classification of the diagnosis. It has been alleged that the rate of diagnosis is increasing and, therefore, this tendency and the related aetiology of ASD has been examined in the current study. The parents of children with ASD play a vital role in the life of their child, therefore, they cannot be excluded from this discussion. As a result, the early signs of ASD are discussed and the effects of the ASD diagnosis on parents are explored. Focusing solely on children with ASD, all the aspects and hallmarks of the disorder, including language and social communication, restrictive and stereotypical behaviours and importantly the gross motor deficits were investigated. Early intervention is vital, and therefore, the current study focused on the exploration of dance as a form of therapy for children with ASD and as a method for developing body awareness.

THE EVOLUTION OF ASD

The profound saying: ‘Never judge a book by its cover’ is particularly true when dealing with Autism Spectrum Disorder (ASD), because the term ASD has had many variations and the diagnostic criteria have broadened as research evolved. The history of the term, for this lifelong disorder, dates back to the 1911’s when Eugen Bleuler derived the word ‘Autism’ from the Greek word *autos* meaning ‘one’s self’. Bleuler applied this term to refer to the

Autistic individual's tendency to isolate him- or herself from social interaction in an external environment (Scharoun *et al*., 2014:209-210). The year 1943 is considered a significant moment in Autism history, because Leo Kanner identified *Infantile Autism* as a unique syndrome in which the individual experiences extreme aloneness, as well as insistence on sameness. One year later, Hans Asperger used the term *Autistic Psychopathy* to describe characteristics similar to those Kanner had observed (Martin, 2014:546; Scharoun *et al*., 2014:209-210; Mthombeni & Nwoye, 2017:1; Postorino *et al*., 2017:1051).

In the past, Autism was regarded as 'infantile psychosis' due to the ignorance of the vast differences between Autism and childhood Schizophrenia. In the 1970's clear distinguishing features were found between childhood Schizophrenia and Infantile Autism. Childhood Schizophrenia was said to be characterised by a disordered personality, cognition, moods and blunted affect. Additionally, the onset of childhood Schizophrenia was after the age of 11 years, and therefore, at first the child generally had normal intelligence. Infantile Autism was noted shortly after infancy and a wide range of intellectual functioning was documented. It was likewise associated with speech delays, ritualistic behaviour, deficits in social relationships and no voluntary imaginative play. There was, therefore, later an agreement not to view Autism as an early manifestation of schizophrenia. Individuals with autism also differed significantly from those with intellectual disabilities such as, sex ratio, cognitive functioning and patterns, social interaction, infant head circumference and neurological findings (Rutter, 2011:17). ASD, according to the American Psychiatric Association (APA), is a condition that is associated with known medical, genetic, environmental factors or with other neuro-developmental, mental or behavioural deficits (APA, 2013:51). Autism is well-known for over a half a century since Kanner (1943) first presented the syndrome of Autism to the world, and there have been vast changes in the understanding of ASD since then (Rutter, 2011:17).

In the latest version of the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5), Autism is thought to be on a spectrum (Rutter, 2011:30; Skewes *et al*., 2015:301).The term spectrum, in ASD, refers to a range of neurodevelopmental disorders that include a number of related disorders (which were separately described in the DSM-4), such as early Infantile Autism, childhood Autism, Autistic disorder, high functioning Autism, Kanner's Autism, atypical Autism, Asperger's syndrome and pervasive developmental disorder not otherwise specified (PDD-NOS), Rett's disorder and Childhood Disintegrative

Disorder (Lang *et al*., 2009:566; Rutter, 2011:30; APA, 2013:57). See Table 2.1 for a description of neuro-developmental disorders associated with ASD as described in the DSM-4. Although, the ASD definition according to DSM-5 is considered to be the 'gold standard', Martin (2014:546) suggests that the description is still evolving due to the nature and the complexity of the disorder. It should be noted that no cure for ASD exists yet (De Bruin *et al*., 2015:907; Rollins *et al*., 2016:219; Mthombeni & Nwoye, 2017:11).

Table 2.1: The neurodevelopmental disorders described in the DSM-4 associated with ASD, and the prominent characteristics thereof.

NEURODEVELOPMENTAL DISORDER	PROMINENT CHARACTERISTICS
Asperger's Syndrome	Social impairments. Restricted interests. Communication abnormalities, such as flat modulation, higher pedantic speech. Impaired conversational reciprocity which may be associated with topics of restricted interest.
Pervasive Developmental Disorder, Not- Otherwise-Specified (PDD-NOS)	Children who fall short of meeting the autistic criteria or children with patterns of development that fall short of one or numerous symptoms that have been specified as part of the diagnostic criteria.
Rett's Disorder	Rare disorder, which predominantly comes forth in girls. Characterised by stereotypical motor behaviours, mainly hand-wringing, common seizures and breathing abnormalities such as breath holding or excessive hyperventilation. Associated with an identifiable mutation of gene on the X Chromosome (MECP2).
Childhood Disintegrative Disorder	Rare cases of 2 per 100000 children. Severe acute regression in all areas of development after relatively normal development until 2-3 years of age. Skills are absent in two or more of the following areas: language, social interaction, motor skills, play or setting or environmental adaptive behaviour. Development of speech is limited to 3 to 10 single words, and exclusively present for a few weeks or months.

Adapted from Gotham *et al*. (2011:30-33).

THE DSM-5 DIAGNOSTIC CRITERIA

The APA describes the five pillar markers for the diagnostic criteria of ASD.

According to Criterion A, definite deficits in social communication exist, which impacts on the social interaction of individuals, such as inappropriate responses to conversations.

These deficits merge and persist (or are pervasive) across multiple settings and environments. The symptoms can be evident in the social communication of a child, or it can be part of the developmental history of the child. Such deficits can range from inadequacy of social-emotional reciprocity (the child's reduced ability to share interests, or the inability of having a conversation). Nonverbal communication is typical during social interactions, where the child may have the inability to develop, maintain and understand relationships with family, friends or peers. The child will struggle to build age-appropriate friendships (APA, 2013:50, 53-54).

Criterion B entails that the child displays restricted, repetitive patterns of behaviour, interests or preferred activities, such as stereotyped or repetitive motor movements (hand flapping or finger flicking); specific ritualised movements with objects (spinning objects or lining them up in lines); or echolalia (repetition of the same word or sound). A core characteristic is the child's over-dependence on routine. Routine has to be strictly adhered to, for example, how their favourite food should be packaged or being insistent on the adherence to rules with rigid thinking. Additionally, they may present abnormally highly restricted intensity when focusing on thoughts or objects (which may also be an intense attachment to unusual objects such as a blender). Unusual sensory interest can either be hyper- or hypo-responsive to sensory inputs in the environment (excessive smelling or touching objects continuously). This feature may lead to apparent indifference to pain, heat or cold, because the child receives a positive sensory stimulus out of what would be perceived as hurting him- or herself (APA, 2013:50, 53-54).

Criterion C states that the above-mentioned symptoms must be present at the time of the initial diagnosis and should have been noted during the early developmental period of the child, which includes their milestones (APA, 2013:50, 53-54).

As stated by Criterion D, the above-mentioned symptoms should clinically cause significant impairments in the individual's social, occupational, educational, leisure and other important aspects of life, preventing them from achieving goals set by family or teachers (APA, 2013:50, 53-54).

Lastly, Criterion E notes that all of the above-mentioned disturbances should not be better explained by an intellectual disability or global developmental delay. The diagnosis should specify if there is any accompanying, intellectual impairment, language impairment, associated known medical, or an environmental condition, or other neurodevelopmental disorders (APA, 2013:50-51).

GENDER DIFFERENCES

Studies suggest that males are three to four times (M:F ratio of 4:1), more likely to be diagnosed with ASD than females (Rutter, 2011:30; APA, 2013:57; Louw *et al*., 2013:69; Ornoy *et al*., 2015:156; De Milander *et al*., 2016:37; Mthombeni & Nwoye, 2017:2; Postorino *et al*., 2017:1051). Postorino *et al*. (2017:1051), however, reported that early ASD signs are more common in girls. It is suggested that females often remain undiagnosed or are mislabelled as having other disorders (Mthombeni & Nwoye, 2017:2; Postorino *et al*., 2017:1052). According to Herlihy *et al*. (2015:21), this finding has not been consistent. There seems to be a higher rate in the severity of cognitive impairments in female ASD individuals, than in males. However, it has been debated and speculated that the gender factor may be associated with various etiological subgroups in the ASD population (Herlihy *et al*., 2015:21).

THE AGE OF DIAGNOSIS

The age range at which a child is usually formally diagnosed with ASD is between one and 5.5 years. Children are initially diagnosed at two years and a follow-up is essential after their third birthday. In severe cases, though, the diagnosis could take place prior to the age of two. Early diagnosis is dependent on factors such as the severity of the symptoms and socio-economic status. The median age of diagnosis is suggested to be 50 months (Watt *et al*., 2008:1519; Luyster *et al*., 2009:1305,1306; APA, 2013:55; Arzoglou *et al*., 2013:563; Herlihy *et al*., 2015:20; Bradstreet *et al*., 2016:359; Fletcher-Watson *et al*., 2017:62). During the first year of life, delayed language development, a lack of desire for social ventures and particular interest in unusual social interactions or communication patterns (such as reciting the alphabet, but not responding to their own name), may be observed. The repetitive and restricted behaviour is not yet evident at this age. Nonetheless, many children have a strong preference for their favourite food or movie (APA, 2013:54). Parents have noted disturbing behavioural patterns between two and 19 months. Infants with ASD have shown to exhibit a decrease in eye gaze between two and six months. Consequently, they do not readily engage in eye contact and a lack of reciprocal social interaction is present in these infants. It has been suggested that the neurons that would normally be activated in these activities, have not yet been activated. This, in turn, prevents typical neural pathways from being formed (Rutter, 2011:18; Bradstreet *et al*., 2016:360).

Early ASD symptoms have been observed from the age of three to six months in high-risk individuals. These symptoms include social and regulatory symptoms, as well as a lack of social or joint attention, whereas, lower risk infants (at six months of age) have been found to display symptoms of gradual diminished gaze, shared smiles and social vocalisation (Rutter, 2011:18). Some pronounced developmental regressions that have been noted at the end of the second year include atypical language, social and general behavioural developmental problems in children who were formally diagnosed with ASD at a later stage. A reliable diagnosis can usually be made within the first 36 months (Rutter, 2011:18; Bradstreet *et al*., 2016:359). Recently, the mean age at which early signs were evident were found to be 14 to 17 months, although it has been strongly suggested that this age may have declined as the awareness of the public regarding the warning signs have increased over the past few years (Kleinman *et al*., 2007:606; Scharoun *et al*., 2014:210; Herlihy *et al*., 2015:20; Crane *et al*., 2016:153; Rollins *et al*., 2016:220).

The earlier 'Autistic-related' behaviours that infants and children show, include a lack of pointing, showing or bringing objects to share interest with others and the inability to follow someone else's pointing, which is a result of poor eye gaze. ASD children's repertoires of functional gestures are more limited than the repertoires of their neuro-typical peers (APA, 2013:53). When viewing pre-school children diagnosed with ASD, common essential features present include a representation of lack of interest towards peers, an inability to show empathy towards others, severe delayed communicative speech and constant insistence on sameness, whether it is objects or routines, limited interests, various self-stimulatory activities, some of which may be self-injurious and stereotypical movements (Mthombeni & Nwoye, 2017:2).

AGE OF FORMAL DIAGNOSIS

It has been reported that parents typically encounter a delay of 3.5 years from the initial contact session with a health care professional to the date of formal ASD diagnosis (Crane *et al*., 2016:158). Parents usually wait about one year after their first concerns before contacting a health care professional, which generally results in a delay of 4.5 years between the parents' first and foremost observations of the child's developmental delays to the date of formal diagnosis (Crane *et al*., 2016:158; Konukman *et al*., 2017:65). One of the first groups of children who present a formal assessment are those who have concurrent intellectual disability, motor or language delays or deficits such as social communication or interaction preferences, as well as medical problems (Herlihy *et al*., 2015:21).

METHODS OF DIAGNOSIS AND UNDERSTANDING OF THE ASD POPULATION

ASD has benefited from the advancement of research-based standardised measures (Gotham *et al*., 2011:36). ASD is typically classified according to the DSM-5 and by the International Classification of Disease (ICD). However, four categorical measurements have been used as vital tools for diagnosis and assessments, namely: (1) diagnostic measures; (2) questionnaires; (3) diagnostic interviews; and (4) observational measures (Gotham *et al*., 2011:36-38).

Diagnostic measures are typically used by clinical diagnosticians, as well as for research purposes. The three measures that will be discussed are the Behaviour Rating Instrument for Autistic and Other Neuro-typical Children (BRIAAC), the Social Communication Questionnaire (SCQ) and the Social Responsiveness Scale (SRS). BRIAAC, one of the earliest measurements, use a direct observation to assess children of all ages in terms of their relationship with an adult, by means of communication, drive for mastery, vocalisation and expressive speech, reception of sound and speech, social responsiveness and psychological development. Other standardised clinical observations include the SCQ and the SRS. Methods that have been translated to assist individuals in most parts of the world include the ADI-R, which has been translated into 20 languages. The SCQ has been translated into 17 languages and the SRS into 18 languages (Gotham *et al*., 2011:36; Scharoun *et al*., 2014:210).

Questionnaires involve collecting large amounts of information in a relatively short period of time, as well as the input from a multi-disciplinary team (Gotham *et al*., 2011:36). The Autism Behaviour Checklist (ABC), Gilliam Autism Rating Scale (GARS), Social Communication Questionnaire (SCQ), and the Autism Spectrum Screening Questionnaire (ASSQ) will be discussed in this section (Gotham *et al*., 2011:36-37). The ABC is a questionnaire which has been specifically developed to aid in ASD diagnosis, which may be completed by parents or teachers. The primary focus of this checklist is sensory interest behaviour, body and object use, language and social interaction and self-help ability. The ABC has some limitations and it has been advised that this checklist should be used to document change in response to education or treatment, rather than as a diagnosis measure. The GARS is also completed by parents and its primary aim is to indicate the likelihood of Autism. It has, however, been strongly suggested not to use this scale as a primary diagnostic measure. The SCQ works relatively well with identifying ASD in certain populations, especially when used in conjunction with the ADOS. The ASSQ is mainly used in a clinical setting, which specifically intends to identify characteristics of Asperger's Syndrome and high functioning Autism (Gotham *et al*., 2011:36-37).

Diagnostic interviews aim to collect vital information about the behaviour of individuals with ASD from parents and/or care givers. A major advantage of an interview is that the interviewer may elaborate or interpret questions in different manners, if needed. Two diagnostic interviews will be discussed in this section, namely the Autism Diagnostic Interview-Revised (ADI-R) and the Diagnostic Interview for Social and Communication Disorders (DISCO) (Gotham *et al*., 2011:36-38). The ADI-R is a standardised semi-structured interview, which lasts for two or three hours and involves the informants and a trained clinician. With concluding 'Autism' or 'Non-autism' results, this measurement has an excellent validity when used in correlation with the ADOS. The DISCO is another semi-structured, yet standardised interview measurement for ASD assessment. This interview assess a number of non-ASD specific behaviours (Gotham *et al*., 2011:36-38; Smith *et al*., 2016:1-2).

Observational measures are exclusively intended for trained clinicians who never make a diagnosis without directly observing and interacting with the individual. Five observational measures will be discussed in this section, namely: Childhood Autism Rating Scale (CARS); Autism Diagnostic Observation Schedule-2 (ADOS-2); the Communication and Symbolic

Behaviour Scale (CSBS); Screening Tool for Autism in Toddlers (STAT); and Autism Observational Scale for Infants (AOSI) (Gotham *et al*., 2011:36-38). The CARS is one of the most widely used Autism diagnostic scales. It rates children on a scale from one to four based on social relationships, body awareness, relation to objects, ability to adapt to change, as well as verbal and nonverbal communicative skills. The ADOS-2 is a semi-structured standardized assessment of the child's social interaction, means of communication, restricted and repetitive behaviours, play and imaginative use of given materials. It provides a standardized observation as part of the diagnostic process of children with possible ASD (Smith *et al*., 2016:1-2). The primary use of the ADOS-2 is interactive social behaviour between the child and the examiner. The CSBS evaluates communication and symbolic abilities specifically for babies and toddlers. The STAT is a great interactive screening measurement for children aged 24 to 35 months and is especially good at distinguishing a two-year-old ASD child from a non-ASD two-year-old child. More recently, the AOSI was designed to identify children aged between six and 18 months that may be at risk of having ASD (Gotham *et al*., 2011:36-38; Scharoun *et al*., 2014:210; Smith *et al*., 2016:1-2).

ASD AND CO-MORBID PSYCHIATRIC DISORDERS

Accompanying co-morbid psychiatric symptoms and disorders are fairly common in both children and adults with ASD (Gotham *et al*., 2011:35; Gjevik *et al*., 2015:433). Additionally, ascertaining co-morbidity is currently a critical part of assessment rather than an exception because of the high rates of co-occurrence conditions within the ASD population (Gotham *et al*., 2011:35). Approximately 70% of ASD individuals have one co-morbid mental disorder and 40% have one or more co-morbid mental disorder (APA, 2013:58; Gjevik *et al*., 2015:433). In Nigeria, 75% of the children with ASD were found to have neurological co-morbidities, although the type of neurological co-morbidity was not stated (De Vries, 2016:133).

It has been a challenge for researchers and physicians to assess co-morbid psychiatric disorders in children with ASD because specialised instruments have only recently been developed. Another challenge faced is the fact that the psychometric properties of common childhood diagnostic tools and instruments applied to ASD children, have not yet been studied (Gjevik *et al*., 2015:434). Intellectual disability accompanying ASD in African individuals appears to be more common. Other co-morbid disorders include anxiety, depression, hyperactivity, attention problems, obsessive-compulsive features, tics, tuberous sclerosis, Fragile X, epilepsy and according to one case, oculocutaneous albinism was present (Bakare & Munir, 2011:209; Gotham *et al*., 2011:35).

THE ASD POST- DIAGNOSTIC SEVERITY CLASSIFICATION CRITERIA

Once the child has been evaluated and a positive ASD diagnosis has been made, a further classification of three severity levels (one to three) are made. This classification can be an indication of the amount of support that the child requires and it can be used to distinguish the child's level of dependency in terms of social communication abilities and restrictive, repetitive behaviours. However, the amount of 'support' that the individual requires does not describe his or her actual level of functioning (APA, 2013:52). These severity levels can be described as follows:

Level 1 (the child requires assistance), indicates that the child is able to cope with everyday environments, yet displays clear and notable social impairments and may appear to have ineffective responses to social overtures, as well as decreased awareness of social interaction. The child's fixed and inflexible behaviour causes a significant interference when required to function in one or more settings. The child has an inability to switch between two different activities and has a definite deficit in planning and organisation, which in turn affects dependency (APA, 2013:52).

Level 2 (the child requires substantial support), indicates that the child displays clear deficits in verbal and nonverbal social communication skills and that the child has limited initiation of social interaction towards peers. The child's behaviour is inhibited and inflexible and he or she is incapable of handling change or shifting focus due to the fixation on repetitive behaviour (APA, 2013:52).

Level 3 (the child requires a significant amount of substantial support), indicates that the child displays a severe deficit in verbal or nonverbal social communication. Extremely limited social interaction and minimal response to social communication can be seen (APA, 2013:52; Mthombeni & Nwoye, 2017:2). Behaviour is highly inflexible and the child finds it extremely difficult to cope with change. Repetitive and restricted behaviour influence the functioning of a child in a variety of contexts and environments (APA, 2013:52; Di Rezze *et* *al*., 2016:2). A recent study has concluded that repetitive and restricted behaviours in children (between one and two years of age) are not valid indications of ASD severity (Troyb *et al*., 2016:1292). Further research is needed on the classification of the everyday functioning of a child with ASD (Di Rezze *et al*., 2016:2).

AETIOLOGY OF ASD

ASD is undoubtedly not a one-size-fits-all diagnosis (Marco *et al*., 2011:48R). This statement is also true for the cause of this disorder. There is no definitive cause of ASD. The aetiology of ASD is largely unknown, although strong evidence points to significant genetic contribution and environmental risk factors (Ornoy *et al*., 2015:156; De Milander *et al*., 2016:37; Roberts *et al*., 2016:26; Fletcher-Watson *et al*., 2017:62; Mthombeni & Nwoye, 2017:2; Sanford & Horner, 2017:46). There are said to be more than 1000 genes that have been predicted to play a central role in ASD (Sealey *et al*., 2016:289).

There are several core factors that have been noted by researchers that could have an influence on ASD. It all begins with environmental risk factors such as: the prenatal stage may be a sensitive period, although less extensive literature regarding this topic is available; and pregnancy-related factors, including maternal gestational diabetes mellitus, hypertension, proteinuria, drugs such as valproic acid and thalidomide, pre-eclampsia, alcohol, dietary factors, such as the quality of nutritional intake, folic acid deficiency, exposure to pollution chemicals and high levels of pesticides and pollution, have all been identified as factors that could contribute to the aetiology of ASD (Springer *et al*., 2013:98; Dawson & Rice, 2016:1; Roberts *et al*., 2016:26).

Pre-pregnancy factors are also implicated, such as: victimisation of the mother by an intimate partner; and poor adherence to medication, inadequate prenatal care and harmful behaviours towards the foetus such as smoking, substance abuse, poor diet, maternal infection and hormonal dysregulation, have been linked to an increased risk of ASD (Roberts *et al*., 2016:26). According to Roberts *et al.* (2016:31) they ‘have found an increased risk of ASD in children of mothers exposed to abuse in the two calendar years before the child’s birth year, but not in women exposed in other years before or after the birth year’. Moreover, abuse during or before pregnancy has been associated with negative sequelae for the mother and the foetus. Some foetal characteristics associated with ASD include extreme premature birth (3.6 to 12.9%) when compared to the general population prevalence (1%), of low birth weight and small gestational age (Dawson & Rice, 2016:1; Pritchard *et al*., 2016:2; Roberts *et al*., 2016:27).

Additionally, maternal exposure to psychosocial stress during pregnancy has been hypothesised to increase the risk of ASD in the foetus because several neurological pathways are affected. Stressors experienced by the mother may deregulate the locus caeruleus-noradrenergic (LC-NA system) through the effects of maternal cortisol on the genes controlling the development of this system. Additionally, stressors from the mother may disrupt the brain development of the foetus by impairing placental circulation (Scharoun *et al*., 2014:211; Ornoy *et al*., 2015:157; Roberts *et al*., 2016:27). Therefore, foetal exposure to psychosocial stressors (from the mother) during pregnancy, have been linked to cognitive and language deficits (Roberts *et al*., 2016:27).

The development of Autism has also been investigated and associated with pre-, peri-, and neonatal factors. It has been speculated that complications during the prenatal and neonatal period could be the cause. In utero foetal exposure to hazardous toxins, such as alcohol, has been positively associated with ASD. However, in utero toxin exposure is often under reported (Roberts *et al*., 2016:27). Short inter-pregnancy intervals have also been included as a possible risk factor (Dawson & Rice, 2016:1).

Studies have indicated that a woman's chance of giving birth to an ASD child increase throughout her reproductive years. Research suggests that mothers older than 35 years have a 30% increased risk. Mothers older than 40 have a 51% increased risk. The risk is less for a mother aged between 25 and 29 years (Sandin *et al*., 2012:484; Sealey *et al*., 2016:290). A young maternal age (30 years and younger) will only have an impact if the father is older (Sealey *et al*., 2016:290). Advanced maternal and paternal age has been found to increase the risk of the offspring having ASD (Durkin *et al*., 2008:1268; Parner *et al*., 2012:143,147; Sandin *et al*., 2012:484; Ornoy *et al*., 2015:157; Sealey *et al*., 2016:290). It has been found that an increased maternal age may increase the risk in ASD for a male offspring. An increased paternal age results in an increased risk for ASD in a female offspring (Sandin *et al*., 2012:484).

With regard to the maternal stressor that affects the brain development of the foetus, viable evidence has been obtained from neuropathological studies indicating that ASD indeed has origins in abnormal brain development early in prenatal life. This follows atypical neurodevelopment, which continues postnatal, with a unique pattern of acceleration in brain growth when head circumference is measured. This, in turn, correlates with enlarged grey matter volumes in children aged two to four years when behavioural characteristics are identified (Zwaigenbaum *et al*., 2005:143; Scharoun *et al*., 2014:211). Socio-economic status is not an aetiological or risk factor for ASD (Smith *et al*., 2016:1).

BRAIN DEVELOPMENT

There appears to be four significant phases of brain growth specifically in ASD children. The first phase refers to the slight undergrowth of the prenatal brain because the average head circumference measurement was on the 25th percentile at birth. This suggests prenatal neural defects. The second phase involves rapid and large brain overgrowth within the first year of life. The third phase only emerges between one and four years and is represented by the overall rate of brain growth rapidly slowing down by the age of four to five years. The fourth phase involves a progressively decline in the overall brain size and this phase extends from middle to late childhood until adulthood (Courchesne, 2003:343). High rates of co-occurrence of severe neonatal brain abnormalities in children with ASD that were born prematurely have been linked to the behaviours displayed by them (Pritchard *et al*., 2016:2; Fletcher-Watson, 2017:62).

TWIN STUDIES

Twin studies reveal a unique aspect with regards to genetic aetiology of ASD (Parner *et al*., 2012:143). The first systematic twin study was regarded as vital information because it portrayed that the genetic susceptibility extended beyond the traditional diagnosis in which to include a broader phenotype. This ultimately indicated the requisite to broaden the concept of ASD (Rutter, 2011:18). If the twins are identical (monozygotic), 100% of their genetic material is shared, while only 50% of genetic material is shared if the twins are non-identical (dizygotic). In other words, if a non-identical twin has ASD, there is a 50% chance that the other twin will also be affected by the disorder (Arieff *et al*., 2010:292; Ornoy *et al*., 2015:157; Matelski & Van de Water, 2016:2). Monozygotic twin concordance has been found to be between 70 and 90%, solely for Autistic traits (Sealey *et al*., 2016:289).

EARLY SIGNS AND SYMPTOMS OF ASD

Increasingly attention has been paid to the recognition of early signs and symptoms of ASD in infants. There are distinguishing features between infants with a high and low risk for ASD. It remains important to promote awareness about the early signs and symptoms of ASD, encouraging parents to immediately follow-up with a paediatrician when they have concerns (Herlihy *et al*., 2015:20; Bradstreet *et al*., 2016:359).

Several studies have revealed that delayed motor milestones in infants are present prior to communicative or social deficits, which in turn could imply that delayed or impaired motor behaviour may be an open opportunity for researchers, clinicians and parents to understand the underlying mechanism of the core characteristics of ASD (Bo *et al*., 2016:52; Allen *et al*., 2017:813). Impairments and/or delays that have been continuously observed and associated with ASD infants are recognised at 12 to 18 months and are represented in one or more of the following five domains, namely: social communication; language development; observational play; visual examinations; and motoric repertoire. In the social communication domain, the child displays atypical responses in eye gaze, orienting to their own name, social smiling and interest, and displays reduced expression especially associated with positive and happy emotions. Regarding the language domain, the child has significant delays in babbling (especially reciprocal social babbling), verbal comprehension and expression, as well as gesturing. In the play domain, the child displays delays in motor imitation, functional use of toys and unusual repetitive actions with toys and other interested objects. Regarding the visual domain, the child displays atypical visual tracking and fixations and also presents with prolonged visual examination of toys and other objects of interest. For the motor repertoire domain, the child displays delays in gross and fine motor areas and motor mannerisms and interactions with objects, people and parents are also delayed (Zwaigenbaum, 2011:77). Parents have noted developmental concerns as early as at six months. Additionally, at this age, the persistence of primitive reflexes, such as grasping, sucking and rooting should also be taken into consideration. It has been found that the primitive reflexes decrease as the age of the ASD child increases, however, the persistence of these reflexes has been related to the child's reduced motor repertoire (Zwaigenbaum, 2011:77; Harris, 2017:2; Ketcheson *et al*., 2017:481; Setoh, 2017:14).

Parents of infants with a high risk of developmental delays such as, premature babies or those with a very low birth weights, should be encouraged to have early formal developmental assessments done on the child (Luyster *et al*., 2009:1306; Herlihy *et al*., 2015:21).

THE EFFECT OF DIAGNOSIS ON PARENTS WITH AN ASD CHILD

"The claim that autism was a psychogenic disorder associated with poor parenting, had long since become discredited" (Rutter, 2011:18).

ASD symptoms that are present in infants can have a great influence on, and interfere with family relationships, learning and development, which may all effect the outcomes of the child (Rollins *et al*., 2016:230). According to Crane *et al*. (2016:154), parents seem to be more satisfied after a positive ASD diagnosis when the child is still very young. Additionally, if there was a shorter time interval from initial concern to the stage of formal diagnosis; and, if they had received clear and direct diagnosis from a professional certain feelings were triggered. Some of these feelings and reactions that parents of an ASD child experienced included anxiety, depression, somatic complaints and a greater 'burn-out' feeling than parents with neuro-typical children. More than 90% of parents with ASD children have reported substantial parental, emotional, financial and societal stress (De Bruin *et al*., 2015:906).

Parents and professionals are now more educated and the result thereof is that ASD is more widely recognised and simultaneously more children have been referred to clinicians, subsequently receiving positive diagnoses (Luyster *et al*., 2009:1306; Crane *et al*., 2016:153). Although parents are more educated, it has been said that parents need to develop 'rhino skin' (which is an African image to develop tough skin), in order to manage the stresses and strains of raising and living with an ASD child (De Vries, 2016:134).

LIMITATIONS AND RECOMMENDATIONS FOR RESEARCH ON ASD IN AFRICA (SPECIFICALLY SOUTH AFRICA)

One cardinal challenge of research in the ASD field is that many articles and readily information can be found about ASD in the high-income countries of the world, such as the USA, UK and other European countries. However, 90% of people who live with ASD and other related neuro-developmental disabilities, live in low- and middle-income countries such as Africa, South and West Asia and South America. There is very little known research about ASD in these countries (De Vries, 2016: 130,135).

It is quite unlikely that there will ever be enough, sufficiently skilled therapists that would be able to individually work with African children with ASD (De Vries, 2016:132). Between the period of 2015 and 2016, there were no new ASD specific interventions published in Africa. Unfortunately, research on ASD in Africa and the low-resourced communities and environments remain limited (De Vries, 2016: 130,135).

In South Africa the 'large' three-year funding budget for ASD research grants were as little as R600 000 due to the prioritising of HIV and Tuberculosis (TB) research in Africa (De Vries, 2016:130, 135). In South Africa, no reliable and culturally appropriate diagnostic and prevalence rate tool is available (Smith, 2016:1). One of the major practical and equally ethical challenges in Africa lies in the overall lack of appropriate services and inadequate gold standard educational, therapeutic and medical services. There is a dearth of knowledge regarding ASD among the general public, as well as the medical community (Ruparelia *et al*., 2016:1019; Mthombeni & Nwoye, 2017:9).

In Africa, a large proportion of the population have a low socio-economic status. It has been observed that some communities, including those living in a lower socio-economic community, have regarded ASD as having a supernatural cause, which could be as a result of angered or displeased ancestral (supernatural) spirits, wrongful doings portrayed by the mother, or an action from the devil (Ruparelia *et al*., 2016:1019). It is commonly regarded that some families first seek help from a traditional healer for their ASD child before seeking mainstream medical assistance and this, in turn, may cause late diagnoses. In a report by the Department of Health (2004/2005), it was concluded that 70% of black South Africans made use of healing based on cultural believes (Ruparelia *et al*., 2016:1019; Mthombeni & Mwoye, 2017:9).

No research to date have explored the risk factors of ASD, especially in Africa. Although the number of ASD children in South Africa are increasing it is essential for intervention programmes and treatment programmes to be made available to everyone, including those with limited resources (Mthombeni & Mwoye, 2017:3). There are very few ASD specialised public schools in the rural areas. Most of these schools are in the urban areas and are inaccessible to the majority of children. It has been estimated that 135 000 children with ASD are not getting the specialised education that they require (Schlebusch *et al.*, 2016:412).

Specialised schools have the means to provide the children with the necessary interventions that they require. Families are, however, required to bear the financial costs themselves in order to support and provide a professional service for their children. More than 40% of all South African families are headed by a single parent (mostly women) and the number of families that are living without a father are increasing (Schlebusch *et al*., 2016:413), which place a tremendous financial burden on families.

Lastly, a major limiting factor that can be regarded with formally testing ASD children from a lower socio-economic community, is that the ADOS-2 is somewhat biased. It does not take certain socio-economic and cultural factors into consideration. For example, children from lower socio-economic communities are likely to make use of jugs or buckets for cleaning and drinking purposes, and they are highly disadvantaged by the lack of familiarity of stimulation activities and materials (Ruparelia *et al*., 2016:1023; Smith *et al*., 2016:2). The ADOS-2 was developed in the United Kingdom and the United States, although it is used as a diagnostic tool around the globe. The ADOS-2 has been translated into 18 different languages; however, none of these translated versions are applicable to South Africa's 11 official languages, other than English, although translations are currently going underway. This limitation of the ADOS-2 also limits the use of ADOS-2 within the South African population (Smith *et al*., 2016:2).

A specific study conducted in the Western Cape Province of South Africa addressed the 'coloured' population of the Western Cape, which is a specific term used to refer to an ethnic category which has mixed ancestry (Smith *et al*., 2016:2). Smith *et al*. (2016:2) stated: "In all, 76.5% of coloured people in the Western Cape speak Afrikaans. However, 'Kaaps' is a vernacular of Afrikaans". The literature on the coloured population of the Western Cape is limited. Smith (2016:6) evaluated the cultural appropriateness of an Afrikaans translation of the ADOS-2 specifically for low- to middle-income groups of Afrikaans-speaking coloured people. There was a challenge with the gap between standard Afrikaans and 'Kaaps Afrikaans' and the examiner needed to be familiar with the different responses (Smith *et al*., 2016:9). This is just an additional example of challenges that researchers, medical practitioners, teachers and therapist face in South Africa and Africa.

Four recommendations have been made to increase the awareness of ASD diagnosis and treatment in Africa. Firstly, a basic checklist that visually demonstrates the developmental milestones and the accompanying age a child should reach these milestones, would be beneficial. Secondly, a baseline screening tool that should be tailored to the child's medical routine (when a child undergoes his/her18-month immunization), would be beneficial as it could be monitored by the child's chronological age. With regard to this information, setting up regional data bases that are regulated and easy accessible is important. Thirdly, setting up a brief screening tool at schools so that teachers can be aware of the warning signs and behavioural irregularities would increase awareness of ASD, diagnosis and treatment. Teachers would then be able to refer the child to a health care professional, if they note atypical behaviour. Lastly, having a multidisciplinary team that can transfer knowledge and ensure children from all different regions are either able to get screened or formally diagnosed, would be beneficial. Therefore, it will be necessary to build the required human resource capacity that engages in roles from teaching, to medical practitioners, to therapists. It has been suggested that it is unlikely to be feasible to have specifically trained therapist for one-on-one sessions. A parent support group is essential for parent-based interventions (Kakooza-Mwesige *et al*., 2014:447; Ruparelia *et al*., 2016:1023-1024; Mthombeni & Nwoye, 2017:11).

One crucial element that should be taken strongly into consideration is the fact that intervention programs should be customised to South Africa's immense cultural diversity and indigenous understandings of illnesses and disorders (Mthombeni & Nwoye, 2017:3). In addition, the fine and gross motor skills performance of children in lower socio-economic communities are often delayed and they are at risk of motor delays. This can be because of environmental constraints, such as the safety aspect of the outdoors or limited space indoors, task constraints, such as insufficient funds for equipment and individual constrains, such as the lack of proper technique or instruction of motor skills (Liu *et al*., 2017:54).

PREVALENCE RATE IN AFRICA AND SOUTH AFRICA

"Growing ASD prevalence and awareness of the disorders in turn demand greater research attention to the boundaries of and within this spectrum" (Rutter, 2011:29).

Prevalence rates of this ubiquitous developmental disorder is rather challenging to report as the rate of the disorder is constantly growing and developing. In 2007 the unofficial estimated number of South Africans that have been diagnosed with ASD was 270 000 (Arieff *et al*., 2010:292), but samples of convenience such as developmental clinic attendance cannot be used to estimate prevalence (Springer *et al*., 2013:98).

When observing the prevalence rates, it is important to note that some countries worldwide use the term ASD as reference exclusively to Autistic disorder, Asperger's syndrome and pervasive developmental disorder (PDD), not specified otherwise (Springer *et al*., 2013:95). Specifically, in South Africa, the terms ASD and PDD are still used interchangeably and included Rett's disorder and Childhood disintegrative disorder until fairly recently (Springer *et al*., 2013:95). However, this discrepancy has been resolved with the latest DSM-5 classification, which excluded Rett's and Childhood disintegrative disorder. Following on this statement, no studies have been conducted regarding the prevalence rates and the characteristics of the ASD population in Africa (Springer *et al*., 2013:95).

During the period of 1996 to 2005, a study conducted in Johannesburg in a developmental clinic, described an increase of 8.2% in the number of children presenting characteristics of ASD, which was presented by Jacklin at the Autism Safari in 2006 (Jacklin, 2006). Regarding this increase, it remains unclear whether the increased rate of the disorder was directly related to the broadening definition of the diagnostics criteria or the increased awareness of the condition among parents, professionals and other parties involved (Springer *et al*., 2013:95).

However, the present situation in Africa on various aspects of ASD is unclear (Bakare & Munir, 2011:208). In 2016, it was stated that specifically in South Africa, studies on the prevalence rates of ASD were non-existent or limited and the clinical studies that have been done were too limited to draw any meaningful conclusion (Chambers *et al*., 2016:1; De Vries, 2016:131; Schlebusch *et al*., 2016:412). This could be due to a lack of standardized screening and diagnostic tools that have been specifically validated for the African population. The screening tests are mostly in English, which do not accommodate children with an African language. Translation and adaptation of the procedures would be required (Chambers *et al*., 2016:2). In 2016, it was stated that while evidence has indicated an increase around the globe, little is known regarding the prevalence rates in Africa (Ruparelia *et al*., 2016:1019).

In the African society the baseline knowledge about ASD remains low across all levels, from the public to the government (De Vries, 2016:131), which would explain why limited statistics are available.

PREVALENCE RATES IN OTHER PARTS OF THE WORLD

According to Pritchard *et al*. (2016:2), "ASD is the leading cause of disability in children younger than five years of age". The global prevalence rate for children with ASD has been estimated to be 62/10,000 or 0.62% (Ornoy *et al*., 2015:156; Chambers *et al*., 2016:1). In the Middle East in Sultanate of Oman, it has been estimated that 0.14 per 1000 Omani children aged 0 to14 years have been diagnosed and identified with ASD (Al-Sharbati *et al*., 2015:7). This lower prevalence rate is largely a result of under-diagnosis and under-reporting of individuals with ASD in Omani. As speculated by Al-Sharbati and co-workers, a reason for the under-diagnosis of children with ASD is that it is largely due to the negative connotation and stigma of having a child with special needs. Families are often ashamed of the child and prefer to 'hide' the child from society (Al-Sharbati *et al*., 2015:7).

ASD is defined as the fastest-growing developing mental disability in the United States of America (USA) (Konukman *et al*., 2017:65). The recent figures of ASD in the USA indicate that approximately 10 in every 100 (10%) individuals have ASD, although it has been suggested to be even higher. An estimated 1.5 million Americans have ASD (Crane *et al*., 2016:153, Konukman *et al*., 2017:65). In 2014, the Centres for Disease Control and Prevention (CDCP) estimated that 1 in 68 children have been diagnosed on the Autism spectrum (Bradstreet *et al*., 2016:359; Rollins *et al*., 2016:219).

It can clearly be seen that the indications of prevalence rates from the different countries are not set in stone and that they are either under-reported or under-diagnosed, which makes the current figures of prevalence rates to be inaccurate (Al-Sharbati *et al*., 2015:7).

ASD IN LOWER SOCIO-ECONOMIC COMMUNITIES

A variety of factors such as race, ethnicity and socio-economic status have not been legitimately classified as factors which may influence the manifestation of ASD. Nevertheless, an early diagnosis of children with ASD from a lower socio-economic community are often obstructed by less sensitive referral sources, such as limited access to specialised clinics, specialists and expensive evaluations (De Vries, 2016:131-132).

A study concluded that children with ASD from ‘poor’ or ‘near to poor’ families had received an initial diagnosis up to 11 months later than children from a wealthier family. In 2009, Rutter attempted to examine the age of initial diagnosis in children from different race groups and found that African-American children were diagnosed at a chronological mean-age of 70. 8 months; whereas Latino and Asian children received a diagnosis at a much younger age (Rutter, 2011:28).

Most people and children with ASD live in lower and middle socio-economic countries around the world. It is vital that research should be done in these countries in order to have an effect on clinical services and training (De Vries, 2016:135).

CHARACTERISTICS OF CHILDREN WITH ASD

Most children with ASD continue to display core deficit characteristics across their lifespan. The particular nature of these symptoms and characteristics can change dramatically with age (Gotham *et al*., 2011:34).

Autism can be described as a disorder where an individual has a developmental disability, which impairs his or her ability to communicate, form relationships with society, socially interact with peers and to respond appropriately within their given environment (Arzoglou *et al*., 2013:563). Children on the Autism spectrum, are often described as detached, isolated and disengaged and they would rather attach themselves to an object than a human being (Martin, 2014:545).

Collectively the Autism Spectrum Disorders are a cluster of heterogeneous neurodevelopmental disorders that manifest as significant delays in the rate and sequence in the development of social relatedness and communication towards others, reciprocity, joint attention and learning (Rollins *et al*., 2016:219). Predominantly, the symptoms in individuals with ASD, specifically reduced social attention, often emerges early on in life, yet it becomes more evident as age increases (De Bruin, 2015:907; Herlihy *et al*., 2015:21).

INTELLECTUAL QUOTIENT LEVELS OF INDIVIDUALS WITH ASD

In general, if a child has an Intellectual Quotient (IQ) of above 50 at the initial diagnosis, and develops communicative speech before the age of six years, he or she may have a better probability of achieving social and academic success. Children with ASD with higher IQ's, generally exhibit better language skills (Norrelgen *et al*., 2015:940).

LINGUISTIC, COMMUNICATION AND SOCIAL DEFICITS

In the past few years, researchers have accentuated that there is a lack of knowledge about children with ASD who do not develop spoken language. However, if they do indeed develop spoken language, it is only to a minimal degree and during their preschool years. It has been noted that young children with ASD evidently display little or no initiation of social interaction with others and little emotions (APA, 2013:53). As early as the first observation of autistic characteristics, linguistic deficits have always been considered as one of the dominant features that are displayed (Sterponi *et al*., 2015:517). Children with ASD display difficulties with initiation of speech and are delayed in response to other people

Many individuals with ASD have language deficits ranging from a complete lack of speech, poor comprehension of speech when spoken to echoed speech or on the other hand, stilted and overly literal language (APA, 2013:53). Children that have been noted to have a language impairment during their initial diagnosis may have three possible outcomes, namely; (A) no intelligible speech, which can also be related to a non-verbal aspect; (B) the display of only single words or phrases; and (C) functional language. When children with ASD, without an accompanying language impairment may be described as children who speak in full sentences or have fluent speech (APA, 2013:53).

There are three core linguistic characteristics that have been examined with the sentence discourse of the ASD population, mainly consisting of: (1) deterioration in speaker-hearer role, where the individual with ASD has difficulty shifting from the role of talking to listening to the other parties dialogue; (2) the demonstration of an impairment in socially accepted rules of directing a conversation; and (3) they display an impairment specifically in differentiating between fore- and background information, particularly distinguishing between old and new information (Sterponi *et al*., 2015:518).

An estimation of children with ASD who do not develop spoken language prior to age five, vary considerably. Likewise, it has been stated that approximately 50% of children with ASD will not develop functional speech during their life span. It has been noted that considerably fewer than 50% of children diagnosed with ASD remain either nonverbal or minimally verbal by age six when they are 'school ready' (Norrelgen *et al*., 2015:934, 939). ASD speech characteristics cannot be assumed to be instinctive, non-communicative and unresponsive (Sterponi *et al*., 2015:520). A core criterion for Asperger's syndrome that distinctly distinguishes it from other Autism Spectrum Disorders, is an absence of a clinically significant language delay, which is noted between the ages of two and three years (Barrow *et al*., 2011:620).

LANGUAGE DEVELOPMENT

In recent years, the estimated 50% of children with ASD did not develop functional speech age; however, it is believed that this figure decreased significantly. There are nonetheless several reasons why there was a decrease in the number of children with ASD who do not acquire spoken language. Parents are more aware of the early symptoms of ASD, thus, children are diagnosed at an earlier age (than in the past). This results in children starting preventative therapies and earlier intervention, which may in turn result in children developing phrase speech or language. Due to a substantial amount of research in the field of therapies, interventions are more efficient due to the treatment strategies executed and this in turn may largely contribute to children who may have otherwise remained nonverbal. The recent update of the DMS-5, include more updated diagnostic criteria and definitions, which are stated in much broader terms (Norrelgen *et al*., 2015:935). Table 2.2 provide an extension of the language and communication development of children with ASD:

Table 2.2: Age related language and communication characteristics.

LANGUAGE AND COMMUNICATION PERIOD	AGE	CHARACTERISTICS
Preverbal period	0-12 months	ASD children tend to not show preference for infant directed speech, which is vital for development of language. This can be characterised by exaggerated phonetic and prosodic features that facilitate in the emergence of early language development. Delays in attainment of major milestones, such as the production of babbling, first words and comprehension of speech.
Early language	12-30 months	*During this phase it is important for children to move from phase one to phase two.* <u>Phase one:</u> Preverbal communication which refers to the infant's method of communication where no words are being dialogued. <u>Phase two:</u> The first words of a child. <u>Phase three</u>: A combination of words which refers to the child's ability to put words together to form a sentence as form of communication dialogue. ASD children tend to show delays in receptive and expressive language. Receptive language deficits: This is due to the ASD child's overall lack of social responsiveness. Somewhere in an ASD child's second year of life, between 15 to 40% of ASD children exhibit a loss (or regression) of verbal and non-verbal communication skills. ASD children are less likely to use social cues, such as the specific direction of a speaker's eye gaze. Although, if the objects are interesting and the speaker use tactile cues, the ASD child can rapidly learn the meanings of new words. The ASD child's language is a lot more directed: 1. Use of language to meet their specific needs and wants ("More juice"). 2. They are less likely to use language in a pro-social way, such as directing someone's attention to an object ("A bird!"). 3. They are less likely to use language to engage in reciprocal exchange of thoughts.
Later language	30-48 months	High functioning ASD children score well on standardised vocabulary tests. ASD children have difficulty understanding social-emotional terms. They additionally display difficulties in reciprocal and flexible dialogue.

Adapted from: Tager-Flushberg *et al*. (2011:174-175) & Norrelgen *et al*. (2015:935).

MINIMAL AND NONVERBAL ASPECTS

When viewing children with nonverbal ASD, it is important to keep in mind that the borders between verbal and non-verbal are ill-defined. Non-verbal features can be illustrated by anything from a few words to a child who is unable to be understood, while communicating with the general population. The term 'minimally verbal' has been used to describe children with an extremely limited repertoire of clear communicated words or fixed phrases and a fixed number of vocabulary words has not been found for this category. The terms 'non-verbal' and 'minimally verbal' do suggest a need for a classification because two different degrees of impaired speech can be observed (Norrelgen *et al*., 2015:935).

AN ALTERNATIVE COMMUNICATION SYSTEM FOR NON-VERBAL CHILDREN WITH ASD

Children who remain non-verbal and who do not use any words may show lower cognitive abilities at a later preschool age. Non-verbal individuals with ASD usually display absent or reduced eye contact, gestures or facial expressions in a social communication setting (APA, 2013:53). Children with ASD, who are unable to communicate verbally, often display frustration and unacceptable behaviours (Travis and Geiger, 2010:40).

It has been argued that children with ASD respond better to visual stimuli. The use of visual stimuli allows for easier cognitive understanding and improves the following five components: memory retention; concentration; stereotypical behaviours; skill development; and social interaction. In turn it reduces anxiety due to the fact that it creates a certain order, which is a predictable routine for the child (Allen *et al*., 2017:815).

One important and effective communication method that was developed for the non-verbal ASD population is the picture communication symbol (PCS). This form of communication shows cartoon-like pictures, which display and symbolise essential concepts that are vital for everyday functioning within the education and living environments. This form of communication is a suggested manner to display daily routine and has been reported to reduce disruptive behaviour and improve the productivity of task engagement (Travis & Geiger, 2010:40; Gillespie-Smith *et al*., 2014:460).

A second non-verbal communication system is the Board Marker (BM), which refers to visual prompts that were initially introduced to individuals with impaired attention spans and poor comprehension of linguistic input. This visual communication system uses pictures that illustrate actions of objects (snack time, reading or play time), to portray vital information to the child with ASD regarding the required activity, as well as the environment of his or her daily routine. This representation may be in the form of a timetable (Gillespie-Smith *et al*., 2014:460).

The Picture Exchange Communication System (PECS) was developed to allow the individual to relate in a functional communication system. The PECS aims to develop social exchange forms, which underlie all communicative acts. Additionally, it improves a child's ability to express wants, needs, feelings, dislikes and preferences towards others. Its primary aim includes teaching the child with ASD spontaneous communicative skills. Furthermore, it minimizes prompt dependency and constructively allows the child to freely and spontaneously initiate communication through the exchange of a picture, which directly corresponds to an item or activity. The symbols and images used in the PECS are linked to an 'I want image' when the child portrays that he/she is requesting an activity, object or interest. The 'I want image' is a direct link to what the child desires at that moment in time. It was only in 2004 that the PECS was formally introduced in South African. The PECS research has indicated that it can increase nonverbal communication in children with ASD and some children have even assimilated spoken language through the regular daily use of the PECS (Travis & Geiger, 2010:40; Gillespie-Smith *et al*., 2014:460).

The PECS allows for functional communicative requests and responses that links an interaction between the child with ASD and the environment because it entails that the child has to approach the person he/she would like to communicate with and initiate some sort of interaction. Although this is not their typical nature, and may be intently difficult, it is vital for the child to learn this 'new world of communication' as it is significant for daily social skills (Gillespie-Smith *et al*., 2014:460).

The 21st century technological advantages are not a relatively new concept for the ASD population. The development of mobile technology such as iPods and iPads has been promoted as a medium for learning in this population. Research has been regulated across multiple domains of individual learning, such as academic, communication, employment and self-prompting. Van der Meer *et al*. (2014:68) concluded that the use of mobile technology is an effective method or approach to teach picture and word matching to children with ASD, especially those with severe social communication impairments (nonverbal children) (Van der Meer *et al*., 2014:68).

Language and speech should be appreciated because the child with ASD is communicate to other people through the gate of their world, processes and past experiences (Sterponi *et al*., 2015:524). This can be a very valuable tool in order to try and see the world through their eyes and verbally hear their experiences.

SOUTH AFRICA'S ASD COMMUNICATION STATISTICS

South Africa does not have accurate statistics regarding the proportion of nonverbal children with ASD because most studies included small samples of convenience, such as referrals to developmental assessment clinics (Springer *et al*., 2013:97). Springer found that the prevalence of developmental regression was 17.2%, yet this figure may be an underestimation because only language regression was assessed and documented (Springer *et al*., 2013:98).

According to information obtained from caregivers, up to 40% of children diagnosed with ASD experience developmental language regression. This is closely associated with the regression in speech and or social responsiveness (Springer *et al*., 2013:98). Echolalia occurs in some children who lack functional speech, which entails the immediate repetition of speech that the child had just heard. In the South African context, it has been suggested that mostly black South African caregivers have reported frequent occurrences of echolalia in children with ASD (Mthombeni & Mwoye, 2017:2,10).

REPETITIVE AND STEREOTYPICAL BEHAVIOURS

Repetitive and stereotypical patterns of behaviour, personal interests and activities have been considered a dominant characteristic of the ASD population, since Kanner's original description (Watt *et al*., 2008:1518). Restricted repetitive behaviours, which include, motor stereotypes (such as hand flicking), preoccupations with external parts of an object (clapping a doll's hands together), insistency on the sameness in their fixed routine, restricted interests (having heaps of knowledge on one specific topic and the topic is integrated into many parts of the child's world), ritualistic behaviours (stacking or lining up objects), as well as unusual sensory interests (Troyb *et al*., 2016:1282). These stereotypes may vary from spinning, jumping and other rhythmically movements of the body (Watt *et al*., 2008:1518).

Recently, it was noted that there was an overlap in particular symptoms of several child-related disorders, such as repetitive behaviour, stereotypes that involve individual specific rituals, very specific and restricted interests and obsessive-compulsive disorder (OCD) towards objects, activities or people (Watt *et al*., 2008:1518; Gjevik *et al*., 2015:434). The root of the restrictive and repetitive behaviours is unknown; however, theories propose that some types of restricted and repetitive behaviours may be a signal of over arousal, cognitive impairment, executive dysfunction or tender coherence (Troyb *et al*., 2016:1282).

The downside of the restricted and repetitive behaviours is that it is at the cost of the activity that the child should be involved in. Most of these activities impair cognitive, social and communication development, which results in a delay in a development of these respective skills. Furthermore, the dearth of appropriate vigilance to the environment may prevent the child from receiving the necessary input regulated by the environment for typical neural development, which potentially could result in further developmental delays (Troyb *et al*., 2016:1283).

LEVELS OF REPETITIVE AND STEREOTYPICAL BEHAVIOURS

The term ‘repetitive behaviour’ can be seen as an umbrella term used to describe the broader range of actions, which are linked by repetition, rigidity and inappropriateness (Bodfish, 2011:200). There are generally five series of repetitive behaviours classified in individuals with ASD, namely: stereotypic behaviours; repetitive self-injurious behaviours; rituals and routines; resistance to change; and restricted interests.

Stereotypical behaviours are distinctly seen with repetitive motor movements such as hand flapping. These behaviours are also commonly observed in neuro-typical infants and young children (Bodfish, 2011:200). According to Watt *et al*. (2008:1518), there are two levels of repetitive and stereotypical behaviours. Firstly, lower-level behaviours that are characterized by repetition of movement including dyskinesia (which denotes to a category of movement disorders which are characterized by involuntary muscle movements), stereotypical movements, repetitive manipulation of objects and repetitive forms of self-injurious behaviour. Secondly, higher level behaviours include object attachments, insistence on sameness, repetitive language and circumscribed interests.

Repetitive self-injurious behaviour can be negatively associated with the child's IQ and positively correlated with the severity of the disorder (Bodfish, 2011:201). Individuals with ASD may unintentionally injure themselves by head banging or wrist biting. These disruptive and challenging behaviours are seen more commonly in children with ASD rather than adults (APA, 2013:54).

Rituals and routines in children with ASD are highly elaborated and can be extended to multiple areas of the child's life (eating, cleaning and travelling routines), which goes hand in hand with the restricted and resistant type of child with ASD (APA, 2013:54-55).

Sameness and resistance to change is normal in neuro-typical children between the ages of two and four years, although it greatly extends into the life span of a child with ASD (APA, 2013:54).

Interests, preoccupations and attachments may range from the individual with ASD being highly preoccupied with an event, object or unusual aspect of the environment (such as barcode numbers), to an intense all-absorbing interest in more common hobbies (such as cars) (Bodfish, 2011:200-202; Mthombeni & Nwoye, 2017:4).

A negative relationship has been noted between the child's functioning level and the level of repetitive sensory motor behaviours. Children with ASD, who exhibit a higher level of repetitive and restricted behaviour, generally acquire less developmental receptive and expressive language abilities, and fewer adaptive communication and peer socialisation skills (Troyb *et al*., 2016:1283). It has been illustrated that children with lower functioning are more likely to display stereotypical motor movements, repetitive movements of objects, unusual sensory interests and repetitive self-injurious behaviours, while higher functioning individuals display more repetitive speech and limited interests (Troyb *et al*., 2016:1282; Mody *et al*., 2017:156).

Table 2.3, 2.4 and 2.5 further describes typical repetitive and stereotyped behaviours and their accompanying descriptions that are commonly displayed by the ASD population:

Table 2.3: Typical repetitive and stereotyped behaviours displayed by ASD children in relation to objects.

IN RELATION TO AN OBJECT	DESCRIPTION
Bangs/pats	The individual makes contact between two objects.
Rocks/ flips	The individual tilts the vertical axis of an object back and forth at least 30 degrees. Or the individual rotates the vertical axis of the object at 180 or 360 degrees at least 3 consecutive times.
Swipes	The individual swipes an object (or group) in a back-and-forth motion for at least 3 consecutive times without any interceding action.
Rubs/squeezes	The individual rubs or squeezes an object by manipulating the whole or part of the object for at least three consecutive times.
Lines up/ stacks	The individual must at least move 3 objects consecutively into a line or stack them with no other actions being commenced in between.
Collects	The individual holds or gathers 3 or more objects for at least three seconds.
Spins/ wobbles	The individual rotates or turns an object around its vertical axis.
Rolls	The individual knocks an object over, or rotates it around its horizontal axis in order to proceed to roll it.
Moves/places	The individual intentionally places an object to the same side or on a unique location on a table, floor or their lap. This action occurs at least three consecutive times.
Clutches	The individual insists on holding onto the object from the previous activity, and are not eager to release it even if a new object is presented.

Adapted from Watt *et al*. (2008:1525).

Table 2.4: Typical repetitive and stereotyped behaviours of ASD children in relation to their own bodies

IN RELATION TO INDIVIDUAL'S OWN BODY	DESCRIPTION
Bangs surface	While not holding an object, the individual bangs or taps their hand or arm to any surface.
Pats body	The individual pats, tap or smacks their body with a definitive clear up-and-down motion. Additionally, while there body is relaxed and contracting with fingers or hands, the individual displays a flicking motion away from the body.
Rocks/ swivels	The individual moves the trunk of their body back-and-forth, or swivels their body from left to right for three consecutive times.
Flaps	The individual moves his or her hand, wrist, or arm in a vertical up-and-down motion while not holding an object and this action lasts for at least three consecutive times.
Rubs body	The individual rubs his or her hands on any body part in a back-and-forth motion for at least 3 rubs, in one direction while lifting a hand or finger between the rubs
Stiffens	The individual displays stiffening of body posture, fingers, hands or arms. Fingers are usually spread apart or clenched into a fist.

Adapted from Watt *et al*. (2008:1525).

Table 2.5: Typical repetitive and stereotyped behaviours displayed by ASD children related to sensory behaviours.

IN RELATION TO SENSORY BEHAVIOURS	DESCRIPTION
Licks	The individual moves his or her tongue towards an object or surface, or his or her own body with visible and tactile contact.
Sniffs/smells	The individual lifts an object to the nose, or bends the head to the surface in order to smell it.
Feels/touches	The individual places any part of the skin (other than the hand) against an object in order to feel it.
Fixates gaze	The individual visually examines an object that is held to the side or very close to the eyes.
Covers ears	The individual holds both hands over the ears in response to an environmental sound, or in a situation where there might be a potential sound (when chalk is being picked up to write on a chalk board).
Finger sucking	The individual puts one or more fingers, or a thumb into their mouth for a period of 5 seconds or longer.

Adapted from Watt *et al*. (2008:1525).

THE RELATIONSHIP BETWEEN COMMUNICATION, BEHAVIOUR, SENSORY BEHAVIOURS AND MOTOR SKILLS

As ASD is characterised by deficits in social communication and behaviour as part of its core characteristics, it is of cardinal interest to research when exactly these deficits emerge in the process of development of the child with ASD. It is believed that the underlying atypical perception of sensory stimuli may be the cause of communication deficits in individuals with ASD (Blasi *et al*., 2015:123). Many behavioural problems are projected to be directly related to the inability to communicate effectively using a language of some sort or of preference (Gillespie-Smith *et al*., 2014:459). A study done in 2008 acknowledged that children with ASD who displayed sensory behaviours did not necessarily display repetitive behaviours (with themselves and objects or their own body in relation to an object) (Watt, 2008:1530). Furthermore, intact sensory abilities are predominantly relied on when performing a motor skill (Tryfon *et al*., 2017:52).

SENSORY PROCESSING SYSTEMS OF CHILDREN WITH ASD

ASD is associated with atypical sensory processing across multiple sensory systems (Schauder, 2015:194). Children who display unusual sensory interests have a habit of assembling items, which are related to repetitive use of an object and even the individual's own body. This can occur in children as young as 24 months (Watt *et al*., 2008:1530). Sensory processing is commonly considered the perception and integration of senses, i.e. the response of the central nervous system (CNS) to physical energy from the perceived external environment.

SENSORY AND SELF-INJURY ASPECT OF CHILDREN WITH ASD

During the past two decades, researchers have continuously identified significant pervasive differences in children with ASD. Sensory aspects or features that are frequently seen in children with ASD are conceptualised to include hyper-responsiveness (over-reaction to sensory stimuli) or hypo-responsiveness (an under-reaction to sensory stimuli) (Accardo & Barrow, 2015:606; Kirby *et al*., 2015:361). More than 96% of children with ASD have been reported to be hyper- or hyposensitive in multiple domains. Distress may occur when particular sensory stimuli cause self-injury and aggressive behaviour in individuals who are incapable of communication under distress (Marco *et al*., 2011:48R).

There is a direct patterned flow of a cause and effect mechanism, which helps explain the poor gross motor execution. The skill will be distorted if there is impairment in the sensory input. It has been hypothesized that a deficit in sensory modulation may have an impact on movement and the motor planning thereof. A distortion in the organisation of the motor knowledge and the variability of the motor execution will also be present (Scharoun *et al*., 2014:211-212; Accardo & Barrow, 2015:606).

GROSS MOTOR SKILLS AS A NON-OFFICIAL BUT CARDINAL FEATURE OF ASD

Gross motor skill (GMS) development is not officially listed in the ASD diagnostic criteria, and GMS development has been neglected in intervention literature. GMS deficits will have a significant impact on the core characteristics of ASD. As the inability to acquire a fundamental milestone for a motor skill may be the core of motor dysfunction in ASD (Provost *et al*., 2007:321; Bremer *et al*., 2015:980; Bo *et al*., 2016:51; De Milander *et al*., 2016:38; Grace *et al*., 2017:1006; Mody *et al*., 2017:156).

It is estimated that 21 to 100% of children diagnosed with ASD display a number of notable motor deficits, which may also suggest that this figure indicates that motor impairments are significant, yet under-estimated among the ASD population (Bo *et al*., 2016:51). Motor challenges were included in the possible criteria list for the diagnosis of ASD in the *Diagnostic and Statistical Manual of mental Disorders-Third Edition.* There is some disagreement amongst some researchers who deny that there are definite delays in the gross motor development of children with ASD (Martin, 2014:546). According to other researcher's motor impairments, both fine and gross motor impairment should be considered as a cardinal feature of ASD (Dawson & Watling, 2000:416; Scharoun *et al*., 2014:211; Bo *et al*., 2016:51). In both the DSM-4 and DSM-5 there are limited reference to descriptions of motor impairments, which may result in a lack of awareness of motor deficits, which in turn may prevent an appropriate diagnosis and subsequent intervention (Bo *et al*., 2016:51).

Limited research has also been published on the gold standardisation assessment for ASD motor skills, especially for very young children (Provost *et al*., 2007:327).

INFANTS AND TODDLERS WITH ASD's GROSS MOTOR SKILLS DIFFICULTIES

Gross motor developmental difficulties can be seen as early as in infancy when children struggle with the coordinated sequence of crawling, which subsequently leads to walking problems (Scharoun *et al*., 2014:212; Ketcheson *et al*., 2017:481). Infants with ASD often exhibit delays in both supine and prone positions and skills such as sitting in the first year of life, along with identifiable sensorimotor symptoms which are present by nine to 12 months of age (Bo *et al*., 2016:51).

In a study of low-risk infants, Harris (2017:2) reported a significant ($p=0.03$) motor performance delay in infants aged three to six months. Toddlers (12 to 36 months) that have been diagnosed with ASD also showed significant motor delays when evaluated with a standardised test (Harris, 2017:2).

Children who present gross motor milestone delays, as early as four months, are at risk of being diagnosed with ASD (Martin, 2014:547). Atypically, a child with ASD who walks independently within the normal age range (11 to 14 months), will necessarily acquire preschool motor skills within the typical time period (Provost *et al*., 2007:322).

Studies have measured infants that were are at high risk of ASD, and found head lag during milestones such as pull-to-sit tasks, at the age of 36 months (Ketcheson *et al*., 2017:482).

Harris (2017:2) also noted impairments such as a delay of 3.75 months for sitting without support, a delay of 2.42 months for standing without support and a delay of 6.31 months for walking unaided.

Toddlers with ASD usually demonstrate difficulties in actions such as reaching, clapping and pointing, as well as crawling, walking and the rest of the milestones that follow after walking. Significant developmental delays can be seen when moving their hands, wrists, fingers, toes, lips and tongue. This transfers to their fundamental motor skills (FMS) in which motor coordination effects both gross and fine motor tasks (Bo *et al*., 2016:51).

FUNDAMENTAL GROSS MOTOR SKILLS

One developmental area that is commonly overlooked in children with ASD is the development of FMS. As for early interventions, core challenges are common in the social, communicative and behavioural domain, yet not in the FMS domain (Bremer *et al*., 2015:980). Of the earliest deficits that have been found, were in children under the age of three years (Provost *et al*., 2007:322). During the development of GMS, deficits that are manifested in children with ASD include: basic motor control ability; poor coordination and difficulty with skilled gestures; clumsy gait; postural instability; and accompanying low muscle tone (Scharoun *et al*., 2014:212; Lee & Vargo, 2017:8).

SPECIFIC GROSS MOTOR SKILLS ASPECTS

Two words are commonly used to describe the gross motor patterns of individuals with ASD, namely 'clumsiness' and 'akinesia/ dyskinesia' (Bo *et al*., 2016:51). GMS require a child to use the large musculature of the body to produce actions such as throwing, catching, galloping, etc. (Liu *et al*., 2017:53). These deficits include clumsiness in gait, overall clumsiness and toe-walking (APA, 2013:55, Mody *et al*., 2017:156). Other deficits include: difficulty or inability to execute a series of movement (praxis/motor planning); sequencing (i.e., slow preparation in simple goal-directed motor tasks); movement stability; arm movements; gait (i.e., swinging of leg, waddling gait); replicating imitation; balance; postural stability (i.e., less static and dynamic symmetry standing position); joint flexibility; locomotor skills; object control; manual dexterity; upper-limb coordination on visual-motor tasks; hand-eye coordination and lower speed in carrying out movements (Ming *et al*., 2007:566; Provost *et al*., 2007:322; Lang *et al*., 2009:566; Martin, 2014:547; Scharoun *et al*., 2014:212; Bremer *et al*., 2015:981; Bo *et al*., 2016:51; De Milander *et al*., 2016:38; Allen *et al*., 2017:813; Dieringer *et al*., 2017:421; Lee & Vargo, 2017:8; Setoh *et al*., 2017:13-14). High functioning individuals with ASD have been reported to experience complications with balance (specifically dynamic) and gait (the succession of movements), as well as visual-motor coordination difficulties (Arzoglou *et al*., 2013:567). Additionally, these noteworthy delays increase significantly as chronological age increases (Bremer *et al*., 2015:980; Ketcheson *et al*., 2017:481).

When comparing the wide range of the spectrum, individuals display developmental disorders of motor coordination in comparison to the average neuro-typical individual. Moreover, individuals with ASD require more time to design and execute their specific movements, and therefore, researchers have acknowledged that developmental motor coordination disorders has a link with ASD (Arzoglou *et al*., 2013:563; APA, 2013:58-59). Coordination disorders have been found in all three groups of children in the Autism Spectrum, although children with Asperger's syndrome were more impaired than the children in the other two groups (Ming *et al*., 2007:566).

Difficulties with planning desired movements for a task or an activity may effect a person's ability to regulate movements when communicating, relating to and participating with others (Bo *et al*., 2016:52). Children with ASD, display weaknesses, as well as the inability to perform with norm accepted performance success in a variety of GMS and this largely depends on the developmental environment and age (Arzoglou *et al*., 2013:563).

If a child has a deficit in either gross or fine motor skills, it may be further transferred and affect the voluntary participation in sport, academic performance and social interaction with peers. On the other hand, mastering these skills may be advantageous for the child because it builds stepping stones for future participation in physical activity and skilfulness, as well as cognitive and psychological development. Therefore, structured physical activity programmes should be incorporated into the daily school timetable of a child with ASD (Dieringer *et al*., 2017:421; Liu *et al*., 2017:53, 54).

TOE WALKING OBSERVATIONS IN CHILDREN WITH ASD

Over two decades of research, it has been noted that the prevalence of persistent equinus gait, also referred to as toe walking, in the ASD population was increasing (Ming *et al*., 2007:568; Accardo & Barrow, 2015:606). Toe walking is characterised by walking on the toes or the forefoot, with a distinct lack in the heel strike upon initiation of the stance phase of gait (Ruzbarsky *et al*., 2016:40). Toe walking is accustomed to be part of a stage in gait development, however, it should be resolved by the between the age of three and seven years (Ruzbarsky *et al*., 2016:40). Without the presence of other neuro-orthopaedic disorders, an equinus gait lasting longer than three months after onset of independent walking can be classified as persistent toe walking with associated developmental delays and language impairment (Barrow *et al*., 2011:619). Although it does not come forth in all individuals, the degree of severity of the toe walking may vary. It is of utmost importance to approach each toe walking individual with a high index of suspicion, because toe walking could be the result of anatomical structural deviants (such as contracted tendon) or other neuro-muscular conditions (Accardo & Barrow, 2015:606, 607; Ruzbarsky *et al*., 2016:40). Toe walking is often described as a habit, because 15 to 92% of children have the ability to perform a voluntary heel strike when they are reminded to do so (Ruzbarsky *et al*., 2016:41).

With reference to the aetiology of toe walking, three hypotheses are available. Firstly, toe walking is seen as a counterpart of a defective sensory integration processing system. Although sensory integration disorders do not occur in all children with ASD, it can be present in different degrees of severity. A child may either be hypo- or hyperactive to sensory input or may crave an unusual sensory interest (Ruzbarsky *et al*., 2016:40).

Secondly, toe walking is seen as the prolongation of the primitive reflex, the tonic labyrinthine in supine reflex (TLR supine). The TLR is found in the neck extensors of infants which is a stimulus and a response. The TLR is stimulated by extending the head at the neck with the response being retraction of the shoulders and of the lower extremities, which in turn produces a ‘surrender’ posture (Accardo & Barrow, 2015:606, 607). The total body extension might contribute to persistent toe walking. Other identifiable characteristics of this inhibited reflex include detachment (not wanting to be cuddled) of very young infants and the head lag described previously, which might reproduce the neck hyperextension associated with this primitive reflex (Barrow *et al*., 2011:620; Accardo & Barrow, 2015:606, 607).

Thirdly, toe walking has a definite association with language delay, especially in children with Autism and pervasive developmental disorders not otherwise specified (PDDNOS). Toe walking will be more persistent in those with severe language impairments and the possibility exists that accompanying general cognitive impairments may occur (Barrow *et al*., 2011:620; Accardo & Barrow, 2015:606, 607; Ruzbarsky *et al*., 2016:41).

Toe walking has been associated with abnormalities in executive functioning, gait, social skills, learning, memory, motor control, balance, fatigue and perception. Other downfalls toe walkers may experience are more frequent ankle sprains, less adequate gait, decrease step length and the overuse of the gastroc-soleus resulting in muscle cramps (Ruzbarsky *et al*., 2016:41).

The prevalence of toe walking at the age of 5.5 is approximately 2% in neuro-typical children and approximately 41% in children with neuropsychiatric diagnosis, developmental delays or neuro-muscular conditions (Ruzbarsky *et al*., 2016:40). The peak age of the onset of toe walking varies greatly and it is also less likely to be delayed by inattentive parents (Accardo & Barrow, 2015:607). The onset of walking is exhibited with toe walking, although some children only display toe walking after their second birthday (Accardo & Barrow, 2015:607). Most parents perceive toe walking as a behavioural act, rather than a physical disability (Ming *et al*., 2007:569). Toe walking has been included in a screening protocol of children with ASD (Barrow *et al*., 2011:620).

Persistent toe walking in children with ASD can significantly contribute towards the development of secondary motor deformities, because the heel cord undergoes an extreme shortening that prevents the foot from dorsiflexion. This could be due to the overuse of the gastroc-soleus complex and the persistent position in plantar flexion (Ruzbarsky *et al*., 2016:41; Barrow *et al*., 2011:620).

Because of possible associated cognitive impairments with toe walking, as well as a heightened sensory drive in many children with ASD, toe-walkers may be resistant to treatment (Ruzbarsky *et al*., 2016:45). In most cases, children with ASD will not tolerate cast, brace or any other orthotics. If toe walking is not causing any pain, anatomical or functional related issues, it is advised to avoid treatments that may be potentially futile for the individual (Ruzbarsky *et al*., 2016:45).

PHYSICAL FITNESS LEVELS OF INDIVIDUALS WITH ASD

Individuals with ASD usually demonstrate lower physical fitness levels when compared to neuro-typical developing children. Suggested physical activity guidelines for children with ASD, between the ages of five and 18, as well as for neuro-typical children, are 60 minutes per day with intensity levels between moderate and vigorous (Sanford & Horner, 2017:46).

Developmental deficits in the following areas are evident: sensorimotor; gross and fine movement; gross motor coordination; balance (static and dynamic) muscle weakness; muscle tone (hypotonic); asymmetrical posture; walking gait; locomotion; and coordination. These deficits and overall developmental deficits can lead to a sequence of significantly higher risk of inactivity of young individuals with ASD, which in turn increases the likelihood of obesity and other risk factors associated with sedentary lifestyle problems (Arzoglou *et al*., 2013:563; Scharoun *et al*., 2014:212; Dieringer *et al*., 2017:421; Setoh *et al*., 2017:13-14).

It has been asserted that children with ASD, in comparison to neuro-typical children, have a 60% risk of becoming obese (Sanford & Horner, 2017:47). Previous research indicated that health problems, including, but not limited to cardiovascular diseases and insulin resistant syndromes, are quite common in sedentary children with developmental disorders such as ASD (Lang *et al.*, 2009:566).

It has been suggested that girls with ASD are more inclined towards sedentary activities, which could have a connotation with limited access to social interaction (Lang *et al*., 2009:566).

Children may not be physically able to participate in play because of their poor motor skills (Bremer *et al*., 2015:981). Play forms an essential part of childhood and provides children with opportunities to improve their executive functioning and problem solving skills when playing and manipulating objects and toys (Lang *et al*., 2009:566, 574; Bremer *et al*., 2015:981; Memari *et al*., 2017:22; Nelson *et al*., 2017:170; Sanford & Horner, 2017:46). Nelson *et al*. (2017:170) reported that the skills of children with ASD are severely impaired during play when observing both object and symbolic play, as their movements would be more repetitive or stereotyped.

LANGUAGE IMPAIRMENT LINKED TO MOTOR DEFICITS

Neuro-physiological studies and brain imaging have reported a distinct link between motor skills and communicative skills. Areas of the brain which are involved in language functioning have been found to be linked to motor tasks such as execution, imagination and imitation. Other potential links in minimally verbal children with ASD have been found between manual, motor (which can be sign language), and oral-motor (speech) gestures. The patterns of activation are associated with general neural mechanisms, which aid language production and motor sequencing. Therefore, further exploration is needed in motor deficits as a core feature of ASD (Bo *et al*., 2016:52, Mody *et al*., 2017:160).

EARLY INTERVENTION STRATEGIES FOR GROSS MOTOR SKILLS

It is believed that a child learns through developmental movement patterns and the ability to relate his or her body to the environmental surroundings (Martin, 2014:546). In line with the significant gross motor development delays, it is estimated that 60% of individuals with ASD display a coherent motor dysfunction. Evaluation and screening of motor activity should play a vital role in the early identification and intervention of children with ASD (Bo *et al*., 2016:51; Grace *et al*., 2017:1014; Mthombeni & Nwoye, 2017:2).

Interventions that focused on FMS have shown to increase physical proficiency, which allowed a reduction in the victimisation of children with ASD when in company of other neuto-typically developing children (Sanford & Horner, 2017:46). An early gross motor skill intervention needs to be created and included in the overall intervention programme of children with ASD in order to minimise motor delays and in order to promote optimal overall development (Martin, 2014:547; Bremer *et al*., 2015:981; Bo *et al*., 2016:51). Ming and co-workers, however, did note that treatment for motor deficits had not been preferentially provided to children with subtler motor deficits (Ming *et al*., 2007:569). When working with toddlers with ASD, child-specific intervention goals and objectives, as well as educating parents need to incorporate specific behavioural and developmental strategies into daily routines and family activities and a commitment to these strategies is also vital (Rollins *et al*., 2016:219-220).

Figure 2.1 displays the global intervention hierarchy specific for interventions for individuals with ASD. It is important to note that the abilities of children with ASD vary along the spectrum, and therefore, the therapist must be able to adapt to the needs and abilities of the child and include age-appropriate activities and games, which may increase the individual's level of motivation to engage in exercise voluntarily (Lang *et al*., 2009:574; Scharoun *et al*., 2014:212, 215; Rollins *et al*., 2016:220). Interventions should also be evidence-based, cost effective (for the parents) and beneficial for the overall development of children with ASD (Bremer *et al*., 2015:989).

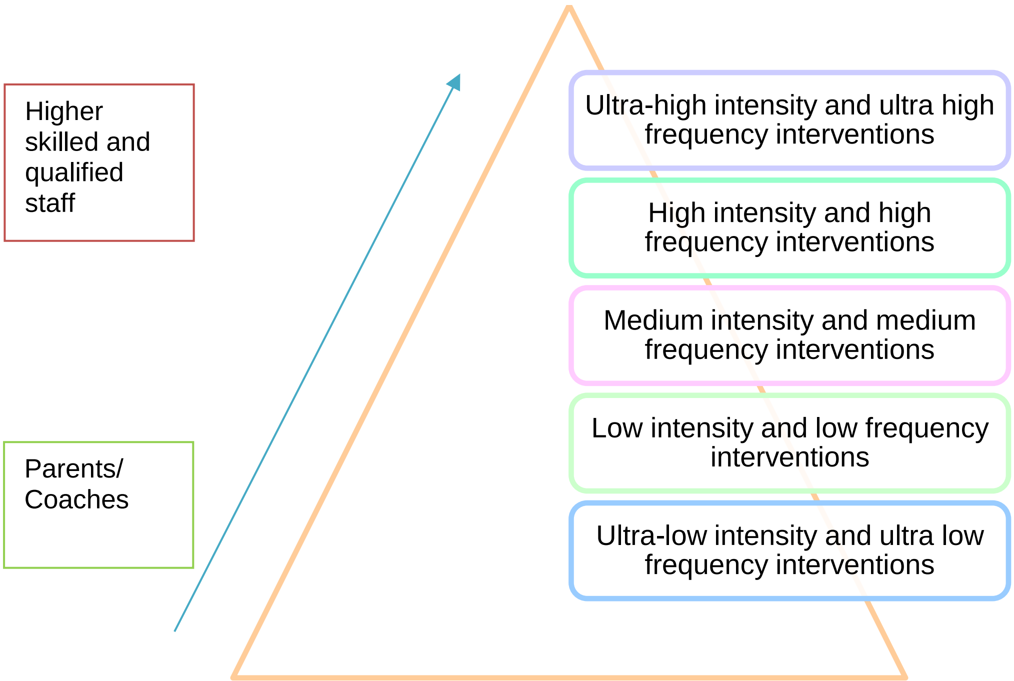

Figure 2.1: Global intervention for children with ASD. Adapted from De Vries (2016:133).

TYPE OF INTERVENTION APPROACH

The type of intervention strategy that focuses more on responsiveness is known as a top-down perceptual-cognitive bias for sensory information (Skewes *et al*., 2015:302). A top-down modulation in the sensory cortex occurs because the brain processing capacity of an individual with ASD is limited, and thus, an individual can only represent and interpret a segment of the incoming sensory stimuli at any given time. ASD-specific interventions mostly focus on the core features that emerge, such as foundational, social-communication skills, face-to-face reciprocal social interaction and communication that are the precursor to joint attention (Rollins *et al*., 2016:220).

The concept of joint attention has been identified and described as the instantaneous engagement of two or more people, while the individual is focusing mentally on one person, as well as on the same external object or event. In neuro-typically developing children, joint attention appears as early as infancy and continues to develop to become more coordinated and complex. This occurs between the ages of eight and 18 months and it can mainly be observed when the child engages in social interactions with people and objects (Murza *et al*., 2016:237). As the joint attention develops, the child gains improved social awareness of the partner that is communicating with him/her, which can be demonstrated by the child shifting their focused attention between the social partner and the object or event of interest. Children with ASD particularly have greater difficulty engaging in coordinated joint attention with social partners. Joint attention is especially valuable as it provides a reference for learning language and how to socially interact and behave in certain contexts (Murza *et al*., 2016:237).

Limited researches denotes to type of gross motor therapy conducted on the ASD population. However according to Dawson and Watling (2000:416) three of the most popular forms of therapy are; traditional form of occupational therapy, sensory integration therapy and auditory integration training. Other forms of interventions where GMS are incorporated are TEACCH *(treatment and education of Autistic and communication handicapped children) (Panerai *et al.*, 2002: 326), as well as therapeutic horseback riding (Bass *et al*., 2009: 1261). Although the literature of interventions based on physical activity is limited, interventions that produced improvements in motor control, neuromuscular coordination and behaviour (decrease repetitive behaviours), an increase in social interactions and improvement in physical fitness have been reported (Arzoglou *et al*., 2013:564; Scharoun *et al*., 2014:212). When viewing GMS interventions as part of the bigger picture it can often be used as an adjunct to a more holistic intervention plan (Baranek, 2002: 399).

DANCE AND ITS BENEFITS FOR AN INDIVIDUAL WITH ASD

Dance enables every child, regardless of their physical capabilities or degree of sociability, to communicate and be expressive in a nonverbal manner. It provides the incorporation of physical aspects as a part of a holistic social being. Dance promotes inclusivity and provides ample layers of learning experiences that deepen the person's repertoire of behaviour and response to the world. It is a creative process that involves movement of the body in a particular time and space. Dance is used around the world – like a universal language. Dance, as a form of therapy, is holistic; providing physical, social engagement and cognitive benefits and challenges to the individual (Scharoun *et al*., 2014:219-220).

The inclusion of dance is, therefore, essential to integrate the bodily dimensions of perceptual and expressive processes as part of the child's social interaction and social relationships. The physical component includes increased balance, flexibility, muscular tone, strength, aerobic endurance, spatial awareness and finally the integration of the sensory motor systems. Dance is, furthermore, the perfect marriage between art and science (Scharoun *et al*., 2014:212; Devereaux, 2017:51; Samaritter & Payne, 2017:2). According to Scharoun *et al*., (2014:213) “creative movement and dance are practical and feasible options for ASD.”

DANCE AS A FORM OF THERAPY: DIFFERENT APPROACHES

Dance movement as a form of therapy can be applied to address a developmental link in infants and young children with ASD or in individuals who are at high risk of ASD. It is further asserted that dancing could work significantly well for infants and children with ASD because children primarily communicate with their bodies before verbally communicating. It has also been proclaimed that dance can provide potential neurological pathways that integrate motor and social/communicative understandings that affect gross motor coordination of the child with ASD (Martin, 2014:548).

Traditional dances, which incorporate music-kinetic activities can be applied as a form of intervention as they require minimal equipment and they make use of a very simple teaching method. Individuals with ASD have the ability to control their body posture during the execution of dance movements although a delay in the control of movements were noted (Arzoglou *et al*., 2013:567). Music is also often included in physical education programmes because it enhances instruction, decreases aggression and disruptive behaviour, increases target behaviour goals, increases attention and social interaction, especially when working with the ASD population (Dieringer *et al*., 2017:422). When a child with ASD partakes in a dance programme that includes mirroring, the therapist must get as close as possible to the movement patterns of the child (Samaritter & Payne, 2017:3). When looking at dance as a form of therapy for children with emotional disabilities, the movement can aid in guiding them to explore their emotions, decrease inappropriate behaviours and create a sense of creative energy, which improves their overall behaviour (Devereaux, 2017:51; Nelson *et al*., 2017:172).

Creative movement and dance are instinctive means of communication, regardless of the person's abilities (Scharoun *et al*., 2014:213). A variety of approaches of dance and movement therapy include the child expressing movement, creative dance, role-playing, GMS and perceptual motor activities, which can either be in form of structured or improvised movement (Erfer & Ziv, 2006:240).

Dance provides benefits to its participants (Barnet-López, 2015:136). A distinctive finding of participants with ASD was reported when they were included in a traditional dance programme, which aimed at improving neuromuscular coordination, developmental stance and locomotion. The findings indicated that individuals with ASD improved their individual motor coordination (Arzoglou *et al*., 2013:566, 567).

Dance in the form of regular exercise has a positive effect on the motor development and physical fitness levels of individuals with disabilities or developmental disorders (Arzoglou *et al*., 2013:567). Children in a dance group may learn and improve their cognitive and social skills towards themselves and their peers. Additionally, they could develop self-awareness and through movement learn to express their emotions (Erfer & Ziv, 2006:239).

All children move in their own unique way and movement is a form of communication. Children often learn more about the world through their own bodily experiences that will in turn determine their social, emotional, physical, communicative and cognitive development (Erfer & Ziv, 2006:239). Results have indicated positive changes in aspects such as physical and psychological characteristics through a dance movement therapy. These changes included the daily functioning and enhanced body image and self-awareness of individuals (Erfer & Ziv, 2006:240; Barnet-López, 2015:136).

Lastly, it is important to note that successful performance of FMS is likely to have a comprehensive effect on individuals with ASDs' personality because of the social and emotional interaction that forms part of participating in traditional dances, which has a direct relationship with the improvement of the quality of life of the individual (Arzoglou *et al*., 2013:567).

PROPRIOCEPTION AND INTEROCEPTIVE AWARENESS

Proprioception and Interception Awareness (IA) can widely be described as the conscious awareness of internal bodily cues, such as heartbeat and breathing rates. These internal bodily cues are related to compassionate abilities that the individual is able to display such as the awareness of emotional experiences (Schauder, 2015:194).

BODY AWARENESS

Just as a child must primarily first learn how to speak in a specific language before socially interacting with people, a child must also first establish a sense of self through body awareness and movement. When a child moves, the neural wiring of the whole body is activated and, thus, it allows the whole body to become a platform of learning (Martin, 2014:550). The use of naming body parts enriches the child's ability to communicate about themselves and others. Remarkably, little research has addressed the development of children's body part vocabulary. Table 2.6 links the typically developmental ages to the amount of body part words that a child must know. From the foundations of infancy, children explore and discover their own bodies and accompanying body parts. Neuro-typically, during the second year of life, major developments occur in the child's perception and understanding of his/her body. Between the ages of 15 and18 months, infants can visually discriminate body forms. By 24 months they are able to categorise differences between body parts. Between 24 and 30 months they have the ability to represent how their body parts are spatially arranged both on their own body, as well as on the bodies of other people. Table 2.7 describes the verbs that accompany the developmental ages. During this period, children are developing the essence of a body part (Waugh & Brownell, 2014:1166-1167). Accompanying the body part words, Table 2.8 indicates the developmental ages at which a child must be able to draw a body part.

Table 2.6: Neuro-typical ages that children verbally display their body parts.

NEURO-TYPICAL MEAN AGE	AMOUNT OF BODY PART WORDS
12 months	Less than 1 body part word
18 months	9 words
24 months	13 words

Adapted from Waugh and Brownell (2014:1167).

Table 2.7: Neuro-typical ages that children allocate verbs to their body parts.

NEURO-TYPICAL MEAN AGE	TYPE OF BODY PART WORD UNDERSTANDING AS WELL AS VERBS OF BODY PARTS
12 months	Eyes, nose, mouth, ears and head.
21 months	Mouth-related: kiss or bite Leg-related: climb and kick
22-27 months	Hand or arm-related: hug and tickle

Adapted from Waugh and Brownell (2014:1167).

Table 2.8: Neuro-typical ages at which children draw body parts.

NEURO-TYPICAL MEAN AGE	ABILITY TO DRAW BODY PART
4 years	Draw human figure ● Typical a 'tadpole image' o Head and torso as one single picture o Both arms and legs as a line on either side of the torso
6 years	Begin to differentiate the correct location of the allocated different body parts.
Between 7 and 11 years	Begin to pay in-depth attention to finer details such as accessories, hair styles.
10 to 12 years	A representation of a realistic human figure.

NOTE: The rate, at which a child develops the cognitive ability to produce a realistic human figure, is individual specific.

Adapted from Imuta *et al*. (2013:1).

Children perceive the comprehension of body part words in reference to their own bodies and, thus, children will be familiar with the body parts that are visible to them (hands, feet and stomach), rather than those that are not visible (back, buttocks and ears). This could be due to a more salient and consistent focus to the parts that they see daily. A toddler specifically develops an internalised map of the body in the brain, which is coloured by mental images that they see rather than those body part images that they are unable to see. Children are also able to better comprehend the body part words when reference is made to themselves through improved self-exploration and self-knowledge (Waugh & Brownell, 2014:1173).

Body awareness can be described as the volume of attention that an individual pay to his or her internal body sensations (Bekker *et al*., 2008:749). Body awareness is known to be a fundamental development of dance (Nelson *et al*., 2017:172).

RUBBER HAND ILLUSTRATIONS AS A FORM OF BODY AWARENESS THERAPY

A recent study examined external body awareness, while using the rubber hand illusion paradigm as a measurement. The rubber hand would illustrate reflections of the ability to perceive the rubber hand as one's own hand by means of integrating information from the following systems: visual; tactile; and proprioceptive. It was suggested that Interoceptive Awareness leads to preservative negative self-thoughts, which in turn has an effect on body image and the manner in which an individual sees him-or herself. Children with ASD are observed to have depression and anxious, as they spend too much attention on the internal awareness of interoceptive awareness (Schauder, 2015:194).

BODY IMAGE

Body image refers to the picture an individual has about his or her body as it is formed and painted in the mind of the individual. In turn, body image has been acknowledged as a complex and multifaceted feature encompassing many aspects of how individuals experience their bodies (Scharoun *et al*., 2014:215; Tiggemann, 2015:168). It forms the core for the sense of acquisition of self-help skills and many other basic concepts (Erfer & Ziv, 2006:240).

Studies have indicated that children with ASD may have primary socio-psychological deficits, such as expressing emotions, recognising and interpreting emotions on the faces of peers, body positions and social judgement in context (Paquet *et al*., 2017:39). Positive body image, on the other hand, can be described as an overarching love and respect that the individual feels for his or her body, appreciating the uniqueness of the beauty of the body and the functions that it is able to perform and it is also accepted by others (Tylka *et al*., 2015:121, 126).

Body image can also be seen as a three-dimensional picture or image of the body and with this in mind, the individual can examine how his or her body appears to him- or herself, as well as what the relationship between the body and movement is. It is a mental image of the basis of emotional attitudes towards one's body (Erfer & Ziv, 2006:240), from acceptance to admiration, feeling comfortable, confident and happy in one's own skin. It can be narrowed down to appreciating and praising the body's features and functionality (Tylka *et al*., 2015:121, 122). Although body image is based on the input from the vestibular, kinaesthetic, proprioceptive, tactile and visual systems, it also has an underlying physiological basis (Erfer & Ziv, 2006:240). Alexithymia is known to have the inability or incapacity to identify and describe a feeling or emotion, which may lead to being unempethetic or displaying inappropriate emotional responses (Bekker *et al*., 2008:750).

INDIVIDUALS WITH ASD: BARRIERS FACED AND ACCOMPANYING EMOTIONS

ASD is a lifelong condition that significantly interferes with the development of all phases in life, particularly during transition periods, from childhood to adulthood. As the rate of anxiety and depression raises from 14 to 37%, it is evident why relationships become increasingly important as the child undergoes emotional, physical, academic and biological changes (De Bruin *et al*., 2015:907).

Barriers that individuals with ASD face when attempting to realize their full potential are not limited to social and communication skills. This condition prevents them from expressing themselves, as well as their strengths, abilities and potentials (Martin, 2014:545, 551). In South Africa, the concerns of behavioural and emotional deficits in children with intellectual disabilities have not yet been addressed (Molteno *et al*., 2001:515).

BODY IMAGES ASSESSED THROUGH HUMAN FIGURE DRAWINGS

Children must have the ability to consciously understand their own bodies and their capacity to move before facing the demands that are perceived from the external environment (Martin, 2014:550). It has been suggested that children with ASD may lack self-esteem, self-determination and motivation to participate in physical activities, especially when the task requires the child to interact with others (Dieringer *et al*., 2017:421).

Before a child can be asked to draw a human figure, three vital and distinct skills need to be in place. Firstly, some sort of mental image of what they want to draw needs to be in place. Secondly, that same mental image should form some sort of description as to what they would like to represent in the drawing and thirdly, they should select the best form (for themselves) of marks and formulate a plan, which will be most informative towards the child and the viewer. It is important to remember that some children may have to overcome difficult mental images and related experiences when planning a mental picture of the drawing to be executed (Barnet-López, 2015:136-137).

By the age of five years, a child is assumed to have a recognisable individual style (Lee & Peter Hobson, 2006:548). When a child is asked to draw a human figure, it can be used as a nonverbal tool through which the individual can express his or her emotions. Symbolic representation of human figure drawings shows the therapist what the relationship between the representations is and how the individual symbolises it. The information received from human figure drawings are crucial because it provides clues on the current status of different aspects of themselves and factors of development, such as: mental development; attitudes toward certain aspects; concerns they might have; cognitive and maturity development; and their views of experiences (Barnet-López, 2015:136-137). The impending significance of children drawing human figures reflects not only their cognitive development, but also their reflection towards the feelings that they portray towards themselves and the importance of other people in their lives (Barnet-López, 2015:137).

There is a long tradition of research that analyses children's drawings of themselves and other people that they desire to draw. Components that are studied are children's intellectual development, their consideration towards the detail of the human figure, as well as the emotional aspect of these drawings (Lee & Peter Hobson, 2006:548). Human figure drawings can additionally be used for participants to express their perceptions of body schema and reveal information about individual concern or their personality traits. Every person should have knowledge of their own body, ability to define it and the perception of the whole body in relation to the body parts. During dance therapy, a human figure drawing can potentially be used as a re-test opportunity in order to allow the therapist to detect if any changes have appeared in subjects during the intervention (Barnet-López, 2015:137). Human figure drawings are often related to an influence of a social engagement, but children with ASD do not have such a near-universal experience (Lee & Peter Hobson, 2006:548).

There are five drawing tests that will be discussed below, namely: The Goodenough Draw-A-Man Test; Goodenough-Harris Drawing Test (GHDT); Draw-A-Person Intellectual Ability Test; House-Tree-Person Test (HTP) and the Synthetic House-Tree-Person Drawing Test (SHTP) (Imuta *et al*., 2013:1-2).

The Goodenough Draw-A-Man Test was the first systematic scoring system used for the drawings of children. This test accommodated children between the ages of four and 10 years and required children to draw a single man in a picture. The scoring system is simply based on the number of details that the child has incorporated into their drawing and importantly, the accuracy of each body part. The scoring system allows evaluating the intelligence of the child rather than their drawing or manual dexterity skills (Imuta *et al*., 2013:1-2).

Later, the first revision of the test was done by Harris, resulting in the Goodenough-Harris Drawing Test (GHDT), which accommodated children up to and including the age of 15 years. This test involved drawing three pictures, namely: a man; a woman; and themselves. A new scoring system was also in place to assess the overall maturity, attention to detail and localisation of proportion of the child (Imuta *et al*., 2013:1-2).

A Draw-A-Person Intellectual Ability Test for Children, Adolescents and Adults (DAP: IQ) was more recently developed. This test allowed a person (aged four to 90 years) to draw a single drawing of him-or herself. After the individual had drawn the features recommended by the scoring criteria, a score from 0 to four is given (Imuta *et al*., 2013:1-2).

It has been suggested that the drawings of children with ASD are very specific with peculiar shapes due to their awkwardness and some research studies have displayed that cases have been found where the drawings produced were original and with very interesting results (Imuta *et al*., 2013:1-2; Fujii *et al*., 2016:8).

The HTP-house-tree-person test, requires participants to draw the respective three items (a house, a tree and a person), on three pages, whereas the SHTP-synthetic house-tree-person drawing test required the child to draw all three objects on one page. The latter test has been reported to be interpreted as a variety of tests, such as intelligence tests, personality tests, a detector of mental disorders, and lastly, as a sort of behaviour observation throughout the test (Fujii *et al*., 2016:8).

LATERALITY

Lateralisation is a relatively complex process that develops as the child progresses through their early developmental milestones. There are numerous indicating factors that can influence this process, such as maturation of the hemispheric brain organisation, the environment and social interaction (learning and imitation). There are four elements of laterality, namely: hand dominance (normal laterality); psychosocial laterality (both are mainly influenced by the environment); tonic laterality; and spontaneous laterality of posture (which is influenced by the maturation process) (Okamoto *et al*., 2017:39; Paquet *et al*., 2017:39-50).

Laterality is known for the characteristics and state of functional asymmetry observed in numerous body parts and manifested by the dominance of a certain hemisphere of one part of the body over its counterpart. This manifestation results in directed behaviours. It is believed that the left hemisphere of the brain is responsible for symbols involved in language, communication and praxis (which ASD children have deficits in), whereas the right hemisphere is responsible for the use of symbols such as visuo-spatial abilities. According to neuroimaging studies, a dysfunction of the left side of the brain can be seen in the ASD population (Okamoto et al., 2017:39; Paquet *et al*., 2017:39-50).

Laterality of the hand is considered to be a functional marker of ASD because it is a result of cerebral dominance. Hand laterality can have three corners of a continuum, namely: a strong left handedness; a strong right handedness; and intermediate literalities that are less clearly affirmed or undetermined by the individual. In order to determine hand dominance in an individual with ASD, three questionnaires are frequently used: (1) Edinburgh Handedness Inventory; (2) Waterloo Handedness Questionnaire; or (3) Self-assessments. The hand dominance of the ASD population can be described as having a disturbed lateralization, either ambiguous, inconsistent or mixed. Functional laterality involves an asymmetrical encounter when the child is confronted with an external object. This type of laterality can counteract with hand dominance involved in writing or throwing a ball (Paquet *et al*., 2017:39-50).

Primary socio-psychosocial laterality involves body positions, expressing emotions, gestures and making judgement in a social context. Individuals with ASD have atypicalities in some of these areas, such as body and face recognition (Paquet *et al*., 2017:39-50).

Tonic laterality refers to internal passive movements, which takes place when there is a resistance of a body part to a muscle that is being stretched during a passive motion (Okamoto *et al*., 2017:39).

Innate or spontaneous postural laterality is the internal lateral preference, which is not learned of influenced by a social context. Crossing arms or placing one hand over the other can be seen as examples of innate or spontaneous postural laterality (Okamoto *et al*., 2017:39; Paquet *et al*., 2017:39, 50).

Laterality becomes established during a neuro-typical child's course of development and hand dominance should be established from four years of age (Paquet *et al*., 2017:50). It has been suggested that GMS deficits of children with ASD can be accompanied by deficits involving tasks, such as to bring the hands to the midline. These deficits may indicate midline impairments (Harris, 2017:2).

Dr. Temple Grandin said the following: "You see the person not the label". If we have to focus and look at all the good and unique qualities that ASD children portray, we will be pleasantly surprised". ASD is characterised by a good performance on tasks that require the individual to be systemizing. ASD children are exceptional at perceiving small detail and very good at discriminating a pitch (Schunke *et al*., 2016:134).

SUMMARY

The chapter focused on the evolution and refinement of the term ASD over the past 74 years, as well as listing the latest ASD diagnostic criteria. The diagnostic manual (DSM-5) has five categories each with criteria that must be met in order for a valid diagnosis to be made. Additional to the DSM-5, the researcher examined other methods that can be used to diagnose ASD. The increasing rate of diagnosis was, furthermore, discussed, as well as the age and gender differences in this condition. Once, a diagnosis has been made it is vital to determine the severity level of the disorder as this will have an impact on the child and family members. The parent's emotions of the child with ASD were addressed and a review of the warning signs of ASD was given. The effect of the ASD diagnosis on parents was also explored.

With regards to the bigger picture of ASD, the reported prevalence rates in the world were reviewed, as well as the limiting factors that researchers experience in South Africa and more specifically in relation to lower socio-economic communities.

The researcher examined literature on the specific characteristics that children with ASD display and the accompanying barriers that they face. Some of the vital characteristics were categorised in three main sections, namely: social and language communication; repetitive and stereotypical behaviours; and gross motor deficits. The latter was further grouped into four subcategories: FMS; specific gross motor deficits; toe walking; and physical fitness. The researcher examined the benefits of dance as a form of therapy as well as body awareness and its related aspects. The current researcher used the literature findings to assist with the development of the intervention such as physical activity guidelines for children with ASD, between the ages of five and 18, are 60 minutes per day with intensity levels between moderate and vigorous. Additionally, the estimation that 21 to 100% of children diagnosed with ASD display a number of notable motor deficits, was a starting point for the aims and objectives of the current study. Lastly, according to research findings dance as a form of intervention has improved neuromuscular coordination, developmental stance and locomotion- which was helpful as this was also an aim and objective of the current study.

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CHAPTER 3

METHODOLOGY

"It is debated that the segregation in research of disabled subjects is largely the result of unsustainable research methods and dearth of expertise of researchers in communication with these subjects rather than the limitations of subjects themselves" (Sloper & Beresford, 2014: 245).

OVERVIEW OF CHAPTER

Scientific research encompasses a systematic process that emphasise the analysis of data that has been collected in order to reach a statistical conclusion. In this chapter the methodological procedures as well as the research design implemented will be discussed. To ensure that the steps used in the current study can be followed meticulous by other researchers, this discussion is important.

Specific aspects that will be discussed in this chapter are:

- The research objectives and how they are applicable to the current study.
- The research design and how it is known to be the 'gold standard' for interventions.
- The sample of the study, including the inclusion and exclusion criteria.
- The manner in which the researcher prevented any form of bias when dividing the subjects.
- The aim of the study, it's relating sub-aims and complementary objectives, which the intervention was based on.
- An in depth description of each scientific assessment and the necessary outcomes of each are provided.
- A brief description of the data analysis that was used for the interpretation of data is also outlined.
- The ethical considerations that was applicable for this study.

RESEARCH OBJECTIVES

The main aim of the research question is to help the researcher focus, and to aid in the data collection (Karlsson, 2009:67). The objectives of a research project are to indicate the intentions of the researcher and the nature and purpose of the investigation (Karlsson, 2009:66). Six possible research objectives that are applicable to the current study, are mentioned and explained in Table C1 (*Appendix C)*.

RESEARCH THEME

Trial design

A study is designed with the aim of finding a comparative difference in the outcome of the subjects that received the treatment or intervention. One likely method to determine this difference is by dividing the subjects into two groups: a control and an experimental group. In most disciplines, the control group's subjects are compared to the subjects of the experimental group. The role of the control group ensures that the data obtained is interpreted in an unbiased manner. In terms of an experimental research design, equality between the experimental and control groups are usually achieved by randomisation (Howitt, 2011:37).

The type of trial design implemented in the current study was a group design. The group trial design compares two groups (of similar nature) with each other. The subjects were randomly allocated into either the experimental or control group. In the current study the subjects were randomised by an independent third party to ensure that the researcher did not by any means influence the division of the subjects into the two groups. The composition of the groups were as follows:

Group 1: The control group (n=8)

Semi-weekly on a Tuesday and Thursday between 09:00-10:00, these subjects only participated in their prescribed curriculum / daily activities, with no form of prescribed Kinderkinetics gross motor therapy. Their curriculum activities involved arts and crafts, reading stories or they occasionally participated in yoga, presented by their teacher. The teacher also involved all the subjects in a weekly drumming session. If the results of the current study indicate improvement in specific areas (components) after completion, the control group will also be subjected to the structured group dance intervention programme.

Group 2: The experimental group (n=7)

Semi-weekly on a Tuesday and Thursday between 09:00-10:00, these subjects participated in several group structured dance programmes that were designed to meet the specific gross motor and body awareness of the group see B1 (*Appendix B*). Although the intervention sessions was designed for 60 minutes, there were odd days, where if the subjects were sensory over stimulated the session would only be 45 minutes long. The content of the programme remained relatively constant weekly. ASD subjects require structure (they need to know what is happening when) and a fixed routine, therefore the sequence of the sessions and the dances were routinised, leaving room for slight changes depending on the needs of the group. This programme occurred twice weekly.

RESEARCH STUDY DESIGN

The current study made use of an experimental research design. The most elementary form of an experimental design is a randomised experimental design (Brown & Melamed, 2011:20). Additionally, it is known as the 'gold standard' for studying interventions in both fields of an applied research setting and in a more basic research setting (Bickman & Rog, 2013:143). When an experiment has the nature of randomised comparison, it assesses the effects of a treatment or a designed intervention, while the subjects are assigned randomly to one of two different groups.

The impact of varying factors, which might have been controlled, was studied. Subsequently the outcomes measured were assessed to determine whether a difference between the control and experimental groups existed (Dos Santos Silva, 1999:83). These results were used to determine the estimated size of the treatment effects (Reichardt, 2011:150).

Randomisation is a significant feature of an intervention study, which ensures that the outcome of the allocation of the subjects in a control and an experimental group are determined by chance only, and that neither the researcher, nor the subjects, had any subjectivity influence (Dos Santos Silva, 1999:84). Random subject assignment removes bias because of the initial group differences (Reichardt, 2011:150). In the current study randomisation granted each subject a fair chance to be part of the experimental group.

SAMPLE POPULATION AND SETTING

The population, also referred to as the target group or target population, is represented by a larger group, from which a smaller group is selected as a sample for a study (Joubert *et al.*, 2016:94). Because of many constraints, researchers are often unable to include the entire population in a study. As the sample group is retrieved from the population group, the participants all have the same characteristics and are virtually a mirror image of each other - there might be slight differences but no significant differences (Joubert *et al.*, 2016:94).

The ASD unit of the selected LSEN (learners with special educative needs) school for the current study included ASD children with varying severity levels of social communication and restrictive, repetitive behavioural functioning. For the purpose of the current study, most of the children were in the Level 2 functioning category (Refer to *Chapter 2*: The ASD post diagnostic severity class criteria), and their age ranged between 7 and 14 years. The class description, with accompanying verbal classification of the subjects is presented in Table 3.1. The ECD (early childhood development) class, were for the developmentally younger children, whereas the Autism classes were for the older children. There were no specific age ranges related to these classrooms, it was all dependant for the child's development. Although Table 3.1 indicates both verbal and non-verbal subjects, the subjects still had to adhere to the eligibility criteria.

Table 3.1: The ASD subjects, LSEN School class description with accompanying verbal classification.

Autism 1			
Subject	**Gender**	**Age**	**Communication status**
1	Male	10	Non-verbal
2	Male	10	Verbal
3	Male	10	Verbal
4	Male	9	Verbal
5	Male	8	Verbal
6	Male	9	Verbal
7	Male	14	Verbal
8	Male	8	Verbal
Autism 2			
1	Male	9	Verbal

2	Male	13	Verbal
3	Male	14	Verbal
4	Male	12	Non-verbal
5	Male	10	Verbal
6	Male	12	Verbal
7	Female	9	Non-verbal
ECD 1			
1	Male	6	Non-verbal
2	Male	10	Non-verbal
3	Male	9	Verbal
4	Female	10	Non-verbal
5	Male	10	Non-verbal
6	Female	8	Non-verbal
7	Female	6	Non-verbal
ECD 2			
1	Male	7	Verbal
2	Male	8	Non-verbal
3	Male	6	Verbal
4	Male	7	Non-verbal
5	Female	7	Non-verbal
6	Male	6	Non-verbal
7	Male	8	Non-verbal
8	Male	7	Non-verbal
**ECD: Early childhood development*			

The subjects remained in their class classification yearly to ensure that they are familiar with their teacher and the assistant teacher, as well as their daily routines. Each class had a variety of daily activity and made use of the Picture Communication System (PCS) as described in *Chapter 2*. The PCS is a form of communication using cartoon-like pictures, which display and symbolise essential concepts that are vital for children with ASD's everyday functioning within the education and living environment. In the classroom, the PCS displays their daily routines indicating when each activity is scheduled. When a new activity had to be included, for example, a Kinderkinetics session, the teacher included a new picture in their routine. In the current study, the PCS was not utilised to indicate the intervention activities, however, the PCS did come in handy with the emotion wall, which consisted of animated emotions and was used in the intervention *(Table B3 in Appendix B*).

The current study took place in two different locations:

- The Department Sport Science, Stellenbosch University: It was of utmost importance to take the weekly routine of the subjects' schools into consideration, and therefore, it was decided to keep the arranged timeslot for the entire period of the intervention. The location for the scientific assessment was in the Coetzenburg Hall. The test battery used was the BOT-2 (Bruininks-Oseretsky Test of Motor Proficiency 2nd Edition) (Bruininks & Bruininks, 2005:1). This location was selected because it is spacious and free from distractions. The location for the intervention was the Department of Sport Science's Kinderkinetics centre, which is small and sensory stimulating for therapy sessions. A too large area would cause a disruption allowing the subjects to run around and explore the space.

- A LSEN School in Mitchells Plain: Assessment took place in the school's library since it is a quiet and non-disruptive environment. The QNST-3 (Quick Neurological Screening Test, 3rd Edition), requires the absence of distractions and was, therefore, administered in this location (Mutti *et al*., 2012:21). The intervention took place in the Autism 2 classroom. This classroom was not unduly sensory disruptive, and the size of the classroom (with the tables and chairs removed), was roughly the size of the Kinderkinetics centre at the Department of Sport Science, Stellenbosch University.

The main reason for two different locations were due to the school had a limited budget which allowed the children to go on an outing once a week. The teachers ensured that after the intervention (at Department Sport Science, Stellenbosch University) the children had a picnic, which was seen as their weekly outing.

Inclusion and Exclusion criteria

The following eligibility criterion had to be adhered to, in order for the subject to be part of the current research study.

Inclusion criteria:

- Formally diagnosed with ASD.
- Classified in either the intermediate or high functioning group.
- The subject had to be verbal.
- The subject had to attend the selected school and be part of the ASD unit.

If the following criterion was observed, the subject's would not be able to participate in the current research study.

Exclusion Criteria:

- Not formally classified with ASD.
- Classified as non-verbal.
- Incomplete assent form.
- Incomplete consent from parents or guardians.

- Non-attendance of 60% of the sessions.
- Sickness which affected his/her ability to be physically active.
- Refusal to physically partake in the intervention.

Research sampling method

Sampling can be regarded as the process of selecting elements of a specific population for an intended study to enable the researcher to make generalisations about the specific population (Tucker, 2011:390). When referring to methods of sampling, two categories can generally be distinguished, namely: probability and non-probability sampling. With probability sampling, each population has a known (non-zero) chance of being selected for the sample. With non-probability sampling, the probability that each population would be chosen, is unknown to the researcher, and/or the researcher cannot be assured that each population respectively, has a non-zero chance of being selected (Joubert *et al.*, 2016:95).

Although, a researcher can choose a sample technique, the method of sampling dependents on the purpose of the assessment. In the current study, a homogenous purposive sample as well as a sample of convenience was implemented. Homogenous purposive sampling technique involves identifying and selecting individuals or groups of individuals that are especially knowledgeable with a phenomenon of interest (such as their diagnosis) (Palinkas *et al.,*2015:534).

Convenience sampling was used for the current study because the scientific test batteries, which were administered in this study, required the subjects to be verbal. Convenience or accidental sampling involves selecting subjects that are readily accessible to the researcher (Phua, 2011:197). The advantages of a convenience sample is that it is relatively inexpensive, easily accessible (especially relevant for hard-to-reach populations, such as ASD individuals), and it can be used for both quantitative and qualitative research protocols (Phua, 2011:197). The sample group was single blinded. Blinding is very important presenting a safety mechanism against bias, especially when assessing subjective outcomes. With single blinding, the subjects are not aware that they are part of either the experimental or the control group (Phua, 2011:197).

AIM OF THE STUDY

The main aim of the current study was to determine the effect of a self-designed dance programme, focusing specifically on gross motor skills (GMS) and body awareness of selected verbal subjects with ASD.

The first sub-aim was to identify the extent of GMS deficits of the selected verbal subjects with ASD.

The objectives were to:

- determine the level of gross motor development of each subject;
- determine any delays in motor planning and motor sequencing when performing the GMS (tasks);
- identify each subject's sense of rate and rhythm when performing gross motor movements;
- classify the spatial organisation of each subject;
- identify the subject's bilateral coordination (this requires bodily control and simultaneous coordination of upper and lower limbs);
- identify the upper body coordination of each subject, which coordinates the visual tracking with arm or hand movements;
- determine the trunk, upper and lower body strength of the subjects because this is essential for daily gross motor performance;
- determine each subject's balance and stability linked to their vestibular system;
- determine the agility of each subject.

The second sub-aim was to explore the body awareness of the selected verbal subjects with ASD.

The objectives were to:

- subjectively identify and examine their body image and the emotions accompanying this;
- subjectively identify their kinaesthetic body schema;
- subjectively examine their laterality and directionality;
- explore their midline and midline crossing.

INTERVENTION BASED ON THE DYNAMIC SYSTEMS THEORY

The theory that the intervention was based on mainly depended on the manner in which the nature of the subjects' development was interpreted by the researcher, and in turn, the manner in which the subjects were treated because of their developmental level. It is well-known that disabled children have profound developmental patterns, such as children with ASD that experience difficulties with social relationships (Thelen, 2008:256). The current study was based on the dynamic systems theory, which includes the changes that occur in a developmental movement pattern of a child that is brought about by three integral interactions between the constraints of the environment, task and child (Lee & Porretta, 2013:41). When a movement skill is acquired by a child, it is thought not to be a direct result of developmental change, but rather a result of over time acquisition because of the dynamic interactions between the integral factors of the human movement system. This theory strongly correlates with Newell's constraint model, which has been used as a guide when working with disabled children (Pope *et al*., 2013:37).

When examining Newell's constraint model, the three constraints described by Lee and Porrette (2013:41) regarding the ASD population, certain factors as projected in Figure 3.1 have to be considered. Pope *et al*. (2013:36) distinguishes between individual, environmental and task constraints.

- ***Individual constraints*** can further be pigeonholed into two categories: structural constraints (composed of the individual's anatomical structure); and functional constraints (balance, coordination and a variety of cognitive factors like attention, intrinsic motivation etc.). Individual constraints work together to either inhibit or facilitate the learning of GMS.
- ***Environmental constraints*** either encourage or discourage certain actions of GMS, which is of great importance in the ASD population. This constraint is further divided into two categories: physical and socio-cultural constraints, which involves the manner in which a child acts in a group, relating to norms and values.
- ***Task constraints*** relate to GMS and specifically the skill that the subject has to perform in order to be successful.

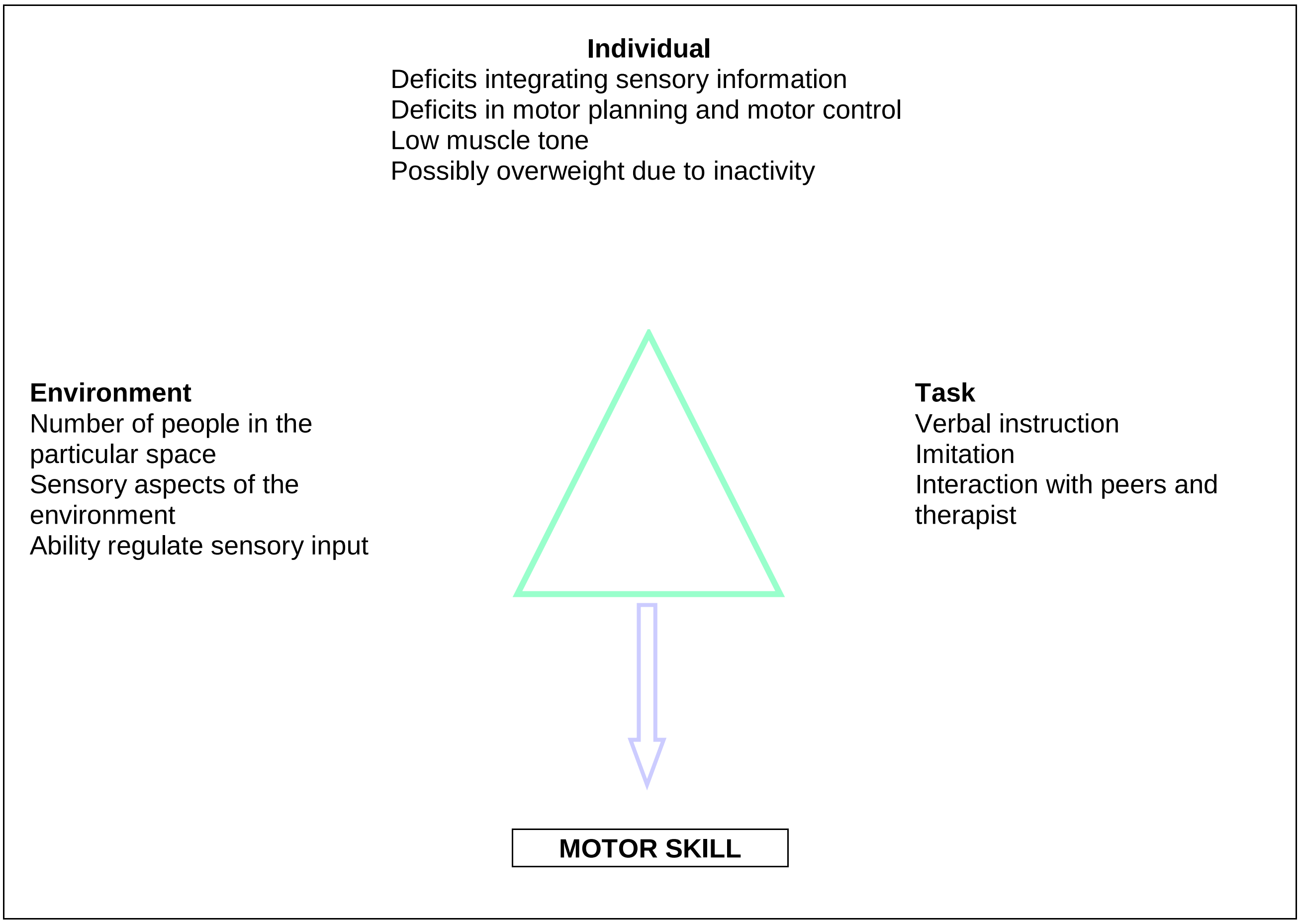

Figure 3.1: Adapted Newell's Model of Constraints with relation to ASD children.

Adapted from Pope *et al*. (2013: 36).

The intervention programme was developed, based on the individual needs of the subjects with ASD, while including the 10 key therapeutic strategies based on the work of Parham *et al*. (2007:219):

1. the researcher arranged the classroom/ Stellenbosch Kinderkinetics centre to entice engagement;
2. ensured physical safety for the subjects;
3. presented sensory opportunities throughout the duration of the intervention, which was specifically incorporated in every dance;
4. attained and maintained optimal arousal levels of the subjects;
5. tailored the dances to ensure a 'challenging factor';
6. ensured that activities are successfully executed;

7. guided the self-regulation of the subject's behaviour;
8. created a 'child friend/ playful' context;
9. collaborated in activity choice with the subjects, listened to what activity they enjoyed most and would like to repeat; and
10. encouraged therapeutic alliances.

The 10 therapeutic strategies can be categorised into three main domains of the Dynamic Systems Theory: (1) provide the child with environmental modifications and sensory stimulating opportunities during the intervention; (2) foster adaptive responses for the tasks and provide a sense of challenge for the subjects; (3) promote the therapist–child relationship (Pfeiffer *et al*., 2011:79).

INTERVENTION PROGRAMME

Researchers have been particularly interested in the application of physical exercise for subjects with ASD and mainly because of its effect on maladaptive or self-stimulatory behaviours (Baranek, 2002:414).

The researcher is a registered Kinderkineticist at SAPIK (South African Professional Institute of Kinderkinetics) (01/014/02/1415/005), and therefore, made use of scientific norm-based test batteries. Four Kinderkinetics honours students, assisted with the intervention programme, as well as data collection. Prior to testing, the honours student's received intensive training on the data collection protocol. Both the researcher and the honours students obtained first aid level certificates as well police clearance, before the study commenced.

Empirical evidence confirming the manifestation of both sensory and motor impairments in subjects with ASD can be found, which may be linked to the core features of ASD (Baranek, 2002:397). This evidence encouraged the researcher to design a programme that incorporated both sensory-motor stimulation and GMS, including aspects of body awareness.

Numerous studies found that the prevalence of impaired fine and GMS in the ASD population appears to be relatively high (Dawson & Watling, 2000:416; Dewey *et al*., 2007:246; Provost *et al*., 2007:321; Pan *et al.*, 2009:1695; Lloyd *et al*., 2011:134). As the field of Kinderkinetics specialises and focuses specifically on GMS impairments in fine motor skills was not focussed on in this intervention, as it is beyond the scope of practice.

As mentioned in Chapter 2, subjects with ASD exhibit specific GMS impairments, as well as non-locomotor deficits. They are further characterised by a lack of anticipation during the preparation phase of their movements, which could be related to an internal motivational struggle (Baranek, 2002:399). This influenced the manner in which the intervention was designed.

The GMS that were focused on throughout the dances were mainly: (1) locomotion (walking, running, hopping, galloping and skipping) and hand-eye coordination (warm-up); (2) locomotion and coordination, (activity 1); (3) core strength, bilateral and hand-eye coordination, static and dynamic balance, spatial awareness, proprioceptive and vestibular stimulation, visual motor integration, imitation, tactile discrimination, motor planning (activity 2); (4) object manipulation, hand-eye coordination and foot-eye coordination (activity 4); (5) object manipulation, hand eye coordination and foot- eye coordination (activity 5) and (6) bilateral coordination, locomotion, anaerobic endurance (cool down: head, shoulders, knees and toes). See *Appendix B* (B1) for an in-depth description of each activity and dance.

Dance has the ability to improve the body perception and body image of a child with ASD, and it can simultaneously increase their well-being and empathy towards others. Dance often connects at a deeper level than verbal approaches (Koch, 2016:447, 451). The body awareness dance aspects that were brought into the intervention programme were: (1) body awareness, body concept, body image, laterality and directionality (warm-up); (2) directionality, laterality, body concept and body schema (activity 1); (3) body schema and directionality (activity 2); (4) body schema, laterality, directionality and spatial awareness, (activity 3); (5) directionality, lateral discrimination, body schema and body concept, (activity 4); (6) body awareness, body concept and body schema (cool down: head, shoulders, knees and toes). Refer to *Appendix B* (*B1, Table B2 and Table B3*) for an in-depth description of the body awareness dance components.

According to Koch (2016:452), music-based movement and mirroring could improve the body image and body awareness of a child with ASD. All of the dances were accompanied with music, folk, as well as melody. Music has the ability to be adapted to any environment or situation, and both subjects with ASD and neuro-typical subjects have the ability to participate in music-based activities (Allgood, 2005:93). It is approximated that 8 to 12% of all school-based interventions aimed at children with ASD involve music (Nelson, 2017:172). Since the 1950's, folk dancing and rhythm activities were used as a means to achieve various goals for subjects with ASD because they have a rare interest in music (Reschke-Hernandez, 2011:172, 173). Rhythmic and whole body movements have been identified as critical elements of a child with ASD's music experience (Nelson, 2017:172).

The type of equipment used throughout the dance programme were music, a speaker, animated body part pictures, large white paper (to trace themselves), pencils, a variety of animated emotions, decorated hula hoops (each subject had their own with their name on it), primary colour circles, wooden benches, plastic rocks, bean bags, medicine balls, pictures of variety of shapes, ropes, plastic poles, scooter boards, tactile balls, mini trampolines, foam dice, chalkboard, chalk, a parachute, tunnel and a Swiss ball. See *Appendix B* (Table B1) for more information regarding the equipment.

Numerous studies reported that between 45 and 95% of subjects with ASD have unusual sensory (tactile, olfactory, visual, auditory, proprioceptive and vestibular) perceptions, organisation, regulations and responses, which may be hypo or hyper responsive. Hypo-responsiveness occurs when a subject is under-responsive or slow to respond to sensory input, whereas hyper-responsiveness occurs when a subject has an exaggerated response towards sensory input. Additionally, subjects with ASD may be preoccupied with the sensory aspect of an object, have perceptual misrepresentations, are inconsistent towards their responses to sensory stimuli, have poor sensory integration and are either hypo- or hyper-responsive to proprioceptive and vestibular stimulation (Dawson & Watling, 2000:415; Baranek, 2002:398; Bhat *et al*., 2011:1120-1121; Schaaf *et al*., 2014:1493). Therefore, the importance of stimulating a child prior to each activity or when needed, should be implemented in the beginning of a new activity or dance.

The vestibular and proprioceptive systems of the subjects were stimulated by pulling themselves on the floor through a path on a scooter board. The researchers also applied pressure on the subjects' major joints; waved a colourful parachute slowly up and down, while they were lying on their backs on the ground; and lastly, the subjects had to jump up and down on a trampoline. The trampolines were set out in a circle. Additionally, the subjects had to jump in a rotational manner, or run and jump on multiple trampolines.

Somatosensory and vestibular activities are vital for subjects with ASD because it enables their nervous systems to control, organise and integrate information perceived from the environment. This, in turn, provided an opportunity for further adaptive responses in the intervention programme (Baranek, 2002:405). Sensory stimulation through a demarcated modality, such as pressure touch (involving a firm touch, which provides a calming input for the individual), or vestibular stimulation (which is frequently used to modulate arousal), can occasionally be incorporated within a broader sensory-motor integration based programme (Baranek, 2002:408). The dances in the intervention programme of the current study were also designed to include active sensory stimulation, such as colourful ribbons hanging from the hula hoops and tactile spiked balls. Sensory or gross motor therapy is frequently used in combination with a more holistic intervention programme (Baranek, 2002:399).

Small intervention adaptations were made to allow each subject to have the ability to perform the desired movement, while at the same time not feeling excluded from the rest of the group who were able to perform the skill without adaptations.

DATA COLLECTION

Quantitative research relies solely on numerical data and objective measurement with the assistance of questionnaires, structured observation and data collected from tests. It allows the researcher to get acquainted with the problem statement that is to be studied (Golafshani, 2003:597; Joubert *et al.*, 2016:37).

Quantitative data could take on two aspects, namely experimental and descriptive. Experimental aspects refer to the determination of the extent and characteristics of a relationship (this can be in a descriptive manner), or to the prediction or control of the study (Golafshani, 2003:597; Kalaian, 2011:725; Joubert *et al.*, 2016:37).

The descriptive aspects are closely related to the objective and numerical summary of the characteristics of the research question (Joubert *et al.*, 2016:246). The methods of assessment involve standardised measures to ensure that the variable perspectives can appropriately fit into a limited number of predetermined response categories to which a quantity is assigned (Golafshani, 2003:598). This form of data collection is solely numerically based and is adaptable to analytical methods such as statistical correlations (Walliman, 2011:37).

Both the QNST-3 and the BOT-2 that make use of quantitative data were administered by the researcher. The researcher was also responsible for processing the scores and data. The only secondary data used by the researcher was the population statistics from Statistics South Africa that was conducted in 2011.

TESTING AND RELATED OUTCOMES

When the QNST-3 and BOT-2 assessments were administered, it was essential for the researcher to know how to determine the chronological age of the subjects. This is vital for the scoring procedure when determining the total or standard scores of each test, and the overall classification of the subject.

Calculating the chronological age entails subtracting the subject's birth date from the testing date. The researcher subtracts the date of testing row from the date of birth row. Starting at the 'day' column working their way through to the year column. If the researcher needs to 'borrow' days it is generally 30 days, and if needed to 'borrow' months it will be 12 months (Mutti *et al*., 2012:23).

The following contains an example of how to calculate the chronological age of a subject.

Date of Testing	~~2016~~ 2015	02 +12	29
	Year	month	day
Date of Birth	2009	06	10
	Year	month	day
Chronological Age	6	08	19
	Year	month	day

Note: In the case of QNST-3, the months will be rounded up by one if the days exceeded 15. In the case of BOT-2, the researcher should never round months upward, even if the days exceeded 15 days.

QNST-3 OVERVIEW

The QNST is a standardised test (Parush *et al*., 2002:187), originally designed in 1974 to identify neurological soft signs (NSS) in preschool children, with the intended purpose of detecting learning problems. This version was later revised and reprinted in 1978 as the QNST-2, followed by minor revisions and variations in 1998. The third version of the QNST provides norms, which are based on a nationwide sample representation. This version of the QNST covered a wide age range (5 to 80 years+) (Parush *et al*., 2002:188; Mutti *et al*., 2012:6-7). NSS are inconsequential motor abnormalities that may include poor praxis (motor coordination), sensory perceptual changes, difficulty planning and sequencing complex gross motor activities (Seidl, 2009:525). It has been estimated that the incidence of subjects with ASD with NSS is 50% (Mutti *et al*., 2012:14).

The QNST-3 offers a quick and precise way for therapists to detect neurological soft signs, minor motor irregularities that include poor motor coordination, sensory perceptual changes and difficulty sequencing complex motor tasks (Seidl *et al*., 2009:525).

The individually administered standardised test is observational, consisting of 15 subtest tasks of neurological integration, which are easily related to learning, occupational function, leisure and activities of daily living. The 15 subtest tasks are commonly found in neurological and neuropsychological test batteries (Parush *et al*., 2002:189). Numerous outcomes are related to each of the 15 subtest tasks (Table 3.3). The subtest tasks have been accurate at assessing both the development of motor coordination and sensory integration. Additionally, it aids in identifying possible neurological interferences with learning (Mutti *et al*., 2012:8).

The QNST-3 shares properties with standard neurological and neuropsychological batteries that include the assessment of balance, visual-motor integration, fine and gross motor control, sound discrimination and other developmental tasks. The primary outcomes of the QNST-3 include: Motor maturity and development, sensory processing, sensorimotor, perceptual, motor gross and fine muscle control, motor planning and sequencing, the sense of rate and rhythm, spatial organisation, visual and auditory perception, balance and vestibular function and disorder of attention (Parush *et al*., 2002:187; Pfeiffer *et al*., 2011:81; Mutti *et al*., 2012:8).

Table 3.2: Outcomes of each QNST-3 sub-task.

OUTCOME	SUB-TASK
Auditory acuity and attention	Sound patterns
Auditory discrimination	Sound patterns
Auditory perception	Sound patterns
Auditory-spatial orientation	Sound patterns
Body image	Arm and leg extension, tandem walk, stand on one leg and skipping
Brain maturity	Double simultaneous stimulation of hand and cheek
Fine hand skill	Hand skill, figure recognition and production
Hand eye coordination	Hand skill, figure recognition and production
Lateral preference	Hand skill
Lateral discrimination	Palm form recognition, sound patterns, thumb and finger circles, double simultaneous stimulation of hand and cheek, rapidly reversing repetitive hand movements, arm and leg extension, tandem walk, stand on one leg, skipping and hand/eye/foot preference
Motor control	Finger to nose, thumb and finger circles, rapidly reversing repetitive hand movements, arm and leg extension, tandem walk, stand on one leg and skipping
Motor maturity	Hand skill, figure recognition and production, sound patterns, finger to nose, thumb and finger circles, rapidly reversing repetitive hand movements, arm and leg extension, tandem walk, stand on one leg, skipping and hand/eye/foot preference
Motor Planning	Hand skill, figure recognition and production, sound patterns, finger to nose, thumb and finger circles, rapidly reversing repetitive hand movements, arm and leg extension, tandem walk, stand on one leg and skipping
Proprioceptive/ kinaesthetic sense	Arm and leg extension, tandem walk, stand on one leg and skipping
Rhythm	Finger to nose, thumb and finger circles, rapidly reversing repetitive hand movements, arm and leg extension, tandem walk, stand on one leg and skipping
Sequence	Finger to nose, thumb and finger circles, rapidly reversing repetitive hand movements, arm and leg extension, tandem walk, stand on one leg and skipping
Strength	Arm and leg extension, tandem walk, stand on one leg and skipping
Tactile discrimination	Palm form recognition and double simultaneous stimulation of hand and cheek
Visual acuity and attention	Eye tracking
Visual discrimination	Figure recognition and production and eye tracking
Visual-motor coordination	Eye tracking
Visual perception	Figure recognition and production
Visual spatial perception	Figure recognition and production

Adapted from Parush (2002:189) and Mutti (2012:114-11).

Besides the usefulness of the QNST, it is also practical, brief, relatively simple to administer and does not require specialised equipment, other than a pen, scoring sheet, a blank sheet of paper, a table, two chairs and a large room that is relatively quiet (Parush *et al*., 2002:187,190). The QNST-3 requires approximately 20 minutes for administration and 10 minutes for scoring per subject. If the subject is uncooperative or resistant, evaluation may be administered over two days (Mutti *et al*., 2012:21).

The authors of the QNST-3 recommend that the assessment should be conducted in the morning (Mutti *et al*., 2012:21). In the current study, the test was conducted at 08:45 in the school library. This guaranteed a minor chance of inexcessive sensory stimulation prior to evaluation, which enabled the subjects to have optimal attention for the task. The subjects were prepared by their teacher a week in advance that they would perform different types of activities on the selected evaluation days. This was done in order to reassure, pacify and prepare the subjects because these activities were not part of their 'normal' regular daily routine. See *Appendix B (Table B4)* for equipment required for evaluating subjects with the QNST-3.

The description of QNST-3's 15 tasks:

1. Hand skill:

The subject's dominant hand had to be identified. The subject was requested to write his/her name at the top of the page, as well as an age-appropriate sentence of 6 to 8 words. Hand dominance, pencil grip, as well as the presence of a tremor or conflicts of a smooth writing style was observed by the researcher (Mutti *et al*., 2012:25).

2. Figure recognition and production:

The subjects had to identify 5 figures. The subject firstly had to identify the figure and secondly, he/she had to draw each figure on a separate page. The researcher then asked the subject how the figures differed. The presence of a tremor (if the subject displays one), may emerge in the task (Mutti *et al*., 2012:26).

3. Palm form recognition:

The subject was requested to recognise numbers through an external tactile input. Numbers were drawn on the palm of the subject hand by the researcher's index finger or a blunt stick.

If the subject was 8 years or younger, the researcher could write the numerals 1 to 10 on a page, not in numerical order, and then ask the subject to identify each numeral (Mutti *et al*., 2012:30).

4. Eye tracking:

The researcher had to determine the subject's eye dominance prior to the tests. The researcher held a pencil at the subject's eye level, 45 cm away from the eyes, and asked the subject to follow it as it moves back and forth, while the researcher made a shoulder-width horizontal motion back and forth. This activity was repeated up and down to check vertical tracking and to detect crossed or wandering eyes (Mutti *et al*., 2012:31).

5. Sound patterns:

This task consisted of two components, namely the motor and the sound task. For the motor task the researcher and the subject began by facing each other with both palms down on their thighs. Using both hands, the researcher first patted out a pattern and the subject had to imitate the motor pattern with eyes closed. If the subject was younger than eight years and unable to execute the motor task, the researcher could instruct the subject to reproduce the sounds by clapping his/her hands. After the motor production was completed, the researcher presented the patterns verbally for the oral production, by means of pronouncing the word 'dot' in the sequence. The subject's eyes had to be open for the verbalisation of the patterns (Mutti *et al*., 2012:32).

6. Finger to nose:

The researcher instructed the subject to close both eyes and with their index finger, reach back and forth from the researcher's hand (hand was kept in a stationary position), to the tip of their own nose. The researcher had to note whether the subject used his right or left hand. The test was performed with eyes open and closed uninterruptedly. Once the pattern was completed with the right hand, the subject had to repeat the action with the left hand (Mutti *et al*., 2012:35).

7. Thumb and finger circle:

The subject was asked to form circles successively by touching his/her thumb with each of his/her fingers in sequence, starting with the right forefinger and ending with the little finger. The researcher was not allowed to mention the word "right" or "left" (Mutti *et al*., 2012:36).

8. Double simultaneous stimulation of hand and cheek:

The subject began in a seated position with eyes closed, placing both palms on his thighs. The researcher touched the back of both hands, then both cheeks, then the right hand and right cheek and then the left hand and left cheek. The researcher then touched the left hand and right cheek and then the right hand and left cheek. All touches had to be done lightly, quickly and simultaneously. After each contact, the researcher asked: “Where did I touch you?” If the subject was unable to verbally indicate where the researcher touched him, the subject was allowed to show by pointing his/her finger (Mutti *et al*., 2012:38).

9. Rapidly reversing repetitive hand movements:

The researcher demonstrated a series of rapid, repetitive hand movements by placing his/her hands on his/her thighs, palms down, with fingers close together. Then the researcher turned both hands over simultaneously, slowly at first and then rapidly. After the researcher demonstrated this action, the subject was instructed to repeat the movements (Mutti *et al*., 2012:38).

10. Arm and leg extensions:

The subject was seated (facing the researcher), with arms and legs extended in front of him/her. Firstly, the feet and legs were extended vertically, then the arms were stretched out, palms down and fingers spread widely, while the eyes were closed and the tongue stuck out. This position had to be held for a few seconds (Mutti *et al*., 2012:39).

11. Tandem walk:

In this task, the subject’s eyes were open and he/she had to walk on a straight line for at least 3meters, placing the heel of each foot directly against the toe of the opposite foot. The subject then had to walk backwards on the line, heel-to-toe. Next, the subject repeated the tandem walk forwards with eyes closed (Mutti *et al*., 2012:41).

12. Stand on one leg:

The subject was asked to balance on one foot with eyes open for 10 seconds and then balance on the other foot. Five seconds was acceptable if the subject was younger than 6 years. If the subject balanced well on both feet with eyes open, the subject was asked to repeat the task with eyes closed (Mutti *et al*., 2012:42).

13. Skipping:

The subject was asked to skip across the room and the researcher observed how the subject followed directions and balanced (Mutti *et al*., 2012:43).

14. Left-right discrimination:

This section was scored using the outcome of the performances from three other subtests. If the subject responded on any of the three tasks as if they were looking in a mirror, for example it the researcher held up her left hand the subject would also hold up their left hand. If this response occurred it was developmentally immature (Mutti *et al*., 2012:44).

15. Behavioural irregularities:

This item was composed from the general observations of the subject's behaviours during the entire test session. After the test had been conducted, any behaviour that seemed out of the ordinary during completion of any of the individual tasks, was recorded (Mutti *et al*., 2012:44).

The scoring procedures of the QNST-3

There are 13 discrete tasks and two sections that are overall observations, mainly observing laterality and behavioural irregularities. A score of 0, 1 or 3 is allocated, which is a direct indication of what the researcher observed during the task. A score of 1 is assigned to each criterion of the observed performances that could indicate a developmental discrepancy. In contrast, a score of 3 is specifically reserved for subjects indicating severe impairment and could also indicate neuro-typical development which can be associated with severe learning disabilities.

For each subtest, the task scores are added and then the sum of all 15 subtests is calculated. The total overall test scores are a summation of the subtest scores. In addition, the total overall score is translated into one of three criterion areas, namely: severe discrepancy (SD); moderate discrepancy (MD); or normal range (NR). See *Table C2* in *Appendix* C, for the discrepancy criterion and indicative explanation. Any unusual behaviour or response should be described in the *Comments* section of the protocol before the researcher commences with the next task (Parush *et al*., 2002:189; Pfeiffer *et al*., 2011:81; Mutti *et al*., 2012:25, 47, 49).

Reliability and validity of the QNST-3

There are predominantly three categories of reliability that are often denoted to quantitative data, namely: (1) the degree to which a measurement, given recurrently, remains constant ; (2) the steadiness of the measurement over a period of time; and (3) the resemblance of measurements within the given period of time (Golafshani, 2003:598).

Test reliability refers to consistency within the test. The three different types of reliability tests are: (1) the sampled items in relation to the domain of interest (internal consistency); (2) how consistent and stable the test results are produced over a period of time (test-retest); or (3) if there are different researchers testing (e.g. inter-rater reliability). Reliability must primarily be established in order to preclude scores of a specified test from confounding experimental results (Parush *et al*., 2002:194; Golafshani, 2003:598). When the researcher deals with a stable constant measure, the results derived from the study should be similar. A high degree of stability in turn indicates a high degree of reliability, in other words, the results are repeatable (Golafshani, 2003:599). When evaluating and considering the statistics, it has been noted that a coefficient of 0.80 or above will be accepted, although the researcher aims for 0.90 and above for a desirable effect (Mutti *et al*., 2012:60). The QNST-3's test–retest reliability correlations were largely at 0.70 or above (ranging from 0.49 to 0.96 for task scores) and 0.87 for the total score of the test (Pfeiffer *et al*., 2011:81; Mutti *et al*., 2012:61).

Validity in quantitative research regulates whether or not the test accurately measures what it envisioned to measure, or how truthful the results really are (Golafshani, 2003:599). There are three main types of validity, namely: (1) content validity, in which the researcher examines whether the items tested are sufficiently represented in the particular areas; (2) criterion-related validity examines the test scores of the particular test in relation to other tests that assesses the same aim; and (3) construct validity, which examines how well the designed test measures what it is intended to measure (Mutti *et al*., 2012:64). In short, validity, evaluates whether the means of the measurement are undeniably truthful and whether they are essentially measuring what they are proposed to measure (Golafshani, 2003:599). The QNST-3's internal validity is accepted by the strength of the correlation between subtasks and total test scores. All scores were reported to be moderately high (0.52-0.74), except for Task 1, which was the lowest at 0.21. This is due to specific behaviours noted when the subject was writing (fine motor), while the rest of the subtasks focused on other types of GMS (Mutti *et al*., 2012:66).

BOT-2 OVERVIEW

The BOT-2 is an individually administered test that has sub-tests that are engaging and goal directed, and which indirectly measure a wide range of gross and fine motor skills in four to 21 years old individuals. This test allows the researcher to reliably and efficiently measure the motor skills of the subjects (Bruininks & Bruininks, 2005:1). The BOT-2 is one of the most extensively used measures for evaluating motor discrepancies in subjects with disabilities, including the ASD population (Wuang & Su, 2009:848).

In 1978, the original Bruininks-Oseretsky Test of Motor Proficiency (BOTMP or Bruininks) was extensively used as a standardised measure of motor proficiency. It was used to detect motor skill deficits in individuals with mild to moderate motor control deficits, in a fun and reliable manner for both the researcher and subject (Bruininks & Bruininks, 2005:1).

The second edition of the BOT displays prodigious differences from the first edition, such as the removal of the response speed subtest and the inclusion of the visual-motor control subtest. The revision and addition of items in the running speed and agility, as well as the strength subtest and rearrangement of the subtests allow for easier administration and minimisation towards the subject's fatigue state (Wuang & Su, 2009:848). See *Appendix B* (*Table B5*) for equipment required when evaluating subjects with the BOT-2.

The BOT-2 Composites

There are four main motor area composites in the BOT-2: (1) Fine manual control, which specially focuses on control and coordination of the distal musculature on the hands and fingers; (2) manual coordination, which focuses on control and coordination of the arms and hands; (3) body coordination, which incorporates the control and coordination of large muscles that assists in maintaining skeletal posture and balance – both static and dynamic; and lastly (4) strength and agility, which emphasises control and coordination of large muscles involved in all locomotor aspects of movement (Bruininks & Bruininks, 2005:2).

There are two evaluation options for the BOT-2, namely the complete or the short form. The difference between the two tests are that the complete form is the preferred option in that it provides the most reliable measure of the subject's overall motor proficiency. The administering time is between 40 and 60 minutes, with an additional 10 minutes to set up the testing environment. When a researcher wants to screen an individual or use the results as part of an evaluation tool, the short form can be administered. The short form is fast and easy to administer and gives the researcher a single score of the subject's overall motor proficiency. The administering time is between 15 to 20 minutes, with an additional five minutes to set up (Bruininks & Bruininks, 2005:4, 5). The BOT-2 short form has been used in an ASD study (N=45) of high functioning ASD individuals aged between four and 21 years old (Bruininks & Bruininks, 2005:68).

In the current research study, the researcher decided to make use of the short form because 60 minutes could be very stressful and exhausting for a subject with ASD, which could result in inaccurate data collection. Previous studies have also used the BOT short form as part of their research to test subjects with ASD's motor functioning (Bruininks & Bruininks, 2005:68; Pan *et al*., 2009:1695; Bhat *et al*., 2011:1117).

The BOT-2 short form has eight different subtests with a total of 14 different activities, and numerous outcomes for each activity. An overview of these activities is provided in Table 3.3.

Table 3.3: The primary and secondary outcomes of the BOT-2 short form

PRIMARY OUTCOME	SECONDARY OUTCOME
Balance	Posture control. Static and dynamic balance. Stasis and movements.
Bilateral Coordination	Body control. Sequential and simultaneous coordination.
Fine Motor Integration	Visual-motor integration.
Fine Motor Precision	Precision of the hand and finger movements and muscles.
Manual Dexterity	Bimanual coordination especially with smaller objects. Precision with differentiating levels of dexterity.
Running Speed and Agility	Observation regarding individual's gait.
Strength	Trunk strength. Upper and lower body strength.
Upper-Limb coordination	Visual tracking of upper limbs. Hand eye coordination. Bilateral coordination.

Adapted from Bruininks & Bruininks (2005:5-6).

The BOT-2 Subtests

The following descriptions explain the purpose and outcomes of each subtest, while Figure 3.2 provides a thorough overview of the subtests:

***Fine Motor Precision*:** These tests involved activities that require precise control of hand and finger movements. Because the primary focus is precision, these activities were not timed. The activities involved the subject to draw lines through a crooked path and folding a paper (Bruininks & Bruininks, 2005:5).

***Fine Motor Integration*:** This subtest entailed visual stimuli integration with additional motor control. The subject had to accurately and precisely reproduce a variety of geometric shapes, which was referred to as visual motor integration. Subtest 1 (draw a square) and 2 (draw a star), enabled the researcher to determine the subject's preferred hand. This subtest was not timed (Bruininks & Bruininks, 2005:5).

***Manual Dexterity*:** Goal directed activities are included in this subtest. Although the activities were timed, the emphasis was on how accurate the tasks were performed. The activities involved the subject to transfer pennies from one point to another (Bruininks & Bruininks, 2005:5).

***Upper Limb Coordination*:** Visual tracking, with coordinated hand and arm movements was assessed by this subtest, through activities such as dropping and catching a ball with two hands and dribbling a ball while alternating hands. The researcher also had to determine which hand the subject preferred (Bruininks & Bruininks, 2005:6).

***Bilateral Coordination*:** This subtest involved the control of body parts, mainly the upper and lower limbs that work in successive and synchronised coordination. Because most of these movements were unfamiliar to the subjects, creative protocols had to be found to demonstrate and explain the activities to the subjects. The activities consisted of jumping in place and tapping feet and fingers while same sides of the body were synchronised (Bruininks & Bruininks, 2005:6).

***Balance*:** The most integral motor control skill, which is essential for maintaining body posture when performing a locomotor or object manipulative skill, was found in this subtest.

Trunk support and stability was assessed through activities such as walking on a line and standing on one leg on a balanced beam (Bruininks & Bruininks, 2005:6).

Running Speed and Agility: This subtest assessed running speed and agility through assessing a one legged stationary hop. It additionally, provided an opportunity to make clinical observations regarding the subjects' gait (Bruininks & Bruininks, 2005:6).

Strength: This subtest measured trunk, upper and lower body strength, which are integral parts of GMS and leisure activities. The type of strength activities included push ups and sit ups (Bruininks & Bruininks, 2005:6).

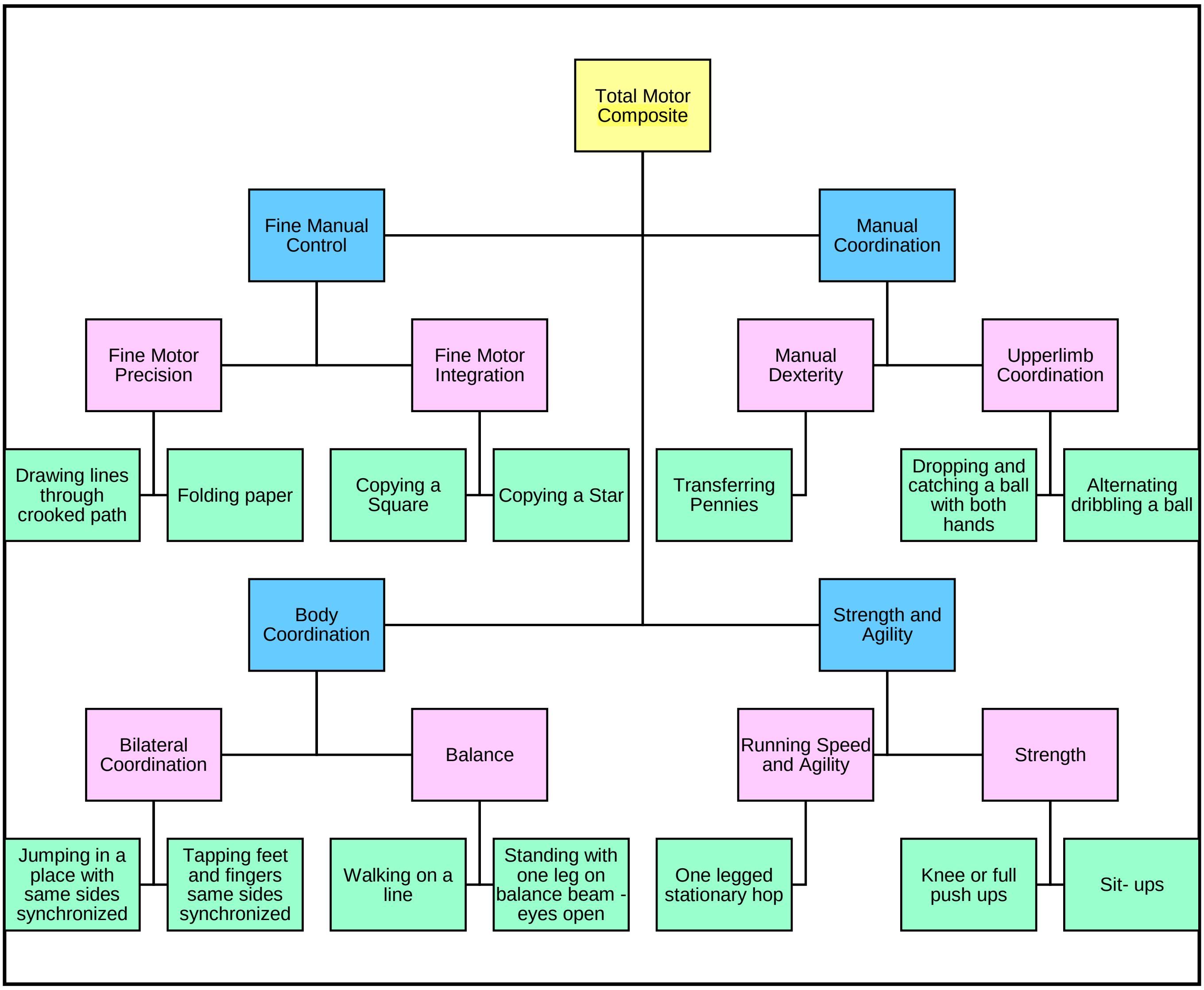

Figure 3.2: BOT-2 short form overview.

Adapted from Bruininks & Bruininks (2005:4); Wuang *et al*. (2009:849).

Scoring procedures for the BOT-2

The most important aspect to take into consideration with objectivity is to obtain the validity of the results. The subtests were scored by making use of different numbers of response categories (Bruininks & Bruininks, 2005:29; Wuang *et al*., 2009:848).

Once the raw scores were correlated with the standard norms, the researcher could additionally, refer to the descriptive categories, which made it easier to explain the results to parents or teachers. There are five different descriptive category levels of motor proficiency in the subtests. The categorical combinations that make use of a broad range of standard and scale scores are described in Table C3, in *Appendix* C.

Objectivity, reliability and validity of the BOT-2

Reliability tests serve to observe whether a study's outcomes can be replicated (Golafshani, 2003:599). The test-retest reliability was determined by using the Pearson correlation between scores from the pre- and post-tests. Generally, the reliability coefficients for the BOT-2 test are quite high. The average of the subtest correlation coefficients is in the upper 0.70's for subjects aged 4 to 21 years old and 0.69 for subjects aged 13 to 21 years old. The average of the composite correlation coefficients is in the low 0.80's for subjects aged 4 to 12 years and 0.77 for subjects aged 13 to 21 years. The reliability coefficients for the short form and the total motor composite are in the mid to upper 0.80's (Bruininks & Bruininks, 2005:54, Wuang *et al*., 2009:848). The inter-rater reliability coefficients are extremely high for the subtests in Manual Coordination, Body Coordination, Strength and Agility composites, with coefficients of 0.98 and 0.99. The Fine Manual Control composite coefficient is also relatively high at 0.92, with correlation coefficients ranging from 0.38 to 0.55.The associations among subtests and composites reduced slightly with age. Validity is the degree to which a test measures what it intended to measure. This is the most essential consideration in test development and assessment (Bruininks & Bruininks, 2005:56). Reliability and validity in quantitative research reveal that, firstly, the results of reliability tests are repeatable, and secondly, that the measurement is actually accurate and measures what it intends to measure (Golafshani, 2003:599).

ETHICAL CONSIDERATIONS

Marczyk *et al.* (2005) stated that most studies involving human participants, include some degree of risk. The researchers ensured the best possible protection to ensure that all the subjects' rights, interests and ethical considerations were employed throughout the duration of the research study.

The following was required from all participating parties, in order for the research study to commence. Permission was granted by the Research Ethics Committee: Human Research (Humanities) at Stellenbosch University: SU-HSD-001759. Refer to A1 in *Appendix A*. The Western Cape Education Department (WCED) as well as the principal and governing body of the participating school also granted the researcher permission (A2 & A3 in Appendix A).The parents or legal guardians of the subjects were given a consent form which explained the nature of the study. No research was conducted without a signed informed consent form (A4 in *Appendix A)*.The nature of the study was verbally explained to each ASD subject using pictures. No research was conducted on a subject without signed informed assent form (A5 in *Appendix A)*. The confidentiality aspect of the study was of high importance as the subjects and parents or legal guardians were informed that all data collected would be kept confidential. The data was filed and stored on a password protected computer in a locked office. Only the researcher, supervisors and statistician had access to the data.

DATA PROCESS, ANALYSIS AND STATISTICS

The subjects were randomised by the Director of Statistical Consultation at Stellenbosch University, Prof. M. Kidd, who was not involved with the subjects in any way. He performed a randomisation sequence, in order for the subjects to be randomly assigned to the control and experimental groups using the Excel random number generator.

The statistical methods used were the mixed model repeated measures ANOVA, to simultaneously compare pre- and post-test measurements among the groups and the effect of the intervention over time. The group*time effect was used to test the hypothesis of the change over time for both groups, and typically if the change would be the same for both groups.

The researcher depend on the results of the degrees of freedom, as well as the F statistic, which would in turn, provide the p value to indicate whether a statistical significant difference occurred or not. Relevant means, standard deviations and p values were reported. The confidence interval was set at 95%, indicating significance of $p=\leq 0.05$.

SUMMARY:

The study made use of a group trial design that consisted of a control (n=8) and an experimental group (n=7). Subjects were randomly assigned to one of the two groups. The population of the study were children with ASD. The sample were homogenous purposively and conveniently selected from an LSEN School in Mitchells Plain, as all the subjects were formally diagnosed with ASD. The subjects were mainly in the Level 2, ASD functioning category. The study was conducted in two different settings, namely the Department Sport Science at Stellenbosch University and the selected school in Mitchells Plain. The study had a series of inclusion and exclusion criteria, which the subjects had to adhere to in order to participate in the study.

The aim of the study was to explore the effect of a self-designed dance programme for selected children diagnosed with ASD. There were three sub-aims: (1) to explore the extent of the gross motor skill deficits of children with ASD; (2) to explore the body awareness of children with ASD; and lastly (3) to determine the influence that the dance programme had on the GMS and body awareness of the selected children with ASD.

Quantitative data was collected four weeks prior to the intervention (16 weeks), as well as four weeks after the intervention. Both the QNST-3 and BOT-2 are standardised tests.

The QNST-3 that consists of 15 tasks observed neurological soft signs and minor motor irregularities. It has a test- retest reliability between 0.70 and 0.87 and an internal validity of 0.52 to 0.74. The BOT-2 measures GMS and is most reliable and effective for an ASD population. It consists of four main composites and eight sub-tasks. Furthermore, it has a correlation coefficient of 0.70, a composite correlation coefficient of 0.80, a reliability coefficient of 0.80 and an inter-rater reliability coefficient of 0.98 to 0.99.

The intervention programme was designed by the researcher. It focused on the gross motor skill needs of the subjects, such as locomotion, hand-eye coordination, bilateral coordination and foot-eye coordination, core strength, balance, spatial awareness, proprioceptive and vestibular stimulation, tactile discrimination, motor planning, object manipulation and anaerobic endurance. The body awareness components that were focussed on were body concept, body-image, body-schema, laterality and directionality. The music included in the dances was a combination of both melody and folk music.

The programme remained unchanged throughout the intervention period, yet small adptations were allowed to meet the subject's needs. With regards to the ethical component of the study, the researcher obtained permission from all relevant parties.

The data analysis of the study was determined using a mixed model of repeated measures ANOVA, to compare the pre- and post-test results of both the control and experimental groups.

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CHAPTER 4

RESULTS AND DISCUSSION

> *"Movement experiences are integral for the early development of a child's neural network of their brain, this also forms that basis for further learning and development"* (Lam, 2011: 189).

OVERVIEW OF CHAPTER

The relevant results will now be reported and discussed. The results presented in this chapter comply with the sequence of the pre-test, followed by the implementation of the intervention programme and finally concluding with the post-test. The following terminology was used in this chapter: the term 'activity' refers to an activity in the intervention (*Appendix B – B1*); and the term 'task' or 'subtest' refers to the scientific assessments of the QNST-3 and/or BOT-2. In this chapter the research question and the corresponding sub aims were answered. The outcomes of the scientific assessments are presented in figures and the significant variations explained below the specific figure. Research with related and those with conflicting results were discussed.

INTRODUCTION

The aim of study was to explore the effect of a self-designed dance programme, with a specific focus on the gross motor skills (GMS) and body awareness of selected children with ASD. The sub aims were to:

1. identify the extent of GMS.
2. explore body awareness.
3. investigate the influence of a self-designed dance programme.

DEMOGRAPHICS OF THE SUBJECTS

The subjects that participated in the study were all formally diagnosed with ASD by psychologists. Additionally, all the subjects lived in the Mitchells Plain area, which is situated on the Cape Flats, Cape Town, Western Cape Province, South Africa (Stevens, 2013:1).

The subjects attended a school for Learners with Special Education Needs (LSEN), which is a school for children with barriers to learning. The school is bilingual, allowing for both English and Afrikaans learners and has an ASD unit with four classes.

The chronological ages of the subjects corresponded with the scientific assessments used in the current study. The QNST-3, as well as the BOT-2 requires the chronological age of each subject in order to determine the total point score, as well as the standard score for the BOT-2. The QNST-3 covers a wide age range, 5- to 80+ years (Parush *et al*., 2002:188) whereas the BOT-2 has an age range of 4- to 21 years (Bruininks & Bruininks, 2005:68).

Figure 4.1 represents the age ranges of the control (n=8) and experimental (n=7) groups. The minimum age was 7.0 years and the maximum age, 13.11 years for both groups. The experimental group's mean age was 9.92 years and that of the control group, 9.28 years. The overall mean age of the subjects (total group) was 9.58 years. The control group consisted only of boys (n=8), whereas the experimental group consisted of boys (n=5) and girls (n=2). Out of the total group of subjects (N=15), 87% were boys and 13% girls. This supports the finding by Ornoy *et al*. (2015:156) that ASD is three to four times more likely to occur in males. The ASD unit of the school had five girls; however, not all of them could be included in the study because they were non-verbal. Primarily coloured (87%) and black (13%) children with ASD participated in the study.

In 2011, a national census was conducted by Statistics South Africa. The following information, specifically for Mitchells Plain, was recorded: the ethnicity of the Mitchells Plain community revealed that 90.8% were coloureds and 7.3% were blacks; and the primary home languages of the community were English (47.4%) and Afrikaans (46.9%).

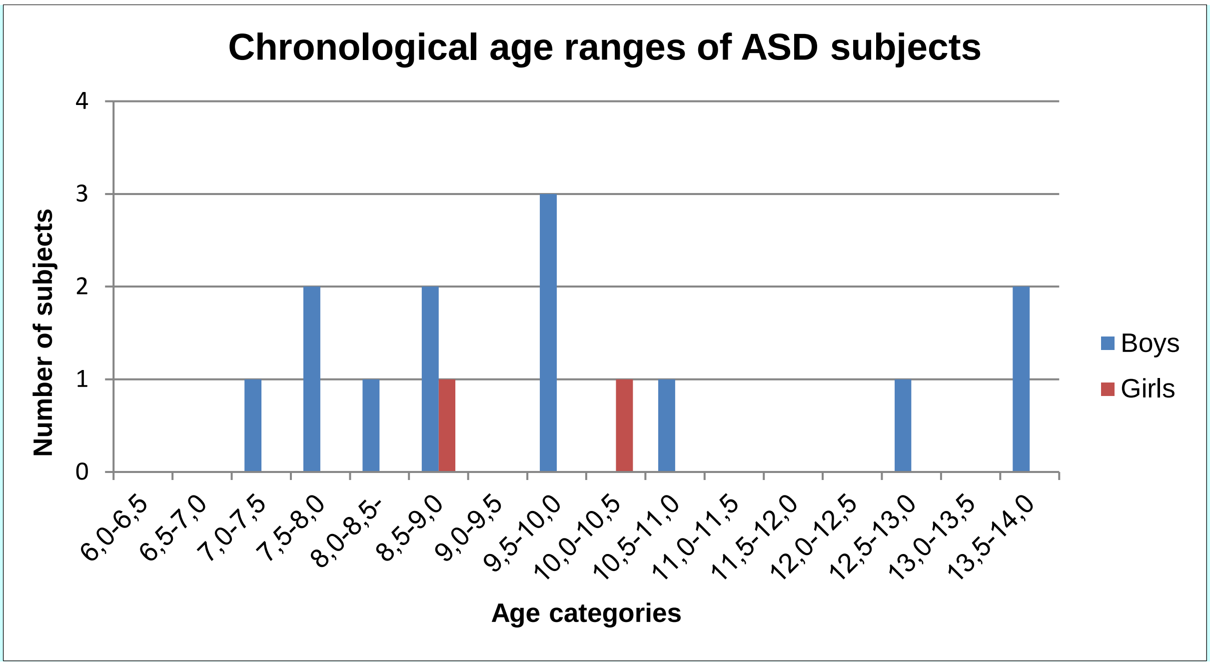

Figure 4.1: The chronological age ranges of the ASD subjects.

OUTCOME VARIABLES

Results obtained from the QNST-3

The following discussion portrays the results obtained from the QNST-3 during the pre- and post-tests. The term, task or subtask will be used when referring to the content of the QNST-3.

With reference to Figures 4.2 to 4.17, a decrease in score indicates an improvement, and in turn an increased score is an indicative of poorer performance made during the test. *Table 4.1* represents the QNST-3 subtasks (1 to 15). The group*time effect of the ANOVA was used to disregard the fact that both groups will have the same effect of change over time. Table *4.1*, has symbols (a, b, c), where the symbols are the same from pre- to post-test, it is an indication of significance. The aim of the current study was, amongst others, to determine whether a self-designed dance programme had a significant change over time in the experimental group. In order to verify whether a significant difference occurred, the degrees of freedom in the F bracket are provided in *Table 4.1*. The F statistic was also reported in *Table C4*, where the F bracket indicated the p value, which could be a significant value. Furthermore, the means and standard deviations of the control and experimental group during the pre- and post- tests can also be observed in *Table 4.1.* The figures below

(Figures 4.2 to 4.25) represent the group*time effect for both the control and experimental groups. The vertical bars on the figures denote 0.95 confidence intervals.

Table 4.1: **The group* time effect of the QNST -3 for the control and experimental groups indicating the means and standard deviations**

MEASUREMENT	GROUP * TIME	CONTROL PRE TESTING	CONTROL POST TESTING	EXPERIMENTAL PRE TESTING	EXPERIMENTAL POST TESTING
Task 1	F(1,13) = 0,36 P=0,56	0,63 (1,41)	1,75 (1,76)	0,14 (0,38)	1,89 (1,46)
Task 2	F(1,13) = 0,74 P=0,41	1,63 (2,26)	3,63 (2,77)	2,57 (1,81)	3,57 (3,21)
Task 3	F(1,13) = 6,93 P=0,02	5,38 (3,25) a	4,38 (2,97) a	6,00 (3,06) a	1,00 (1,15) b
Task 4	F(1,13) = 6,78 P=0,02	2,38 (2,39) b	6,25 (3,37) a	3,00 (3,32) ab	2,57 (2.51) b
Task 5	F(1,13) = 2,61 P=0,13	8,75 (3,24)	7,00 (4,47)	7,57 (2,07)	3,14 (2,27)
Task 6	F(1,13) = 5,70 P=0,03	3,63 (3,34) ab	5,63 (2,72) a	2,43 (1,40) bc	0,71 (0,49) c
Task 7	F(1,13) = 0,01 P=0,94	2,38 (2,39)	1,88 (1,25)	1,14 (0,69)	0,57 (0,53)
Task 8	F(1,13) = 5,42 P=0,04	3,13 (3,18) ab	3,13 (3,56) ab	4,29 (3,59) a	0,57 (1,13) c
Task 9	F(1,13) = 1,37 P=0,26	4,75 (3,45)	3,00 (2,33)	3,86 (2,41)	0,29 (0,49)
Task 10	F(1,13) = 10,9 P=0,01	4,88 (3,91) b	1 0,50 (5,07) a	3,86 (4,49) b	2,14 (1,46) b
Task 11	F(1,13) = 13,39 P=0,00	2,38 (1,77) bc	3,88 (2,75) a	2,71 (2,29) ab	0,86 (0,69) c
Task 12	F(1,13) = 5,02 P=0,04	1,50 (0,93) b	2,50 (1,31) a	1,43 (0,79) b	1,00 (0,58) b
Task 13	F(1,13) = 8,15 P=0,01	2,63 (2,45) a	2,75 (2,49) a	2,29 (1,60) a	0,29 (0,49) b
Task 14	F(1,13) = 0,61 P=0,45	1,38 (0,92)	1,88 (0,83)	1,29 (0,49)	1,29 (1,25)
Task 15	F(1,13) = 0,02 P=0,89	2,50 (1,93)	2,50 (1,07)	2,71 (1,50)	2,57 (1,27)
QNST TOTAL POINT SCORE	F(1,13) = 56,23 P=0,01	47,88 (19,33) b	60,63 (24,17) a	45,29 (12,20) ab	22,43 (10,53) c
NOTE:					

*The group * time column: F is indicated as the Degrees of Freedom in (), thereafter the value indicates the F- statistic. Lastly, the p- value is indicated, this is a summation of the previous two values.*   *The control & experimental pre- testing and post- testing results: Indicates the mean and the standard deviation. Additionally the symbols allocated are the same as those indicated on the Figures of the various tasks- indicating significance.*

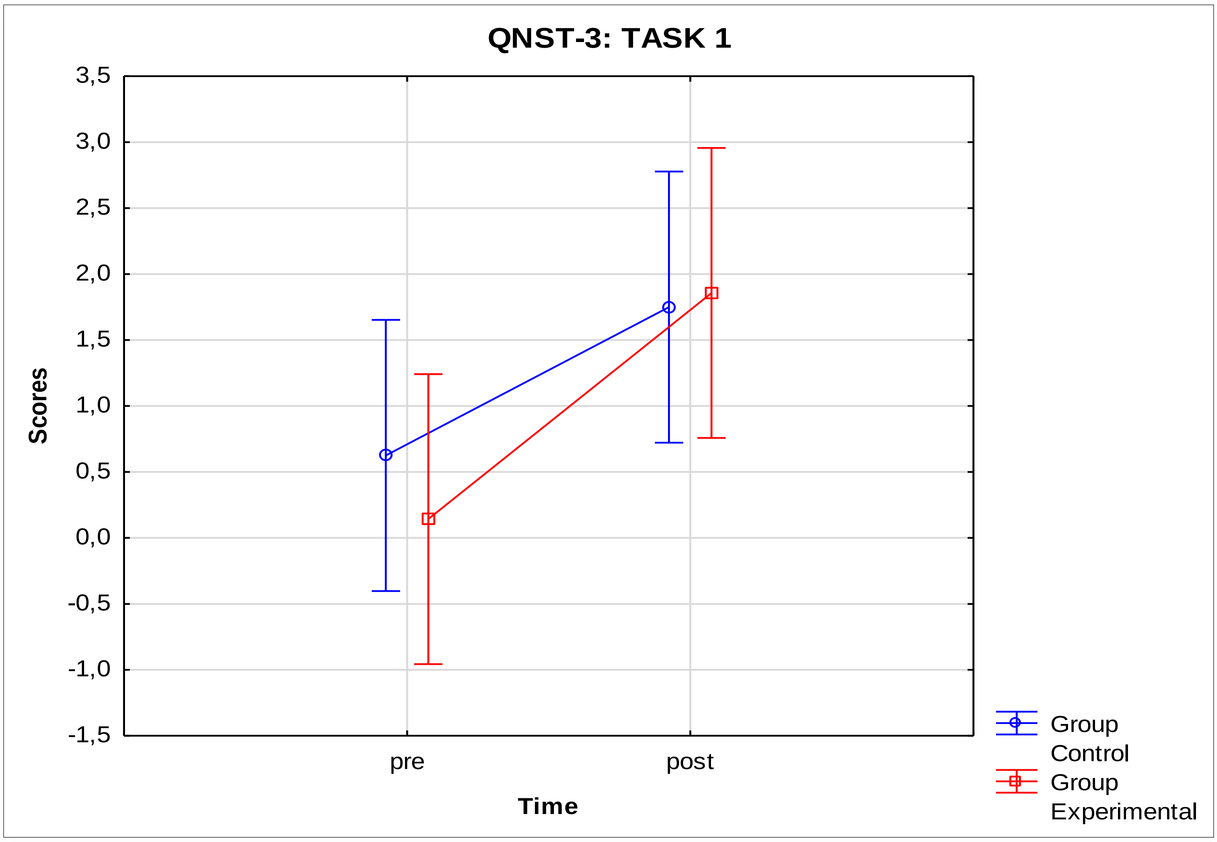

Figure 4.2: Hand skills task

The results of the hand skills task (Figure 4.2) indicate that the experimental group performed 78% better than the control group during the pre-test (p=0.50). The experimental group performed significantly poorer ($p \leq 0.05$) by 1250%, from the pre- to post-test. In addition, the control group worsened significantly ($p \leq 0.05$) by 178% over time. According to the results, the performance of both groups in motor maturity, motor planning, fine motor skills, hand eye coordination and lateral preference worsened.

Conson *et al*. (2016:1052) alleged that hand laterality tasks require the participant to make an informed decision as to whether a presented visual stimulus will be revealed in the left or right hand. Additionally, Conson *et al.* (2016:1052) proclaimed that hand laterality involves two core indicators: the biomechanical effect, which enables the individual to mentally activate the sensorimotor information during the handwriting action; and the postural effect of the participant, which enables the individual to incorporate the particular dominant side for the execution of the task. Grace *et al*. (2017:1006) stated that handwriting can be particularly challenging for children with ASD because it involves cognitive, linguistic, perceptual and motor processes that occur simultaneously.

Fuentes *et al*. (2009:1535) proclaimed that children with ASD overall had a lower quality of handwriting when compared to neuro-typical children. The quality of handwriting can be a direct link to motor deficits, which in turn, may result in poor letter formation. Kushki *et al*. (2011:1710) agreed with this statement and found significant results ($p \leq 0.05$) in his study. Additionally, Viadero (2009:5) reported that children with ASD had deficits in handwriting, specifically in forming words; however, this deficit did not carry over to handwriting spacing and alignment thereof. Kushki *et al*. (2011:1710) disagreed with Viadero, by confirming that handwriting readability can be associated with certain aspects such as letter formation, alignment, appropriate sizing and spacing of the letters. Fuentes *et al*. (2009:1535), however, found no difference between the alignment and sizing of the letters of children with ASD and neuro-typical children. Paquet *et al*. (2017:45) found no significant results in the lateral preference in a sample of children with ASD. Naider-Steinhart (2007:396) and Kushki *et al*. (2011:1710), highlighted important factors, which could contribute to the quality of handwriting with an individual with, including sub-optimal motor skill, written language and perceptual factors.

Blythe (2006:426) confirmed that after an exercise intervention programme, no notable handwriting difficulties were found. Parush *et al.* (2002:192) evaluated children with perceptual motor deficits using the QNST-2, and found a significant difference ($p \leq 0.001$) in Task 1 when comparing children with ASD to neuro-typical children. The results of the current study corresponded with the findings of Parush *et al*. (2002:192). However, the control group of the current study consisted of children with ASD and not neuro-typical children.

In the current study, it was found that both ASD groups (control and experimental) did not perform well at the pre-test, which is supported by the findings of Fuentes *et al*. (2009:1535), Viadero (2009:5) and Kushki *et al*. (2011:1710) who found deficits in the handwriting quality and readability of children with ASD. It was envisioned that both groups' handwriting skills would significantly deteriorate over time, because the current study did not focus on fine motor skills during the intervention. This aspect is out of the researcher's professional scope of practice. Although the hand eye coordination component of the task was incorporated in activities 2, 3 and 5, as well as fine motor skills being part of their school curriculum, it was anticipated that the integration of this component would result in some sort of an improvement.

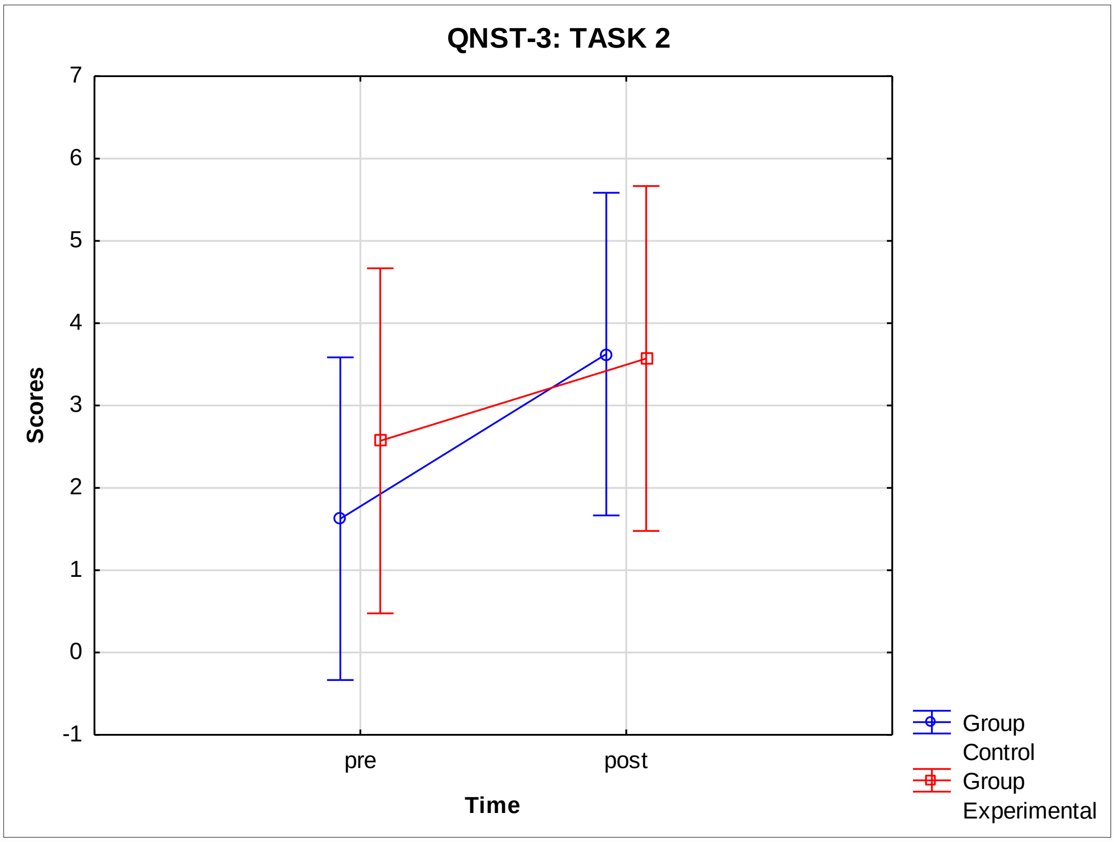

Figure 4.3: Figure recognition and production task

The results of the figure recognition and production task indicate that the control group performed 58% poorer than the experimental group during the pre-test ($p=0.49$). From pre- to post-test, the control group performed significantly poorer by 123% ($p\leq0.05$). The experimental group worsened slightly by 39% ($p=0.26$) over time. The experimental group performed 2% better than the control group ($p=0.97$) during the post-test. According to the results (Figure 4.3), both groups worsened over time with reference to motor maturity, motor planning, fine motor skills, hand eye coordination, visual discrimination, visual perception and visual spatial perception.

Haswell *et al*. (2009:971) claimed that children with ASD, who display imitation impairments and proprioception deficits, have significantly increased ($p=0.03$) social impairments. Additionally, Haswell *et al*. (2009:971) indicated that children with ASD displayed impaired imitation when compared to neuro-typical children. In accordance with Haswell *et al.* (2009:971), Parush *et al*. (2002:192) assessed children who displayed perceptual motor deficits by administering the QNST-2, and found a significant difference ($p\leq0.001$) in Task 2 when compared to neuro-typical children. Smith *et al*. (2016:3488) found conflicting results indicating no significant difference ($p\geq0.05$) between the drawings of children with ASD and neuro-typical children. In agreement with Smith *et al*. (2016:3488), Kushki *et al*. (2011:1712) found no significant difference ($p\geq0.05$) between the visual perception of children with ASD and neuro-typical children.

Blythe (2006:426) found a significant improvement in the coordination of children who participated in an intervention programme. Venetsanou and Kambas (2004:130) evaluated typically developing children between the ages of 9 and 11 years, and found that the directional awareness of subjects improved after they participated in a 9-week traditional dance programme. However, Krog and Kruger (2011:81) found no significant results ($p\geq0.05$) regarding the perception of children with special needs after a 10-week movement programme.

The results of the current study indicate that both groups did not perform exceptionally well during the pre-test. These findings are supported by Haswell *et al*. (2009:971), who alleged that imitation deficits were present in children with ASD. The current study predicted that an improvement would occur in the experimental group because activities 1, 2, 4, 5, and the cool-down, involved the subjects imitating the researcher during the dance. The visual perception aspect of the task was also incorporated in the visual motor integration of activity 2 and between stimulation activities. The task also required hand-eye coordination, which formed part of activities 2, 3 and 5. Thus, when taking into consideration the integration of skills in the various dances, an improvement could theoretically be envisioned.

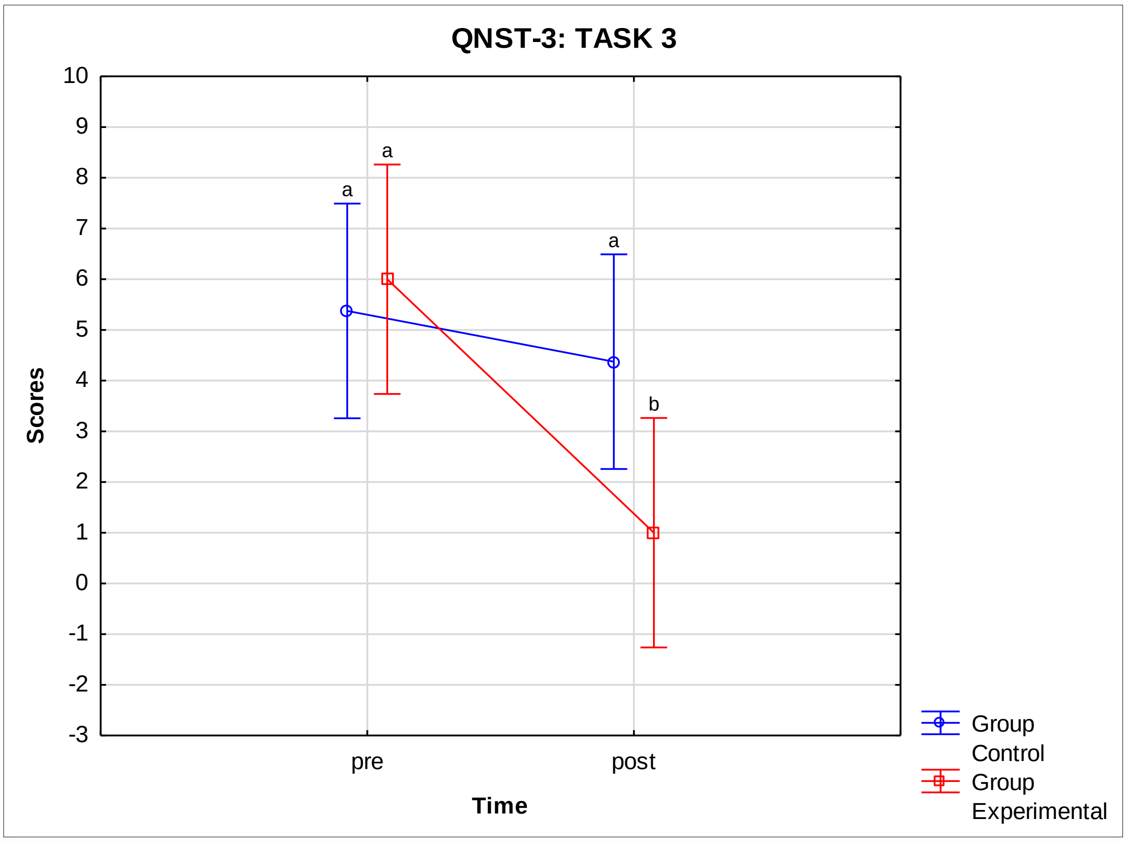

Figure 4.4: Palm Form Recognition Task

The results of the palm form recognition task (Figure 4.4), indicated that the control group performed 12% better than the experimental group (p=0.67) at the pre-test. The experimental group increased their performance significantly (p≤0.05) by 83% from the pre- to post-test. The control group also improved slightly by 19% (p=0.35) over time. The experimental group performed better at the post-test, having a significance of p≤0.05 and improving by 77%. According to Figure 4.4, both groups improved with reference to lateral and tactile discrimination.

When compared to neuro-typical children, children with ASD demonstrate sensory processing abnormalities (Baranek *et al*., 2006:598; Fuentes *et al*., 2011:1359). Comparable results, after evaluating children with perceptual motor deficits by administering the QNST-2, were found by Parush *et al*. (2002:192). In comparison to neuro-typical children, Parush *et al*. (2002:192) established a significant difference (p≤0.001) in the results of children with ASD for Task 3. With specific reference to the tactile aspect of the task, DeBoth and Reynolds (2017:45) reported that ASD children have deficits in the perception of tactile and external tactile stimulation. Agreeing with DeBoth and Reynolds (2017:45-46), Ashburner *et al*. (2008:570) reported that increased tactile sensitivity has been positively associated with attention difficulties. However, O'Donnell *et al*. (2012:591) found no significant difference (p=0.46) between the tactile sensitivity of an ASD group and a PDD-NOS (Pervasive Developmental Disorder-Not Otherwise Specified) group. The numeral and letter spatial aspects of the task have been noted by Bobis (2008:4), who reported the significant influence that spatial abilities have on the numeracy development of children with ASD.

As depicted in Figure 4.4, both groups did not achieve desirable scores at the pre-test, because the results were above eight and revealing many errors, which is in agreement with ASD children's sensory abnormalities (Baranek *et al*., 2006:598; Fuentes *et al*., 2011:1359). However, both groups improved over time. Reasons for the improvement of the control group cannot be accounted for as the researcher had no control over this improvement. The significant improvement of the experimental group can be a result of the underlying link of lateral discrimination and tactile awareness that were components of activities 1, 2, 3, 4, 5, the cool-down and stimulation activities. An additional element of the intervention programme was that most of the equipment used provided tactile stimulation.

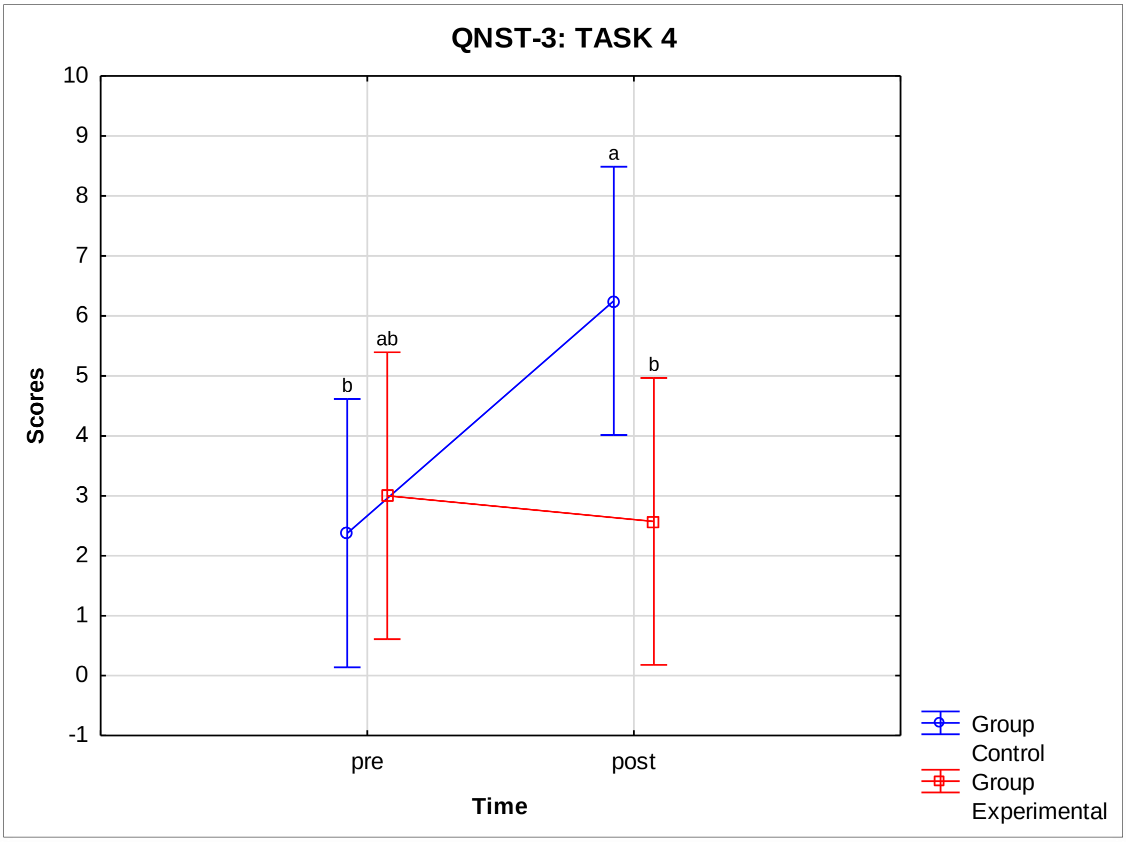

Figure 4.5: Eye tracking task

The results of the eye tracking task (Figure 4.5), indicate that the control group performed 26% better than the experimental group during the pre-test ($p=0.69$). The control group performed significantly worse ($p\leq0.05$) by 163% from the pre- to post-test. Over time, the control group worsened significantly ($p\leq0.05$) by 163%. Over time, a slight improvement of 14% occurred for the experimental group ($p=0.73$). The experimental group performed significantly better (59%) ($p\leq0.05$) at the post-test. Therefore, the visual discrimination, visual acuity, attention and visual motor coordination skills of the control group deteriorated, whereas all these aspects of the experimental group improved.

Schärli *et al.* (2012:81) stated that neuro-typical children should have a fully developed visual system by the age of 12 years. Contrasting findings were made by Leekam *et al*. (2007:906). A sample of 200 children with ASD, with a mean age of 12 years and 7 months, indicated significant deficits ($p\leq0.01$) in the visual domain of the sensory system. In accordance with Leekam and co-workers, Hilton *et al*. (2010:941) indicated that ASD children have significant visual sensory processing difficulties ($p\leq0.05$) when compared to neuro-typical children. In accordance with the previous authors, Tomchek and Dunn (2007:194) depicted that subjects with ASD have definite sensory processing deficits in comparison to neuro-typical children when assessed with the QNST-2.

A significant difference ($p\leq0.05$) was found in the results of task 4 compared to the results of neuro-typical children. Parush *et al*. (2002:192), assessed children with perceptual motor deficits by administering the QNST-2, and found a significant difference ($p\leq0.05$) in task 4, when compared to neuro-typical children. Fuentes *et al*. (2011:1356) found that children with ASD had significantly 'lower registration' scores for a visual processing test ($p=0.02$), which suggest that there is a neurological threshold of hyposensitivity. Paquet *et al*. (2017:45) found that their ASD sample were less lateralised, for they had a significant difference ($p\leq0.001$) in the strength of ocular laterality, however, no significant difference was found in eye preference.

In disagreement with Leekam, Fuentes, Hilton and their co-workers- O'Donnell *et al.* (2012:591) found no significant visual sensitivity differences ($p=0.52$) in a sample of ASD and PDD-NOS children. Interestingly, Baranek *et al*. (2006:598) reported that 38% of the ASD sample indicated simultaneously hypo- and hyper-responsiveness, which indicated a mixed pattern of response.

Leekam *et al*. (2007:906) and Hilton *et al*. (2010:941) found that sensory processing difficulties were present in ASD children, and therefore, the lack of desired performance at the pre-test by the control and experimental groups could be rationalised. In the current study, the experimental group's improved performance over time could be a result of the integration of the visual system and dances (activity 2). The distractibility component of the task can also be drawn back to the dances, because the children were stimulated prior, or whenever needed, in order to focus. The children enjoyed the music which allowed them to remain, on the activity, and not be distracted.

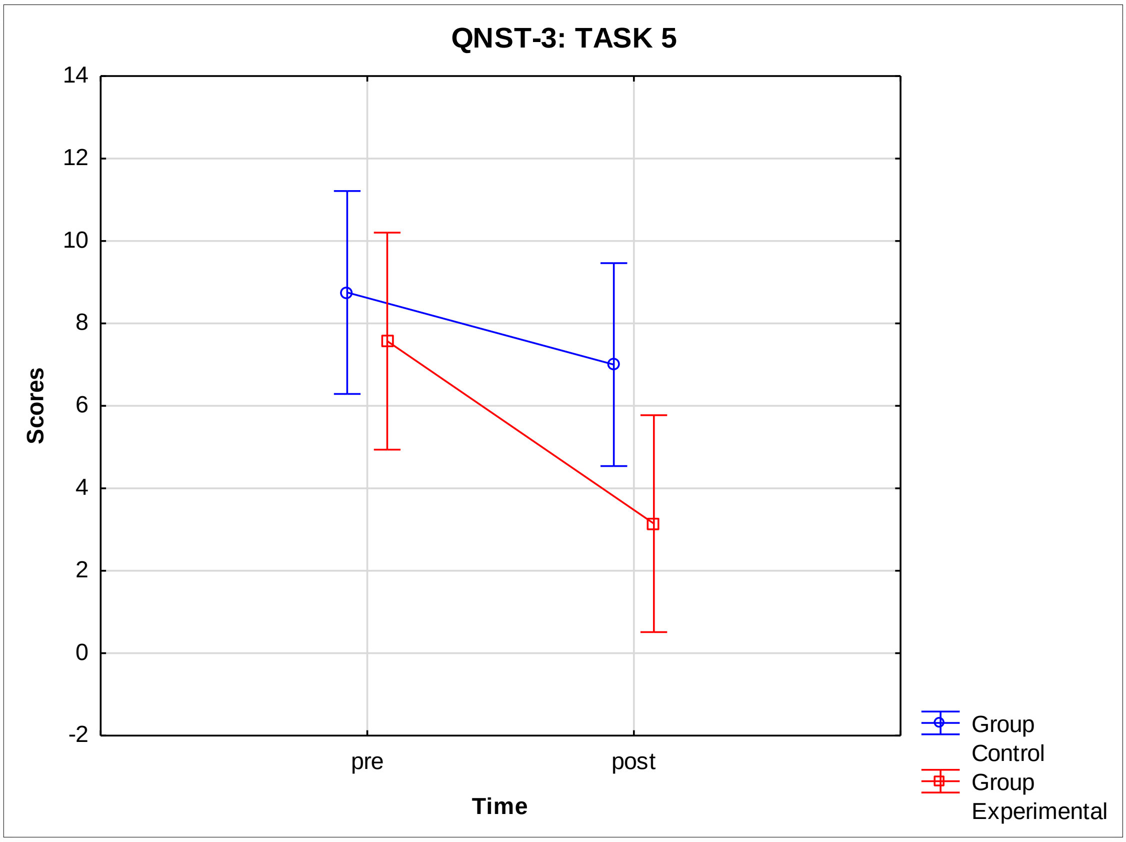

Figure 4.6: Sound patterns task

The results of the sound patterns task (Figure 4.6) indicate that the experimental group performed 13% better than the control group during the pre-test (p=0.49). As portrayed in Figure 4.6, the experimental group improved significantly (p≤0.05) over time by 59%. The control group also improved by 20% over time (p=0.49). During the post-test, the experimental group performed significantly better (p≤0.05) by 55% when compared to the control group. The following skills of both groups improved over time: motor maturity, motor planning, lateral discrimination, auditory acuity and attention, auditory discrimination, auditory perception and auditory spatial orientation.

Baranek *et al.* (2002:411) found no significant difference ($p \geq 0.05$) between the auditory acuity of an ASD control and experimental group. However, their experimental group displayed less auditory associated behaviour and more peculiar behaviour. Conversely, a study by Hilton *et al*. (2010:94) displayed significant results ($p \leq 0.01$), indicating that children with ASD had atypical sensory auditory processing responsiveness in comparison to neuro-typical children. In addition to addressing the sound and motor patterns of task 5, Haswell *et al*. (2009:972) confirmed that children with ASD have significant impairments ($p=0.01$) in their motor (gestures) and verbal (commands) performance. When solely focussing on the verbal aspect, Ingersoll and Schreibman (2006:493) observed lower rates of imitative language in children with ASD during the pre-test. However, at the post-test, four of the five subjects in their study improved their verbal imitation (Ingersoll & Schreibman, 2006:493).

In contrast, Ceponiene *et al*. (2003:5570) reported that a sample of high functioning children with ASD had intact sensory sound processing. Leekam *et al*. (2007:906), on the contrary, found no significant shortfalls ($p \geq 0.05$) in the auditory sensory domain of individuals with ASD. O'Donnell *et al*. (2012:591) found no significant difference ($p=0.75$) in auditory filtering when comparing ASD and PDD-NOS participants. With reference to the impact of auditory responsiveness and academic performance, Ashburner *et al*. (2008:570) reported that children with ASD, with under-responsive auditory filtering, were significantly more likely to demonstrate poor academic performance and attention.

Regarding the rhythm aspect of sound patterns, Derri *et al*. (2001:777-778) stated that 'sense of timing' can be used to express an individual's rhythmic ability in addition to the capability to perform a succession of regulated, recurring gross motor events. The author stated that there was no significant difference ($p \geq 0.05$) in rhythmic performance between boys and girls. Parush *et al*. (2002:192) who evaluated children with perceptual motor deficits, found a significant difference ($p \leq 0.001$) in task 5, in comparison to neuro-typical children.

The results of the present study were in conflict with findings of Baranek (2002:411), as a significant difference between the control and experimental groups had been observed over time. The improvement of the control group may be attributed to the fact that the teachers of the school had implemented a drumming circle to assist the children with mathematics and rhythm. The rhythmical drumming aspect could have had a positive effect on the control group's results. The improvement of the experimental group can be drawn back to the fact that every dance had a specific song, whether it was melody or folk dance music, and that the children were aware of what song was being played. Some children referred to the song as the preferred dance, for instance: "Teacher, when are we doing the sunshine dance?" Additional dances integrated auditory rhythmic integration such as activities 1, 2, 3, 4 and cool-down.

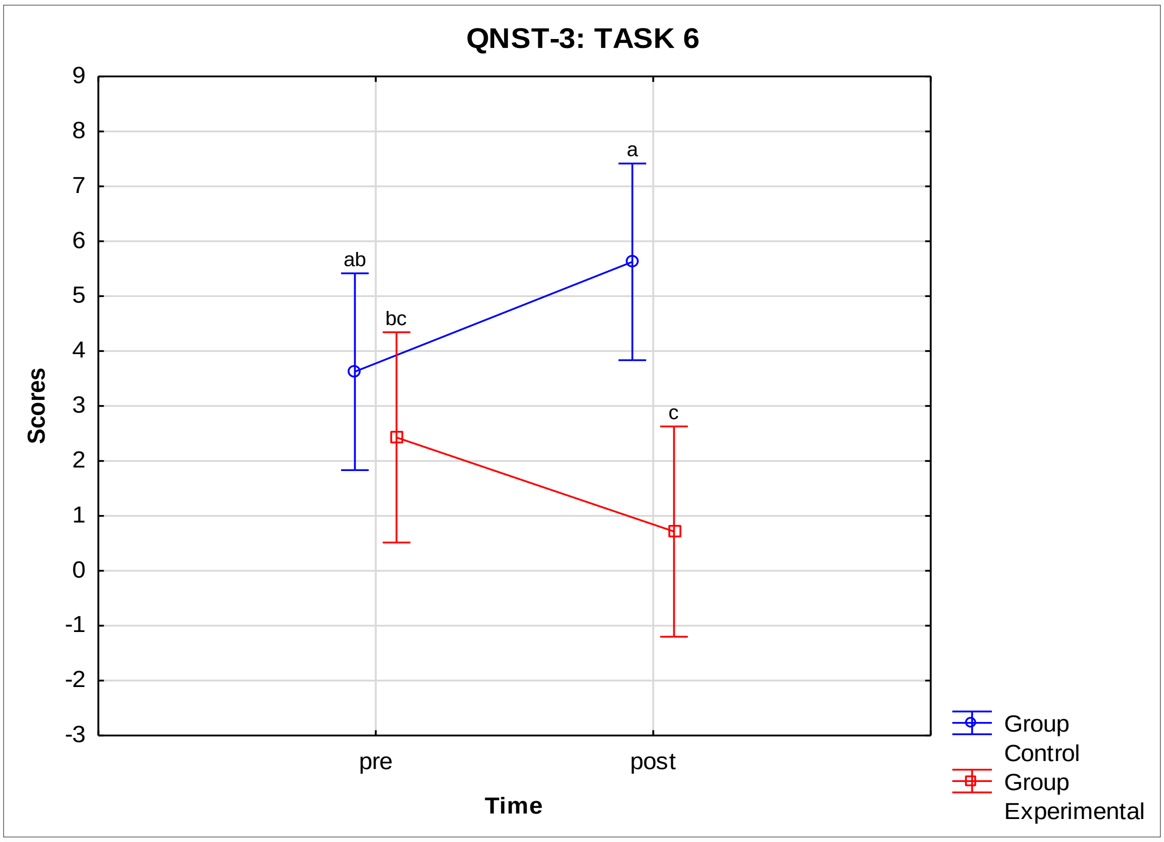

Figure 4.7: Finger-to-nose task

The results of the finger-to-nose task (Figure 4.7) indicate that the experimental group performed 33% better than the control group ($p=0.39$) during pre-testing. As indicated in Figure 4.7, the control group worsened over time by 55% ($p=0.08$), whereas, the experimental group improved over time by 71% ($p=0.16$). At post-testing, the experimental group performed significantly better ($p\leq0.05$) by 87% in comparison to the control group.

Consequently, the control group deteriorated in motor maturity, motor planning, motor control, rhythm and sequence skills, whereas the experimental group improved in all these aspects.

Derri *et al*. (2001:776) alleged that preschool children across age groups had the ability to synchronise arm movements more accurately when paired with external visual and auditory stimuli. However, it is vital to take note that spatial accuracy errors (the ability to be present at a specific point in place), and temporal accuracy errors (the ability to be present at a specific time), decrease as the age of children increase (Derri *et al*., 2006:22).

Although *Table 3.2* (*Chapter 3)* does not state that proprioception is important for the outcome of the finger-to-nose subtask, the researcher suggests, with acknowledgment to Cheatum and Hammond (2000:200) that the index finger-nose task is a viable assessment to test the proprioceptive system, with eyes open. In subtask 6, the subject has to perform five repetitions with eyes open and five repetitions with eyes closed. To maintain balance when the subject performs the test with eyes closed, additional stress is placed on the subject's sensory systems, such as the vestibular system. Riemann and Lephart (2002:81), furthermore agrees that proprioception is crucial during movement execution. In agreement with the previous authors, and specifically looking at the ASD population, Fuentes *et al*. (2011:1356) claimed that a sample of children with ASD in their study were significantly hypersensitive ($p=0.001$) to proprioception and vestibular stimuli. Leekam *et al*. (2007:906) found a significant deficit ($p \leq 0.05$) in the kinaesthetic system of children with ASD. After a 10-week movement programme, Krog and Kruger (2011:81) found a significant improvement ($p \leq 0.01$) in the proprioception of children with special needs, which indicated the remarkable success of a movement programme on subjects with special needs. Gouws (2015:1360) found a significant improvement in their subjects' finger-to-nose subtask after an eight-week Kinderkinetics intervention programme. In agreement, Parush *et al*. (2002:192) assessed children with perceptual motor deficits and found a significant difference ($p \leq 0.001$) for task 6 in comparison to neuro-typical children. However, Fuentes *et al*. (2011:1359) stated that movement processing impairments displayed by children with ASD are not necessarily the result of the presence of proprioceptive deficits.

The pre-test results of the present study indicate that children with ASD have kinaesthetic-, motor planning- and rhythm deficits, which concur with the findings of Leekam *et al*.

(2007:906). The control group of the current study deteriorated over time, which could be an indication of a lack of movement therapy and specific gross motor activities. The improvement of the experimental group is in agreement with the findings of Krog and Kruger (2011:81). The improvements can be linked to the fact that several dances were included in activities 1, 2, 4, 5 of the intervention and that the stimulation activities had motor planning as a sub-focus. Furthermore, proprioception was included as a sub focus for activities 1, 2, 3, 4, 5 and the stimulation activities. Rhythm as a focal component was included in every dance, as the subjects had to listen to the music and perform the movement on certain counts.

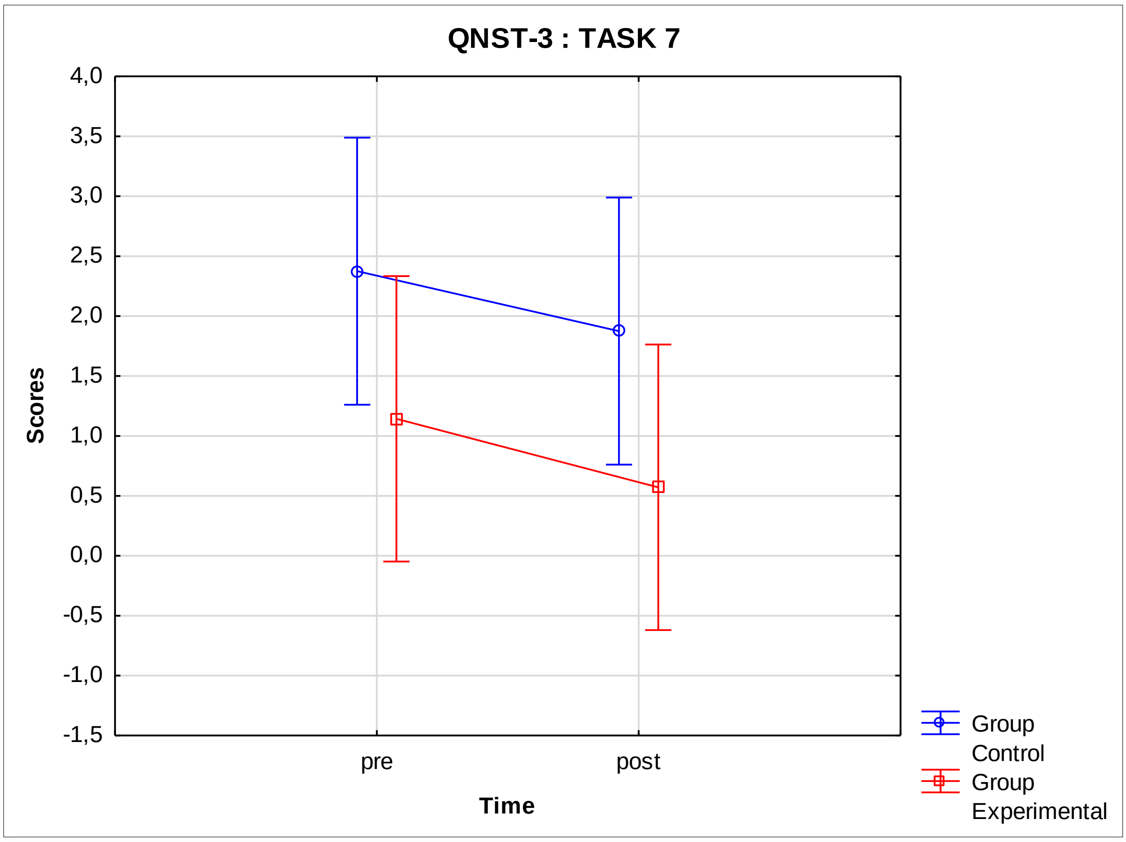

Figure 4.8: Thumb-and-finger-circles task

The results of the thumb-and-finger-circles task (Figure 4.8), indicate that the experimental group performed 52% better than the control group during the pre-test (p=0.13), although no significant differences are indicated. The performance of the control group improved by 21% (p≥0.05) over time, and the performance of the experimental group improved by 50% over time (p=0.41), thus, the experimental group performed 70% better during the post-test (p=0.11). As the results indicate, over time both groups refined the following skills: motor maturity, motor planning, lateral discrimination, motor control, rhythm and sequence.

Hilton *et al*. (2010:941) alleged hat children with ASD have significant sensory responsiveness deficits (p≤0.01) in comparison to neuro-typical children. Parush *et al*. (2002:192) found similar results when comparing children with perceptual motor deficits with neuro-typical children performing task 7. Parush and co-workers found a significant difference (p≤0.001). Contradictory to the previous findings, Leekam (2007:906) found no significant differences (p≥ 0.05) in the aspects of the kinaesthetic systems of 200 individuals with ASD. In agreement with Leekam and co-workers, Marco *et al*. (2011:49R) found that children with ASD had no tactile perceptual difficulties with vibrotactile perception, which is related to the perception of vibration through touch.

When investigating movement tactile sensitivity, O'Donnell *et al*. (2012:591) found no significant difference (p=0.78) in movement sensitivity when comparing children with ASD with a PDD-NOS sample. In a study regarding the naturalistic behavioural treatment of children with ASD, Ingersoll (2006:493) stated that children with ASD displayed significant increases in the rate of imitation when exposed to therapy. Zelaznik and Goffman (2010:385) reported that the coordination aspect of the thumb-circle of each individual finger is vital as the cerebellum plays a role in the production and sequence of the movement in a motor skill, as well as the perceptual timing process. Additionally, De Jong *et al*. (2011:643) indicated that 60% of his ASD sample presented mild coordination abnormalities.

When considering the pre-test results of both the control and experimental groups, the findings of the current study corresponds with the findings by Hilton *et al*. (2010:941), in that ASD subjects have significant sensory responsiveness deficits. However, the findings of the current study disagree with Leekam *et al*. (2007:906) because clear tactile deficits could be seen in both groups. Ingersoll and Schreibman (2006:493) confirmed an improvement similar to the results of the current study.

The control group's improvement cannot be solely explained, however, the children's environment at school introduced them to a few different tactile surfaces, which could have indirectly stimulated them. The children also frequently played outside on the jungle gym, which provides natural tactile stimulation. The researcher cannot explain the improvement in areas such as motor control and laterality. The improvement of the experimental group in the subtask may be due to a generalisation of skills from focal areas in the dance. Activities 1, 2, 4, 5 and the stimulation activities had a sub focus of motor planning, whereas activities 1, 4, the stimulation activities and the cool-down had laterality components, and lastly, activities 2, 3, 4 and 5 had components of tactile awareness.

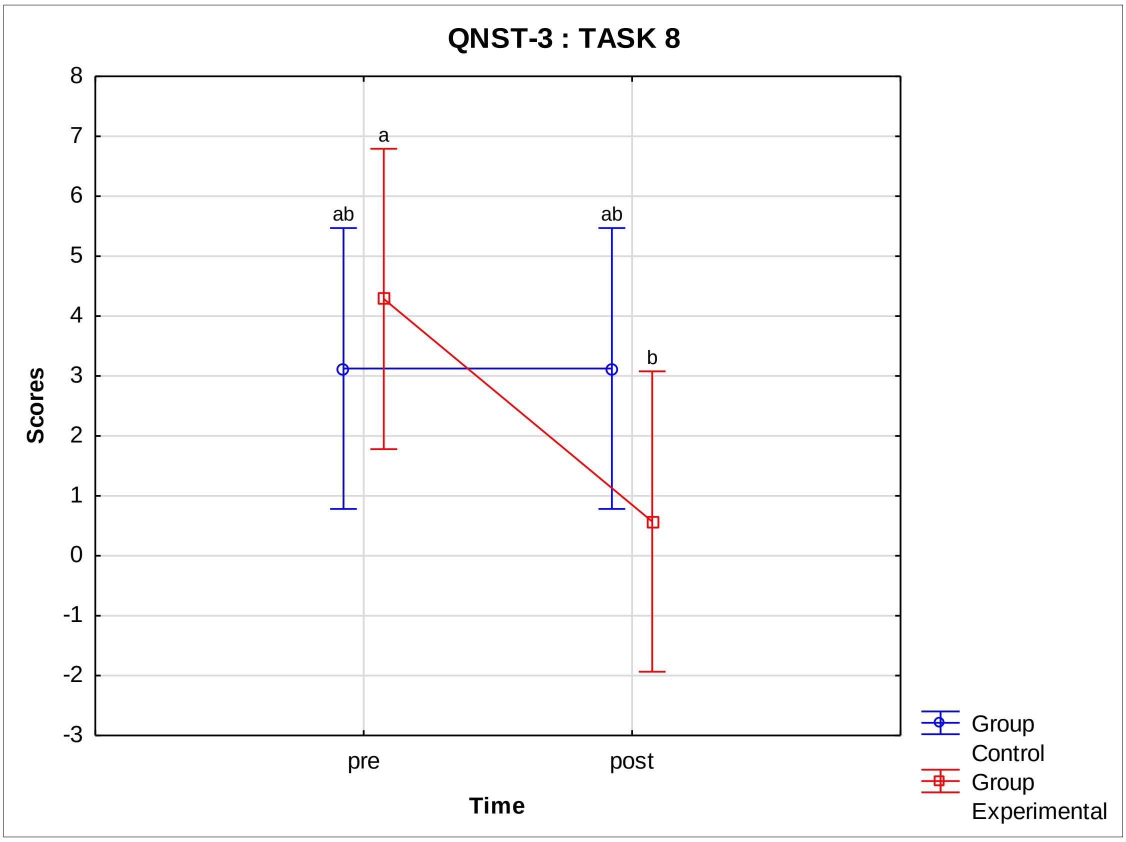

Figure 4.9: Double simultaneous stimulation of hand and cheek task

The results of the double simultaneous stimulation of hand and cheek task (Figure 4.9) indicate that the control group performed 37% better during the pre-test than the experimental group (p=0.48). As indicated in Figure 4.9, the experimental group displayed a significant improvement (p≤0.05) of 87% between pre- and post-test. The results of the control group between the pre- and post-test remained unchanged, thus, resulting in an improvement of 0% (p=1.00). The experimental group performed 82% better during the post-test (p=0.13). The brain maturity, lateral discrimination and tactile discrimination of the experimental group improved, however remained unchanged for the control group.

Ashburner *et al*. (2008:567) found a highly significant difference (p≤0.05) between children with ASD and neuro-typical children indicating that children with ASD have sensory input deficits. Similar results were found by Parush *et al*. (2002:192), however, the samples differed. Parush *et al*. (2002:192) assessed children who had perceptual motor deficits and found a significant difference (p≤0.001) in task 8 in comparison to neuro-typical children.

Task 8 focuses on tactile perception and is confined with reference to the spot where the examiner touches the subject. Cheatum and Hammond (2000:200) allege that stress is placed on the proprioception system, not to mention the vestibular system, of the child when the task is executed with eyes closed. DeBoth and Reynolds (2017:45) reported that children with ASD have deficits in tactile perception and proprioception. When looking at South African neuro-typical children, Gouws (2015:1360) found a significant improvement in the thumb and finger circles of subjects after an eight-week Kinderkinetics intervention programme, whereas no significant improvements were noted in the control group.

Tomchek and Dunn (2007:194) found that 60% of their ASD sample was tactile sensitive compared to neuro-typical children. In addition, Krog and Kruger (2011:81) found a significant difference (p≤0.05) in the tactility of children with special needs after a 10-week movement programme. However, Krog and Kruger, found contradictory results indicating no significant improvement (p≥0.05) in the body awareness of their subjects. Furthermore, Koch *et al*. (2015:344) concluded that after seven sessions of dance movement therapy, the body awareness of the ASD intervention group significantly improved (p≤0.05). According to Cheatum and Hammond (2000:203), the proprioceptive problems of children with ASD could be directly linked to deficits in body awareness. Cheatum and Hammond (2000:203) further elaborated that the movements of a child will be uncoordinated if the child is unable to identify the parts of his or her body.

The researcher agrees with DeBoth and Reynolds (2017:45) that deficits can be identified just by observing the pre-test scores. The correlation between this essential task and the unchanged performance of the control group over time clearly indicates that children with ASD require gross motor or sensory-motor based therapy in order to improve their brain maturation, body awareness, lateral and tactile discrimination (DeBoth & Reynolds, 2017:45).

The improvement of the experimental group could have been the result of the integration of specific focuses of the dances, such as lateral discrimination incorporated in activities 1, 4 and the cool-down. Furthermore, tactile awareness was integrated in activities 2, 3, 4 and

5. Lastly, the body awareness component was integrated in the warm-up, activity 5, the stimulation activities and the cool-down, whereas, proprioception as a sub focus was included in all five activities.

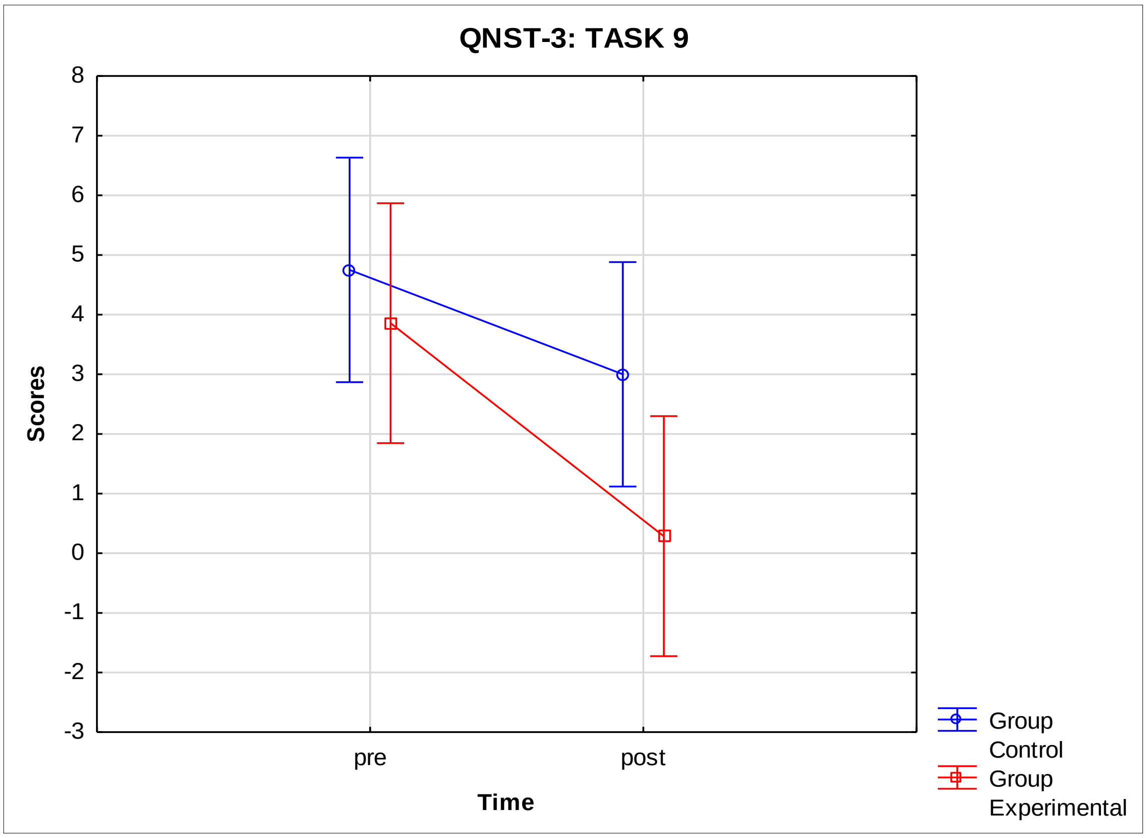

Figure 4.10: Rapidly reversing repetitive hand movement task

The results of the rapidly reversing repetitive hand movement task (Figure 4.10) indicate that the experimental group performed 19% better than the control group during the pre-test ($p=0.50$). Over time, the experimental group improved significantly ($p\leq0.05$) by 92%. The control group also improved by 37% ($p=0.12$) over time. At the post-test, the experimental group performed significantly better ($p\leq0.05$) by 92%. The motor maturity, motor planning, lateral discrimination, motor control, rhythm and sequence skills of both groups improved.

Derri *et al*. (2006:17) reported that ‘rhythmicity’, also known as internal timing when tapping to the beat of a metronome, is closely related to the development of a motor skill. Furthermore, Ceponiene *et al*. (2003:5570) noted that the orientation to sound changes were impaired in a high functioning ASD sample. Taking Derri and Caponiene and their co-workers into consideration, Fuentes *et al*. (2011:1359) confirmed that children with ASD demonstrated sensory execution impairments, which directly relates to motor impairments. Although it was noted that children with ASD had a delay in this aspect, 60% of four-year-old children had the ability to clap a steady beat (Derri *et al*., 2001:779).

When children with ASD and children with special needs completed an intervention programme, significant results were found. Krog and Kruger (2011:81) found a significant improvement ($p \leq 0.01$) in the auditory variability of children with special needs after a 10-week movement programme. Similarly, Srinivasan *et al.* (2015:11) found a significant reduction ($p \leq 0.001$) in the imitation errors of children with ASD over time after completing 32 rhythmic music-based sessions. Srinivasan and co-workers additionally noted that the children with ASD, which participated in a robotic imitation intervention, also significantly improved ($p \leq 0.001$) their imitation performance. Lastly, the children with ASD who participated in a table top (PlayDoh, Lego and Zoob-infinitoy) intervention improved their imitation performance significantly over time ($p \leq 0.001$) (Srinivasan, 2015:11). Not specifically related to the ASD population, however, applicable to South African neuro-typical children, Gouws (2015:1360) found a significant improvement in the rapidly reversing repetitive hand movements of subjects after an eight-week Kinderkinetics intervention programme. Furthermore, in a non-ASD sample, Parush *et al*. (2002:192) assessed children with perceptual motor deficits and found a significant difference ($p \leq 0.001$) in task 9 in comparison to neuro-typical children.

When taking the pre-test data of both groups in the current study into consideration, the researcher agrees with Parush *et al*. (2002:192). When noting the over time results, the research findings are in agreement with Krog and Kruger (2011:81) and Srinivasan *et al.* (2015:11), who found improvements in motor skills after both rhythmical- and movement-based interventions.

The control group's improvement over time was directly associated with the same trend that occurred in task 5 when the children with ASD participated in a drumming circle during school hours. Furthermore, the repetitive nature of the drumming could have had an influence on the outcomes of task 5 and 9 indicating a positive effect on the control group. The experimental group also improved over time as seen in task 5, although this task placed more demand on the motor planning and motor maturation of an individual.

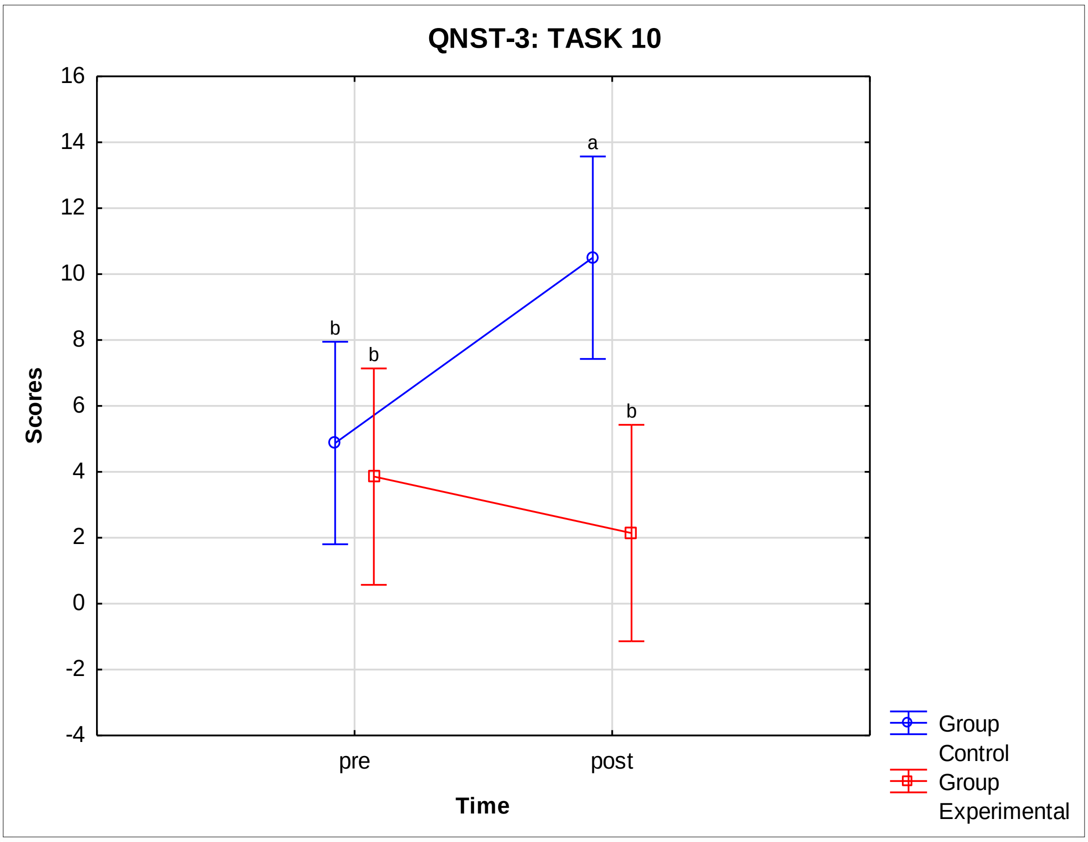

Figure 4.11: Arm and leg extension task

The results of the arm and leg extension task (Figure 4.11) indicate that the experimental group performed 21% better than the control group (p=0.50) during pre-test. As depicted in Figure 4.11, the control group worsened significantly (p≤0.05) between the pre- and post-test, and over time a 115% decline occurred, whilst the experimental group presented an improvement of 45% (p=0.31). At the post-test a significant difference occurred between the two groups (p≤0.01). The experimental group performed 80% better than the control group. The control group displayed a decline in motor maturation, motor planning, lateral discrimination, motor control, rhythm, sequence, proprioception, body image and strength skills. With regards to the experimental group, all the latter skills improved.

De Jong *et al*. (2011:643) found that eight-year-old children with ASD have dysfunctional posture and muscle tone. At the post-test, Longhurst (2006:105) found that children with ASD, who completed their perceptual motor intervention, performed 33% better in the strength component than the sensory motor group in their study. Children with perceptual motor deficits had similar results as reported by Parush *et al*. (2002:192) who found a significant difference ($p \leq 0.001$) in task 10 when compared to neuro-typical children. In agreement with the above-mentioned authors, Hawkins *et al*. (2014:142) found, after 15 sessions of Equine-assisted therapy, that the strength of participants with ASD improved. Similarly, De Milander *et al*. (2016:45) found that the self-esteem (body image) of a female participant in a case study surprisingly improved after Equine-assisted therapy. However, Krog and Kruger (2011:81) did not find any significant results ($p \geq 0.05$) after a 10-week movement based intervention with special needs children, because their muscle tone and body awareness did not improve. More specifically, and not in agreement with the previous author, Gouws (2015:1360) found a significant improvement in the arm and leg extension of the experimental group in their study after an 8-week Kinderkinetics intervention programme for neuro-typical South African children.

The below average pre-test scores of children with ASD in the current study is a validation of De Jong *et al*.'s (2011:643) finding on postural dysfunction and poor muscle tone in children with ASD. However, in the current study's results indicate that with no additional gross motor therapy, the scores of the control group declined further over time. In contrast, the scores of the experimental group improved greatly following the dance programme. The integration of the following foci in the dances could have contributed to the improvement in motor planning as it was an underlying focus activities 1, 2, 4, 5 and the stimulation activities. Lateral discrimination was integrated in activities 1, 4, the stimulation activities and the cool-down; proprioception was integration in activities 1 to 5; body awareness was integrated in the warm-up and activity 5, the stimulation activities and the cool-down; strength was a focus in activities 2, 3, the stimulation activities; and lastly, the rhythm component was included in all the activities.

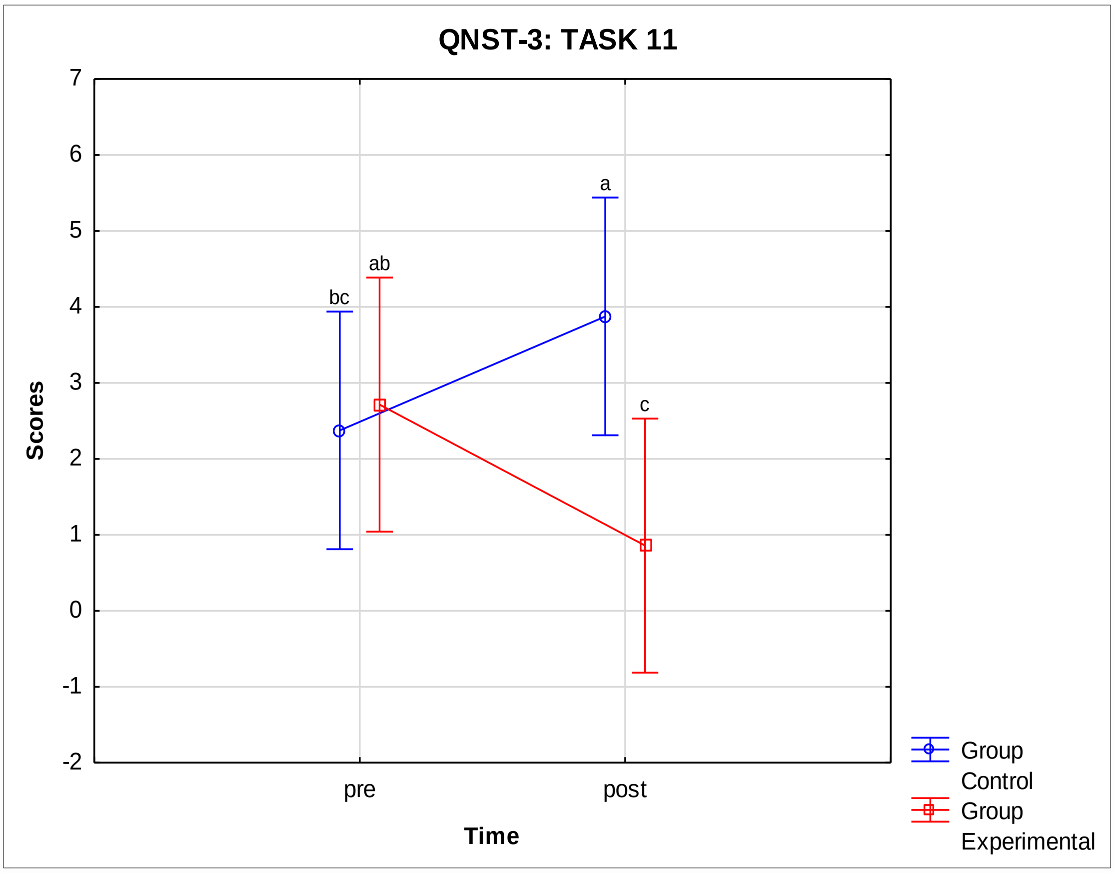

Figure 4.12: Tandem walk task

The results of the tandem walk task (Figure 4.12) indicate that the control group performed 14% better than the experimental group (p=0.75) during the pre-test. Over time, the scores of the control group significantly (p≤0.05) declined by 63%. In comparison, the experimental group improved significantly (p≤0.05) between the pre- and post-tests by 68%. In comparison to the control group, the experimental group performed significantly better (p≤0.05) by 78% during the post-test. The following skills deteriorated for the control group, while the experimental group improved: motor maturity, motor planning, lateral discrimination, motor control, rhythm, sequence, proprioception, body image and strength.

Fuentes *et al*. (2011:1356) found that children with ASD showed significant impairments in gait. Although *Table 3.2 (Chapter 3)* does not include dynamic balance as an essential component for the outcome of tandem walk, the researcher of the current study suggests that it should be a vital part. Gupta *et al*. (2011:430) did not find a significant difference (p≥0.05) at the post-test when assessing the balance of children with Down syndrome. In contrast, Parush *et al*. (2002:192) assessed children with perceptual motor deficits and found a significant difference ($p \leq 0.001$) in task 11 in comparison to neuro-typical children. After 24 sessions of a traditional dance programme, Arzoglou *et al*. (2013:565) found no significant effects ($p \geq 0.05$) after evaluating the balance of children with ASD. Nonetheless, Arzoglou and co-workers found a significant difference ($p \leq 0.001$) between the control and experimental groups over time.

However, some authors found contradictory results. The fact that their results were exclusively based on a population with ASD may contribute to the findings of the current study. Zachopoulou *et al*. (2004:640) found that the experimental group improved their balance skills after a music and movement intervention, whereas the balance of the control group did not improve. Additionally, Saracoglu and Sirinkan (2016:97) found that the balance of children with ASD improved significantly ($p \leq 0.001$) after a 12-week Pilates-based intervention programme. Findings of an intervention that had similar principles as the current study were presented by Gouws (2015:1360), who found significant improvement in the heel-to-toe walk of neuro-typical subjects after an 8-week Kinderkinetics intervention programme.

With reference to the pre-test results of children with ASD, the findings of the current study is definitely in agreement with Fuentes *et al*. (2011:1356), who identified deficits in the gait of children with ASD. However, with reference to the post-test results, the findings of the current study are in agreement with Zachopoulou *et al*. (2004:640) and Saracoglu and Sirinklan (2016:97), who found comparable results after similar interventions. The findings of the current study, however, still disagrees with the results published by Arzoglou *et al*. (2013:565), regarding post-intervention results.

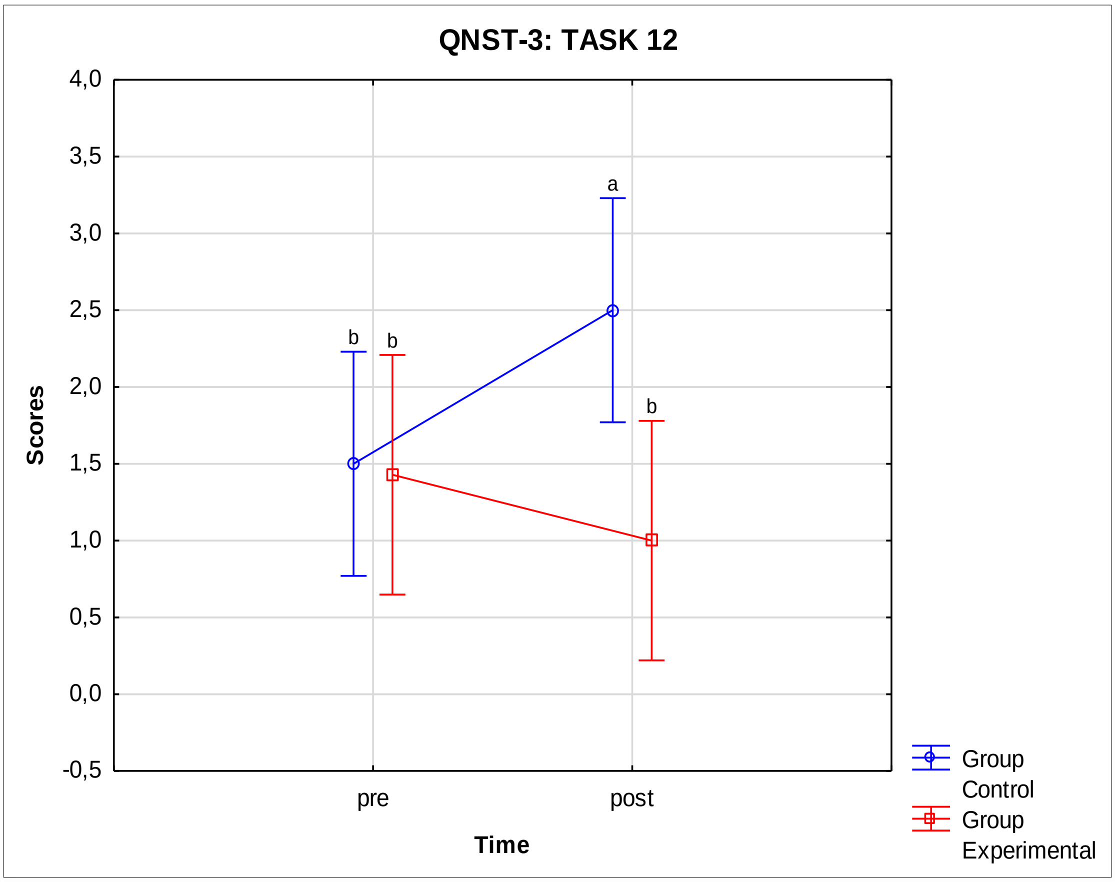

Figure 4.13: Standing on one leg task

The results of the standing on one leg task (Figure 4.13), indicate that the experimental group performed 5% better than the control group at the pre-test (p=0.89). Over time, the control group deteriorated significantly (p≤0.05) by 67%. Conversely, the experimental group improved by 30% over time (p=0.37). At post-test, a significant difference was found between the control and experimental group (p≤0.05), where the experimental group performed 60% better than the control group. The control group stagnated in the following skills: motor maturity; motor planning; lateral discrimination; motor control; rhythm; sequence; proprioception; body-image and strength, whereas the experimental group improved in these skills.

Fuentes *et al*. (2011:1358) purported that subjects with ASD performed significantly worse in a balance subsection in comparison to neuro-typical children. Liu and Breslin (2013:1247) also found significant deficits (p≤0.001) in the static balance of individuals with ASD when compared to neuro-typical children. Blythe (2006:426) found a significant improvement (p≤0.05) in the balance component of children with special needs after completing an eight to 14-month exercise intervention programme. Similar results were found by Parush *et al*. (2002:192), who assessed children with perceptual motor deficits and found a significant difference ($p \leq 0.001$) in task 12 in comparison to neuro-typical children. When looking at neuro-typical children in South Africa, Gouws (2015:1360) found significant improvements in the static balance (standing on one leg) of subjects after an 8-week Kinderkinetics intervention programme, whereas the control group did not improve significantly.

Three other authors reported similar results. Firstly, Arzoglou *et al*. (2013:565) found that their experimental group of children with ASD, who participated in 24 traditional dance sessions, improved their static balance (standing on one leg), whereas the control group did not improve significantly. Secondly, Niklasson *et al*. (2009:660) found an improvement in the balance of children with ASD. Lastly, Saracoglu and Sirinkan (2016:97) found significant improvements ($p \leq 0.05$) in the balance of an ASD experimental group after a Pilates-based intervention, while the control group did not improve significantly ($p=0.279$).

Although task 12 assessed a variety of other skills and systems, the primary skill was static balance. When relating the findings to the literature, the current study's finding are is in agreement with the findings of Niklasson *et al*. (2009:660), Arzoglou *et al*. (2013:565) and Saracoglu and Sirinkan (2016:97). In addition, when relating the static balance subtask to the dynamic balance subtask, the results for both the control and experimental groups were similar.

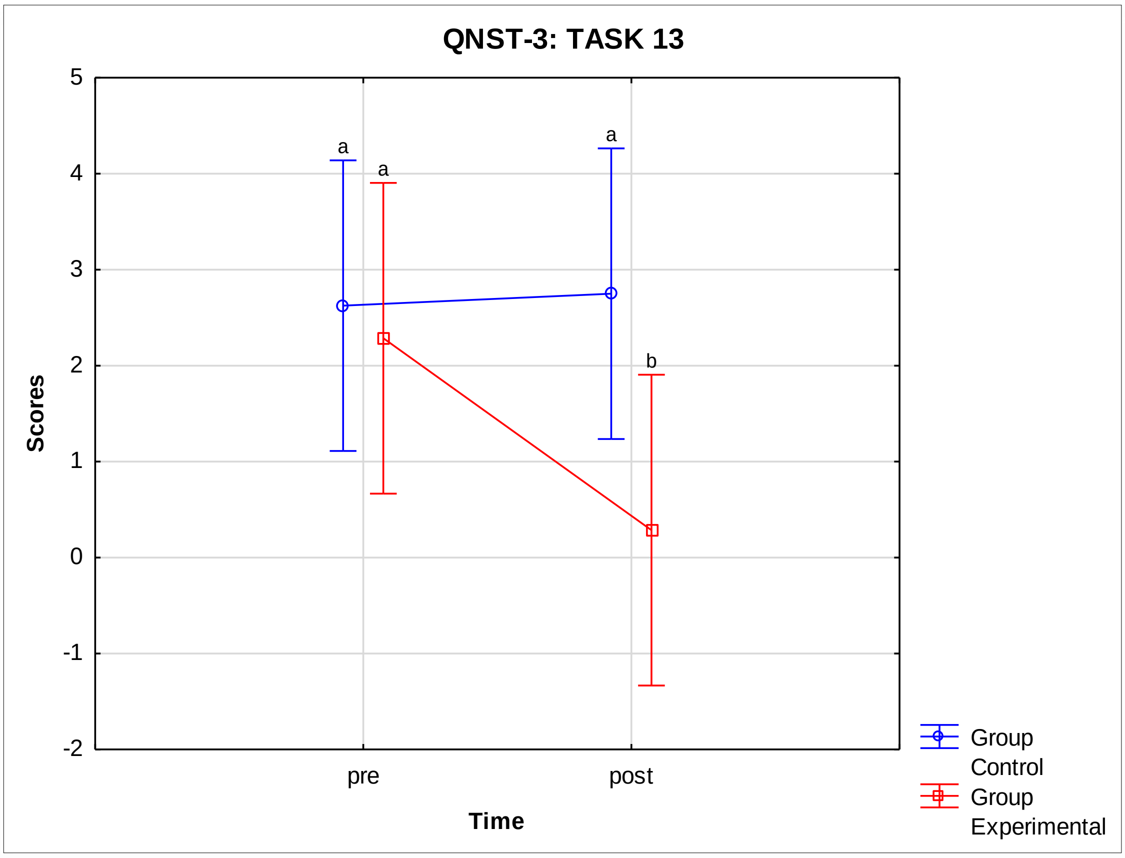

Figure 4.14: Skipping task

The results of the skipping task (Figure 4.14) indicate that the experimental group performed 13% better than the control group (p=0.75) at the pre-test. Over time, the experimental group showed a significant improvement (p≤0.05) of 87%, while the control group worsened by 5% (p=0.81). During post-test, the experimental group outperformed the control group by 89% (p≤0.05). The control group worsened in the following skills over time: motor maturity; motor planning; lateral discrimination; motor control; rhythm; sequence; proprioception; body-image; and strength. The experimental group improved significantly in these skills over time.

According to Derri *et al*. (2006:23, 25), neuro-typical children's ability to skip is usually attained by 6½ years, due to its relatively complex nature. De Jong *et al*. (2011:643) indicated that 60% of an ASD sample displayed mild coordination abnormalities. Following an intervention programme, Liu and Breslin (2013:1247) observed improvements (p≤0.01) in the deficit of dynamic balance of children with ASD in comparison to neuro-typical children. Similarly, Ketcheson *et al*. (2017:487) found a significant difference (p≤0.001) in the locomotor skills of children ASD.

With reference to interventions which included the same principles of the current study, such as the integration of dance or music movement, Derri *et al*. (2006:22) found that a 10-week music and movement programme for preschool children had a positive influence on their skipping ability when evaluated with the Test for Gross Motor Development (TGMD). Furthermore, a study by Venetsanou and Kambas (2004:130) reported that improvements in GMS, including skipping, can be seen in children (aged 5 to 14), after completing an educational dance programme of 36 weeks. Arzoglou's (2013:656) results indicated that the ASD experimental group who participated in 24 intervention sessions composed of traditional Greek dances, displayed significant improvements ($p \leq 0.05$) in lateral jumping (left and right) abilities. Additionally, Parush *et al*. (2002:192) assessed children with perceptual motor deficits and found a significant difference ($p \leq 0.05$) in task 13 in comparison to neuro-typical children. Lastly, Srinivasan *et al.* (2015:10) found that the body coordination of children with ASD improved significantly ($p=0.01$) after implementing 32 sessions of a music- and whole-body-based movement intervention.

The skipping task involved most of the components that are additionally assessed in the previous tasks of the QNST-3. In the current study the experimental group's improvements in the following tasks could be directly related to the improvement of their skipping task: lateral discrimination improvements in task 3, 5, 7, 8, 9, 10, 11, 12 and 15; motor control improvements in task 6, 7, 9, 10, 11 and 15; motor planning improvements in task 5, 6, 7, 9, 10, 11, 12, 13 and 15; rhythm and sequence improvements in task 6, 7, 9, 10, 11, 12, 13 and 15; proprioception, body awareness and strength improvements in task 10, 11, 12, 13 and 15. Two areas where the focus skill was not carried through to skipping, were the motor maturity and motor control components of task 1 and 2, where no improvements occurred over time.

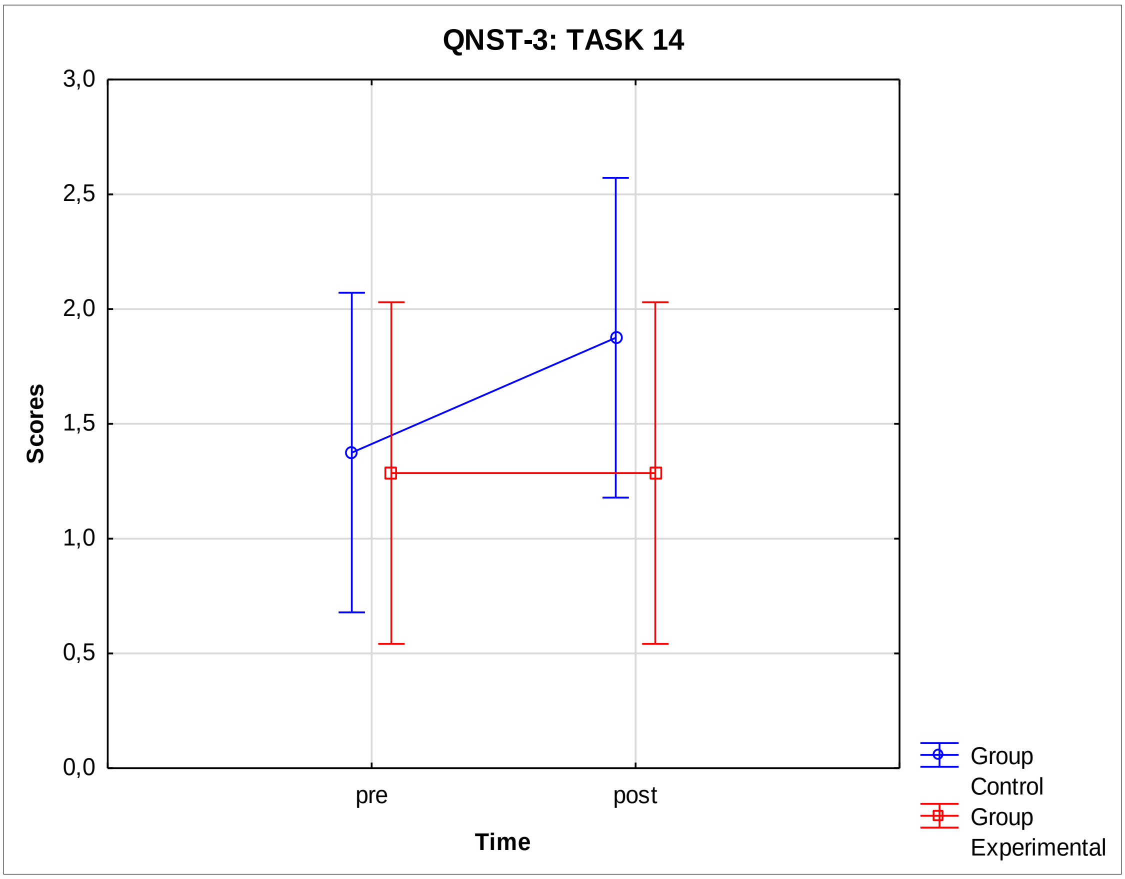

Figure 4.15: Left and right discrimination task

The results of the left and right discrimination task (Figure 4.15) indicate that the experimental group performed 7% better than the control group (p=0.85) during the pre-test. Although no significant results over time are indicated, the control group worsened by 36% (p=0.27), whereas dissimilarly the experimental group remained unchanged (p=1.00). At post-test, the experimental group performed 31% better than the control group (p=0.23). The performance of the control group declined with regards to the following skills: motor maturity; and lateral discrimination, whereas, these skills remained unchanged over time for the experimental group.

Alaniz *et al.* (2015:6) found no significant associations (p≥0.05) between hand dominance and pincer grip. Paquet *et al*. (2017:45), furthermore, found no significant difference between the hand or foot preference of an ASD sample and the prevalence of any intellectual disability. Agreeing with Paquet *et al*. (2017), Parush *et al*. (2002:192) assessed children with perceptual motor deficits and found no significant difference (p≥0.05) in task 14, in comparison to neuro-typical children. Lane and Schaaf (2010:387) noted that interest in the activity or task is an essential contributing factor to enhance the effects of any motor activity.

The scores from task 6, 7 and 12 were used to determine the score of task 14. With reference to the finger-to-nose task, the thumb and finger circles task and the standing on one leg task, contradicting results were found for the experimental group. Over time, the performance in all three tasks indicated improvement for the experimental group, whereas in the current task (left and right discrimination), the ability of the subjects remained unchanged. The control group indicated a decline in laterality discrimination over time.

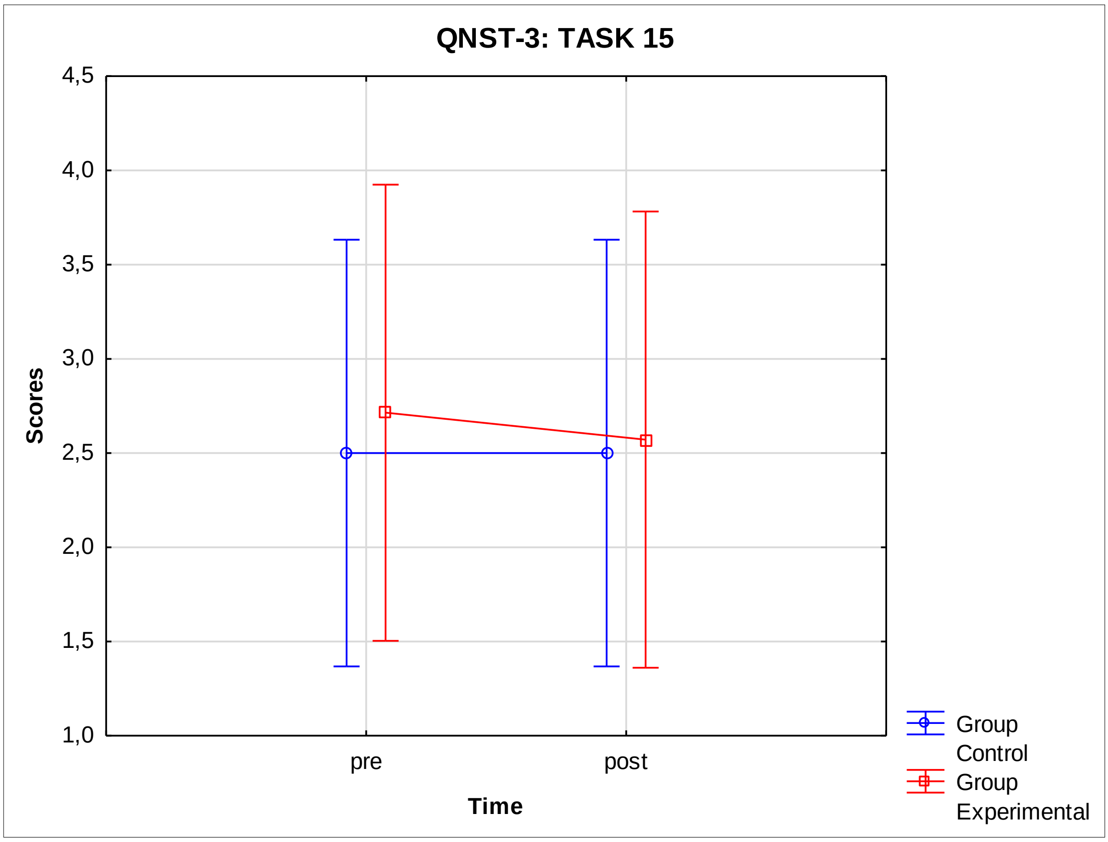

Figure 4.16: Behavioural irregularities task

The results of the behavioural irregularities task indicate that the control group performed 8% better than the experimental group (p=0.28) at the pre-test (Figure 4.16). The figure does not specifically indicate the occurrence of a significant difference, however, the experimental group did improve over time by 5% (p=0.85), whereas the control group remained unchanged over time (p=1.00). During the post-test, the control group performed 3% better than the experimental group (p=0.93). The observed behavioural irregularities of the control group remained the same over time, whereas, the experimental groups' behavioural irregularities decreased over time although there were still behavioural irregularities present.

The DSM-5 indicates the diagnostic criteria for individuals with ASD, along with the associated behaviours, mannerism and stereotypes (APA, 2013:54). The following literature discussions will examine the behaviours of children with ASD in greater detail.

Green *et al*. (2012:1117) found significant increases ($p \leq 0.05$) in the anxiety of toddlers with ASD. Additionally, De Jong *et al*. (2011:6423) indicated that 40 to 45% of the ASD sample displayed excess associated movements.

Parush *et al*. (2002:192) assessed children with perceptual motor developmental problems and, with reference to task 15; found a significant difference ($p \leq 0.001$) in the results of the experimental and the control group (neuro-typical children). Afshari (2012:1335) concluded similar significant findings ($p \leq 0.05$). It was observed by Parush and co-workers that both the control and experimental groups displayed improvement in attention after participating in a perceptual motor training programme. Regarding sensory deficits and sensory related programmes, O'Donnell (2012:591) noted that children with ASD had challenges in adaptive behaviour, in addition to sensory processing difficulties. An intervention programme reported by Pfeiffer *et al*. (2011:81-82) concluded that children with ASD who participated in an 8-week sensory integration programme displayed significant fewer ($p \leq 0.05$) 'autistic mannerism', as well as self-stimulating behaviours.

With regards to researchers using interventions more closely related to the current study, Arzoglou *et al*. (2013:566) found an improvement in the behaviour and stereotypical behaviours of children with ASD after participating in a music-yoga programme. Kim *et al*. (2008:1763) found two standardised measures after assessing the joint attention behaviour by subjects, which indicate that subjects with ASD improved significantly ($p \leq 0.05$) after participating in a music therapy programme. In addition to a music therapy, Kern and Aldridge (2006:287) concluded that, after music embedded therapy, boys with ASD did not improve meaningfully in terms of proactive peer interactions. Dieringer *et al*. (2017:9) found that children with ASD did not improve in their task behaviours with music therapy intervention alone.

Additionally, Alaniz *et al.* (2015:6) reported that children with ASD were less reliable in producing consistent scores or results due to inherent characteristics, such as communication delays, social delays and stereotypical behaviours. Chan *et al*. (2013:10) reported similar findings. After eight sessions of Nei Yang Giong (which is similar to Tai Chi) sessions, Chan *et al*. (2013:10) found that the temper outbursts of subjects with ASD decreased significantly (p≤0.05) and a significant increase (p=≤0.05) was observed in brain activity and self-control.

The findings of the current study correspond with the findings noted by Kim *et al*. (2008:1763), Pfeiffer *et al*. (2011:81-82), Arzoglou *et al*. (2013:566) and Chan *et al*. (2013:10).

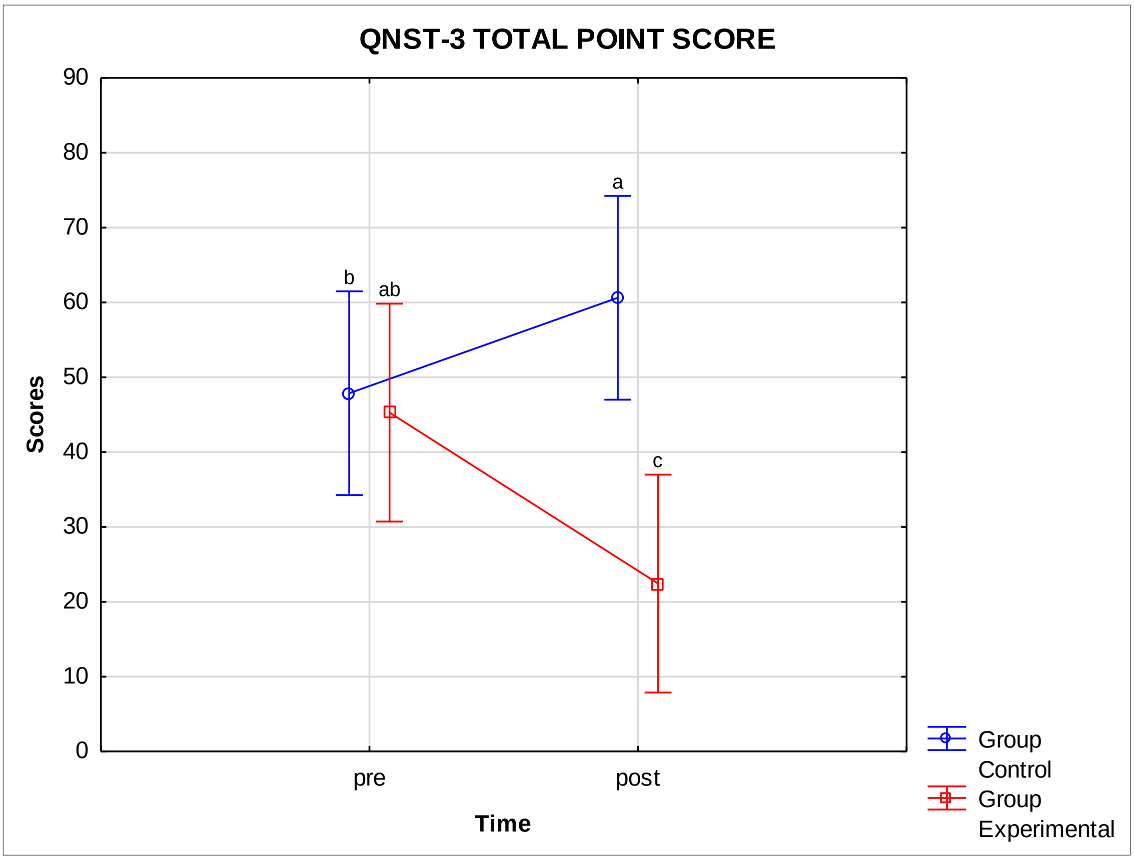

Figure 4.17: Total point score

The results of the total points scores obtained from both the control group and the experimental group are shown in the Figure (4.17). The experimental group performed 5% better overall during the pre-test. Over time, the results of the experimental group indicated a significant difference (p≤0.01). The experimental group improved by 50% over time when comparing their total point scores from the pre- to post-test. Likewise, the results of the control group over time also indicated that a significant difference between the pre- and post-test occurred ($p \leq 0.01$). However, over time the control group scores declined by 27% ($p \leq 0.01$). When comparing the two groups at the post-test, a significant difference between the groups can be observed ($p \leq 0.01$). The experimental group performed 63% better than the control group.

With regards to neurological and sensory abnormalities reported in literature, Leekam *et al*. (2007:905) found that 92.5% of their 200 subjects with ASD had at least one sensory abnormality. In addition, Patankar *et al*. (2012:179) concluded in a study with subjects who had ADHD, that 84% of the children assessed in a physical and neurological examination (PANESS), presented with Neurological Soft Signs (NSS). NSS are minor motor irregularities that include poor motor coordination (Mutti *et al*., 2012:10).

No significant results ($p \leq 0.001$) for an ASD group in comparison to the control group in an intervention of 18 sessions was found by Pfeiffer *et al*. (2011:81). Contrasting results were portrayed by O'Donnell *et al*. (2012:591), who found a significant relationship ($p \leq 0.001$) between their sample of children with ASD and sensory processing challenges.

Parush *et al*. (2002:192) assessed children with perceptual motor developmental deficits by administering the QNST-2, and found a significant difference ($p \leq 0.001$) in the total point score of children with ASD and neuro-typical children. Longhurst (2006:109) found significant motor proficiency improvements ($p \leq 0.05$) after a 12-week perceptual motor intervention programme for children with learning difficulties. Similar results were concluded when a more generic exercise programme was implemented. The following results were found by Blythe (2006:422) indicated that with regards to the experimental group, the neurological scores of children with ASD decreased significantly after an exercise programme intervention.

With regards to the improvements of the performance of the experimental group in various tasks, it is clear that all the GMS tasks (task 3 to 13) corresponds with the findings of the QNST-3 total point score improvement.

Music is an indispensable element of human life.
As movement is a fundamental part of the life cycle,
The integration of these two leads to new directions
(Venetsanou & Kambas, 2004:129).

Results obtained from the BOT-2

In this section, the group*time effect results obtained from the BOT-2 during the pre- and post-test will be discussed. With reference to the figures below, it can be seen that a depicted maximum scale score influenced the standard score. A score with a low scale score indicates more deficits and errors made during the test, and therefore, an increase indicates an improvement as can be seen in Figure 4.18 to 4.27. The terms “test” or “subtest” will be used to refer to the components of the BOT-2. *Table 4.2* represents the BOT-2 group*time effects for each subtest (subtest 1 to 8). Once again, the mixed model repeated measures ANOVA was used to simultaneously compare pre- and post-measurements. *Table 4.2* shows the degrees of freedom in the F bracket and thereafter, the F statistic was reported. These two values indicate the P value, which is a significant value to report. *Table 4.2*, has symbols (a, b, c), where the symbols are the same from pre- to post-test, it is an indication of significance. Furthermore, in *Table 4.2,* the means and standard deviations of the control group and experimental groups during the pre- and post-tests are reported. Importantly, the vertical bars denote 0.95 confidence intervals.

***Table 4.2*: The group* time effect of the BOT-2 for the control and experimental groups indicating the means and standard deviations**

MEASUREMENT	TIME* GROUP	CONTROL PRE TESTING	CONTROL POST TESTING	EXPERIMENTAL PRE TESTING	EXPERIMENTAL POST TESTING
Subtest 1	F(1,13) = 6,33 P=0,03	7,75 (4,10) ab	8,25 (3,11) ab	6,71 (3,73) b	10,14 (3,13) a
Subtest 2	F(1,13) = 9,24 P=0,01	6,25 (2,31) ab	6,25 (2,55) ab	5,71 (1.70) b	8,00 (1,29) a
Subtest 3	F(1,13) = 6,68 P=0,02	3,75 (1,58) ab	3,38 (1,41) ab	3,43 (2,37) b	4,57 (1,51) a
Subtest 4	F(1,13) = 0,91 P=0,36	7,13 (3,94)	8,50 (2,27)	6,86 (3,85)	9,71 (1,80)
Subtest 5	F(1,13) = 0,42 P=0,53	6,25 (2,19)	7,25 (0,71)	5,00 (2,65)	6,71 (0,49)
Subtest 6	F(1,13) = 0,32 P=0,58	6,00 (2,07)	7,13 (1,13)	5,86 (2,73)	7,57 (0,79)
Subtest 7	F(1,13) = 4,10 P=0,06	3,88 (1,81)	4,75 (1,58)	2,57 (1,90)	5,00 (1,63)
Subtest 8	F(1,13) = 7,58 P=0,02	4,50 (2,67) a	3,13 (2,64) a	4,57 (2,23) a	5,86 (2,41) a
BOT TOTAL POINT SCORE	F(1,13) = 12,90 P=0,01	45,50 (15,57) ab	48,63 (10,08) ab	40,71 (14,59) b	57,57 (9,29) a
BOT STANDARD SCORE	F(1,13) = 27,68 P=0,01	35,63 (5,85) ab	35,50 (3,34) ab	30,43 (6,02) b	38,29 (5,82) a

NOTE:

*The group * time column: F is indicated as the Degrees of Freedom in (), thereafter the value indicates the F-statistic. Lastly, the p- value is indicated, this is a summation of the previous two values.*

The control & experimental pre- testing and post- testing results: Indicates the mean and the standard deviation. Additionally the symbols allocated are the same as those indicated on the Figures of the various sub- tests- indicating significance.

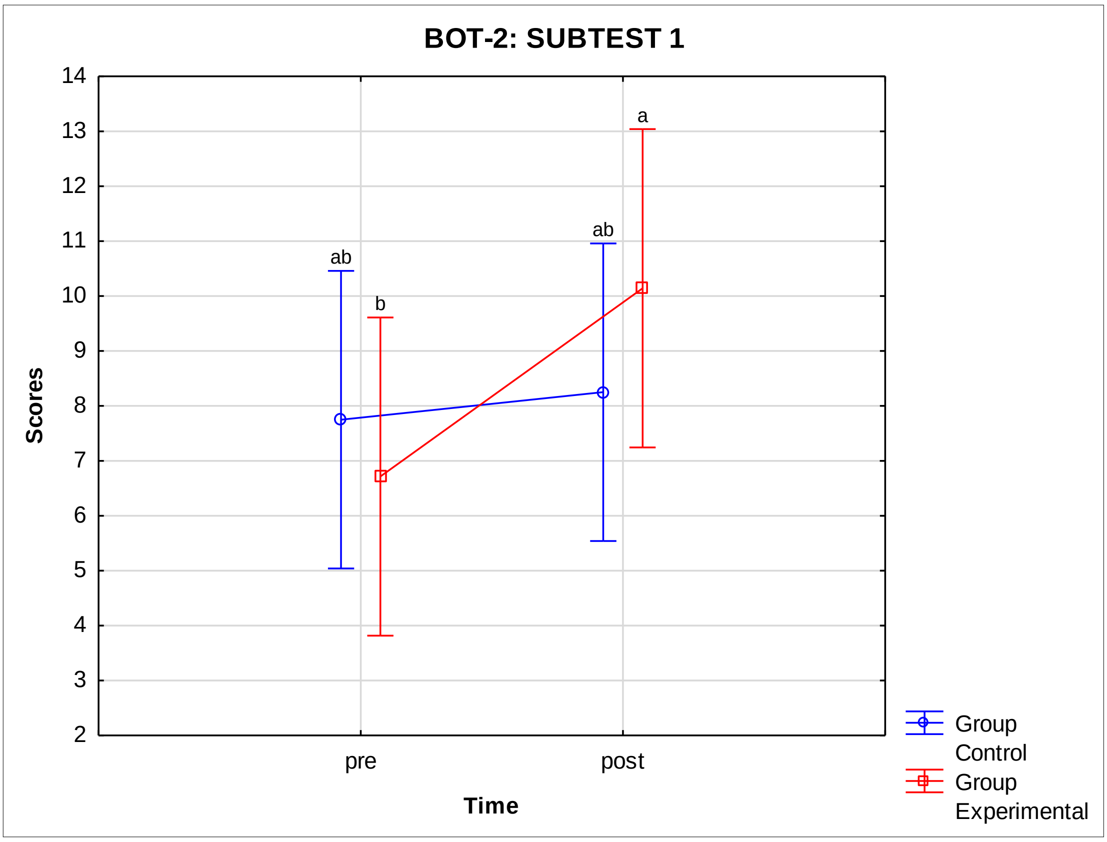

Figure 4.18: Fine motor precision subtest

The results of the fine motor precision subtest indicate that the experimental group performed 13% better than the control group during the pre-test (p=0.58) (Figure 4.18). The experimental group performed significantly better (51%) (p≤0.05) and the control group improved slightly by 6% (p=0.54) over time. Although no significant results (p=0.23) were obtained during the post-test, the experimental group performed 23% better when the two groups were compared.

According to *Table 3.3 (Chapter 3*), this subtest evaluates certain skills. The researcher suggests that the task additionally assessed laterality, lateral discrimination and directionality.

De Jong *et al*. (2011:643) conducted a study involving subjects with ASD with a mean age of 8 years in which they conclusively identified dysfunction in skills that involved fine motor manipulation. Additionally, when children with ASD were compared to neuro-typical children, the results indicated that children with ASD performed significantly worse (p=≤0.05) in motor tasks that required the execution of finely controlled movements of the hand and fingers

(Fuentes, 2011:1358).

The second component of this subtest, as illustrated by *Figure 3.2 (Chapter 3)*, involves folding four lines of a paper. *Table 3.3* suggests that this test requires precision of the hand and finger muscles. The researcher of the current study suggests that imitation and motor planning skills are essential for the successful completion of this test. Children with ASD have shown to display deficits in imitation and motor planning (Haswell *et al*., 2009:921; DeBoth & Reynolds, 2017:45). Smith *et al*. (2016:3489) found a significant relationship ($p \leq 0.05$) between the performance and copying accuracy in children with ASD when assessing an embedded figure test. Smith *et al*. (2016:3488) additionally found no significant difference when they compared the drawing production of children with ASD to that of neuro-typical children.

The results obtained by the current study comply with the results by Haswell *et al*. (2009), De Jong *et al*. (2011), Smith *et al*. (2016) and, DeBoth and Reynolds (2017). The results of these studies indicated that the scores obtained from both groups at the pre-test were low, indicating deficits in fine motor precision. Over time, the control group of the current study improved slightly, which might have been as a result of everyday classroom or academic fine motor skills activities. Initially, the researcher of the current study did not predict an improvement in the fine motor skills section for the experimental group, especially not in fine motor precision, as this skill was not included in the intervention. The improvement might be as a result of the experimental group imitating the researcher, while practicing the dances twice a week. The dances, which involved the sub focuses of motor planning and imitation, were included in activities 1, 2, 4, 5 and the cool-down. The integration of motor planning, which is a vital factor of this subtest as suggested by the researcher, has been integrally carried through from the gross motor tasks to this fine motor precision task.

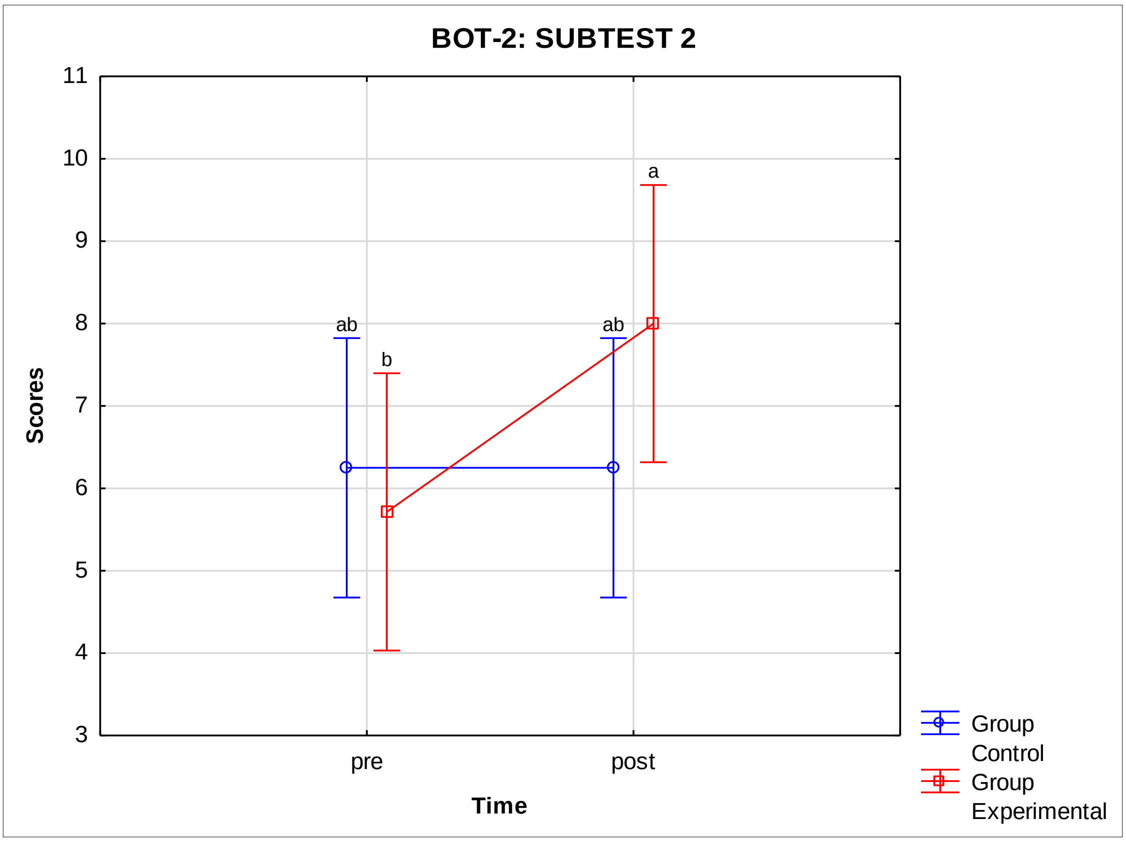

Figure 4.19: Fine motor integration subtest

The results of the fine motor integration subtest (Figure 4.19) indicate that the experimental group performed 9% better than the control group ($p=0.62$) at the pre-test. The experimental group improved significantly ($p \leq 0.05$) by 40% from the pre- to post-test. Over time, the control group remained unchanged with no improvement ($p=1.00$). At post-test, the experimental group performed exceedingly better (28%) in comparison to the control group ($p=0.12$).

According to *Table 3.3 (Chapter 3),* this subtest involves visual motor integration skills. The researcher of the current study additionally suggests that directionality, lateral discrimination, motor planning, figure imitation and production and spatial awareness skills are essential for these tests to be carried out successfully.

In a study by Venetsanou and Kambas (2004:130), it was found that the directional awareness of the experimental group, consisting of children with ASD between the ages of 9 and 11, improved after completing a 9-week traditional dance intervention programme. After a sample of children with ASD completed 32 table top sessions consisting of PlayDoh, Lego and Zoob-infintoy activities, Srinivasan (2015:11) found that the BOT-2 fine manual control composite displayed significant improvements ($p \leq 0.05$) over time. According to a South African study conducted on state supported shelter children (N=24) (Van Niekerk *et al*., 2007:169), it was found that the experimental group improved significantly ($p \leq 0.01$) in fine motor skills during the post-test. The results of Srinivasan (2015:9) at the pre-test indicated a significant difference ($p \leq 0.02$) in the BOT-2 fine manual control of the ASD rhythmic group when the scores were compared to the scores of the ASD control group. However, in contrast, no significant difference ($p \geq 0.05$) was found with the BOT-2 fine manual subtest standard scores at the pre-test.

Over time, Srinivasan (2015:9, 11) found that at post-test the control group had significantly higher scores ($p \leq 0.02$) than the robotic and rhythmic ASD intervention groups for the BOT-2 fine manual control subtest. These findings conclude that both ASD intervention groups did not demonstrate any significant improvements ($p \geq 0.05$) in their fine motor performances over time. Additionally, Pan (2014:160) found no significant results ($p=0.61$) for the BOT-2 fine manual control subtest after comparing subjects with ASD who received stimulant medication to those who did not.

When taking pre-test results into consideration, the current study agrees with the findings made by Srinivasan (2015:9). In the current study, the fine motor integration skills of the control group remained unchanged over time. It is interesting to note that the control group's fine motor precision improved slightly over time, whereas their fine motor integration remained unchanged. This observation can probably suggest that fine motor integration has underlying numeric systems essential for integration to occur. Once again, the researcher did not expect significant results for the experimental group, as the intervention did not include any fine motor activities. The significant experimental group's improvement could be a direct relationship between the underlying systems such as visual motor integration (a focal factor in activity 2 and during stimulation); directionality (an underlying factor in activities 1, 4, 5 and during stimulation); motor planning (a vital contributing factor in activities 1, 2, 3, 4, 5 and the cool-down); and lastly spatial awareness (involved in activities 1, 2, 3, 5 and during stimulation). The results of the experimental group for this visual motor integration subtest can be compared to the results of the QNST-3 eye tracking subtest, which had a primary focus of visual motor coordination. In both tasks the group improved over time. It should be taken in account that the QNST-3 task involved additional contributing focuses.

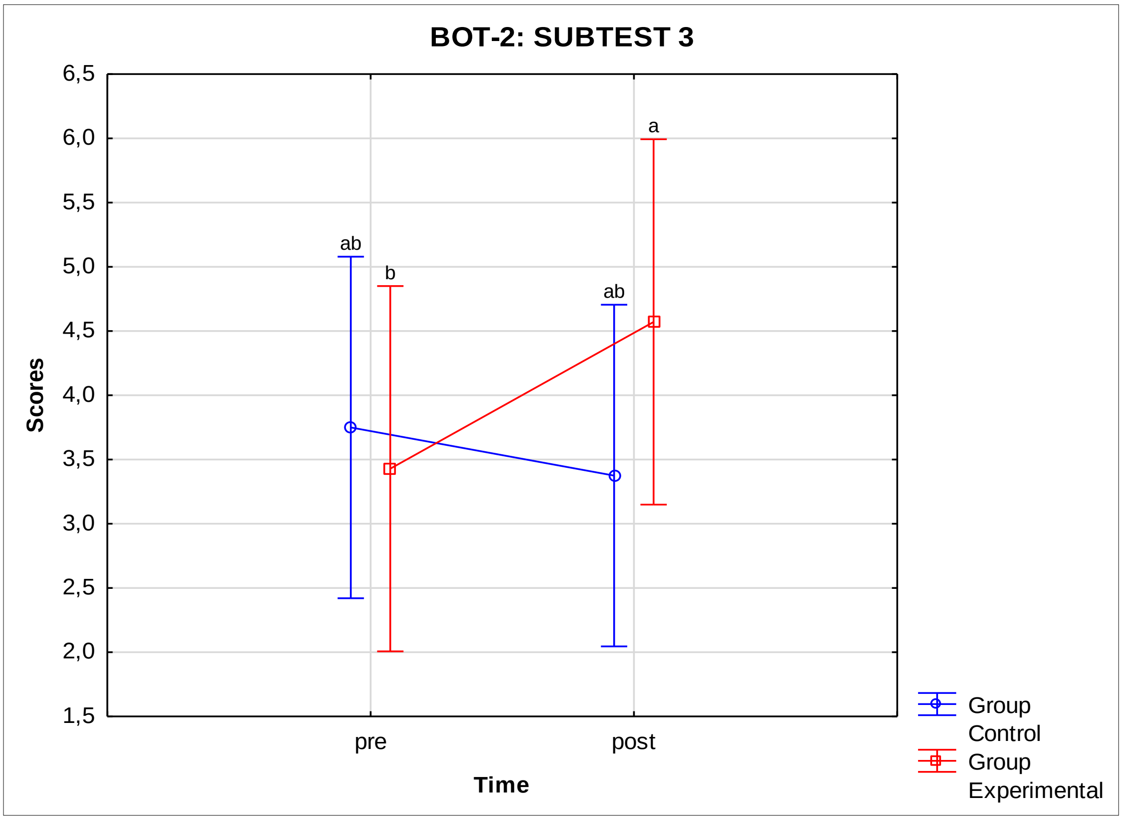

Figure 4.20: Manual dexterity subtest

The results of the manual dexterity subtest indicate that the experimental group performed 9% better in comparison to the control group (p=0.73) during the pre-test. The experimental group showed a significant improvement of 33% during the pre- and post-tests, whereas the control group worsened over time by 10% (p=0.37). The results of the control and experimental groups at the post-test indicate that the experimental group performed 35% better than the control group (p=0.21).

In *Chapter 3* (*Table 3.3*) the secondary outcomes of this subtest is mentioned, however, the current study's researcher additionally suggests that laterality, directionality, motor planning, spatial awareness, coordination and precision had to be intact for the subject to skilfully and successfully complete the tests.

Liu and Breslin (2013:1247) found a significant difference (p≤0.001) in the manual dexterity of children with ASD when comparing them to neuro-typical children. Contrasting results were obtained by Paquet *et al*. (2017:45) who found no significant difference among participants with ASD's lateral preference and lateral dominance with regards to hand-eye coordination speed tests. Derri *et al*. (2001:777,783) stated that rhythm is an essential component in the acquisition and performance of a motor skill. The author reported that one-handed skills develop prior to two-handed skills and that bilateral movements develop earlier than parallel movements. Additionally, it was stated that children across age ranges had the ability to synchronise arm movements more accurately with external visual and auditory stimuli (Derri *et al*., 2001:776). However, children aged 6 to 11 years require two essential components for the execution of rhythmic motor skills, namely spatial accuracy and temporal accuracy. Both of these components have the tendency for errors to be made and decrease as the child's age increases (Derri *et al*., 2001:776; Derri *et al*., 2006:22).

Arzoglou *et al*. (2013:566) concluded that the neuromuscular coordination of children with ASD can be improved when they participate in a traditional dance programme. In agreement with Arzoglou *et al*. (2013:566), Derri *et al*. (2006:26) reported results that suggest an increase in performance speed when it was musically and rhythmically synchronised to movements.

Derri *et al*. (2001:778) found no significant difference ($p \geq 0.05$) in rhythmic performance when comparing boys and girls. Zelaznik and Goffman (2010:383) stated that children who experience difficulties with spoken language can have additional deficits in coordination activities. Furthermore, there has been a high degree of co-occurrence of cognitive-linguistic and motor task deficits (Zelaznik & Goffman, 2010:383).

Although the primary focus area of this subtest is manual dexterity, the current study investigated sub-focal areas in order to make certain comparisons with the results of the QNST-3. With regards to the QNST-3, the performance of the experimental group improved in task 6, 7, 9, 10, 11, 12 and 13. All these tasks have motor planning, rhythm and sequence as sub-foci. The trend of the performance of the experimental group in the above-mentioned QNST-3 tasks and the present BOT-2 subtest, indicated that the particular skills have been carried through, resulting in an improvement over time.

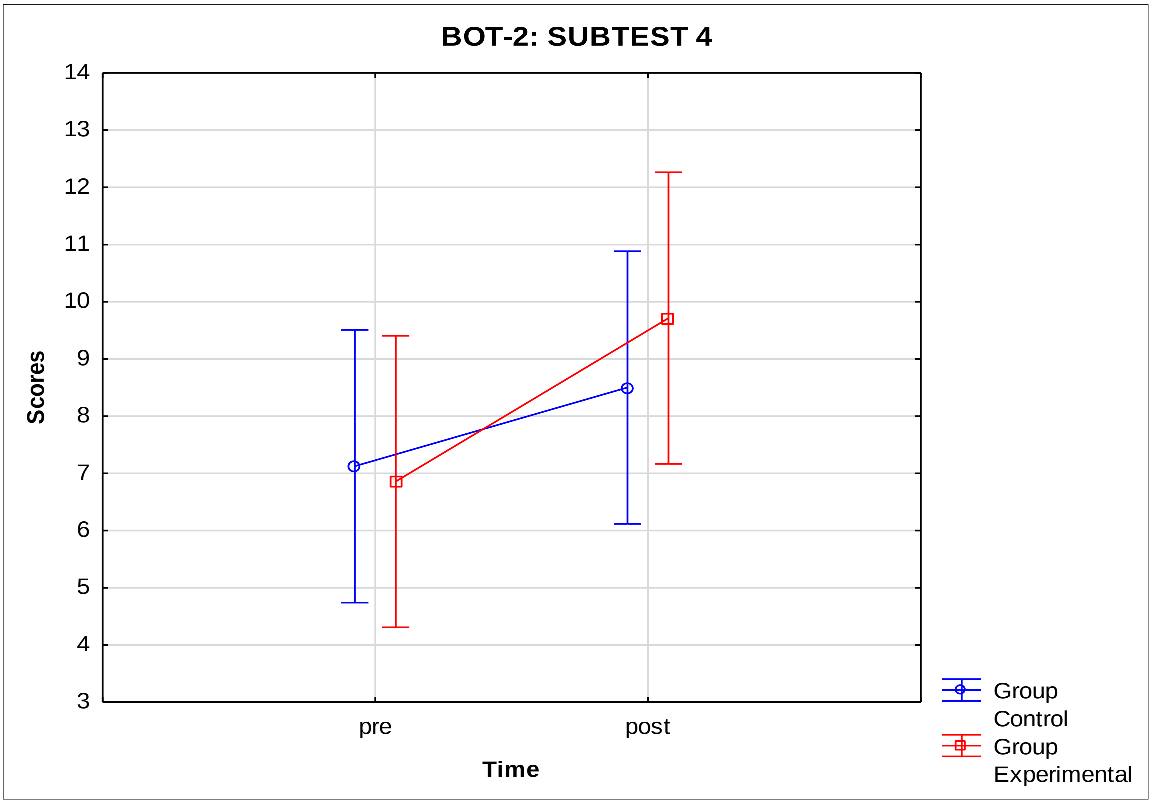

Figure 4.21: Bilateral coordination subtest

In Figure 4.21 the results of the bilateral coordination subtest indicate that the experimental group performed 4% better in comparison to the control group (p=0.87) at pre-test. Over time, the experimental group excelled significantly (p≤0.05) by improving with 42%. During this time, the control group also improved by 19% (p=0.22). The results between the control and experimental groups at the post-test indicate that the experimental group performed 14% better than the control group (p=0.47).

As *Table 3.3* (*Chapter 3*) suggests the outcomes that have to be present. The researcher suggests that additionally laterality, directionality, body awareness and motor planning are indirectly simultaneously evaluated.

Bilateral coordination involves the ability to move both hands in a coercive manner, which requires motor planning and sequencing in order to complete the movement (Wilson *et al*., 2017:7). According to Tryfon *et al*. (2017:52), a child is able to synchronise finger tapping to an external rhythm between the ages of 18 months and 4 years. Dong and Fong (2016:166) conducted an intervention program, ‘remind to move’, on five- to 16-year-old hemiplegic Cerebral Palsy (CP) individuals and found that when assessed by the BOT-2, they benefited from the programme, whilst improving their bilateral coordination skills. Longhurst (2006:105) found a comparative difference between a perceptual and the sensory motor group. The perceptual motor group performed 45% better than the sensory motor group in the bilateral coordination subtest. Another comparative difference was observed by Venetsanou and Kambas (2016:5) after assessing subjects with a mean age of 5.1 years with the BOT-2. Venetsanou and Kambas (2016:5) found that the girls performed significantly better ($p \leq 0.05$) than boys in the bilateral subtest.

Studies focusing solely on subjects with ASD obtained similar results. Srinivasan *et al.* (2015:10) positively concluded that after 32 sessions of a music-based whole body synchrony- and rhythmic joint action-based intervention, the body coordination of both the rhythmic group with ASD ($p=0.01$) and the robot group with ASD ($p \leq 0.02$) significantly improved. Lastly, Hawkins *et al*. (2014:142) concluded that the body coordination of individuals with ASD improved from 21to 77% after they had completed 15 sessions of an Equine-assisted therapy programme and assessed with the BOT-2.

Zelaznik and Goffman (2010:388) found that children with specific language impairments differed significantly ($p \leq 0.05$) in the bilateral coordination subtest of the BOT-2 in comparison to the control group, whereas Longhurst (2006:98) found that children with learning disabilities performed weaker in bilateral coordination tasks over time. When shifting the focus solely to the ASD population, Srinivasan *et al*. (2015:9) depicted that during the pre-test no significant difference ($p \geq 0.05$) between ASD control and experimental (rhythmic and robotic intervention) groups were found after assessment with the BOT-2. Additionally, the authors found no significant improvement ($p \geq 0.05$) over time in the control group's body coordination composite of the BOT-2 (Srinivasan *et al.*, 2015:11).

A similar trend for this BOT-2 subtest can be found in the study by Srinivasan *et al*. (2015:9), as well as in the present study, indicating that no significant differences between the two ASD groups were found at the pre-test. As noted in the QNST-3 (task 5 and 9), the school teachers did make use of a drumming circle as part of the classroom routine. As mentioned in these two tests, the control group also improved over time, whereas a similar trend can be seen in the BOT-2 test. When drumming involves both hands, it is essential for the child's bilateral coordination to be intact. The researcher of the current study suggests that the drumming activity might have had an influence on the control group.

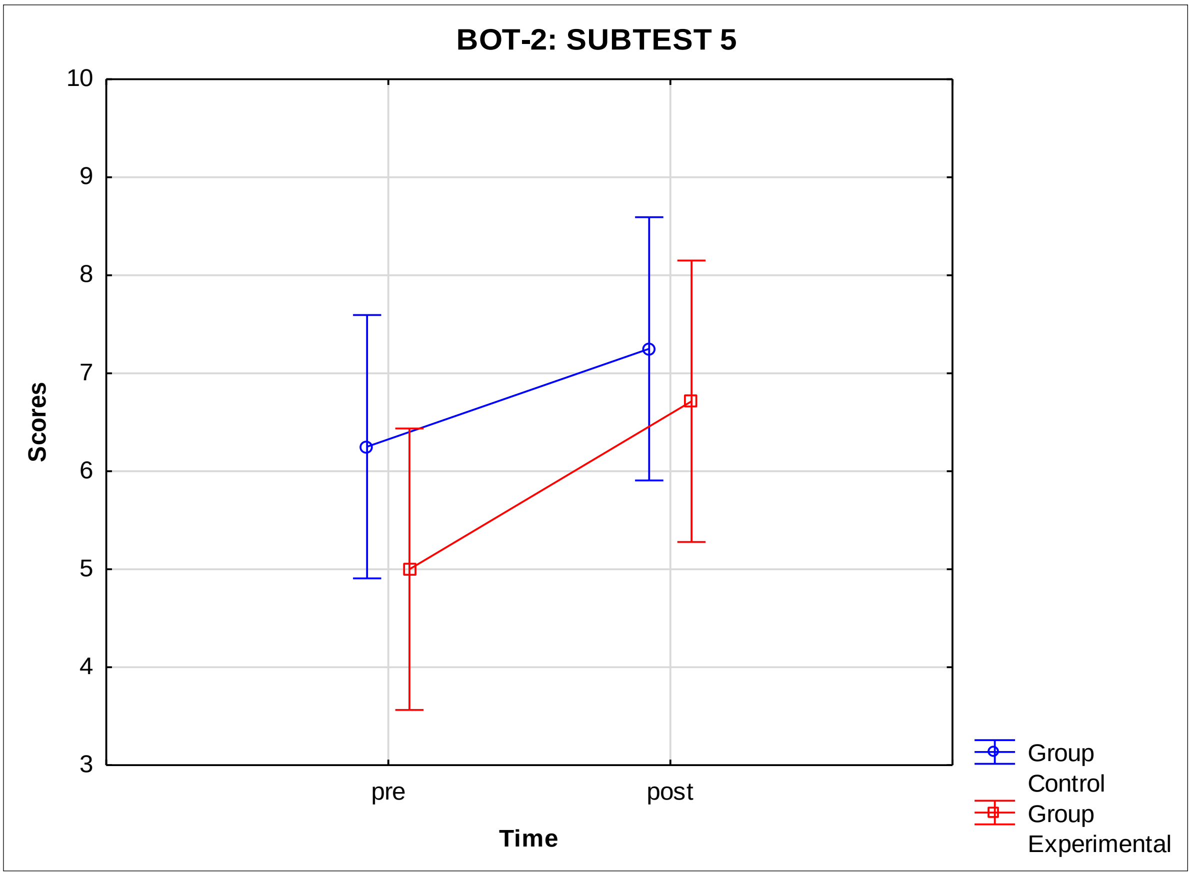

Figure 4.22: Balance subtest

The results of the balance subtest (Figure 4.22) indicate that the experimental group performed 20% better than the control group (p=0.19) during the pre-test. The experimental group revealed a significant improvement (p≤0.05) of 34% over time and the control group improved by 16% (p=0.21) over time. The results comparing the two groups at the post-test indicate that the control group performed 7% poorer than the experimental group (p=0.57).

Zelaznik and Goffman (2010:388) found a significant difference (p≤0.05) in the results of the BOT-2 balance subtest, whilst comparing children with specific language impairments to a control group. When looking at children with intellectual or neurological deficits, Gupta *et al*. (2011:426) reported that after a six-week balance training programme for children with Down syndrome and mental retardation, a significant improvement (p≤0.05) occurred in the balance subtest of the BOT-2. Specific age range studies have produced similar results. Derri *et al*. (2006:22) found that a 10-week music movement programme for children aged between four to six years had a positive effect on static and dynamic balance. Venetsanou and Kambas (2016:5) indicated that girls with a mean age of 5.1 years performed significantly better ($p \leq 0.01$) than boys of the same age in the BOT-2 balance subtest.

When specifically looking at the ASD population, several authors concluded similar findings. Blythe (2006:426) found a significant improvement ($p \leq 0.05$) in balance after children with ASD participated in a balance training programme. In a case study intervention, De Milander *et al*. (2016:44) concluded that the girl participant improved in the BOT-2 balance subtest after Equine-assisted therapy. More closely related to the aims of the current study, Saracoglu and Sirinkan (2016:97) found results of a significant improvement ($p \leq 0.001$) in the balance of children with ASD (six to 12 years) after participating in a 12-week Pilates special movement training programme. Lastly, Arzoglou *et al*. (2013:565) found a significant improvement ($p \leq 0.05$) in the ability of children with ASD to stand on one leg after participating in a traditional dance, whereas the control group did not improve significantly ($p \geq 0.05$) after 24 sessions.

Zachopoulou *et al*. (2004:640) indicated that the subjects of an experimental group improved their balance skills after completing an intervention focusing on a developmentally appropriate music and movement programme, whereas no significant effect ($p \geq 0.05$) was seen in the dynamic balance of the subjects in the control group. Although Gupta *et al*. (2011:430) recorded improvement in the overall balance subtest, no significant differences ($p \geq 0.05$) were found in individual task components, such as walking on a straight line and standing on a balance beam with eyes closed during the post-test. Fuentes *et al*. (2011:1358) confirmed that a sample of children with ASD performed significantly poorer ($p \leq 0.05$) in a balance subsection in comparison to neuro-typical children.

The results of the subtests of this study are in accordance with Blythe (2006:426), Derri *et al*. (2006:22), Arzoglou *et al*. (2013:565) and Saracoglu and Sirinkan (2016:97), who all indicated an improvement in the balance of the subjects after an intervention programme. However, as the results depict, the control group improved as well. When viewing the QNST-3 (task 11: dynamic balance) and (task 12: static balance), the control group performed poorer in both tasks. In this subtest, however, the control group improved over time. The two tests are not exactly the same, because the participant is expected to walk forward, backward and forward with eyes closed in the QNST-3, whereas the participant is only expected to walk forward in the BOT-2. With regards to static balance, participants had to stand on one leg in the QNST-3 task and they had to stand on a balance beam in the BOT-

2 test. On the other hand, the over time improvement of the experimental group in the QNST-3 and BOT-2 balance tasks indicate that their balance improved in all areas.

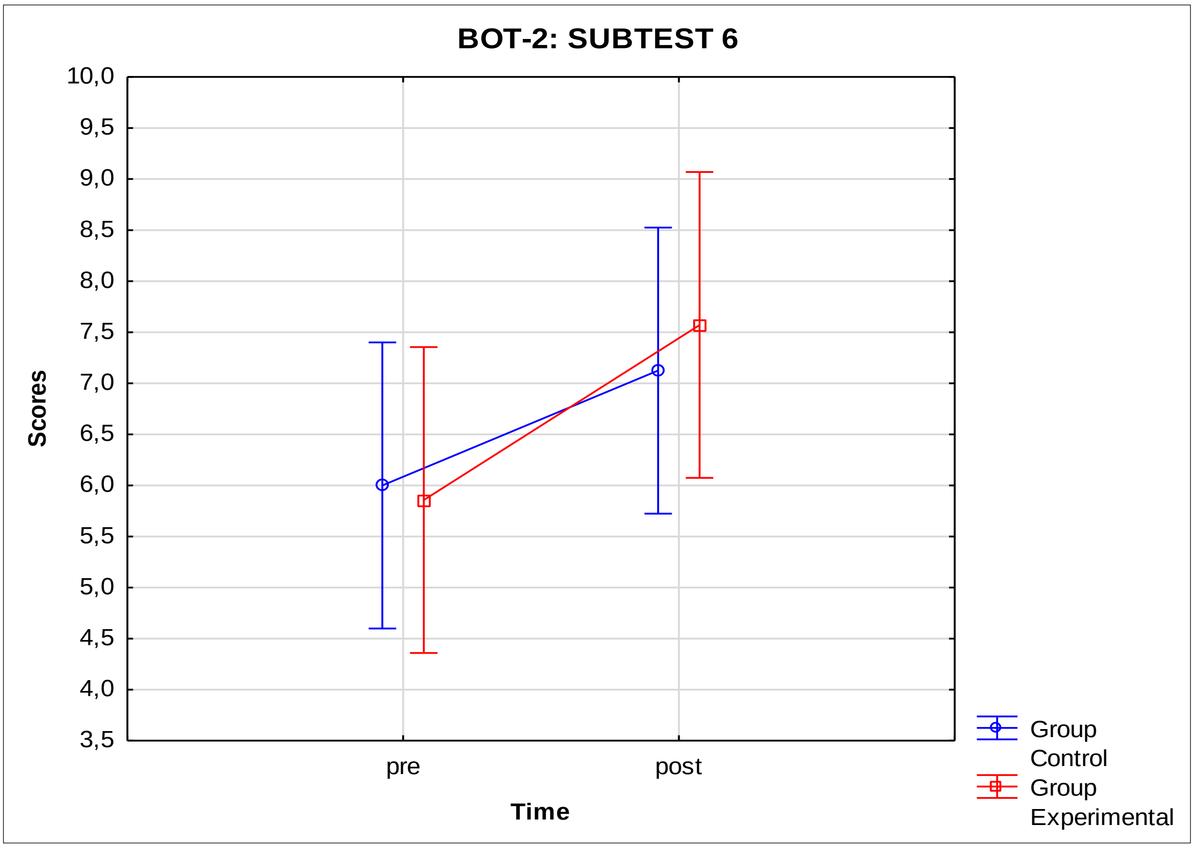

Figure 4.23: Running speed and agility subtest

The results of the running speed and agility subtest indicate that the experimental group performed 2% better at the pre-test than the control group (p=0.88) (Figure 4.23). Over time, the experimental group improved significantly (p≤0.05) by 29%. Furthermore, the control group also showed an improvement of 19% over time (p=0.14). At the post-test, the experimental group performed 6% better than the control group (p=0.65).

After a 12-week intervention, Charles and Gordon (2007:770) found a significant change (p≤0.05) in the speed and agility subtest of the BOT-2 for children (mean age 8 years and 7 months) with mild to moderate Cerebral Palsy. Derri *et al*. (2006:26) reported that a music movement programme improved the running skills of children. Their speed performance increased equally when music was rhythmically synchronised to movement. Venetsanou and Kambas (2016:5) found that boys performed significantly better (p≤0.05) than girls in the running speed and agility subtest.

When comparing individuals with ASD who were using medical stimulants to those who were not, Pan (2014:160) found no significant results (p=0.32) in the speed and agility subtest of the BOT-2. Although this is a running speed and agility subtest, the test involves the subject to hop on one leg. Derri *et al*. (2006:26) stated that it is vital for the development of both balance and strength in order to stand on one foot. Although balance is a vital component, Dieringer *et al*. (2017:9) noted a valuable contributing statement that greater improvement occurred in the GMS tasks of children with ASD when the teacher modelled the movement.

The improvement of both groups in the current study indicate that free time, like playing on the playground during break, was beneficial for improving speed and agility. Additionally, most of the children with ASD enjoyed running, especially as part of their ASD mannerism. This could also possibly have had a notable influence on their running speed and agility.

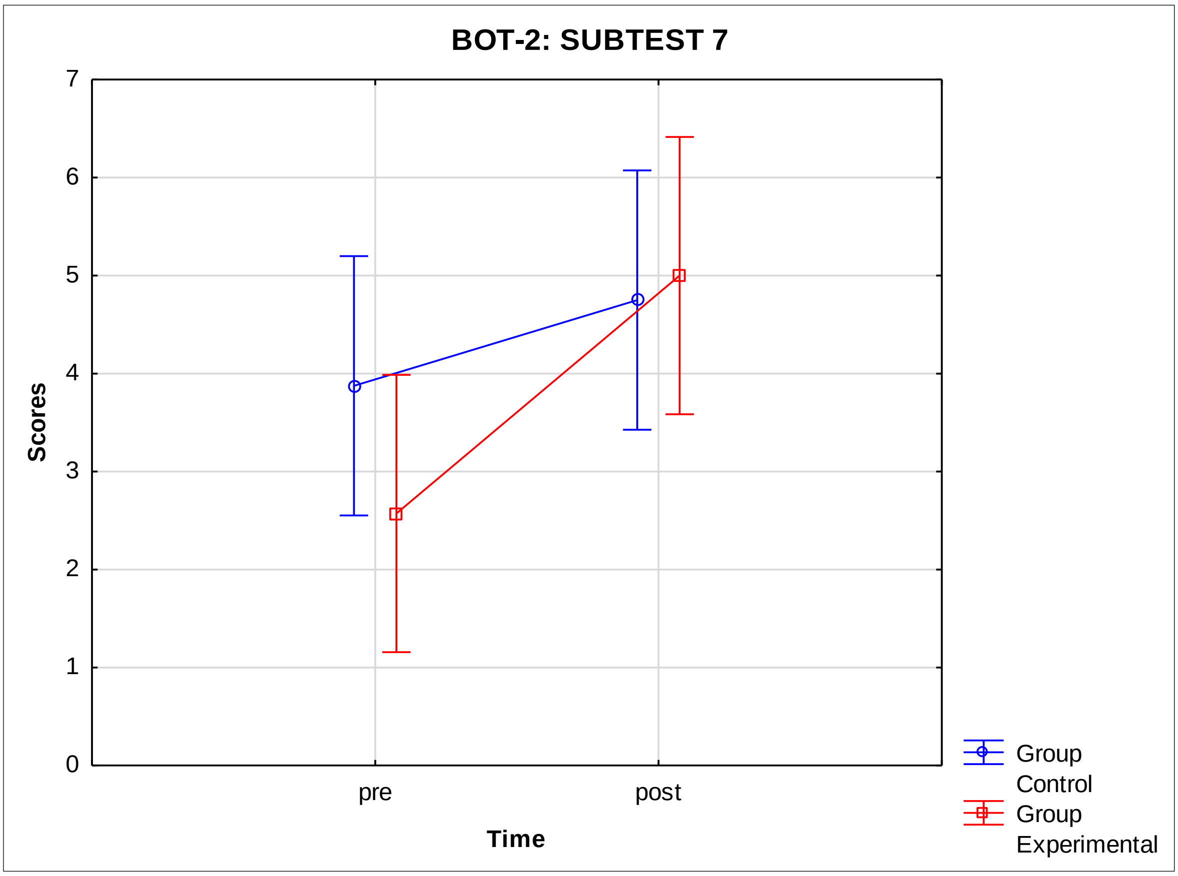

Figure 4.24: Upper limb coordination subtest

In Figure 4.24, the results of the upper limb coordination subtest indicate that the experimental group performed 34% better than the control group (p=0.17) at pre-test. The experimental group indicated a significant difference ($p \leq 0.05$) over time with an improvement of 95%. Furthermore, the control group also improved by 22% over time ($p=0.12$). At the post-test, the experimental group performed slightly better (5%) than the control group ($p=0.78$).

Venetsanou and Kambas (2016:5) found that boys performed significantly better ($p \leq 0.001$) than girls in the upper limb coordination subtest of the BOT-2. Similar results were found by Derri *et al*. (2001:778), who reported that girls performed more accurately in motor-music skills such as motor pattern coordination and hand-eye coordination than boys. Similarly, De Milander *et al*. (2016:44) found in a case study intervention that the girl participant improved in the BOT-2 upper limb coordination subtest after Equine-assisted therapy.

When comparing the control and experimental groups, Ketcheson *et al*. (2017:487) found a significant difference ($p \leq 0.001$) in the object control of the ASD sample. Longhurst (2006:105) found a great improvement of 45% in the upper limb coordination subtest of the BOT-2 of the perceptual motor group, compared to the sensory integration group during the post-test. Srinivasan *et al*. (2015:10) focused exclusively on the ASD population group and concluded that children with ASD improved significantly ($p=0.02$) over time in the body coordination subtest of the BOT-2 when they imitated a robot.

When taking gender differences into account, the current study was unable to relate to this concept, because both girl subjects were in the experimental group, and their results were not singled out from the rest (Derri *et al*., 2001:778; Venetsanou & Kambas, 2016:5). The results of the improvements relate to subtest 4, which assessed bilateral coordination. For both coordination subtests, both groups improved over time. This is a strong indication that the development of coordination was consistent for both the control and experimental groups.

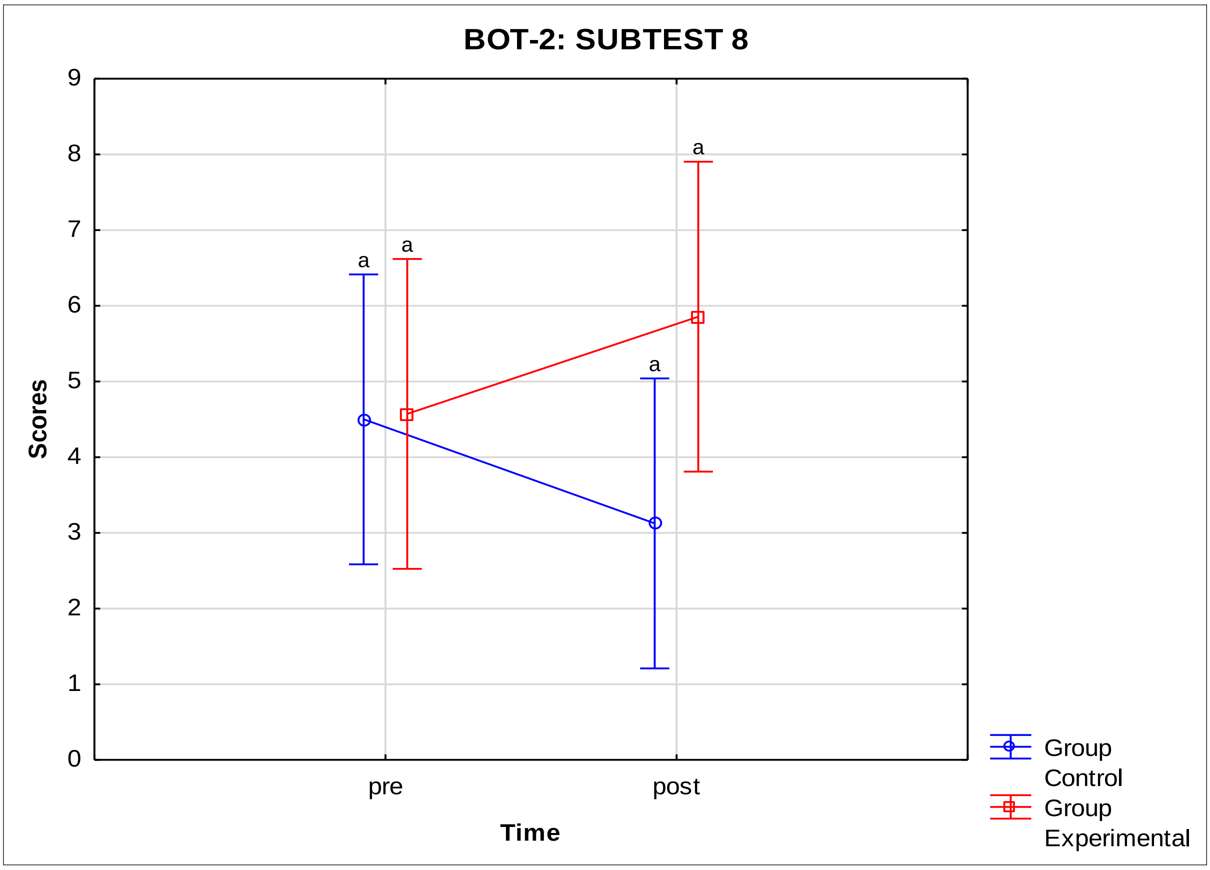

Figure 4.25: Strength subtest

The results of the strength subtest (Figure 4.25) indicate that the control group performed 2% better than the experimental group during the pre-test (p=0.96). Despite no significant results, effects over time had been found. The experimental group improved by 28% over time (p≥0.05). In contrast, the control group performed poorer over time resulting in a 30% decrease in strength (p=0.06). At the post-test, a difference of 87% could be seen between the experimental and control groups, where the experimental group performed better than the control group (p=0.06).

Venetsanou and Kambas (2016:5) found a significant difference (p≤0.001) in the sample of neuro-typical boys with a mean age of 5 years when compared to neuro-typical girls in the BOT-2 strength subtest. When considering studies with special populations, Gupta *et al*. (2011:427) implemented a six-week training programme for children with Down syndrome and found that their lower limbs strength improved. Additionally, Longhurst's (2006:105) results at the post-test indicated that the perceptual motor intervention group performed 33% better than the sensory motor group in the strength component of the BOT-2.

De Jong *et al*. (2011:643) confirmed that children with ASD in a sample with a mean age of eight years old had muscle tone dysfunction. After 15 sessions of an Equine-assisted therapy intervention programme, Hawkins *et al*. (2014:142) found that the strength and agility of the subjects with ASD improved over time when assessed with the BOT-2. Conflicting results were obtained by De Milander *et al*. (2016:44) who found that the girl participant in a case study intervention did not improve in the BOT-2 strength subtest after Equine-assisted therapy. Krog and Kruger (2011:81) found no significant improvements ($p \geq 0.05$) in the muscle tone of children with special needs after a 10-week intervention.

The current study is in agreement with Hawkins *et al*. (2014:142) because the results of both studies are similar; yet the type of intervention differed. When observing the results of the BOT-2, subtest 5 (balance), and the subtest 8 (strength), both indicated that the experimental group improved over time, thus indicating a simultaneous improvement of balance and strength.

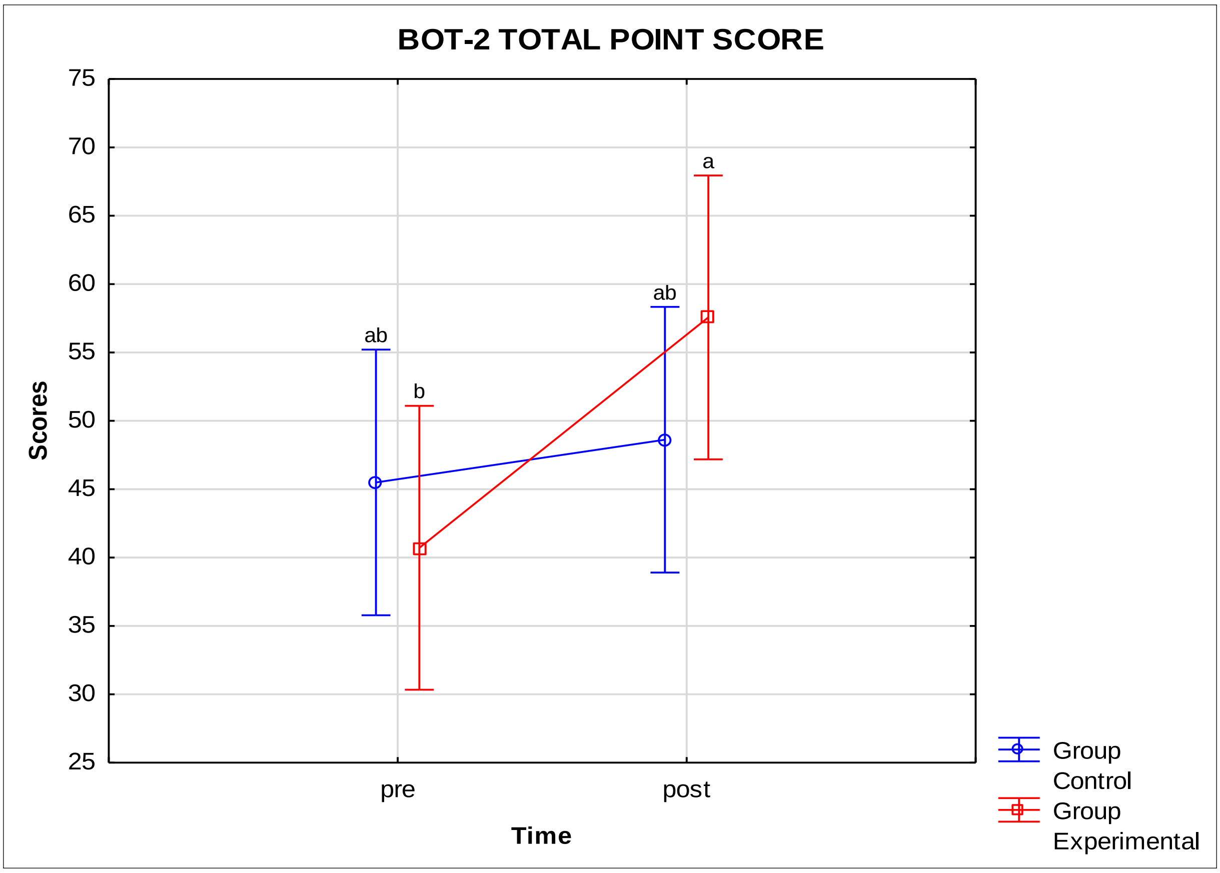

Figure 4.26: Total point score

Comparing the results of the total points scores obtained from the control and the experimental groups (Figure 4.26), the control group performed better by 11% overall at the pre-test. Over time, the results of the experimental group indicated a significant difference ($p \leq 0.01$) between the pre- and post-tests. This group improved by 41% over time. The results of the control group indicated that they improved by 7% over time. At the post-test, the experimental group performed overall better by 18%.

After a 10-week intervention programme on children in South Africa, Van Niekerk *et al*. (2007:169) found a significant improvement ($p=0.02$) in the BOT-2 total score of the experimental group. Similarly, Lee and Hodge (2017:5) found that an eight-week intervention programme on children with ASD increased the GMS of the children.

When comparing the BOT-2 total scores of the control and the experimental group after performing a traditional Greek dance intervention, Venetsanou and Kambas (2004:134) found no significant difference ($p \geq 0.05$) in the motor proficiency of children. Correspondingly, Pan (2014:160) found no significant results ($p=0.88$) in the total motor composites of individuals with ASD when comparing ASD individuals on medical stimulants to those not using medical stimulants. Similar results can also be seen with reference to other disorders. Kooistra *et al*. (2005:201), for example, found that children with ADHD, reading difficulties and ODD (oppositional defiant disorder), displayed a significant regression ($p \leq 0.05$) when tested with the BOT-2.

With reference to the improvements of the experimental group in this study, the researcher's results are contradictory to the results by Venetsanou and Kambas (2004:134) and Pan (2014:160). The experimental group in the current study improved in all subtests of the BOT-2.

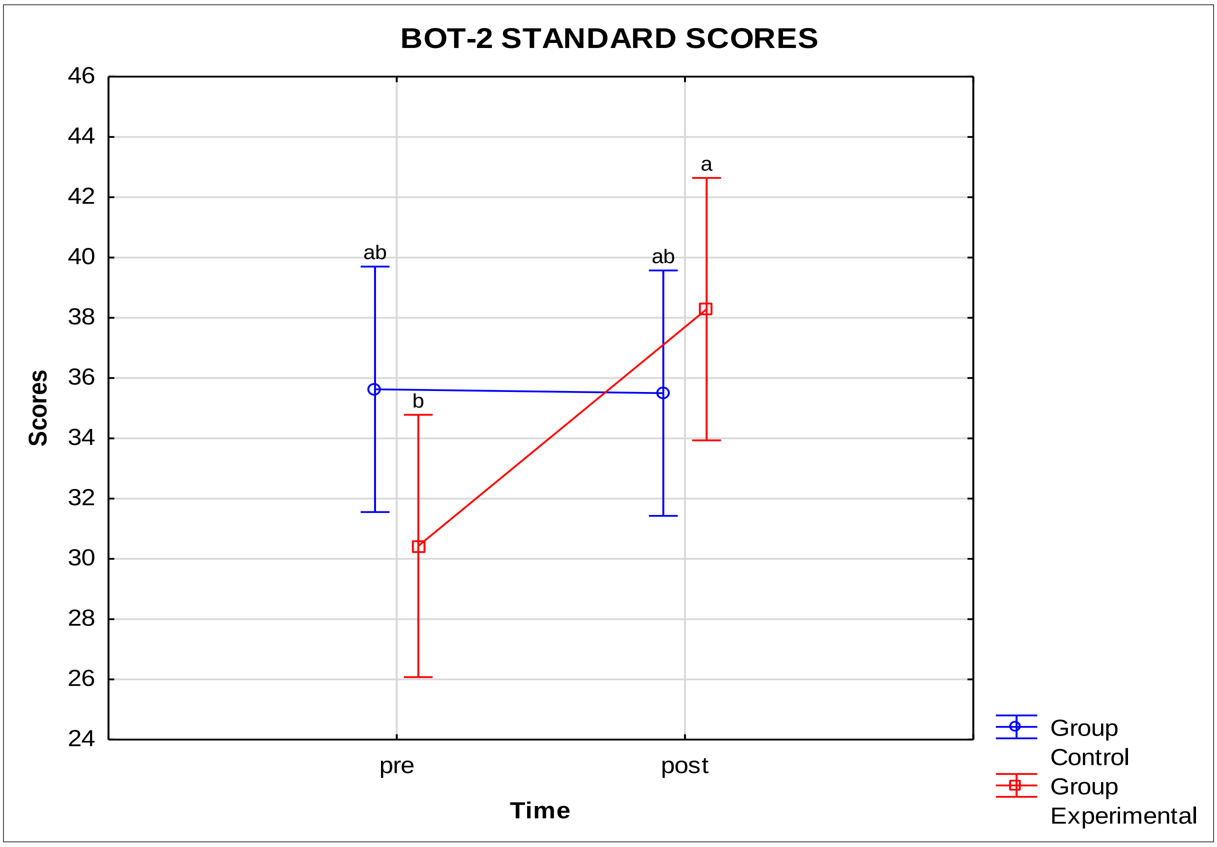

Figure 4.27: Standard scores

The results of the standard scores obtained from both the control group and experimental group in the current study (Figure 4.27) indicate that the control group performed 15% better than the experimental group at the pre-test. Over time, the results of the experimental group indicated a significant difference ($p \leq 0.01$) between the pre- and post-tests. The experimental group improved by 26% over time. The results of the control group indicate that they remained quite stable over time ($p \geq 0.05$). At the post-test, the experimental group performed better by 8% overall.

Srinivasan (2015:11) concluded that the ASD control group improved significantly over time ($p \leq 0.05$), whereas the rhythmic and robotic group did not improve significantly ($p \geq 0.05$) in the BOT-2. In agreement, Longhurst (2006:108) indicated that the perceptual motor group improved significantly ($p \leq 0.05$) in comparison to the sensory motor intervention group, as well as the control group. After an Equine-assisted therapy intervention, Hawkins (2014:142) found that the overall BOT-2 scores of the ASD experimental group increased.

However, contrary to the above-mentioned findings, Longhurst (2006:108) found no significant results ($p \geq 0.05$) at the post-test for the sensory motor intervention group. A noteworthy factor that should be taken into consideration, has been reported by Venetsanou *et al*. (2007:848), that not all children with low scores on the BOT-2 display motor impairments. It may be related to factors outside the motor system such as attention or behavioural deficits. Furthermore, Zelaznik and Goffman (2010:390) reported that children with linguistic deficits, which directly rely on verbal cognitive process, may not correctly comprehend the external instructions given by the examiner administering the BOT-2. This may, in turn, directly affect the performance of the subject and, as a result, affect their total score classification.

With reference to the standard scores, of the current study, it was indicated above that no improvement, just a slight regression of the motor proficiency of the control group was displayed over time. However, a positive relationship between the pre- and post-test scores of the experimental group in the current study revealed that the dance movement programme had a significant effect on their motor proficiency standard and the BOT-2 standard scores.

SUMMARY

With reference to the results of the standardised tests, the QNST-3 detects neurological soft signs and minor motor irregularities (Mutti *et al*., 2012:6-7). The control group improved in four out of the 15 tasks over time, while the experimental group improved in 12 of the 15 tasks. The total point scores indicate that the control group deteriorated significantly by 27% over time and the experimental group improved significantly by 50%.

The BOT-2 is one of the most extensively used measures for evaluating motor discrepancies in the ASD population (Wuang & Su, 2009:848). The results depicted that the control group improved in five out of the eight subtasks over time, while the experimental group improved in all of the tasks. The Total Point Score and the Standard scores were not consistent for the control group. As a result, the over time results of the Total Point Score indicated that both groups improved over time, whereas the Standard Scores indicated that the control group deteriorated or began to plateau over time and the experimental group significantly improved by 26%. The researcher suggests that the standard scores should be taken in account as they are more standardised.

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CHAPTER 5:

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

OVERVIEW OF CHAPTER

This chapter presents the conclusions, with reference to the aims and sub aims of the current study. Study limitations are categorised with regards to (A) Literature, (B) Sample, (C) Testing and (D) Intervention. Recommendations for further research are presented accordingly.

CONCLUSIONS

This study contributes to evidence suggesting that motor impairments may be considered to be a cardinal feature of ASD (Provost *et al*., 2007:321; Scharoun *et al*., 2014:211; Bremer *et al*., 2015:980; Bo *et al*., 2016:51; De Milander *et al*., 2016:38; Grace *et al*., 2017:1006; Mody *et al*., 2017:156). In the following sections the conclusions regarding the sub aims will be provided.

Sub aim 1: The current study included the identification of the extent of gross motor skill (GMS) deficits in selected verbal children with ASD. When taking the pre-test results, obtained from the QNST-3 and BOT-2 of both groups into consideration, it can be concluded that the participants had significant GMS deficits. Deficits in static and dynamic balance, strength, motor planning, motor sequencing, rate and rhythm and spatial organisation were displayed. Furthermore, both control and experimental groups showed mild deficits in bilateral coordination, running speed, agility and upper body coordination, although these deficits improved naturally over time.

When looking more specifically at the results and the subsequent conclusion; delays in motor planning were prevalent in the results of the QNST-3 (task 1 and 2), where the control and experimental groups deteriorated over time. For task 5 and 9, both of these groups achieved relatively high scores during the pre-test. For task 6, 12 and 13, only the control group deteriorated over time. Similarly, the BOT-2 subtest 3 showed that the control group deteriorated over time. Motor sequencing deficits were prevalent in QNST-3, task 12 and 13, where the control group deteriorated over time. Deficits in rate and rhythm were conclusive because the control group deteriorated over time in the following QNST-3 tasks: 3, 9, 10, 11, 12 and 13. Spatial organisation deficits became evident in the BOT-2, subtest 3, where the control group deteriorated over time.

In the latest version of the DSM (5th edition), it is stated that essential features, such as impairments in social communication and restricted, or repetitive behaviours, should be present from early childhood and should limit or impair daily functioning, for a successful diagnosis (APA, 2013:53). Additionally, research has indicated that areas of the brain, involved in language functioning have been linked to motor tasks such as execution and imitation (Bo *et al*., 2016:52; Mody *et al*., 2017:160). Taking these characteristics into consideration, further exploration of motor deficits as a core feature of ASD, is needed. The researcher of the current study strongly suggests that the early detection of any gross motor impairments or delayed milestones, should be included in the screening for ASD. Furthermore, it is important to determine whether a child presents impaired motor skills, and to what extent these impaired motor skills interfere with daily functioning.

Sub aim 2: This aim involved exploring the body awareness of selected verbal children with ASD. It can be concluded that according to the second sub aim, deficits in the body awareness of the selected group of subjects with ASD were found. When considering the lateral discrimination and directionality results of the QNST-3 and BOT-2: Both groups performed poorer in QNST-3, task 1. The control group deteriorated over time in the QNST-3, task 10, 11, 12, 13, 14 and BOT-2, subtest 2 remained unchanged. The experimental group improved in the QNST -3, task 8 and BOT-2, subtest 1. QNST-3, task 14 had taken the entire QNST-3 tasks into consideration to solely determine laterality. It can, therefore, be concluded that the lateral discrimination of individuals with ASD deteriorates over time if no form of therapy or intervention is present. Furthermore, with reference to the results of the BOT-2, it can be concluded that directionality of the control group deteriorated over time, which suggest that children with ASD have directionality deficits.

A similar trend was seen regarding body image, where the control group deteriorated over time when considering the QNST-3 results of task 10, 11, 12 and 13. It can, therefore, be concluded that ASD individuals have body image deficits.

The dance programme allowed for subjects to express themselves and interact with the equipment, music or peers in their own unique manner. Over time, the researcher observed that the self-esteem of each subject developed positively. It is possible that the gain in GMS improved the self-esteem of the children. The DSM-5 noted in the diagnostic features of children with ASD that they lack social-emotional reciprocity, and that they do not express their emotions appropriately (APA, 2013:53). Based on the findings of the current study and the above-mentioned statement, the researcher urges more research to be conducted in this specific field.

The main aim of the study: The researcher aimed at investigating the influence that self-designed dance programme had on the selected verbal subjects with ASD. Specifically designed for the experimental group's GMS and body awareness. With reference to the experimental group's post test results, of QNST-3 task 3, 4, 5, 6, 8, 9, 11, 13 and the Total Point Score, the researcher can affirmatively conclude that the self-designed dance programme had a significant impact on the GMS and body awareness of the selected participants. Results of BOT-2 subtests 4, 5, 6, 7 and the Total Point Score and Standard Score, can also contribute to the above-mentioned conclusion.

Language functioning has been linked to motor tasks (Bo *et al*., 2016:52; Mody *et al*., 2017:160), and there is evidence that a component such as social-emotional reciprocity is associated with body awareness as documented in the DSM-5 (APA, 2013:53). It is, therefore, clear why Martin (2014:548) stated that dance can reinforce potential neurological pathways, which integrate social or communicative functions and gross motor coordination.

Figure C2 (*Appendix C*) summarises the GMS and body awareness deficits that children with ASD may experience and how these deficits are transferred to other areas of functioning. A self-designed dance programme may improve these deficits and might be a viable form of therapy for children with ASD.

When taking the results of the QNST-3 and BOT-2 pre-tests of the current study into account, the researcher agrees with Bo *et al*. (2016:51), Grace *et al*. (2017:1014), and Mthombeni & Nwoye (2017:2) who recommend assessment and screening of motor activity in the early identification of children with ASD and subsequent interventions.

Miyahara (1994:380) stated the following: "Research data applied to practice is the best way to make research elaboration valuable in the real world". The findings of the current study could, therefore, be useful to researchers, therapists, educators and parents of children with

ASD. A self-designed dance programme is a simple, and cost- effective way to enhance a child with ASD's GMS and components of body awareness, which are essential for daily functioning. Motor skills play a vital role in the development of children with ASD and this study could, therefore, be a starting point for further research.

LIMITATIONS

The following limitations were found.

1) Literature:

- Limited research, and an even greater paucity in South African research, has been conducted on the extent of GMS in children with ASD. Similarly, the umbrella term of body awareness, and its underlying factors, has not yet been discussed extensively in literature.

2) The sample:

- The sample was not a true representation of all the subjects with ASD in the Western Cape Province of South Africa.
- The sample size was much smaller than the researcher anticipated because the QNST-3 and BOT-2 required subjects to be verbal.
- A pilot group was not used prior to the study to check for content validity.
- The maturation of each child may have influenced the results because of a wide variation in milestone attainment.
- Only two girls participated in the study, and both of them were included in the experimental group.

3) Testing:

- The scientific evaluations (QNST-3 and BOT-2) had no 'special' allowance or adaptations for subjects with ASD, therefore, the testing procedures, scoring and norms were all based on neuro-typical subjects. The evaluations were highly structured and did not provide any room for the explanation or scoring of ‘other’ skills that the subject with ASD were able to perform.

- The QNST-3 does not take gender into account when interpreting the standard data.
- The QNST-3 and BOT-2 do not take associated reactions into account when scoring.
- Quantitative data obtained from the QNST-3 and BOT-2 does not include the ‘ASD-human factor’ in the scoring criteria, as well as other elements of the evaluations as noted below:
    - The evaluations have been validated on an able population.
    - During the evaluations, the researcher was unsure when to use verbal and when to use non-verbal signs to regulate interaction without altering the testing-protocol.
    - The standardised results and interpretations were based on the norm of the population.
    - Effective communication, social participation and social relationships, were absent during testing procedures, which made the process challenging.
    - During the post-test, there was a chance that subjects recalled parts of the test from the pre-test.

- The researcher did not make use of qualitative data because of resources and time constraints. Qualitative data could possibly be more appropriate for evaluating body awareness.

- Testing took much longer than initially planned because the participation of the subjects with ASD was not guaranteed. Possible reasons for this behaviour could have been that:
    - The subjects with ASD had highly restricted behaviour and had fixated interests that were atypical in their intensity or focus. This phenomenon

resulted in the subject not wanting to participate in the activity due to their attention being elsewhere.

- Being hypersensitive to sensory input resulted in immediate termination of the activity.
- Personal and emotional circumstances influenced their motivation to participate in the activities.
- Fluctuating moods, anxiety and mood problems were more common in high functioning and verbal subjects with ASD, which resulted in unwillingness to participate at times.
- Personal health circumstances such as illness (flu) had a negative effect on regular participation.

4) Intervention:

- Several financial and functional limitations were encountered during the intervention period. For example, financial constraints restricted the participation of some subjects because their parents were not able to finance transportation to school. Additionally, a lack of funding resulted in limited equipment available for the intervention. The researcher had to make alterations to most of the equipment to make it more sensory stimulating for the subjects.
- During the Western Cape school and public holidays, the subjects were not able to participate in the intervention. The school also had numerous outings and school

concerts that affected the scheduled days of testing and/or the sessions of the intervention.

- Lastly, due to the heterogeneity of the sample with ASD, an attempt was made to design a programme, which may not have met the requirements with regards to sensory, motor and body awareness needs of every individual subject.

RECOMMENDATIONS FOR FUTURE STUDIES

With reference to the literature, the sample, testing and intervention, the following recommendations that future studies should consider are the following:

1) Literature:
   - Future research is required to:
     - determine the gross motor milestone development in children with ASD.
     - determine to what extent motor skills map into social changes.
     - determine the extent of gross motor and body awareness deficits in verbal and non-verbal children with ASD.
   - Another research suggestion is directed towards the prevalence rates of children with ASD in South Africa, both provincially and nationally.

2) The sample:
   - This study should be replicated with the following in mind:
     - Include non-verbal ASD children;
     - Recruit more participants;
     - Include more girls;
     - Compare the results of children with ASD in a lower socio-economic community with the results of children with ASD in a higher socio-economic community; and
     - Compare the results of two lower socio-economic communities in the Western Cape, for example, Mitchells Plain and Khayelitsha.

3) Testing:

- A scientific test battery or standardised measure that is specifically designed for ASD children, and that is sensitive enough to detect their GMS deficits is needed. The age and gender norms of subjects also need to be taken into consideration.
- A scientific test battery or standardised measure that specifically assess children with ASD's body awareness, and the related components, is needed.
- Future versions of the QNST-3 and BOT-2 or other scientific assessments, which are adapted for special populations in their testing procedures and norms, are required.
- Furthermore, it is suggested that visual explanatory cards (such as PECS or PCS) should be included in the QNST-3 and BOT-2 (and other standardised tests) for children with ASD.
- It is also recommended that the following focal areas should be included in both the QNST-3 and BOT-2 assessments:
    - QNST-3: Task 6: Proprioception.
    - QNST-3: Task 8: Proprioception and vestibular.
    - QNST-3: Task 11: Dynamic balance.
    - BOT-2: Subtest 1: Imitation, laterality/ lateral discrimination, directionality and motor planning.
    - BOT-2: Subtest 2: Directionality, laterality/lateral discrimination, motor planning, figure imitation and production, and spatial awareness.
    - BOT-2: Subtest 3: Laterality, directionality, motor planning, spatial awareness and precision.
    - BOT-2: Subtest 4: Laterality, directionality, body awareness and motor planning.
- A prospective randomised control study with a tester blinded to the participants and their respective groups of the study should be conducted.

4) Intervention:

- Based on the results of the QNST-3 (task 1 and 2), the researcher recommends that children with ASD require practical attention in the fine motor skill composite.

- Future studies are required to determine the effect that an early gross motor intervention could have on the milestone development and GMS of children with ASD.
- To determine the effect of a GMS intervention on the academic performance of children with ASD future studies are required.
- A replication of this study using culture specific music relating to a certain community or culture could be undertaken.
- The current study could also be replicated to assess the effects of the intervention over a longitudinal period.
- The current study could also be replicated with subjects who display signs of neuro-typical development in order to compare their results with the results obtained from children with ASD.
- Future studies are required to adapt certain aspects of the current studies programme, such as; variation of the duration, progressions and teaching the dance to the subjects in different manners.
- The current researcher does recommend to researchers or therapists that when using the programme, to adapt it to their certain population as well as the particular needs of the subjects.

With reference to the findings of the current study, a dance programme could enable children with ASD to discover aspects about life. Through movement, they can express themselves and provide opportunity to gain insight into their own world.

SUMMARY

In this chapter the researcher concluded with the findings of the current study, by answering the sub aims. The researcher acknowledged the relevant limitations to the current study, and urges researchers to take note of the proposed recommendations.

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Appendix A

Ethical considerations

A1: Research Ethics Committee: Human Research (Humanities) letter of approval

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Approval Notice

Response to Modifications- (New Application)

09-Mar-2016
Africa, Eileen EK

Proposal #: SU-HSD-001759
A SELF-DESIGNED CREATIVE MOVEMENT PROGRAMME AS AN INTERVENTION FOR SELECTED CHILDREN DIAGNOSED WITH AUTISM SPECTRUM DISORDER

Dear Dr. Eileen Africa,

Your **Response to Modifications** -***(New Application)*** received on **17-Feb-2016**, was reviewed by members of the **Research Ethics Committee:**

Human Research (Humanities) via Expedited review procedures on **09-Mar-2016** and was approved.

Please note the following information about your approved research proposal:

Proposal Approval Period: **09-Mar-2016 -08-Mar-2017**

Please take note of the general Investigator Responsibilities attached to this letter. You may commence with your research after complying fully with these guidelines.

Please remember to use your **proposal number** (**SU-HSD-001759**) on any documents or correspondence with the REC concerning your research proposal.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

Also note that a progress report should be submitted to the Committee before the approval period has expired if a continuation is required. The Committee will then consider the continuation of the project for a further year (if necessary).

This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki and the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health). Annually a number of projects may be selected randomly for an external audit.

National Health Research Ethics Committee (NHREC) registration number REC-050411-032.

We wish you the best as you conduct your research.

If you have any questions or need further help, please contact the REC office at 218089183.
Included Documents:

Humanities REC letter_001759.pdf

REC: Humanities New Application

Sincerely,
Clarissa Graham
REC Coordinator
Research Ethics Committee: Human Research (Humanities

A2: Western Cape Education Department letter of approval:

Directorate: Research

Western Cape Government
Education

Audrey.wyngaard@westerncape.gov.za
tel: +27 021 467 9272
Fax: 0865902282

Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20160107-6347

ENQUIRIES: Dr A T Wyngaard

Ms Analja Briel
PO Box 914792
Wingate Park
0153

Dear Ms Analja Briel

RESEARCH PROPOSAL: A SELF-DESIGNED CREATIVE MOVEMENT PROGRAMME AS AN INTERVENTION FOR SELECTED CHILDREN DIAGNOSED WITH AUTISM SPECTRUM DISORDER

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **01 February 2016 till 30 September 2016**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Research Services Western Cape
Education Department Private Bag X9114
CAPE TOWN 8000

We wish you success in your research.
Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 08 January 2016

Lower Parliament Street, Cape Town, 8001
tel: +27 21 467 9272 fax: 0865902282
Safe Schools: 0800 45 46 47

Private Bag X9114, Cape Town, 8000
Employment and salary enquiries: 0861 92 33 22
www.westerncape.gov.za

A3: Participating schools letter of approval

Beacon School for LSEN

For learners with special educational needs

P.O. Box 346, Town Centre, Mitchells Plain, 7789
163 Loganberry Way, Westridge, M/Plain, 7798
Email: admin@beacon.wcape.school.za
www.beaconschoolforlsen.yolasite.com

Tel. 021371 4324 or 021371 7665
Fax # 021374 0916

To whom it may concern

I, Cheryl Muller, herby give permission to Analja Van Zyl to work with the learners in the Autism Unit at Beacon School for LSEN to gather information for her master's degree at the University of Stellenbosch. Sessions will be scheduled with learners between 1 March and 19 December 2016. The governing body and parents of learners involved approve of this study.

C.A Muller
Principal

E. le Roux
Autism Phase leader

BEACON SCHOOL FOR LSEN
(Learners with special educational needs)
P.O. Box 346
Town Centre
Mitchells Plain, 7789
Tel: 021 371 4324 Fax: 021 374 0916

Our Vision: To develop each learners maximum potential by providing quality education

A4: Stellenbosch University consent form

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jou kennisvennoot • your knowledge partner

STELLENBOSCHUNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

A SELF-DESIGNED CREATIVE MOVEMENT PROGRAMME AS AN INTERVENTION FOR SELECTED CHILDREN DIAGNOSED WITH AUTISM SPECTRUM DISORDER

Your child has been asked to participate in a research study conducted by Analja Briel and her team, from the Department of Sport Science at Stellenbosch University. All results will contribute to the research article. Your child was selected as a possible participant in this study because he/she attends Beacon School for LSEN.

1. PURPOSE OF THE STUDY

To explore the effect a self-designed creative movement programme focusing specifically on gross motor skills, quality of movement and body awareness on selected ASD children.

2. PROCEDURES

If your child volunteers to participate in this study, we would ask him/her to do the following things: the first step is that your child will undergo pre-evaluation. This consists of activities that target the relationship between the brain activity and the way the body moves. This will take place at the Department of Sport Science and will be conducted by the researcher, a qualified Kinderkineticists. The evaluation will occur during April and November- December 2016 and each evaluation will take approximately thirty minutes per child. The researchers would also like to obtain your child's confidential records from the Occupational Therapist with relation to their level of functioning as the children will be put in groups according to their level of functioning. The child's mood and emotional state will have a large influence on how long the test will take. After the pre-evaluation, the researchers will use the results to develop a specific programme for your child. The programme will be conducted at the Department of Sport Science as well as at the Beacon School for LSEN.

3. POTENTIAL RISKS AND DISCOMFORTS

Your child may perspire and become hot due to the physical nature of the activities, however he/she is at no more risk than everyday playing. There is a potential risk that your child may fall during the duration of the activities, however if this may happen your child will be properly cared for.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

The main focus of the study is to improve the quality of life and movement of the autistic individual as well as to improve the way their body movement when doing certain activities and body awareness. The researcher also wants to show the education department that this population of children needs more one on one attention than typical children so they hope to show the importance of this so that the education department could possibly make adjustments to ensure that the individuals receive the attention they need.

The researcher also hopes that the positive effect that will come from the program will carry over and aid in slight relief for the parents of these children as they also have to deal with numerous unique stressors.

Ultimately, an improvement in the child's quality of movement and body awareness will aid them in numerous aspects in their lives and function of everyday living and functioning.

5. PAYMENT FOR PARTICIPATION

No remuneration will be issued for participating in this study.

6. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of a secure laptop that only the main researcher will have the password for. Additionally it will place a password protector on the file itself to ensure that no one can open the file if they gain access to the laptop. Even though other honours Kinderkinetics students will be assisting with the testing all final data handling will done only by the researcher. All the hardcopies of the testing will be placed in a locked cupboard, and the main researcher will only have access to this key. Once your child's records have been obtained from the Occupational Therapist they will be reviewed by the researchers in a private environment and then returned to the school and no copies of this information will be made.

7. PARTICIPATION AND WITHDRAWAL

It will be verbally explained to your child that he/ she can choose whether to be in this study or not. If your child volunteer's to be in this study, he/she may withdraw at any time without consequences of any kind. He/she may also refuse to answer any questions they don't want to answer and still remain in the study. The researcher may withdraw your child from this research if circumstances arise which warrant doing.

8. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact: Analja Briel on 072 843 2604 or alternatively analjabr@gmail.com

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; 021 808 4622] at the Division for Research Development.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

The information above was described to me in English and I am in command of this language. I was given the opportunity to ask questions and these questions were answered to her satisfaction.

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

I hereby give the researcher permission to confidentially view my child's records from the Occupational Therapist.

____
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/her] representative ____________________ [*name of the representative].* She was encouraged and given ample time to ask me any questions. This conversation was conducted in English

______________________________ ______ ______________________
Signature of Investigator **Date**

***A5:* Participant information leaflet and assent form**

STELLENBOSCH UNIVERSITY

PARTICIPANT INFORMATION LEAFLET AND ASSENT FORM

TITLE OF THE RESEARCH PROJECT: A SELF-DESIGNED CREATIVE MOVEMENT PROGRAMME AS AN INTERVENTION FOR SELECTED CHILDREN DIAGNOSED WITH AUTISM SPECTRUM DISORDER

RESEARCHERS NAME: Analja Briel, Dr E Africa and Dr PE Springer

ADDRESS: Department of Sport Science, Stellenbosch University.

CONTACT NUMBER: (021) 808 4591

What is RESEARCH?

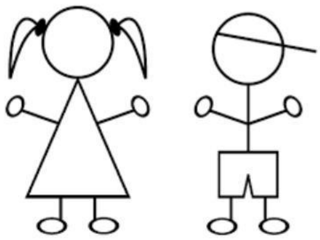
Research is something we do to find new knowledge about the way things (and people) work. We use research to help us find out more about illness. Research also helps us to find better ways of helping, children who are sick.

What is this research project all about?

This research project is about the value of fun games and dances, and how they can help you develop and get to know your body. I want to see if these games and dances can help you move better and do everyday things better.

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

You have been chosen to take part in this study because you are special. I would like to help you improve how you feel about yourself, how you move and how straight you can sit.

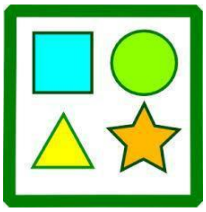


Who is doing the research?

Analja Briel and her team are doing the research. We are doing this study to learn about you and try to help you do certain things better.

What will happen to me in this study?

You will take part in fun activities on Tuesday's and Thursday's. On a Tuesday you will come to me for an hour and on a Thursday I will come to your school for one hour. You will also do a fun exercise two months of the year so that I can see if my activities are helping you. Before you participate in any activities I will tell and show you what you must do. Some of the things you will do are dancing to music, getting to learn your body, learning about two sides of your body and what the difference is.



Can anything bad happen to me?

Nothing can hurt you.

You might get hot so you will sweat and that might not be very comfortable. However, if you do feel sore or sick after the activities you must tell your parents so they can tell me.

Can anything good happen to me?

Yes, good things can happen to you, like you can become better at catching and throwing. You can feel better about your body and everything that comes with it.

.

Will anyone know I am in the study?

No one will know you took part in the study because we will not tell anyone your name. I will keep all your information locked up so no one can get to it besides us.

Who can I talk to about the study?

You can contact Analja Briel on 072 843 2604 and/or Ms Maléne Fouché on 021 808 4622.

What if I do not want to do this?

If you do not want to be a part of this study you do not have to, you can just say no and nothing bad will happen. Also, if you do take part in the study but you don't want to anymore, you can stop and go back to class and you will not get into trouble.

All instructions will be verbally explained to the child in very clear and simple terms to ensure they know what they are going to be doing.

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

YES ☐ NO


Has the researcher answered all your questions?


YES ☐ NO

Do you understand that you can pull out of the study at any time?

YES ☐ NO


__________________________ ____________________

Signature of Child **Date**

Appendix B

Intervention programme and equipment

B1: THE INTERVENTION PROGRAMME

Focus: GMS and body awareness

Equipment:

Music

Speaker

Body part pictures Large

white paper Pencils

Pictures of different emotions

Decorated hula hoops

Different colour dots (blue, yellow, green and red) 2 x

wooden benches / 8 x plastic rocks

8 x bean bags

1 x medicine ball

Shape pictures (circle, square, triangle, diamond, rectangle, oval, star and heart)

4 x ropes

2 x poles

6 x high raised desks

1 x scooter board

1 x bouncy ball

3 x trampolines

Shape dice

Chalk and chalk board

Parachute

Colourful tunnel

8 tactile balls

Swiss ball

Pictures of a child jumping, marching and punching

WARM-UP'S

Musical Freeze and where are my body parts?

WARM-UP ONE

Music: Happy – Pharrell Williams

The subjects moved around the area (classroom or Kinderkinetics center) using different gross motor skill movement patterns that the Researcher called out:

- Running, walking, skipping, galloping, hopping (on two feet or one foot).

When the music stopped the subjects froze for five seconds where they were.

The Researcher then showed the subjects a piece of paper with a body part on.

The subjects had to recognise the body part that were asked of them and indicate where it was on their bodies.

The following versions of the warm-up were only conducted much later in the intervention:

Drawing body parts

The subjects paired up and traced each other‘s body on a large sheet of paper.

The Researcher showed the subjects a body part picture and the subjects needed to recognize the body part and draw it on the outline of the body that was already on the piece of paper.

The subjects had to match separate pictures of body parts such as: head, arms, legs to their body outline that was drawn.

Body image

The subjects were divided into small groups and each group sat with an assistant. The assistant's asked questions like 'what makes you happy?', 'how do you feel today?' and so forth.

Musical Freeze and where are my body parts combined with traced body poster?

Music: Happy – Pharrell Williams

The subject's moved around the area while performing different gross motor skill movement patterns that was called out by the Researcher:

- Running, walking, skipping, galloping, hopping (on one foot or two feet).

When the music stopped, the subjects picked up a body part picture that was scattered on the floor, and went to one of the Assistants to tell her what body part they picked up.

Then the subjects had to show where it fit on their bodies.

Each subject then drew how he/she felt on a big piece of white paper.

PROGRESSIONS

The number of body parts shown was increased with time.

The subjects had to recognise the body parts that were asked to them and show where it was on the Kinderkineticist's body, which was lying down in the centre of the room.

The subjects also had to recognise the body part on their friend's body.

Subjects would skip/hop/gallop/side shuffle for approximately 30 seconds when the music stopped they were shown a body part.

The subjects had to draw this body part on a piece of paper.

ADAPTATIONS FOR SUBJECTS:

For the subjects who struggled with locomotor skills, an assistant would assisted the subject by attempting the skill with them. For example, if a subject struggled to hop with his two feet together, the assistant physically placed his/her feet together and held the feet together while he/she hopped forward.

If subjects were hesitant to give a response as to what body part was on the picture, the personally asked him/ her to tell her what body part was on the picture.

If a subject could not say how he/she felt in front of the other subjects, a Assistant took the subject aside to talk to him/her personally.

ACTIVITY ONE

SUNSHINE: ARMS, FEET, LEGS

Directionality, left - right discrimination, bilateral coordination and locomotion.

Music: Kids folk (you are my sunshine)

SET-UP

Every subject received a hula hoop decorated with ribbons and their name on it.

The subjects stood inside their hula hoops.

There were four colour dots on all four sides of the hula hoop. The dots were placed on the outside of the hula hoops. The colours of the dots were blue, yellow, green and red.

Time: 2 minutes		
COUNTS	**REPETITIONS**	**MOVEMENT**
8	x2	Waved arms from right to left up in the air.
8	x2	Moved the hips in the same directions as the arms.
8	x2	**Progression**: waved arms at their feet (sweeping the floor motion).
8	x2	Jumped outside the hula hoop on the coloured dots. First to the front (red dot), then to the left (green dot), then to the right (yellow dot), then to the back (blue dot).
8	x2	**Progression**: Took the coloured dots away. The subjects had to jump according to directions (forward, left, right and backward).
8	x2	**Progression**: While the subjects jumped in all four directions they had to turn their bodies. When they landed their bodies had to face their hula hoop.
8	x1	The subjects stood still in their hula hoops and twisted their hands/wrists, in circular motions.
8	x1	The subjects moved their body around hula hoop while one foot stayed stationary in the hula hoop and their body had to pivot around

		the hula hoop. Simultaneously they had to perform a hand twist in the direction that they stepped in.
8	x1	The subjects performed this with the right and left foot as well as with the right and left hand.
8	x1	**Progression**: The subjects had to jump on both legs in all directions while twisting both hand's in the same direction as they were jumping in.
8	x1	**Progression**: Increase the pace of the movements.
8	x1	The subjects needed to reach with their right arm to their left and then with their left arm to the right. Alternate between left and right.
8	x1	The subjects had to simultaneously step with their right foot to the right side of the hula hoop and turn their body towards the left. This was repeated with the left arm just in the opposite direction. Alternation between left and right occurred.
8	x1	**Progression:** The subjects had to jump while reaching with their left hand to the right and turning their bodies to the right and extending the left leg to the left. As they were jumping this was done at a much faster pace.

ADAPTATIONS FOR SUBJECTS:

Some of the subjects struggled a lot with directionality and did not know left from right or when to jump forwards or backwards.

An adaption was implemented by placing coloured dots around the hula hoops and, the subjects were instructed to jump on a certain colour dot.

After a few weeks when they all knew their right from left better the dots were taken away as a progression.

ACTIVITY TWO

STEPPING AND SHAPES

Lower body strength, bilateral coordination, static and dynamic balance, spatial awareness, proprioception, vestibular system, hand eye coordination, visual-motor integration, walking, marching, hopping on two feet, form recognition, arm strength, core strength and jumping on one leg.

Music: Olly Murs ft. Demi Lovato – Up (karaoke version).

SET UP

The bench/rocks were placed in a horizontal line in front of the subjects, and then progressed to a circle formation. This was done so that the subjects formed one large circle, looking at each other rather than the researcher or assistants.

Time: 1 minute

COUNTS	REPETITIONS	MOVEMENT
8	x2	The subjects stepped up onto a bench with one leg at a time and stepped down again with one leg at a time.
8	x2	**Progression:** As the subjects stood on the bench; they had to lift their one leg and extended it forward, therefore balancing on one leg on the bench.
		Progression: The above activities were conducted while the subjects balanced a bean bag on their head to be aware of controlled movements. The subjects threw and caught the bean bag 3 times to the Assistant before beginning with the dance.
8	x1	The subjects stepped up with one leg at a time onto the bench and then stepped down with one leg over the bench.
8	x2	The subjects walked around the bench, towards their starting position at the bench.
8	x2	**Progression:** The subjects marched around the bench whilst swinging their arms. - Or the subjects hopped on two legs around the bench.

		- The subjects ran and formed a circle. - The subjects ran towards the middle of the circle and out again (x2).
OR		
8 x3		The subjects jumped over the bench in different ways: 1. Using their arms only. 2. Jumping over without using arms. 3. Jumping backwards. 4. Jumping forwards on one foot.

ADAPTATIONS FOR SUBJECTS:

Some of the subjects who struggled to jump over certain heights were given lower objects to jump over.

Subjects who could not balance at first were assisted by lightly holding their hands.

PROGRESSIONS:

Shape finding – bouncing, catching, walking on toes, dynamic balance, shape recognition

The subjects stood in a line behind each other.

The Assistant threw a tactile ball towards a subject. The subject bounced and caught the ball twice and threw the ball back to the Assistant.

The subject then walked on their tippy toes forward towards a shape that the Researcher or assistant called out.

Progression: The subject would alternate static dribble with a tactile ball (x4).

Circle shapes (walking, hopping, skipping, galloping, and shape recognition)

The subjects stood on the inside of a large circle that was outlined with pictures of shapes (circle, square, triangle, diamond, rectangle, oval, star and heart).

The subjects ran around the area and when the music stopped the Researcher would call out a movement that the subjects had do in order to get to a shape which was indicated by the Researcher.

Movements included: walking backwards, hopping on one foot, hopping on two feet, galloping.

Progression: Skipping, balance on one foot on the shape picture.

Shapes (Galloping, figure recognition, colour recognition, balance, motor planning)

The subjects stood on the black line.

Different coloured shapes were spread over the floor of the room.

When the music started playing, the subjects would gallop around the room.

When the music stopped, one of the Assistants called out a colour and the subjects had to run and stand on that colour.

On that spot the subjects bounced and caught the ball x4, followed by shouting out the shape which they were standing on.

Shapes (figure recognition, hopping, lower body strength, bilateral coordination, colour recognition, auditory-motor integration)

The shapes were placed in a large square.

The subjects jumped to a shape.

The researcher asked them what shape they were standing on and which colour the shape was.

Shapes and jumping [vestibular, locomotion (jumping), figure recognition, drawing, tactile]

The subjects jumped on a trampoline (x10).

They then jumped off the trampoline, and jumped (using both legs) over four poled that were set out at a certain height (this was dependant on the subjects height).

When they got to the end they had to roll a foam dice with different shapes on it.

They had to identify what shape was on the dice which they rolled.

Different shapes were posted on the chalkboard. The subjects were given a bean bag that had to be thrown at the same shape as on the dice, and then draw that shape underneath the picture.

Each subject had to do this 4 times.

Progression: The subjects jumped as high as possible from one trampoline to the next one.

Recognising shapes (vestibular, hand-eye coordination, dynamic and static balance, tactile integration, figure recognition and motor planning).

The subjects crawled through a tunnel one by one.

Then they jumped on a trampoline with two legs and counted loudly from one to 10 while jumping 10 big jumps.

Then on a chalkboard the Researcher drew five different shapes (these shape were randomly chosen each session).

Subjects were asked what shape it was, that they pointed at and then they were asked to draw it on the chalkboard.

Progression: The subjects performed 10 jumping jacks on the trampoline.

Recognising shapes (vestibular, hand-eye coordination, dynamic and static balance, tactile integration, figure recognition and motor planning)

The subjects sat on a scooter board and pulled on a rope to move forwards to the Researcher.

Then they went to the chalkboard where an Assistant pointed to a shape. The subject had to say what shape it was and then draw it on the chalkboard.

There were six different shapes (these shapes alternated weekly) on the chalkboard.

Progression: The subjects stood on their non- dominant leg whilst drawing the shape.

ADAPTATIONS FOR THE ABOVE-MENTIONED PROGRESSIONS:

The assistant would assist the subject's with catching and bouncing the ball by holding their arms.

The assistant would assist the subjects to gallop by explaining what to do and galloping alongside them.

The assistant would help the subjects by pulling along the rope, when they were seated on the scooter board.

ACTIVITY THREE:

Creep & crawl

Creeping and crawling – bilateral coordination, arm strength, core strength, laterality, proprioception, tactile system, creeping, crawling, spatial awareness

Music: Hungarian folk music traditional dance

SET UP

A large rectangular area was used with a place for Researcher/ assistant's to stand or for a rope to be tied across the width of the area.

The subjects needed their own vertical space to crawl forward.

Time: 1:28 minutes

COUNTS	REPETITIONS	MOVEMENT
8	x1	The subjects sat kneeling, with their hands on the floor in front of their knees. The subjects had to walk forward on their hands(x4) without their lower bodies moving. **Adaptations for subjects:** - Placed a rope on the ground. The subjects kept their knees on the rope, while moving their hands forward. - The subjects hula hoops were placed infront of him/her. The subjects stayed in his/her hula hoop while moving his/her hands forward. **Progression:** Once their arms were held out in front, the subjects had to complete a push up before returning hands to the starting point. **Adaptations for subjects:** For subjects that struggled, active assistance was provided by supporting their body weight while they performed a push up.
8	x2	The subjects walked their hands back four times to the starting position.
8	x1	The subjects walked their hands forward until their bodies were completely flat on the floor.
8	x4	The subjects crawled forward 5m and crawled back again.

Progressions:

Crawled forward around in a circle.

Crawled under the rope which was held 1m above the ground.

Implement soldier crawling and normal crawling within the dance of Activity 3.

Adaptations for subjects: For subjects that struggled to pull themselves forward, active assistance was provided by slightly pushing them forward to decrease the weight that the subject had to pull.

ADAPTATIONS FOR SUBJECTS:

The subjects crawled forward under two desks that were about 0.5m above the ground.

They then sat in a sit-up position and caught a tactile ball, performed a sit-up and threw the ball back to the Assistant. This was performed three times.

ACTIVITY FOUR:

Sunshine: twist

Direction and head to toes (directionality, left-right discrimination, tactile, form recognition)

Music: Kids folk (You are my sunshine)

SET-UP

The subjects needed to hold their hula - hoops in front of their bodies and turn the hula-hoop with their hands (making as if they were driving a car, as if the hula-hoop was their steering wheel).

Time: 2 minutes

COUNTS	REPETITION	MOVEMENT
8	x2	They then moved the hula hoop to their right arm, and then to their left arm, up above their head and down to their knees.
8	x2	They then turned around on the spot in a circle formation. They then held the hula hoop in front of their face, first to the right side of their body then to the left side of their body (a twisting motion).
		Progression: The subjects then had to hold the hula-hoop close to floor and climb into hula-hoop and shake the hula-hoop to up towards their heads.
4	x2	The subjects then made two big circles with the hula-hoops to the right by taking two big steps. They then took two big steps to the left making big circles with the hula-hoop to the left.
8	x1	They then took the hula hoop from the top of their body and shook it downwards – from their head to their toes.
8	x2	**Progression:** The subjects had to shuffle to the right making circles with the hula hoop in the direction they moved.
4	x2	**Progression:** The subjects needed to push the hula-hoop forward and backwards when the Researcher instructed them.
		Progression: At the end of the dance, the subjects held the hula-hoop above their heads and skipped in a circle. When

the Researcher	said stop, they had to drop their hula-hoops from their heads to their toes.	

ADAPTATIONS FOR SUBJECTS:

If a subject struggled with the dance, the assistant's would assist the subject by holding his/her hands whilst moving the hula-hoop in the right direction so that he/she could feel where it should go.

ACTIVITY FIVE:

Ball dance

Throwing, catching, bouncing, kicking, hand eye coordination

Music: Hungarian folk music by Arany Zoltan

SET-UP

The subjects would pair up.

If there were not enough pairs, the researcher or assistant would pair up with a subject.

Each pair would stand two meters (2m) from each other. Each pair would start with a tactile ball.

Time: 55 seconds		
COUNTS	**REPETITION**	**MOVEMENT**
8	x1	The subjects each had one tactile ball which they threw up and caught the ball twice. **Progression:** The tactile ball was replaced with a dodge ball.
8	x2	Subjects then threw the ball up into the air and then bounced the ball and then caught it.
8	x1	Subjects got into pairs facing each other.
8	x2	Subjects then threw the ball to their partner. Thereafter they had to perform two bum kicks. **Progression:** The subjects had to perform more repetitions of bum kicks to the rhythm of the music.
8	x2	The subjects bounced the ball to ball to each other, after they bounced the ball they had to perform two straight leg kicks. **Progression:** The subjects had to do five repetitions of straight leg kicks to the music.
8	x2	Each subject kicked the ball to their partner, and then turned around in a circle back to face the partner again. This turn was only performed once per kick. **Progression:** The subjects increased the number of repetitions.

ADAPTATIONS FOR SUBJECTS:

Each of the assistant's gave the subjects special assistance and helped each subject individually with the movement that they struggled with.

COOL DOWN

HEADS SHOULDERS KNEES AND TOES

Bi-lateral coordination, locomotion, body awareness, anaerobic endurance, jumping, marching, punching

Music: Spanish folk music in the background

SET-UP

The subjects danced according to the lyrics of the song and needed to touch each body part that is mentioned.

COUNTS	REPETITION	MOVEMENT
16	x2	"Head, shoulders, knees and toes; knees and toes; knees and toes"- touch the body part mentioned.
8	x1	"And eyes and ears and mouth and nose" - touch the body part mentioned.
8	x1	"Head, shoulders, knees and toes; knees and toes" - touch the body part mentioned.
The Researcher would show a picture of marching.		
16	x1	"March, march, march let us all march. March, march, march get your body charged". The subjects marched on the spot (high knees and strong movements of their arms).
The Researcher would show a picture of a person jumping.		
16	x1	Jump, jump, jump let us all jump. Jump, jump, jump let your muscle pump." The subjects performed jumping jacks.
The Researcher would show a punching a person punching.		
16	x1	Then the lyrics continue as: "punch, punch, punch let's all punch. Punch, punch, punch have a hearty munch." The subjects performed an air punch movement.

STIMULATION ACTIVITIES:

Vestibular and proprioceptive stimulation

Scooter board:

The subjects sat sit on the scooter board and pulled themselves forward 3m using the aid of a rope.

The subjects were then pushed back by the researcher to the starting line.

Parachute:

The subjects would lie in a circle on the ground and the researcher and assistants would hold up a colourful parachute above the subject's heads. The Researcher and assistant's lifted the parachute up and down. They then walked in a clockwise/anticlockwise motion. The Researcher and assistant's ended off by placing the parachute on top of the subjects.

The subjects were not allowed to talk during this session.

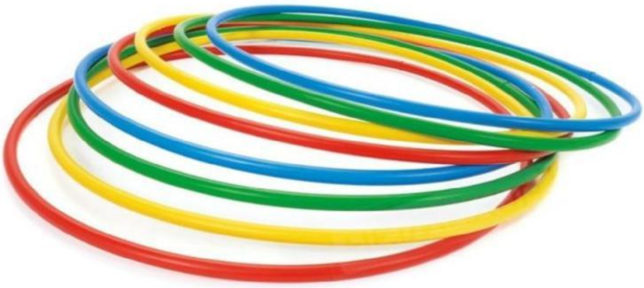
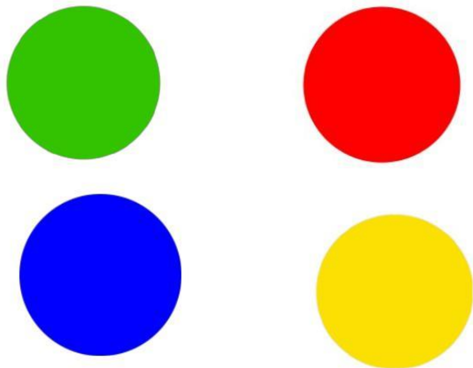
In order to get the subjects to focus on the parachute, the researcher would ask the subjects what colour they saw, or 'point to red'.

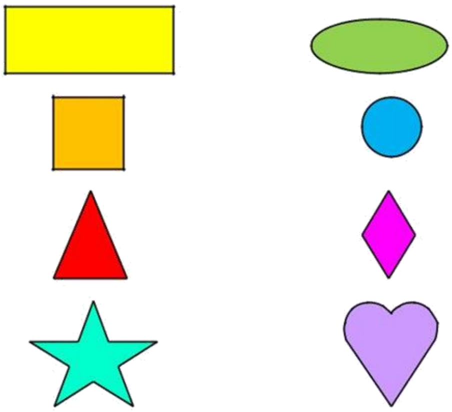
Trampoline:

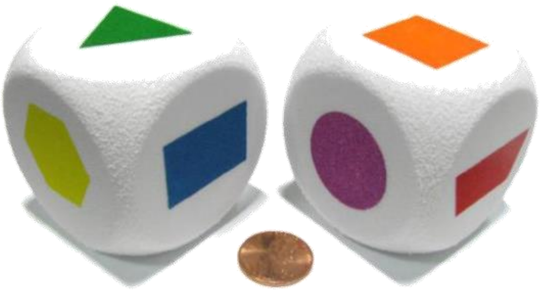
Trampolines were set out in a circle. The subjects ran and jumped on each trampoline 5 times. After every round they had to perform a different jump, such as jumping jacks, jumping up high towards an instructor's hand and jumping on one foot. The assistants assisted by holding the subjects hands.

Progression: The subjects had to run and jump onto the trampolines.

***Table B1*: Equipment for the intervention programme**

 Speaker	 Large white sheet of paper: 166 x 84 cm
 Hula hoops : 90 cm	 Pencils :19 cm
 Plastic rocks: maximum height 29 cm	 Colour dots: 17 x13 cm

 Wooden bench: 1.2 m	 Shapes: 17 x13 cm
 Rope: 6.3 m	 Medicine ball: 500g- 1kg
 Beanbags: 11 x 11 cm	 Poles: 70 cm Base: 31x 15x 10 cm

 High raised desks: 55,88 cm	 Scooter board: 60 x 40 x10 cm
 Tactile balls: 55-65cm	 Trampoline: 101 x 22 cm
 Foam shape dice: 90mmx 90mm x90mm	 Parachute: 1.8m diameter

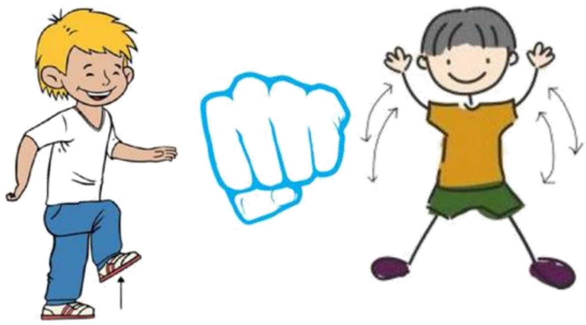
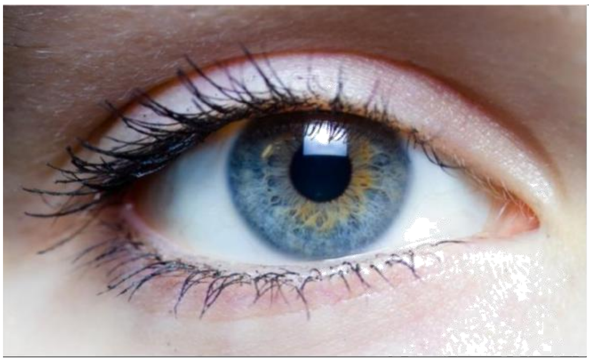
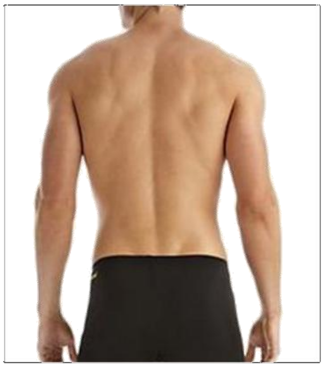
 Jumbo Chalk 11x 2.5 cm	 Chalkboard: 156 x 130 cm
 Tunnel: 1.5 m	 Swiss ball: 55 cm
 Bouncy ball:55 x 65 cm	 Cool down: Marching, jump and punch picture: 17 x 13 cm

Table B2: **Body Part pictures used in the intervention programme.**

 Face: 17x 13 cm	 Ear: 17x 13 cm
 Nose: 17x 13 cm	 Mouth (lips and teeth): 17x 13 cm
 Eye: 17x 13 cm	 Ear: 17x 13 cm

 Back (shoulders): 17x 13 cm	 Arm (elbow): 17x 13 cm
 Arm: 17x 13 cm	 Finger: 17x 13 cm
 Stomach: 17x 13 cm	 Back: 17x 13 cm

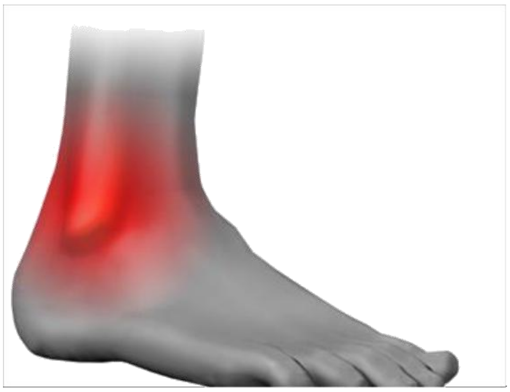
 Knees: 17x 13 cm	 Legs: 17x 13 cm
 Foot (ankel): 17x 13 cm	 Toes: 17x 13 cm

Table B3: **Emotion Wall: Emotion pictures used in the intervention programme**

 Happy: 17x 13 cm	 Excited: 17x 13 cm
 Upset: 17x 13 cm	 Frustrated: 17x 13 cm
 Tired: 17x 13 cm	 Very sad: 17x 13 cm

 Sleepy: 17x 13 cm	 Furious: 17x 13 cm

Table B4: **Equipment for QNST-3 evaluation**

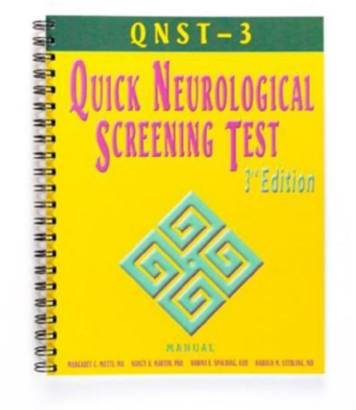
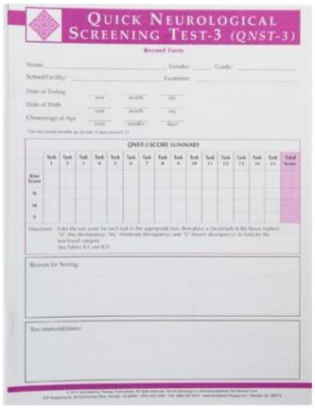
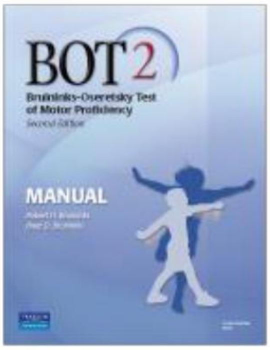
 QNST-3 : Manual	 QNST-3: Record form
 Masking tape: 24 mm	 Measuring tape: 5m
 Pencil/ Pen: 19 cm	 Desk and chair: Age appropriate

***Table B5*: Equipment for BOT-2 evaluation**

 BOT-2: Manual	 BOT-2: Short- form record form: Including booklet with Item 2, 3,6 and 7
 BOT-2: Complete kit	 Stopwatch
 Pencil/ Pen: 19 cm	 Desk and chair: Age appropriate

 Exercise mat: 120 cm	 Masking tape: 24 mm

Appendix C

Chapter content

***Table C1*: Research Objectives that are applicable to the current research study**

<table>
<tr><th>RESEARCH OBJECTIVES</th><th colspan="2">DESCRIPTION</th><th>APPLICABLE TO CURRENT STUDY</th></tr>
<tr><td>Exploratory</td><td colspan="2">Primarily this refers to a broad–ranging, intentional, systematic data collection, which is designed to maximize the descriptions and generalisations based on understanding in the social or psychological domains. Types of generalisations that often emerge are: descriptive facts, cultural artefacts and structural arrangements.</td><td>The researcher will explore a variety of gross motor domains in the field of ASD, which will be included in the literature review.
The primary data collected will describe ASD children’s gross motor skills and body awareness.</td></tr>
<tr><td>Description</td><td colspan="2">Descriptive research relies primarily on the observation of the collected data in which it examines the norm, and also predicts what the outcome will be if under the similar circumstances.</td><td>The researcher will conclude the research with descriptive results that are a direct interpretation of the analysed results. The precise and detailed explanation of the intervention and testing will be provided to allow future researchers the ability to predict outcomes.</td></tr>
<tr><td>Explanation and evaluation</td><td colspan="2">This qualitative objective is a form of rich descriptive research and is specifically designed to deal with multifarious social issues. Its horizon is broadened to not only look past the facts and figures, but to make sense of the myriad human, social, cultural and contextual elements involved. The primary purpose of research evaluation is to examine programmes, from the aspect of costs involved, levels of awareness, benefits and alignment with a set of objectives, and importantly quality assurance.</td><td>In ASD research and literature there are limited studies on gross motor interventions as a form of alternative therapy. The researcher will aim to paint a broader picture of the benefits of this type of therapy for the ASD population.</td></tr>
<tr><td>Comparative</td><td colspan="2">This objective form is frequently applied in cross-cultural, cross-national contexts and different organisational contexts.</td><td>Cross cultural comparison will not be tested here, as the subjects are all located in the same community.</td></tr>
<tr><td colspan="4">Correlation Correlation research is a principle applicable to quantitative research. Correlation can also be interpreted to describe the measure of relationships between two phenomena. Additionally, techniques of statistics are used to put value onto numerical data. Relational and prediction studies are broadly the two types of studies for this method.</td></tr>
<tr><td></td><td>Relational studies</td><td>This exploratory form of research aims to investigate the relationship between phenomena to see if a correlation exists. If there indeed is a correlation, the next step is to explore the extent of this correlation. This form of research is essential when there is little or no previous research conducted in this field, and the</td><td>There have been no South African studies conducted to date in this research area in the ASD population. The results of this study will therefore be the foundation for further research.</td></tr>
</table>

		outcomes of the research can be the basis of further research.	
	Predictive studies	This trend is most commonly used in research areas where there are correlations in the research field. It can, however, be used to predict future behaviours, and based on the knowledge that there is a strong relationship between two or more characteristics.	The researcher will aim to predict future trends in the ASD field regarding efficacy of dance therapy specifically in the South African context.
Action, Intervention and change	This is closely related to quantitative experimental research. The principals of this are designed to be able to deal with a specific problem which is evident in a particular situation.		Testing procedures with ASD subjects and the behavioural observations made during the tests would be recorded in order to assist future researchers.

Adapted from: Walliman (2011:37-41); Stebbins (2012:327).

Table C2: **QNST-3 Discrepancy criterion**

DISCREPANCY	**TOTAL SCORE**	**INDICATIVE EXPLANATION**
Severe Discrepancy (SD)	Total score of 50+	The subject is expected to have difficulty learning in a regular classroom setting. Severe symptoms may also appear to indicate deficits in the following areas: • Visual and auditory perception; • Fine-and gross-motor skills; • Sensory areas such as tactile, time, space, vestibular and directionality.
Moderate Discrepancy (MD)	Total score of 26-50	The subject's score in this range may possibly have one or more symptoms of either developmental or neurological deficits. This is dependent on their chronological age or the severity of symptoms. The MD score category takes account of the subjects who do not perform at the level expected for their age. For a MD total score, the subject must have some individual tasks scored in the MD or SD range.
Normal range (NR)	Total score 25 or less	These subjects are not likely to have a specific learning disability. These subjects are also required to have no individual tasks scored in SD range

Adapted from Parush *et al.* (2002:189-190); Mutti *et al*. (2012:49).

Table C3: **BOT-2 Motor Proficiency categories**

DESCRIPTIVE CATEGORY	**SCALE SCORE RANGE**	**PERCENTILE RANK**
Well-above average	25 or greater	98% or greater
Above average	20 and 24	84% and 97%
Average	11 and 19	18% and 83%
Below average	6 and 10	3% and 17%
Well-below average	5 or less	2% or less

Adapted from (Bruininks & Bruininks, 2005: 29).

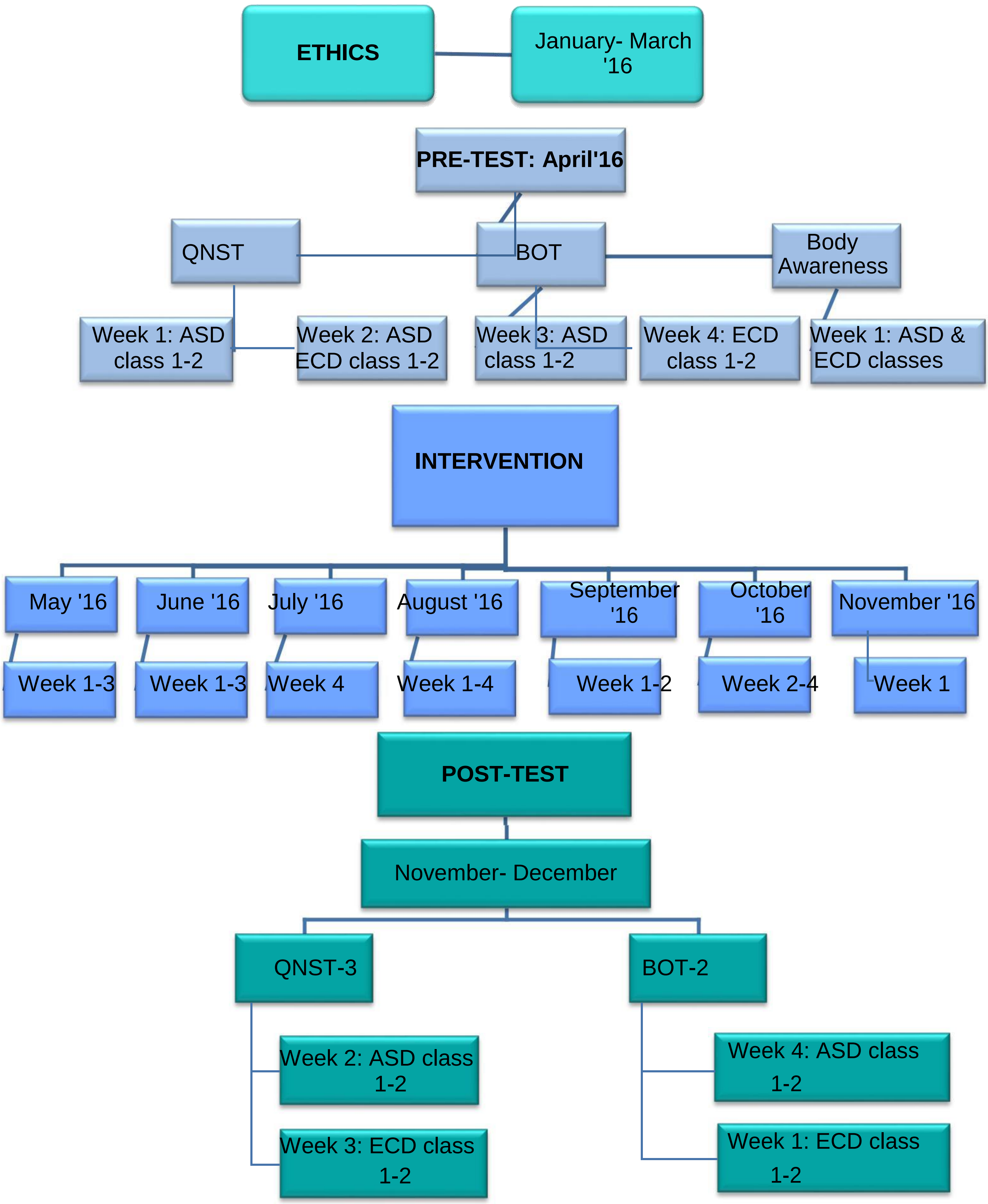


Figure C1: The current study's work timeline

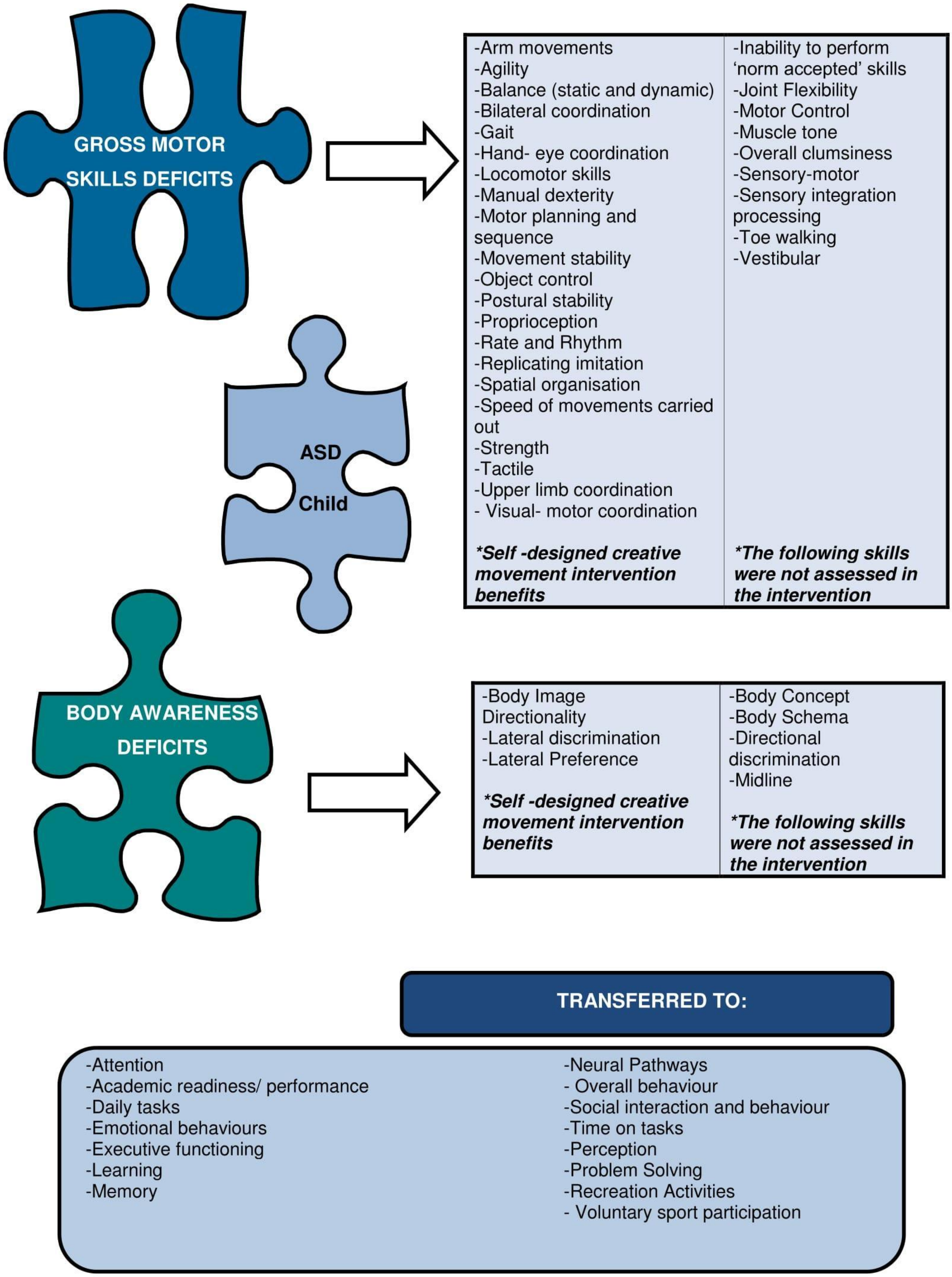


Figure C2: The gross motor skills and body awareness deficits of ASD children and the effects of a self-designed creative movement programme on these skills and body awareness.

Adapted from: Cheatum& Hammond, 2000:85-126; Piek, 2006:72; Ming, 2007:566; Provost, 2007:322; Lang, 2009:566,574; Johnson & Ramon, 2011:V; APA, 2013:55; Arzoglou, 2013:563,567; Martin, 2014:547; Scharoun, 2014:212; Bremer, 2015:980-981; Bo, 2016:51-52; De Milander, 2016:38; Ruzbarsky, 2016:41; Allen, 2017:813; Dieringer, 2017:421; Lee, 2017:8; Liu, 2017:53-54; Setoh, 2017:13-14.