Screening tools for Developmental Coordination Disorder in Grade 1 learners

ALETTA MARGARETHA BUYS

2009087301

In fulfillment of the requirements of the degree

MAGISTER ARTIUM

(KINDERKINETICS)

DEGREE

In the

FACULTY OF HUMANITIES

(Department of Exercise and Sport Sciences)

at the

UNIVERSITY OF THE FREE STATE

SUPERVISOR: Miss M. de Milander

CO-SUPERVISOR: Dr. F.F. Coetzee

BLOEMFONTEIN

January 2014

ACKNOWLEDGEMENTS

I want to thank my Heavenly Father for blessing me with the necessary knowledge and strength. Thank you for giving me the patience to complete this study.

I wish to express my appreciation to the following people. The study would not have been possible without their help:

- My fiancé for all his encouragement, love, support and care.
- My family and friends for all their love, patience and support throughout this study.
- My supervisor, Miss M. de Milander your guidance, motivation and assistance was appreciated. Your positivity towards me throughout the study meant a great deal to me.
- My co-supervisor, Dr F.F. Coetzee for all your support, knowledge, input, motivation and valuable time. I really appreciate it.
- My colleagues for all the support and motivation.
- Prof K. Esterhuyse and Mrs M. Viljoen for their input with the statistical analysis of the data.
- Mrs E. Verster for the translation of the abstract and for the proofreading of the dissertation.
- Mrs. A. du Preez for assisting in collecting information with regard to the study.
- The principals and teachers of all the schools taking part in the study. Thank you for participating in the program and making your school available to me.
- All the parents and children who took part in the study without you the study wouldn't have been possible.
- To the Kinderkinetics honours students of 2012 and 2013 for all your assistance. Without your help the study would also not have been possible.

Declaration

I, ALRETHA BUYS (Student No: 2009087301) certify that the dissertation hereby submitted by me for the Masters degree at the University of the Free State is my independent work and that I have not previously submitted the same work for a degree at another University or Faculty.

I hereby cede copyright of this product in favour of the University of the Free State.

Student: A.M. Buys

Date

Disclaimer

Hiermee bevestig ek dat ek die taalversorging van Me A Buys se tesis gedoen het.

Ek poog om altyd die hoogste gehalte te handhaaf ten opsigte van dokumente wat taalversorg en vertaal word. Aangesien ek egter op geen wyse kan verseker dat brondokumente wel met die taalversorgde weergawes vervang word nie, en ook geen beheer het oor veranderinge wat agterna op dokumente aangebring word nie, rus die finale verantwoordelikheid vir dokumente altyd op die opdraggewer.

Herewith confirmation that I did the copy editing of Ms A Buys' dissertation.

I always strive to consistently maintain the highest quality in respect of document editing and translation. However, as I have no way of ensuring that source documents are indeed replaced with my edited version, and also have no control over changes subsequently made to documents, the final responsibility for documents always rests with the commissioning author.

ER Verster

Abstract

SCREENING TOOLS FOR DEVELOPMENTAL COORDINATION DISORDER IN GRADE 1 LEARNERS

Background: One of the challenges associated with Developmental Coordination Disorder (DCD) is finding the appropriate method of identifying motor difficulties. Motor proficiency tests are used to identify children with motor difficulties; however, it seems that questionnaire-based assessments may be more practical for screening purposes. The Movement Assessment Battery for Children Checklist (MABC-Checklist) has been used as a screening tool to identify motor difficulties in children especially when completed by parents and teachers. Although parents and teachers can identify children with motor difficulties using screening tools, it is still not clear which screening test is the best to use. The original MABC-Checklist (1992) was revised in 2007 and research available on the revised edition (MABC-Checklist-2) is limited indicating that more studies on the MABC-Checklist-2 when completed by parents and teachers are needed.

Objectives: The aim of this study was to determine the agreement between identifying motor difficulties with the Movement Assessment Battery for Children second edition Performance Test (MABC-2) and the identifying of motor difficulties with the MABC-Checklist-2 when completed by (i) their parents as well as (ii) their teachers.

Methods: This study was done using sampling data and a quantitative research method (i.e. questionnaire). Three-hundred and twenty three learners in Grade 1 between the ages of 5 and 8 years participated in this study. The study consists of n=140 boys (43%) and n=183 girls (57%) of various ethnic groups, which consisted of n=193 Caucasian (59.75%, 6.5 years, SD=0.55), n=120 Black (37.15%, 6.2 years, SD=0.4), n=9 Mixed race (2.79%, 6.4 years, SD=0.5) and n=1 Hispanic (0.31%). A total of three hundred and twenty three parents (n=323) and twenty three teachers (n=23) also took part in the

study. The MABC-2 Performance Test was used to determine motor difficulties and DCD in the children. The MABC-Checklist-2 was used by the parents and teachers to identify children with and without motor difficulties. The total test score results of the MABC-2 Performance Test were compared with the total test score results of the MABC-Checklist-2 completed by the parents and teachers. Data from the questionnaires were captured electronically by the researcher on a data form using Microsoft Excel. Further analysis was done by a statistician using SAS Version 9.2. Frequencies and percentages were calculated for categorical data. Medians and percentiles were calculated for numerical data. The measure of agreement with help from the *Kappa (k)*-coefficient were used to explore the aim. The coefficient is known as the Cohen's Kappa and it measures inter-judge agreement.

Results: The results indicated that out of the 47 children identified with motor difficulties (moderate motor difficulties, n=21, and severe motor difficulties, n=26) by the MABC-2 Performance Test, 15 of these children were also identified with motor difficulties (moderate motor difficulties, n=2; and severe motor difficulties, n=13) by the parent completed MABC-Checklist-2 indicating a sensitivity of 31.9% (15/47). With regard to specificity there were 276 children identified with no motor difficulties with the MABC-2 Performance Test, whereas 197 (71.4%) of these children were also identified without motor difficulties with the MABC-Checklist-2 completed by the parents. Therefore, the specificity between the MABC-2 Performance Test and the parent completed MABC-Checklist-2 was 71.4% (197/276). The *(k)*-coefficient of 0.143 indicated that only 14.3% agreement between the two assessments were present after correcting for chance and show that the agreement of the two assessments is not high when completed by parents.

Results with regard to the teachers indicated that out of the 47 children identified by the MABC-2 Performance Test with motor difficulties (moderate motor difficulties, n=21; and severe motor difficulties, n=24), 16 of these children were also identified with motor difficulties (moderate motor difficulties, n=4; and severe motor difficulties, n=12) by the teacher that completed the MABC-Checklist-2 indicating a sensitivity of 35.6% (16/45).

When analysing the specificity there was 276 children identified with no motor difficulties using the MABC-2 Performance Test whereas 193 (72.6%) of these children were also identified with no motor difficulties by the MABC-Checklist-2 completed by teachers. Therefore the specificity between the MABC-2 Performance Test and the teacher completed MABC-Checklist-2 is 72.6% (193/266). The *(k)*-coefficient of 0.161 reveal that only 16.1% agreement between the two assessments were present after correcting for chance and reveal that the agreement between the two assessments is low when completed by teachers.

Conclusion: Several screening tests and questionnaires have been developed to gather information with regard to motor performance of children specifically from parents and teachers. However, studies using parents' and teachers' reports as well as the results in this study have produced conflicting results, thus it is still not clear which screening test is the best to use and whether parents and teachers both need to be used to screen a child.

Key words: Developmental Coordination Disorder, Motor difficulties, MABC, Performance Test, MABC-Checklist for Children, Parents and Teachers.

Opsomming

SIFTINGSTOETSE VIR ONTWIKKELINGSKOÖRDINASIEVERSTEURING BY GRAAD 1 LEERDERS

Agtergrond: Een van die uitdagings betrokke by Ontwikkelingkoördinasieversteuring (DCD) is om die toepaslike metode te vind om motoriese probleme te identifiseer. Motoriese vaardigheidstoetse word gebruik om kinders met motoriese probleme te identifiseer, maar dit blyk dat vraelysgebaseerde assessering praktieser vir siftingsdoeleindes gebruik kan word. Die "*Movement Assessment Battery for Children Checklist (MABC-Stiplys)"* is as siftingshulpmiddel gebruik om motoriese probleme by kinders te identifiseer, veral as dit deur ouers en onderwysers voltooi word. Alhoewel ouers en onderwysers kinders met motoriese gebreke kan identifiseer deur hierdie siftingshulpmiddele te gebruik, is dit steeds nie duidelik watter siftingstoets die beste is om te gebruik nie. Die oorspronklike "*MABC-Stiplys"* (1992) is in 2007 hersien en navorsing wat oor die hersiene uitgawe beskikbaar is, is egter beperk en dui aan dat meer studies oor die *"MABC-Stiplys-2"* nodig is indien dit deur ouers en onderwysers voltooi word.

Doelwitte: Die doel van hierdie studie was tweeledig. Eerstens (i) om te bepaal wat die ooreenkoms tussen die indentifisering van motoriese probleme is deur gebruik te maak van die MABC-2 Uitvoeringstoets en die MABC-Stiplys-2 soos deur die ouers voltooi is, en tweedens (ii) om te bepaal wat die ooreenkoms tussen die identifisering van motoriese probleme is deur gebruik te maak van die MABC-2 Uitvoeringstoets en die MABC-Stiplys-2 soos deur die onderwysers voltooi is.

Metodes: Hierdie studie is uitgevoer deur middel van steekproefdata en kwantitatiewe navorsing (d.i. 'n vraelys). Drie honderd drie en twintig Graad 1-leerders tussen 5 en 8 jaar oud het aan die studie deelgeneem. Die studie het bestaan uit n=140 seuns (43%)

en n=183 dogters (57%) sowel as verskeie etniese groepe wat bestaan het uit n=193 Kaukasiërs (59.75%,6.5 jaar, SD=0.55), n=120 Swartes (37.15%, 6.2 jaar, SD=0.4), n=9 Gemengde ras (2.79%, 6.4 jaar, SD=0.5) en n=1 Spaans (0.31%). In totaal het 323 ouers en 23 onderwysers ook aan die studie deelgeneem. Die MABC-2 Uitvoeringstoets is gebruik om motoriese probleme en DCD by kinders, te identifiseer. Die MABC-Stiplys-2 is deur die ouers en onderwysers gebruik om kinders met en sonder motoriese probleme te identifiseer. Die totale toetstellingresultaat van die MABC-2 Uitvoeringstoets is met die totale toetstellingresultaat van die MABC-Stiplys-2, wat deur ouers en onderwysers voltooi is, vergelyk. Data van die vraelys is elektronies deur die navorser deur middel van Microsoft Excel opgeneem. 'n Statistikus het die data deur middel van *SAS Version 9.2* verder ge-analiseer. Frekwensies en persentasies is vir kategoriese data bereken. Gemiddeldes en persentasies is vir numeriese data bereken. Die mate van ooreenstemming is met behulp van die *Kappa (k)*-koëffisiënt gedoen ten einde die doel te ondersoek. Die koëffisiënt staan bekend as Cohen se Kappa en meet inter-oordeel ooreenkomste.

Resultate: Die resultate het aangedui dat, uit die 47 kinders wat met motoriese probleme (matige motoriese probleme, n=21; en erge motoriese probleme, n=26) deur die MABC-2 Uitvoeringstoets geïdentifiseer is, 15 van hierdie kinders ook met motoriese probleme (matige motoriese probleme, n=2; en erge motoriese probleme, n=13) deur die MABC-Stiplys-2 wat deur die ouers voltooi is, geïdentifiseer is, wat 'n sensitiwiteit van 31.9% (15/47) aandui. Met betrekking tot spesifisiteit was daar 276 kinders wat met geen motoriese probleme deur die MABC-2 Uitvoeringstoets geïdentifiseer is, terwyl 197 (71.4%) van hierdie kinders ook deur die MABC-Stiplys-2 wat deur die ouers voltooi is met geen motoriese probleme geïdentifiseer is. Dus was die spesifisiteit tussen die MABC-2 Uitvoeringstoets en die MABC-Stiplys-2 wat deur die ouers voltooi is, 71.4% (197/276). Die *(k)*-koëffisiënt van 0.143 het aangedui dat slegs 14.3% ooreenkoms tussen die twee assesseringsmetodes teenwoordig was na regstelling van toevalligheid en dui aan dat die ooreenkoms van die twee assesserings laag is indien dit deur ouers voltooi word.

Resultate met betrekking tot die onderwysers het aangedui dat uit die 47 kinders wat deur die MABC-2 Uitvoeringstoets met motoriese probleme identifiseer is (matige motoriese probleme, n=21; en erge motoriese probleme, n=26), 16 van hierdie kinders ook met motoriese probleme (matige motoriese probleme, n=4 en erge motoriese probleme, n=12) deur die MABC-Stiplys-2 wat deur die onderwyser voltooi is, geïdentifiseer is, wat ’n sensitiwiteit van 35.6% (16/45) aandui. Wanneer die spesifisiteit geanaliseer word, is daar 276 kinders met geen motoriese probleme deur die MABC-2 Uitvoeringstoets geidentifiseer, terwyl 193 (72.6%) van hierdie kinders ook sonder motoriese probleme deur die MABC-Stiplys-2 wat deur die onderwysers voltooi is, geïdentifiseer is. Dus is die spesifisiteit tussen die MABC-2 Uitvoeringstoets en die MABC-Stiplys-2 wat deur die onderwyser voltooi word 72.6% (193/266). Die *(k)*-koëffisiënt van 0.161 dui aan dat daar slegs 16.1% ooreenkoms tussen die twee assesseringsmetodes is na regstelling van toevalligheid en dui aan dat die ooreenkoms tussen die twee assesserings laag is as dit deur onderwysers voltooi word.

Gevolgtrekking: Verskeie siftingstoetse en vraelyste vir ouers en onderwysers is ontwerp om inligting met betrekking tot motoriese prestasie van kinders in te samel. Maar, studies wat ouers en onderwysers se verslae gebruik, sowel as die resultate in hierdie studie, het teenstrydige resultate opgelewer. Dit is dus steeds nie duidelik watter siftingstoets die beste gebruik kan word en of ouers en onderwysers gebruik moet word in die assessering van ’n kind nie.

Sleutelwoorde: Ontwikkelingskoördinasiesteuring, Motoriese probleme, MABC Uitvoeringstoets, en MABC-Stiplys vir Kinders, Ouers en Onderwysers.

TABLE OF CONTENTS

LIST OF TABLES

Chapter 2: Literature review of Developmental Coordination Disorder

Chapter 3: Research Methodology

Chapter 4: Results and Discussion

LIST OF FIGURES

Chapter 1: Problem statement and aim of the study

Chapter 2: Literature review of Developmental Coordination Disorder

Chapter 4: Results and Discussion

LIST OF APPENDIXES

Appendixes

CHAPTER 1

Problem statement and aim of the study

1.1 Introduction

Since the 1900's the scientific community has acknowledged a large group of children who develop well intellectually but experience movement skill difficulties (Missiuna, Gaines, Soucie & McLean, 2006:507). These movement skill difficulties had previously been termed as "*clumsy*", "*developmental dyspraxia*", "*perceptual-motor dysfunction*", "*mild motor problems*", *"motor difficulties"* and "*sensory integration dysfunction*" (Edwards *et al.,* 2011:678). In 1994, researchers and clinicians from around the world gathered at an international consensus meeting and agreed to accept the term Developmental Coordination Disorder (DCD) to classify these children (Missiuna *et al.,* 2006:507) and is still well known as DCD (American Psychiatric Association, 2000:449). Therefore in this study the terms DCD, motor difficulties as well as motor impairment will be used interchangeably.

Developmental Coordination Disorder is defined as children with serious and persistent impairment in their motor coordination development which impedes the functional performance and are not due to intellectual retardation, pervasive developmental disorder or any other neurological disorder (APA 2000:449). Lingam, Hunt, Golding, Jongmans and Emond (2009:e693) define DCD as children who experience motor

coordination difficulties which interfere with their academic achievement, physical and psychological development as well as activities of daily living. Therefore it is clear that DCD refers to motor difficulties that lead to long term consequences in daily living activities.

A rapid increase of DCD and motor performance difficulties among children have been a major concern for the past decade (Schoemaker, Flapper, Verheij, Wilson, Reinders-Messelink & De Kloet, 2006:668). Dewey, Creighton, Heath, Wilson, Anseeuw-Deeks and Crawford (2011:43) as well as Wuang, Su and Su (2012:160) find that 5% of school-aged children fail to perform motor skills adequately and 1.8% of 7 year old children have been diagnosed with DCD. Gender also influences DCD. The literature indicates that boys experience more motor difficulties than girls, with boy-girl ratio difference of 2:1 (Wright & Sugden, 1996:1100) and 3-4:1 (Rivard, Missiuna, Hanna & Wishart 2007:634). The prevalence of DCD in children confirms the major concern in modern society and includes various problems which will be discussed in the following paragraphs.

Children with DCD specifically have problems with dressing themselves (home activities), writing and reading (school activities) as well as play activities (ball skills, balance etc.) (Missiuna, 2003:2; Edwards *et al.*, 2011:679; Asonitou, Koutsouki, Kourtessis & Charitou, 2012:996). According to Lingam *et al*. (2009:e693), DCD interferes with academic achievement and activities of daily living. Secondary impairments associated with DCD are physical aspects such as less strength and flexibility, withdrawal from physical activity and potential obesity (Missiuna, Rivard & Barlett, 2003:33; Rihtman, Wilson & Parush, 2011:1378; Wuang *et al.,* 2012:160). These factors lead to emotional and social problems, including low self-esteem and poor social acceptance (Missiuna *et al*., 2006:507).

One of the challenges associated with DCD is finding the appropriate method of identifying motor skill difficulties (Rodger, Ziviani, Watter, Ozanne, Wodyatt & Springfield, 2003:462). Developmental Coordination Disorder is identified with motor

competence tests such as the Movement Assessment Battery for Children second edition Performance Test (MABC-2 Performance Test) and the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2) (Missiuna *et al.,* 2011:549). However, these tests are time-consuming and expensive which has led Faught, Cairney, Hay, Veldhuizen, Missiuna and Spironello (2008:178) to conclude that questionnaire-based assessments may be more practical for screening purposes.

Several screening tests and questionnaires have been developed to gather information with regard to functional motor performance of children, specifically from parents and teachers, for example the Movement Assessment Battery for Children Checklist (MABC-Checklist) and the Developmental Coordination Disorder Questionnaire (DCDQ) (Schoemaker, Niemeijer, Flapper & Smits-Engelsman, 2012:368). However, studies using teachers' and parents' reports have produced conflicting results (Faught *et al.,* 2008:178). Thus, it is still not clear which screening test is best suited to use and whether parents and teachers both need to be involved in screening a child.

1.2 Problem statement

Children with difficulties in daily motor coordination activities can be diagnosed as having DCD if they have no known physical disability or medical reason for the problem (Van Waelvelde, Peersman, Lenoir & Smits-Engelsman, 2007:465; APA, 2000:449). One of the major concerns regarding children with DCD is that they are seldom diagnosed and are rather just described by their teachers as lazy or awkward. The reason for not diagnosing these children is the lack of awareness of the disorder (Zwicker, Missiuna, Harris & Boyd, 2012:575). Teachers and parents are not aware that DCD is associated with problems such as emotional problems, low self worth, perceived competence problems, anxiety problems, depression, bullying, obesity and other behavioural and emotional difficulties which lead to more negative experiences (Cairney, Veldhuizen, Kurdyak, Missiuna, Faught & Hay, 2012:987).

In order to identify children at risk for DCD, the administration of a standardised motor test is needed; however, the motor tests are too time-consuming and expensive (Schoemaker *et al.,* 2006:668). Suggestions are made that questionnaires can offer a valuable alternative to provide information on children with motor difficulties or those at risk for DCD (Schoemaker, Flapper, Reinders-Messelink & De Kloet, 2008:191). This statement is supported by Cardoso and Magalhaes (2012:17) who state that teacher and parent questionnaires illustrate good reliability in identifying children with DCD. There is, however, some dispute as to whether teachers, parents and clinicians would identify the same group of children (Schoemaker *et al.,* 2008:191).

Missiuna *et al.* (2011:550) found that although parents and teachers can identify children with motor impairments using screening tools, their results still differ from each other and from those of the clinicians. Therefore there are heated debates regarding the most suitable tool to use in screening children for DCD (Wright & Sugden, 1996:1100). According to Barnett (2008:117) the most important issue regarding instruments, is their level of accuracy in identifying children with motor difficulties. Schoemaker *et al*. (2006:668) are of the opinion that there is no effective instrument for early detection of DCD.

As previously mentioned, the MABC-Checklist (Henderson & Sugden, 1992:213) is a questionnaire used to screen for motor difficulties and one of the most frequently used questionnaires. The MABC-Checklist was revised and shortened in 2007 and is now known as the Movement Assessment Battery for Children second edition Checklist (MABC-Checklist-2) (Henderson, Sugden & Barnett, 2007:147). Various researchers have done numerous studies on the original MABC Checklist (Henderson &Sugden, 1992:215; Schoemaker, Smits-Engelsman & Jongmans, 2003:427). However, this is outdated and more recent studies on the latest version of the MABC-Checklist-2 when used by parents and teachers are needed (Schoemaker *et al.,* 2012:373). It is important to notice the necessity for establishing the best combination of people and screening tools to identify DCD and motor impairments. With this in mind, the following research questions will be set.

1.3 Research questions

The following questions arises:

- What is the agreement between the identifying of motor difficulties with the MABC-2 Performance Test and the identifying of motor difficulties with the MABC-Checklist-2 when completed by their parents.
- What is the agreement between the identifying of motor difficulties with the MABC-2 Performance Test and the identifying of motor difficulties with the MABC-Checklist-2 when completed by their teachers.

1.4 Aim

The aim of this study is:

- To determine the agreement between identifying motor difficulties with the MABC-2 Performance Test and the identifying of motor difficulties with the MABC-Checklist-2 when completed by (i) their parents as well as (ii) their teachers.

1.5 Structure of the dissertation

The dissertation is presented in five chapters (refer to Figure 1.1), namely an introductory chapter (Chapter 1), a literature review (Chapter 2), a chapter describing the method of research (Chapter 3), a chapter containing the results and the discussion of results (Chapter 4) and a final chapter summarising the study (Chapter 5).

Chapter 1 includes the problem statement and the aim of the study. Chapter 2 contains an overview of literature about DCD. Chapter 3 addresses the research methodology which includes the research design and research methods. Chapter 4 provides the results found in the study as well as the discussion of results. Chapter 5 concludes the study with a summary and recommendations. This chapter is followed by a list of

appendices. Each chapter includes its relevant references. Referencing adheres to the regulations and conventions of the Department of Exercise and Sport Sciences at the University of the Free State, which uses the Harvard referencing method.

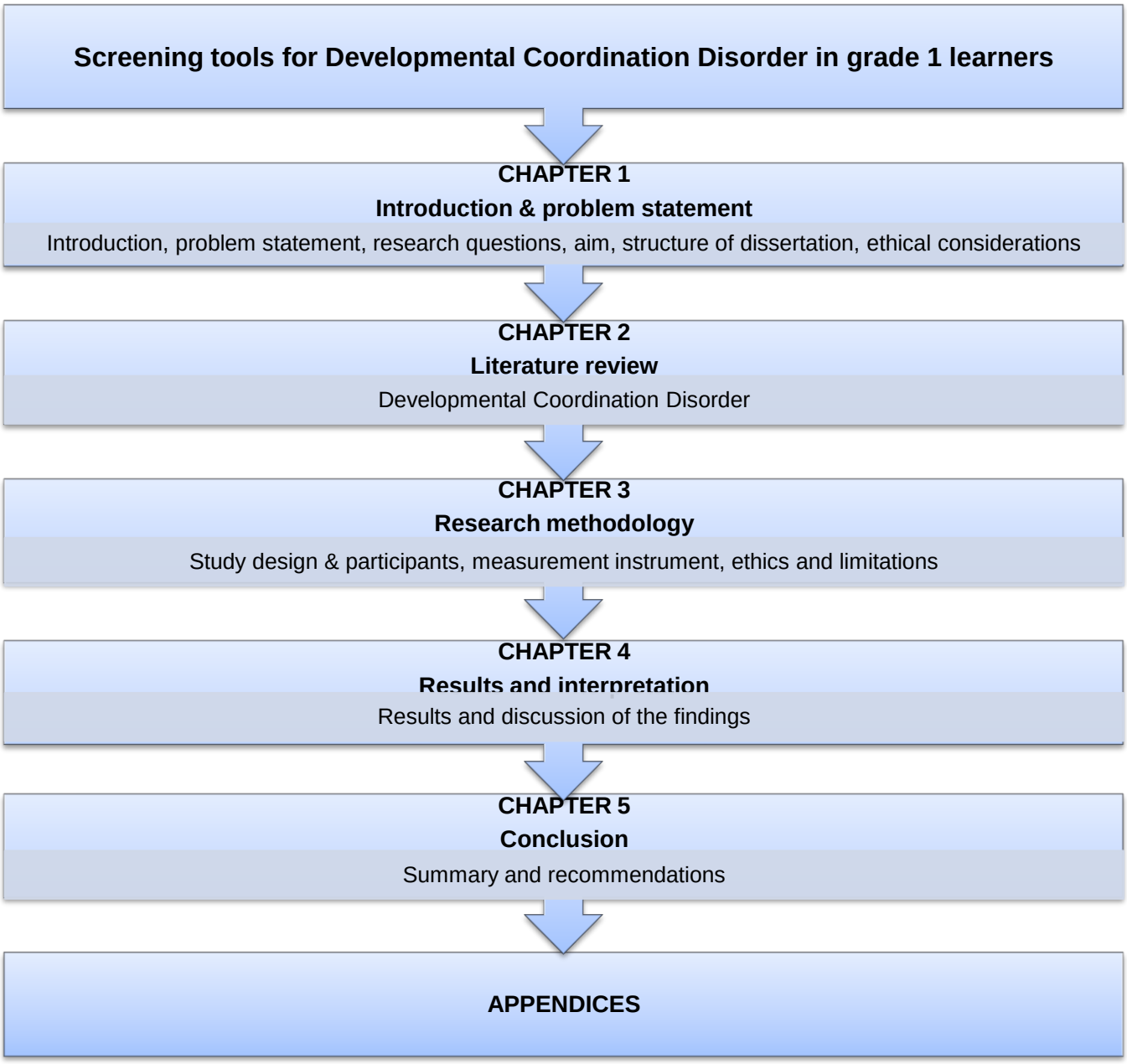

Figure 1.1: Structure of dissertation

1.6 Ethical considerations

Ethical approval was obtained from the Ethics Committee of the Faculty of Health Sciences (ECUFS57/2012) as well as the Basic Education Department of the Free State .The participating parents and children completed a consent form which outlines the aim and procedures of the study. Confidentiality was maintained and the children were allocated a participant number for data recording and analysis. The participants were allowed to withdraw at any time during the programme, but they were encouraged to complete the study.

1.7 References

AMERICAN PSYCHIATRIC ASSOCIATION. 2000. *Diagnostic and statistical manual of mental disorders.* (4th text revision ed.). Washington, DC: American Psychiatric Association.

ASONITOU, K., KOUTSOUKI, D., KOURTESSIS, T. & CHARITOU, S. 2012. Motor and cognitive performance differences between children with and without developmental coordination disorder (DCD). *Research in Developmental Disabilities,* 33(4):996-1005.

BARNETT, A.L. 2008. Motor assessment in developmental coordination disorder:from identification to intervention. *International Journal of Disability, Development and Education,* 55(2):113-129.

CAIRNEY, J., VELDHUIZEN, S., KURDYAK, P., MISSIUNA, C., FAUGHT, B.F. & HAY, J. 2012. Evaluating the CSAPPA subscales as potential screening instruments for developmental coordination disorder. *Archives of Disease in childhood,* 92(11):987-991.

CARDOSO, A.A. & MAGALHAES, L.C. 2012. Criterion validity of the motor coordination and dexterity assessment: MCDA for 7-and 8-years old children. *Revista Brasileira de Fisioterapia,* 16(1):16-22.

DEWEY, D., CREIGHTON, D.E., HEATH, J.A., WILSON, B.N., ANSEEUW-DEEKS, D. & CRAWFORD, S.G. 2011. Assessment of developmental coordination disorder in children born with extremely low birth weights. *Developmental Neuropsychology,* 36(1):42-56.

EDWARDS, J., BERUBE, M., ERLANDSON, K., HAUG, S., JOHNSTONE, H., MEAGHER, M., SARKODEE-ADOO, S. & ZWICKER, J.G. 2011. Developmental coordination disorder in school-aged children born very preterm and/or at very low birth weight: a systematic review. *Journal of Developmental and Behavioural Pediatrics,* 32(9):678-687.

FAUGHT, B.E., CAIRNEY, J., HAY, J., VELDHUIZEN, S., MISSIUNA, C. & SPIRONELLO, C.A. 2008. Screening for motor coordination challenges in children using teacher ratings of physical ability and activity. *Human Movement Science,* 27(2):177-189.

HENDERSON, S.E. & SUGDEN, D.A. 1992. *Movement Assessment Battery for Children.* London: Harcourt Assessment.

HENDERSON, S.E., SUGDEN, D.A. & BARNETT, A.L. 2007. *Movement Assessment Battery for Children-2* (2nd ed.). London: Harcourt Assessment.

LINGAM, R., HUNT, L., GOLDING, J., JONGMANS, M. & EMOND, A. 2009. Prevalence of developmental coordination disorder using the DSM-IV at 7 years of age: a UK population based study. *Pediatrics,* 123(4):e693-e701.

MISSIUNA, C. 2003. Children with developmental coordination disorder: at home and in the classroom. *CanChild,* 1-12.

MISSIUNA, C., RIVARD, L. & BARLETT, D. 2003. Early identification and risk management of children with developmental coordination disorder. *Pediatric Physical Therapy,* 15(1):32-38.

MISSIUNA, C., GAINES, B., SOUCIE, H. & MCLEAN, J. 2006. Parental questions about developmental coordination disorder: a synopsis of current evidence. *Pediatric Child Health,* 11(8):507-512.

MISSIUNA, C., CAIRNEY, J., POLLOCK, N., RUSSELL, D., MacDONALD, K., COUSINS, M., VELDHUIZEN, S. & SCHMIDT, L. 2011. A staged approach for identifying children with developmental coordination disorder from the population. *Research in Developmental Disabilities,* 32(2):549-559.

RIHTMAN, T., WILSON, B.N. & PARUSH, S. 2011. Development of the Little Developmental Coordination Disorder Questionnaire for preschoolers and preliminary evidence of its psychometric properties in Israel. *Research in Developmental Disabilities,* 32(4):1378-1387.

RIVARD, L.M., MISSIUNA, C., HANNA, S. & WISHART, L. 2007. Understanding teachers' perceptions of the motor difficulties of children with developmental coordination disorder (DCD). *British Journal of Educational Psychology,* 77(30):633-648.

RODGER, S., ZIVIANI, J., WATTER, P., OZANNE, A., WODYATT, G. & SPRINGFIELD, E. 2003. Motor and functional skills of children with developmental coordination disorder: a pilot investigation of measurement issues. *Human Movement Science,* 22(4-50):461-478.

SCHOEMAKER, M.M., SMITS-ENGELSMAN, B.C.M. & JONGMANS, M.J. 2003. Psychometric properties of the Movement Assessment Battery for Children Checklist as a screening instrument for children with a developmental co-ordination disorder.*British Journal of Educational Psychology,* 73(3):425-441.

SCHOEMAKER, M.M., FLAPPER, B., VERHEIJ, N.P., WILSON, B.N., REINDERS-MESSELINK, H.A. & DE KLOET, A. 2006. Evaluation of the Developmental Coordination Disorder Questionnaire as a screening instrument. *Developmental Medicine and Child Neurology,* 48(8):668-673.

SCHOEMAKER, M.M., FLAPPER, B.C.T., REINDERS-MESSELINK, H.A. & DE KLOET, A. 2008. Validity of the Motor Observation Questionnaire for teachers as a screening instrument for children at risk for developmental coordination disorder. *Human Movement Science,* 27:191-199.

SCHOEMAKER, M.M., NIEMEIJER, A.S., FLAPPER, B.C.T. & SMITS-ENGELSMAN, B.C.M. 2012. Validity and reliability of the Movement Assessment Battery for Children-2 Checklist for children with and without motor impairments. *Developmental Medicine and Child Neurology,* 54(4):368-375.

VAN WAELVELDE, H., PEERSMAN, W., LENOIR, M. & SMITS-ENGELSMAN, B.C.M. 2007. The reliability of the Movement Assessment Battery for Children for preschool children with mild to moderate motor impairment. *Clinical Rehabilitation,* 21(5):465-470.

WRIGHT, H.C. & SUGDEN, D.A. 1996. A two-step procedure for the identification of children with developmental coordination disorder in Singapore. *Developmental Medicine and Child Neurology,* 38(12) 1099-1105.

WUANG, Y., SU, J. & SU, C. 2012. Reliability and responsiveness of the Movement Assessment Battery for Children-Second Edition test in children with developmental coordination disorder. *Developmental Medicine and Child Neurology,* 54(2):160-165.

ZWICKER, J.G., MISSIUNA, C., HARRIS, S.R. & BOYD, L.A. 2012. Developmental coordination disorder: A review and update. *European Journal of Paediatric Neurology,* 16(6):573-581.

CHAPTER 2

Literature review: Developmental Coordination Disorder

2.1 Introduction

The purpose of Chapter 2 is to provide an overview of Developmental Coordination Disorder (DCD). It is important to understand DCD as a whole to assist children with this disorder in the best way possible. Developmental Coordination Disorder is a condition that is anything but simple to understand and poses a challenge to teachers, parents, therapists and researchers. This chapter contains the previous and current information of DCD from definition to intervention.

2.2 Definitions of Developmental Coordination Disorder

According to Barnhart, Davenport, Epps and Nordquist (2003:722) poor motor coordination in children has been a developmental problem for the last 100 years. This

was first discussed in the early 1900's by Collier (Dewey & Wilson, 2001:6) and continued from 1937 (Barnhart *et al.,* 2003:722) to 1987 when DCD was first introduced (Polatajko & Cantin, 2006:250). Various terms were used to label children with DCD in the past, such as clumsiness, motor disability, motor difficulties, perceptuo-motor dysfunction and dyspraxia (Polatajko & Cantin, 2006:251). However, at an International Consensus Meeting which was attended by the World Health Organization (WHO, 1992:196) and the American Psychiatric Association (APA, 2000:449), it was agreed to refer to motor difficulties as DCD (Barnett, 2008:113).

Two definitions with regard to DCD are generally used. The WHO (1992:196) uses the International Classification of Diseases to define DCD while the APA (2000:449) defines DCD using the Diagnostic and Statistical Manual of Mental Disorders fourth edition (DSM-IV) (Sugden, Kirby & Dunford, 2008:173). The WHO (1992:196) defines DCD as a serious impairment in motor coordination development that is not explainable in terms of general intellectual retardation or any specific congenital or neurological disorder. The other definition according to the DSM-IV is that DCD is an impairment of the motor performance that produce functional performance deficits not explicable by the child's age or intellect or any other neurological disorders (APA, 2000:449). According to Sugden *et al. (*2008:174) as well as Polatajko and Cantin (2006:251) the DSM-IV provides the most adequate working definition for DCD and is used most commonly. The DSM-V also became available but were not available when this study was conducted.

Literature provides various other definitions. According to Cairney, Veldhuizen, Kurdyak, Missiuna, Faught and Hay (2012:987) DCD is referred to as poor motor proficiency that has a negative influence on social and academic functioning and is not the result of other psychiatric, neurological or medical conditions. In addition, Rodger, Watter, Marinac, Woodyatt, Ziviani and Ozanne (2007:99) define DCD as a motor disorder that can have immediate adverse effects on a child’s day to day functioning, academics and psycho-social outcomes with no clear medical or mental disorder evident.

Although various researchers and organisations define DCD in their own manner, the main connotation stays the same. All the descriptions as indicated in the above definitions show that children with DCD demonstrate poor motor performance and poor motor proficiency. The definitions specify that DCD is not the result of any neurological disorder, psychiatric disorder or other medical disorders. The definitions also emphasise the effect of DCD on a child's day to day functioning and social well-being. Therefore it can be concluded that DCD occurs when a child has average intellectual ability, no neurological or sensory problems and present difficulties in movement and functioning. It is further important to understand the prevalence of DCD.

2.3 Prevalence of Developmental Coordination Disorder

Developmental Coordination Disorder is recognised as one of the most common developmental dysfunctions during childhood (Ellinoudis, Kyparisis, Gitsas & Kourtesis, 2009:306) and a large number of children between six and twelve years of age are diagnosed with DCD (Barnhart *et al.,* 2003:723). Literature indicates wide debate regarding the prevalence of DCD (Giagazoglou, Kabitsis, Kokaridas, Zaragas, Katartzi & Kabitsis, 2011:2577) and varies according to the diagnostic criteria used (Carslaw, 2011:87).

The American Psychiatric Association (APA, 2000:59) identifies 5-6% of the general population with DCD (Goyen & Lui, 2009:298; Cairney & Streiner, 2011:88; Rivard, Missiuna, McCauley & Cairney, 2012:1). In addition Gibbs, Appleton and Appleton (2007:535) specify that 10% of school children in different countries have a mild level of DCD, which implies that at least one child per class has this problem. Wilson (2005:806) on the other hand identifies15% of children in Australian schools with motor clumsiness whereas Lingam, Hunt, Golding, Jongmans and Emond (2009:e698) established that 18 out of 1000 7-year old children in England have DCD and 49 out of 1000 have probable DCD. Despite the different percentages, many countries also demonstrate different prevalence of DCD.

In Taiwan the prevalence ranges from 3.5%-17.9% (Tseng, Fu, Wilson & Hu, 2010:34), while America reports an average prevalence of 6% (Bo & Lee, 2013:2048). In addition, Greece demonstrates an unusually high occurrence of 19% (Zwicker, Missiuna, Harris, & Boyd, 2012:575) and Sweden a prevalence of 13.5% (Lingam *et al.,* 2009:e698). The United Kingdom, on the other hand, presents a low occurrence of 1.8% (Lingam *et al.,* 2009:e698). In addition to the above countries, a study by Pienaar (1994) in the North West of South Africa found an extremely high prevalence of 61.2% (Pienaar, 2004:076) as well as 52% in another study (Wessels, Pienaar & Peens, 2008:494).

Gender also plays a role in the prevalence of DCD. Research points out that boys have a higher prevalence than girls (Carslaw, 2011:88). According to Hay, Hawes and Faught (2004:309) the boy-girl ratios for DCD are 4:1 and 7:1, while Zwicker *et al*. (2012:573) state a ratio of 1:9 for boys and 1:0 for girls respectively. Teacher-identified samples indicate high numbers for boys with estimated ratios from 3:1 to 5:1 (Missiuna, Gaines, Soucie & Mclean, 2006:509) as well as 2-3:1 (Wessels, Pienaar & Peens, 2008:494). It is also important to note that the frequent presence of co-morbid conditions such as attention deficit hyperactivity disorder makes it more likely to identify boys (Missiuna *et al.,* 2006:509).

Even though gender differences illustrate a higher prevalence among boys, it needs to be taken into consideration that the teachers' perception of skills among boys and girls may influence their identification (Rivard, Missiuna, Hanna & Wishart, 2007:636). Barnhart *et al.* (2003:723) suggest the difference may reflect higher rates for boys due to their behaviour when they experience motor difficulties. Boys are more difficult to handle at home and in the classroom (Barnhart *et al.,* 2003:723). Thus, the actual boy-girl ratio solely identified on the basis of motor impairment is unknown (Missiuna *et al.,* 2006:509).

It is clear that various incidences of DCD are present in different countries and also indicate a variation regarding boys and girls. After understanding the prevalence of DCD it is important to recognise the characteristics of children with DCD.

2.4 Co-occurring characteristics of Developmental Coordination Disorder

Predictions by several researchers indicate that children with DCD experience numerous functional difficulties related to their motor skills (Cairney, Missiuna, Veldhuizen & Wilson, 2008:933; Dewey, Creighton, Heath, Wilson, Anseeuw-Deeks & Crawford, 2011:43). Hillier (2007:1) is of the opinion that children with DCD experience both sensory and motor skill problems which include difficulties like dressing themselves, tying shoelaces, using utensils, riding a bike, catching a ball, participating in physical education, performing play skills and engaging in leisure activities. Despite these difficulties, Hillier (2007:1) also observes that children with DCD experience restrictions to participate within their life roles.

Another problem previously observed by Maruff, Wilson, Trebilcock and Currie (1999:1321) is the struggle to execute real and imagined motor sequences, whereas more recent studies found that children with DCD struggle specifically to achieve their motor milestones and fine motor skills (Wilson, Crawford, Green, Roberts, Aylott & Kaplan, 2009:183; Zwicker, Missiuna & Boyd, 2009:1273). Piek and Dyck (2004:477) specifically identified walking, sitting, dropping things, poor motor performance in sport and poor handwriting as the motor milestones children with DCD struggle to achieve.

Handwriting is an everyday task that affects academic performance and difficulty with writing is often the first identifiable sign of a fine motor problem (Barnhart *et al.,* 2003:725; Cairney, Schmidt, Veldhuizen, Kurdyak, Hay & Faught, 2008:696). According to Missiuna (2003:4) and Zwicker *et al.* (2009:1273), children with DCD struggle with fine coordinated activities such as cutting with scissors, drawing, painting as well as copying. At the same time these problems increase learning impairments which cause academic challenges such as reading, spelling and mathematics (Rodger, Ziviani, Watter, Ozanne, Woodyatt & Springfield, 2003:463; Missiuna, 2003:5). In agreement, O'Hare and Khalids (2002:244) confirm the high percentage of reading and writing difficulties in children with DCD. Table 2.1 presents a list of motor difficulties among children with DCD.

Table 2.1: Motor difficulties of children with DCD

At home	Dressing, putting socks on, fastening fasteners, doing up zippers; Putting shoes/boots on, tying shoelaces; Using utensils; and Bathing, or showering, washing hair.
At school	Slow and/or messy printing/handwriting; Using scissors, glue; Drawing skills (immature drawings); Pencil grasp; Performance in gym class; and Reports of child falling-off chair in class, bumping into things.
At play	Awkward running gait; Balancing; Climbing onto play structures; Riding bicycle; Skating, rollerblading; Skipping; Playing sports; Throwing/catching/kicking balls.

Adapted from: Polatajko and Cantin (2006:252).

The above mentioned motor difficulties influence physical abilities. According to Raynor (2001:676) the normal increases in strength and power do not occur in children with DCD; however, the problems experienced with power and strength decrease with age. Missiuna, Rivard and Barlett (2003:33) agree with Raynor (2001:676) emphasising the struggle executing power and strength in children with DCD. Missiuna *et al.* (2003:33) claim that children with DCD withdraw from physical activity, demonstrate low participation in sport or leisure activities and experience diminished physical fitness. The diminished physical fitness is furthermore noted by Burns *et al.* (2009:141). Statements by Raynor (2001:676), Missiuna *et al.* (2003:33) and Burns *et al.* (2009:141) highlight the reason why children with DCD are at higher risk for obesity and coronary vascular disease, and according to Zwicker *et al.* (2009:1274) it is mostly due to their low activity

levels. Children with DCD do not only experience physical problems, but also with psychosocial issues.

Developmental Coordination Disorder is a persistent problem that does not appear to resolve with age and leads to significant social and emotional consequences (Missiuna, Gaines & Pollock, 2002:177). Consequences include psychosocial problems like withdrawing from social activities, fear of failure, peer criticism (Slater, Hillier & Civetta, 2010:171); low self-esteem, emotional isolation (Lingam *et al.,* 2009:e693); and behavioural difficulties, poor social competence, social isolation and poor self-worth (Rivard *et al.*, 2007:634). For the same reason Lingam, Jongmans, Ellis, Hunt, Golding and Emond (2012:e887) found that children with DCD show a self-reported depression which correlates with the studies by Rivard *et al.* (2007:634), Lingam *et al.* (2009:e693) and Slater *et al.* (2010:171). From these studies, it is clear that the core difficulties faced by children with DCD relate to motor skills which lead to physical and psychological problems. However, there are associated characteristics outside the motor domain that children with DCD often demonstrate.

According to Zwicker *et al.* (2009:1274) children may struggle with processing visual spatial information, and previous data by Wilson and McKenzie (1998:837) strongly support this statement. Piek and Dyck (2004:484) also express their concern regarding the effect of visual-spatial organisation in children with DCD impacting their motor ability and social interaction. Research done by Mandich, Buckolz and Polatajko (2003:355) points toward two inhibitory deficits regarding intentional movement of attention through visual space: firstly, children with DCD took longer to separate attention from a shown location in order to move to the target position and second, they struggled to prevent the unwanted initiation of movements motivated by external events. Further associated characteristics of DCD include expressive language disorder and mixed receptive-expressive language disorder (Missiuna *et al.,* 2002:173). At the same time DCD can also co-occur with developmental disorders, such as autism spectrum disorder, attention deficit hyperactivity disorder (ADHD), dyslexia (Zoia, Barnett, Wilson & Hill,

2006:616), duchenne muscular dystrophy, epilepsy, and fragile X syndrome (Peters & Henderson, 2008:98).

Even though various co-occurring characteristics can be present, ADHD seems to be the most apparent co-existent characteristic. According to Zwicker *et al.* (2012:576), almost 50% of children with ADHD show motor skill difficulties related to DCD, while Gillberg and Kadesjo (2003:65) indicate that ADHD is present in half of all DCD cases. Watemberg, Waiserberg, Zuk and Lerman-Sagie (2007:923) claim that children with ADHD of the inattentive and combined subtypes are more likely to suffer from DCD, whereas Piek and Dyck (2004:484) are of opinion that all three types of ADHD (hyperactive, inattentive and combined) are present in children with DCD.

Due to the high co-existence of DCD with other developmental disorders the aetiology is still unclear.

2.5 Aetiology of Developmental Coordination Disorder

The aetiology of DCD has been difficult to find because of its heterogeneity (Sugden & Chambers, 1998:139; Barnhart *et al.,* 2003:723; Henderson & Henderson, 2003:9). Piek and Dyck (2004:476) define heterogeneity of DCD as a disorder that has overlapping causes, or the direct cause of one disorder affecting the mechanisms that cause another disorder. Despite heterogeneity, Martin, Piek and Hay (2006:111) claim that research is limited and available literature on aetiology is confusing.

Various speculations regarding the cause of DCD have been submitted: According to De Kleine, Nijhuis-Van Der Sanden and Den Ouden (2006:1202), the aetiology of DCD is secondary to very preterm and very-low-birth weight cases, whereas Missiuna *et al.* (2006:508), are of opinion that the problems occur due to a sensory integrative dysfunction whereby the child cannot integrate sensory or perceptual-motor information in order to perform skilled movement. Maruff *et al*. (1999:1317) suggest that cognitive impairment causes the motor abnormalities in children with DCD. However, Sugden

(2007:467) emphasises the fact that DCD is not due to a general medical condition. Hoare and Larkin (1991:5) previously identified genetics, birth trauma, developmental delays and perceptual problems as the factors that contribute to DCD, while Mon-Williams, Wann and Pascal (1999:247) predict that deficits in visual and kinaesthetic perception contribute to the clumsiness of children with DCD.

It is clear that numerous speculations exist; however, research has focused more on the possibility of neurophysiology as an implication in the aetiology of DCD (Maruff *et al.,* 1999:1323). The correlation between neural and DCD is discussed next.

2.5.1 Neural correlation of Developmental Coordination Disorder

2.5.1.1 Cerebellum

The cerebellum is located at the top of the brain stem and helps with proper positioning of the body in space, and subconscious coordination of motor activity (Sherwood, 2007:141). The cerebellum also helps to adjust voluntary and involuntary motor activities (Sherwood, 2007:141). Given the cerebellum's role in motor coordination and postural control it is clear that it may be involved in the neuropathology of DCD. This statement is confirmed by Geuze (2005:184) who states that poor postural control is one of the main characteristics in children with DCD. According to Ivry (2003:142) children with DCD have diminished motor coordination which is one of the main cerebellum disorders.

Another important role of the cerebellum is sensory processing (Sherwood, 2007:141), and according to Missiuna *et al.* (2006:508), the main hypothesis regarding the aetiology of DCD includes cerebella involvement, named automatisation hypothesis. The above hypothesis suggests that children struggle with automatic motor behaviours, particularly when a secondary task is introduced (Missiuna *et al.,* 2006:508), and at the same time have a problem in one of the different stages while they process information

(Missiuna, 2003:3). Figure 2.1 illustrates the different processes where the difficulty may occur.

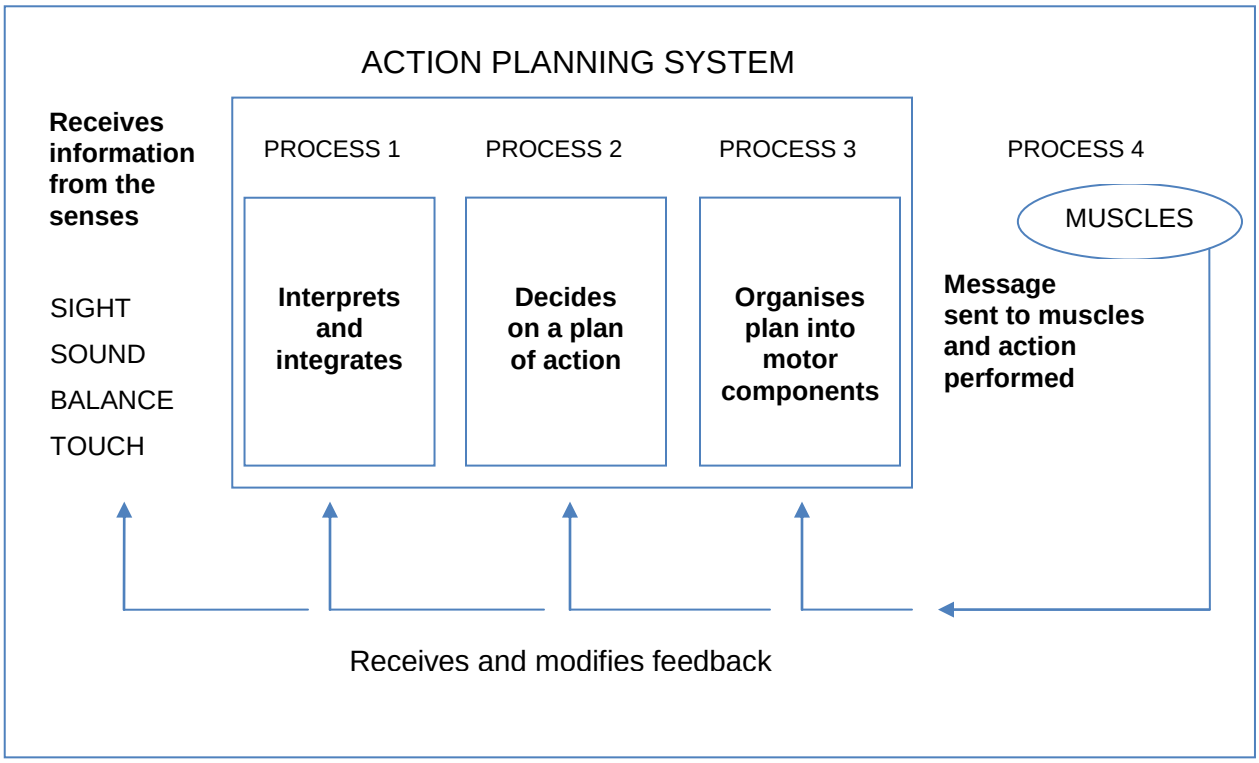

Figure 2.1: Sensory processing system (Adapted from: Missiuna (2003:3).

The child will appear clumsy if he/she struggles to analyse sensory information from the environment (process 1), has a problem to use this information in choosing a desired plan of action (process 2), has difficulty sequencing the individual motor movements of the task (process 3), or cannot send the right message to produce a coordinated action (process 4) (Missiuna, 2003:3). Another part of the brain that could also play a role in the cause of DCD is the parietal lobe.

2.5.1.2 Parietal lobe

The parietal lobe is located on the top of the head and is separated by the central sulcus (Sherwood, 2007:143). The parietal lobe plays an important role in processing visual-spatial information (Zwicker *et al.,* 2009:1275), and without a doubt, as previously

mentioned, children with DCD display difficulty in visual-spatial processing (Wilson & McKenzie, 1998:835). According to Zwicker *et al.* (2009:1275) these children show visual-spatial deficits even when a motor response is not required and the deficit is not related to visual acuity or accommodation problems. Zwicker *et al.* (2009:1275) also suggest the possibility that a broad network of regions, especially in the parietal lobe associated with visual-spatial orientation, is affected by DCD, as well as the slower execution of imagined movement. It has been noted that deficiencies of the parietal lobe have shown dissociations between real and imagined movements (Maruff *et al.,* 1999:1318). This leads to speculation that DCD is present due to parietal lobe dysfunctions.

2.5.1.3 Corpus callosum

Research by Zwicker *et al.* (2009:1275) reports that the involvement of the corpus callosum in children with DCD was only present in limited cases. The corpus callosum helps with hemispheric transfer of information (Martini & Bartholomew, 2003:250). It is speculated that the corpus callosum in a child with DCD is smaller than in a normal child (Zwicker *et al.,* 2009:1276). Research findings are still limited.

2.5.1.4 Basal ganglia

The basal ganglia are masses of grey matter that lie beneath the lateral ventricles and within the central white matter of each cerebral hemisphere (Martini & Bartholomew, 2003:250). The basal ganglia are particularly important in inhibiting muscle tone throughout the body, selecting and maintaining purposeful motor activity while suppressing useless or unwanted patterns of movement and help to monitor and coordinate slow, sustained contractions (Sherwood, 2007:151). According to Diamond (2000:49) the basal ganglia are important for movement control, such as selecting the proper movement, the appropriate muscles to perform a movement, or the appropriate force with which to execute the movement. Many of the aspects of the basal ganglia are present in a child with DCD. Children with DCD struggle performing adequate, fluent

and sufficient motor skills and find it difficult to remove unwanted patterns (Gillberg & Kadesjo, 2003:59).

Despite the numerous theories and speculations regarding the aetiology of DCD, there is no definite answer as to why children experience motor difficulties (Missiuna *et al.,* 2006:507). It is clear that the aetiology of DCD is not yet identified and is a comprehensive disorder that is associated with other conditions. More studies are needed to solve the problem of aetiology. The ability to diagnose DCD is difficult due to the comprehensiveness of the disorder.

2.6 Diagnosis of Developmental Coordination Disorder

Many controversies exist regarding the diagnosis of DCD (Cardoso & Magalhaes, 2012:17). According to Hillier (2007:2) the identification and diagnosis of children with DCD is difficult due to heterogeneity. A statement by Sugden (2007:467) claims that a diagnosis should not be given to individuals with an intelligence quotient (IQ) below 70. In addition, Gibbs *et al.* (2007:536) suggest that the two principal questions to be answered when diagnosing a child with possible DCD are first to see if there is an underlying neurological or physical disorder and second to observe if the child has significant coordination difficulties compatible with DCD. Children experiencing coordination difficulties may only be diagnosed with DCD if the child meets the four diagnostic criteria outlined by the APA (APA, 2000:58; Dunford, Missiuna, Street & Sibert, 2005:207).

The DSM-IV defines a disorder as a clinically significant, behavioural or psychological syndrome that is associated with impairment in one or more important areas of functioning (Henderson & Henderson, 2003:7). According to Henderson and Henderson (2003:8) the DSM-IV lists four diagnostic criteria for DCD, of which two are inclusive (criteria must be satisfied) and two are exclusive (meeting the criteria entails rejection of the diagnosis). In order to make an official diagnosis of DCD, one should understand the four criteria.

Criterion A observes the lack of performance in motor activities, Criterion B determines if a disturbance in Criterion A interferes with academic achievement or activities of daily living, Criterion C states that the interference should not be due to a general medical condition and Criterion D notes that if mental retardation is present, the motor difficulties should be above those usually associated with it (Sugden *et al.,* 2008:174). Table 2.2 provides the diagnostic components for DCD.

Table 2.2: Diagnostic criteria for DCD

A	Performance in daily activities that require motor coordination is substantially below that expected, given the person's chronological age and measured intelligence. This may be manifested by: • Marked delays in achieving motor milestones (e.g., walking, crawling, sitting); • Dropping things; • Clumsiness; • Poor performance in sports; • Poor handwriting.
B	The disturbance in Criterion A significantly interferes with academic achievement or activities of daily living.
C	The disturbance is not due to a general medical condition (e.g., cerebral palsy, hemiplegia or muscular dystrophy) and does not meet criteria for a pervasive developmental disorder.
D	If mental retardation is present, the motor difficulties are in excess of those usually associated with it.

Adapted from: APA (2000:58).

Criterion A can be obtained using a standardised motor test; Criterion B could be established via teacher or parent questionnaires, while Criteria C and D can be finalised respectively after children with cerebral palsy and intellectual impairments are excluded (Barnett, 2011:9). If other medical conditions such as cerebral palsy are present, a multidisciplinary approach to diagnosis and treatment is recommended (Carslaw, 2011:88). Another important aspect of diagnosis is that it has to be based on norm-referenced test items that produce a continuous measure of performance (Henderson & Henderson, 2003:9).

The standardised motor test mentioned in Criterion A and the teacher and parent questionnaires in Criterion B are better known as assessment tools. Peters & Henderson (2008:98) states that children need to be referred to professionals to conduct the standardised motor test (Criterion A) and the questionnaires (Criterion B). For better understanding, the assessment tools are explained next.

2.7 Assessment tools for Developmental Coordination Disorder

In order to understand the assessment tools, it is also important to understand the evaluation of test quality to execute an evaluation.

2.7.1 Evaluation of test quality

The validity and reliability in evaluations are essential in order for motor assessments to be useful (Barnett, 2008:115). Validity is referred to as the degree to which a test or instrument measures what it purports to measure (Bruininks & Bruininks, 2005:56; Baechle & Earle, 2008:238). According to Ulrich (2000:35) a test can only be valid if it tests what it is supposed to test. Furthermore, the test validity is divided into various terms, namely content validity, criterion validity, construct validity and logical validity (Gallahue & Ozmun, 2006:423; Baechle & Earle, 2008:238).

Content validity refers to the degree to which the contents of the test represent an identified domain; and criterion validity indicates the test has been compared with another acceptable standard and is divided into four types: concurrent, predictive, discriminant and convergent validity (Auxter, Pyfer, Zittel & Roth, 2010:69-71). Concurrent validity can be defined as the extent to which test scores are associated with those of other accepted tests that measure the same ability, while predictive validity is the extent to which the test score corresponds with future behaviour or performance. Similarly, convergent validity can be defined as evidenced by high positive correlation between results of the test being assessed; and discriminant validity as the ability of a test to distinguish between two different constructs which is evidenced by a low

correlation between the results of the test (Baechle & Earle, 2008:240). Furthermore, construct validity is defined as the ability of a test to represent the underlying construct and refers to overall validity (Baechle & Earle, 2008:239) whereas logical validity (face validity) is the degree to which a measure obviously involves the performance being measured (Thomas, Nelson & Silverman, 2011:193).

Reliability, on the other hand, indicates that similar results will be obtained across time and between different examiners (Barnett, 2008:115) as well as precision; consistency and stability of the test scores (Henderson, Sugden & Barnett, 2007:132). According to Thomas *et al. (*2011:197), a test cannot be considered valid if it is not reliable, meaning if it is not consistent then the test cannot be trusted. The test retest reliability is the statistical correlation of the scores from the two administrations provided and any difference could cause the following errors: intra subject variability, interrater reliability and intrarater variability (Baechle & Earle, 2008:240). Interrater reliability refers to the degree to which different testers can achieve the same scores on the same subjects (Thomas *et al.,* 2011:199) whereas intrarater is the lack of consistent scores by a given tester (Baechle & Earle, 2008:239). The validity and reliability of each test used in the study are explained later.

2.7.2 Assessments

Children with DCD can be assessed in various ways; however, there is currently no gold standard assessment instrument (Kirby, 2010:572). Hillier (2007:2) states the reason for the statement by Kirby (2010:572) is the fact that none of the tests is sufficient for all the different children being assessed. Assessment tools can either be a screening test or diagnostic test. Diagnostic tests provide clinical information regarding movement competencies and assist in designing treatment programmes, whereas screening tests are used to identify children at risk for some type of developmental problem (Wilson, 2005:810).

A diagnostic test is required to identify a child at risk for DCD (Schoemaker, Flapper, Reinders-Messelink & De Kloet, 2008:191). According to Venetsanou, Kambas, Elllinoudis, Fatouros, Giannakidou and Kourtessis (2011:2) the most commonly used diagnostic motor tests are the Movement Assessment Battery for Children (MABC) and the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP). However, a previous result by Crawford, Wilson and Dewey (2001) cited in Polatajko & Cantin (2006:251) indicates that the MABC identifies more children with DCD than the BOTMP. Even though these diagnostic motor tests are used, the administration of these tests are found to be time-consuming and expensive and therefore screening tests completed by parents or teachers can be valuable alternatives (Schoemaker, Flapper, Verheij, Wilson, Reinders-Messelink & De Kloet, 2006:668). Hillier (2007:2) supports the statement that screening by parents and teachers can be reported to professionals who can then do further assessment if necessary.

Schoemaker *et al.* (2008:197) emphasise how the screening of children before the assessment phase can help to prevent the exclusion of children who truly need intervention for their motor difficulties. Green *et al.* (2005:3), as well as Tseng *et al.* (2010:34), are of the opinion that the screening tests are able to identify functional limitations across a variety of tasks and settings. According to Martini, St-Pierre and Wilson (2011:319) the screening tests provide perspectives from different sources: firstly the teachers with the Movement Assessment Battery for Children Checklist (MABC-Checklist), and secondly the parents, also with the MABC-Checklist, as well as with the Developmental Coordination Disorder Questionnaire (DCDQ). The screening tests are reliable in identifying children with DCD; however, there is some dispute as to whether parents, teachers and clinicians would identify the same group of children when specifically focusing on the MABC-Checklist (Green *et al.,* 2005:3).

A short explanation of the Bruininks Oseretsky Test of Motor Proficiency 2 (BOT-2) and the DCDQ'07 will be given. Furthermore the Movement Assessment Battery for Children second edition (MABC-2) which consists of the Movement Assessment Battery for Children Performance Test (MABC-2 Performance Test) and the Movement

Assessment Battery for Children Checklist (MABC-Checklist-2) will be discussed in full as this assessment tool was used in the current study.

2.7.3 Bruininks Oseretsky Test of Motor Proficiency second edition (BOT-2)

The BOT-2 is an individually administered test to measure motor skills in individuals aged 4 to 21. The BOT-2 assess fine and gross motor control skills (Bruininks & Bruininks, 2005:8). The test consists of eight sub tests (Fine Motor Precision, Fine Motor Integration, Manual Dexterity, Bilateral Coordination, Balance, Running speed and Agility, Upper-limb Coordination & Strength) and is grouped under four composites namely: Fine manual control, Manual coordination, Body coordination as well as Strength and Agility. The Manual dexterity subtest uses goal-directed activities which is timed. The subtest includes speed and accuracy which can assist in identifying DCD (Bruininks & Bruininks, 2005:5). The BOT-2 uses standard scores to describe an examinee's level of proficiency on the four motor composites and the total motor composite. The four motor composites together with the total motor composite can be interpreted by using age equivalents and descriptive categories. The age equivalents indicates the age at which the subject falls for the specific test item whereas the descriptive category indicates the level on which the subject is for the specific composite. Descriptive category includes: well-above average, above average, average, below average and well-below average (Bruininks & Bruininks, 2005:28).

2.7.4 Developmental Coordination Disorder Questionnaire'07 (DCDQ'07)

The DCDQ'07 is a parent-reported measure that is developed to assist the identification of DCD in children 5-15 years of age (Wilson, Kaplan, Crawford & Roberts, 2007:5). It provides a standard method to measure a child's coordination in everyday, functional activities. The DCDQ'07 consists of 15 items and a total score range of 15 - 75 (Fei & Olsen, 2011:573). The parent compares the degree of coordination their child has with other children of the same age. Each performance of the child are rated between one and five. A one indicates not at all and a five indicate extremely like your child (Wilson *et*

al., 2007:4). If the child falls in the probably not DCD category it will indicate that the child do not have motor problems. However if the child falls in the indication or suspect DCD category, the child is identified with moderate to severe motor difficulties. The results are explained in table 2.3:

Table 2.3: Interpretation of total scores for the DCDQ'07

AGE GROUP	INDICATION OF, OR SUSPECT FOR DCD	PROBABLY NOT DCD
4 years 6 months to 7 years 11 months	15-46	47-75
8 years 0 months to 9 years 11 months	15-55	56-75
10 years 0 months to 15 years	15-57	58-75

Adapted from: Wilson *et al.*(2007:7)

2.7.5 Movement Assessment Battery for children second edition Performance Test (MABC-2 Performance Test)

The MABC-2 has been developed to help professionals assess children with movement difficulties (Henderson *et al.,* 2007:3). The focus of the MABC-2 Performance Test is to identify motor impairments in children and requires a child to perform a series of motor tasks in a specified way. The test also provides qualitative information on the approach and performance of the task (Henderson *et al.,* 2007:3). The test is divided into three age bands (age band 1:3-6 years, age band 2:7-10 years and age band 3:11-16 years). Each age band consists of eight tasks grouped under three headings, namely manual dexterity, aiming and catching and balance. Age adjusted standard scores and percentiles are provided for these three groups and for the total test score. The total test score can be interpreted in terms of cut-off points and a traffic light system (Henderson *et al.,* 2007:4). The green zone indicates performance in a normal range (> 15th percentile), while the amber zone indicates a child as being at risk and needs to be carefully monitored (6th - 15th percentile). The red zone is an indication of definite motor impairment (≤5th percentile) and needs remediation. Furthermore the standard score

provide the clearest indication of a child's performance. The standard scores are transformed of a distribution of raw scores and if the standard score is 3 or less the child will need help. A score of 1 or more can put the child into an at risk category (Henderson *et al.,* 2007:84). The higher the score the superior the child's motor abilities.

2.7.5.1 Psychometric properties of the MABC-2 Performance Test

The MABC-2 Performance Test is a revised version of the previously known Movement Assessment Battery for Children (referred as the original MABC test). One of the reasons for the revised test is the findings of considerable differences in lifestyle, activity levels and anthropometrics of children (Civetta & Hillier, 2008:45). Another reason for revising the MABC is the fact that only few items in three broad areas of functioning were tested (Henderson *et al.,* 2007:117). The psychometric properties demonstrate the precision of the scores and the quality of the test score interpretation.

2.7.5.1.1 Validity of the MABC-2 Performance Test

The MABC-2 Performance Test presents good scores in terms of each component and how it correlates with the total test score (Henderson *et al.,* 2007:142). The correlation coefficients of each component is higher than 0.60 (manual dexterity = 0.76; aiming and catching = 0.65 and balance = 0.73) and correlates well with the total test score (Henderson *et al.,* 2007:142). A study by Ellinoudis *et al.* (2011:1049) found correlation coefficients of 0.74 for manual dexterity, 0.70 for aiming and catching and 0.71 for balance indicating a valid tool in assessing motor difficulties.

2.7.5.1.2 Reliability of the MABC-2 Performance Test

The test-retest reliability of the MABC-2 Performance Test is noted as important in the test manual (Henderson *et al.,* 2007:134). Research findings by Wuang, Su and Su (2012:164) found that the total instrument, as well as its separate items and subscales, exhibited excellent test-retest reliability.

The internal consistency found by Ellinoudis *et al.* (2011:1049) illustrated Cronbach's alpha values of 0.51, 0.70 and 0.66 for manual dexterity, aiming and catching, and balance task groups, respectively which are acceptable. Another study conducted by Wuang *et al.* (2012:164) also found a Cronbach's coefficient range of 0.81-0.90 indicating a good to excellent internal consistency. According to Wuang *et al.* (2012:164) the MABC-2 Performance Test is a reliable test that produces reliable results. The total test score of the standardisation study of 60 children, 20 from each age band, showed a reliability coefficient of 0.80, which is a good value and the individual component scores were all above 0.70 (manual dexterity = 0.77; aiming and catching = 0.84; balance = 0.73) which again indicate an acceptable reliability (Henderson *et al.,* 2007:136). A more recent study by Wuang *et al.*(2012:163) identified a very high reliability with a reliable coefficient of 0.97 for the total test score and research by Brown and Lalor (2009:96) rate this test's reliability as reasonable.

In conclusion, the MABC-2 Performance Test is a reliable and valid tool for the assessment of movement difficulties and can therefore be used to screen children in the best way possible. The MABC-2 Performance Test also comprises of a Checklist, namely the Movement Assessment Battery for Children Checklist second edition (MABC-Checklist-2) to identify children with motor impairments.

2.7.6 Movement Assessment Battery for Children Checklist second edition (MABC-Checklist-2)

According to Henderson *et al.* (2007:4), the MABC-Checklist-2 focuses on how the child manages everyday tasks at home and at school. The MABC-Checklist-2 can be completed by parents, teachers or other professionals involved with the child and include a motor and non-motor component. The motor component consists of 30 items grouped into two sections, focusing on the child's performance in a static and moving environment, whereas the non-motor component focuses on aspects that may interfere with the ability to perform a movement skill (Henderson *et al.,* 2007:4). The MABC-Checklist-2 also provides a total motor score which is then categorised on a traffic light

system. The traffic light system shows whether a child falls into the normal range (green zone), at risk range (amber zone) or the highly likely to have a more serious movement problem range (red zone).

2.7.6.1 Psychometric properties of the MABC-Checklist-2

2.7.6.1.1 Validity of MABC-Checklist-2

The test manual focuses on discriminative validity to make sure the MABC-Checklist-2 correctly identifies children with motor difficulties (Henderson *et al.,* 2007:155). A previous study by Shoemaker, Niemeijer, Flapper, & Smits-Engelsman (2012:372) found that the MABC-Checklist-2 was able to discriminate between the group with motor impairments and those without motor impairments. In another study, Shoemaker, Smits-Engelsman and Jongmans (2003:437) found that the original MABC-Checklist also demonstrated a good discriminative power between a random group of children and children referred for physical therapy. Despite the importance of the discriminative validity the concurrent validity is even more important. Limited studies regarding concurrent validity are available and almost no studies for when the MABC-Checklist-2 is completed by parents.

Concurrent validity of the MABC-Checklist-2 can be obtained by calculating the percentage of agreement between the MABC-2 Performance Test and the MABC-Checklist-2 in classifying children as those with motor difficulties (amber and red zone) and those without motor difficulties (green zone) (Shoemaker *et al.,* 2012:370). Previous studies on the original version of the MABC Checklist (1992) found to correlate well with the original MABC Performance Test (0.44). In addition, Ellinoudis *et al.* (2009:306), as well as Green *et al.* (2005:6), found that the agreement between the original MABC Performance Test and the MABC-Checklist were low with a *(k)*-coefficient of 0.14 for both studies. In accordance with Ellinoudis *et al.* (2009:308) and Green *et al.* (2005:6), a study in a Dutch and Flemish sample by Shoemaker *et al.* (2012:371) also indicated a low agreement with a kappa value of 0.28.

However, other studies establish higher agreement percentages between the teachers completed MABC-2 Performance Test and the MABC-Checklist-2. Research carried out by Schoemaker *et al.* (2012:371), found a high percentage agreement of 80% on a population sample of 383 children. A previous study on the original MABC by Schoemaker *et al.* (2003:438) observed an average percentage of 69% for 6-year old children, lower percentage of 35% for 7-year old children and a high percentage of 63% for 8-year old children. Junaid (1998:414) on the other hand, found a more average agreement on the original MABC with a correlation of 51% and at the same time Piek and Edwards (1997:60) demonstrated a 50% agreement between the original MABC Performance test and the MABC-Checklist in a sample of 191 children. It is clear that conflicting results are present in the literature.

The concurrent validity of the MABC-Checklist-2 can further be obtained by calculating the sensitivity and specificity of the MABC-Checklist-2 (Shoemaker *et al.,* 2012:370). Sensitivity is the ability to correctly identify children with moderate- (amber zone) and severe (red zone) motor difficulties with the MABC-Checklist-2 which was also identified by the MABC-2 Performance Test (Schoemaker *et al.,* 2003:430; Ellinoudis *et al.,* 2009:291), while specificity is the ability to use the MABC-Checklist-2 for correctly identifying children with no motor difficulties (green zone) which was also identified by the MABC-2 Performance Test. A previous study on the original MABC by Piek and Edwards (1997:59) found a low sensitivity of 25.0%, which means that the teacher-completed MABC-Checklist only identified moderate and severe motor difficulties in 8 out of 32 children detected by the MABC Performance Test. In agreement with Piek and Edwards (1997:59), research by Ellinoudis *et al.* (2009:289) also found a low sensitivity (27.1%), demonstrating that the MABC-Checklist-2, when completed by teachers in their study, only identified 16 of the 59 children observed by the MABC-2 Performance Test with moderate- and severe motor difficulties. In contrast with the current study, a study by Junaid (1998:35) when using the original MABC, found an even lower sensitivity of 14.3%, implying that the MABC-Checklist failed to identify children with poor scores on the MABC Performance Test.

In contrast with the mentioned studies, Henderson and Sugden (1992:216) found a higher sensitivity of 43.8% on the original MABC. In their study the MABC Performance Test identified 16 children with moderate and severe motor difficulties of which the teachers identified 7 of the 16 correctly, using the MABC-Checklist. Green *et al.* (2005:6) agree with the findings of Henderson and Sugden (1992:216) indicating a sensitivity of 44%. Similar results were found in a more recent study conducted in Germany using the MABC-2 Performance Test, which indicated a sensitivity of 41% (Schoemaker *et al.,* 2012:373), whereas a study in the Netherlands demonstrated an extremely high sensitivity of 80% (Schoemaker *et al.,* 2003:437). Concurrently, Henderson *et al.* (2007:156) observed children specifically identified with DCD, and found that 19 of the 20 children identified with DCD were also classified in the red zone (severe motor difficulties) or amber zone (moderate motor difficulties) of the MABC-Checklist-2. Due to the conflicting results of the researchers it is difficult to determine the sensitivity of the MABC-Checklist-2. However, previous research regarding specificity indicates more agreements.

A study conducted by Green *et al. (*2005:6) indicated a specificity of 74% while Ellinoudis *et al.* (2009:291), showed a higher specificity of 81.6%. In contrast with Ellinoudis *et al.* (2009:291), a more recent study by Schoemaker *et al.* (2012:373) recognised an even higher specificity of 88% when using the second edition of the MABC. Another study conducted in the Netherlands also demonstrated a very high specificity of 90% on the original MABC, indicating a substantially good agreement between the MABC Performance Test and MABC-Checklist when specifically identifying children with no motor difficulties (Schoemaker *et al.,* 2003:437). The higher agreement is positive because if the teacher identifies the child with no motor difficulties it is almost a certainty that the MABC Performance Test would agree. Construct validity is the last important aspect of validity on the MABC-Checklist.

Construct validity is used to ensure that all items measure the same construct. A study by Schoemaker *et al.* (2012:371) found a Cronbach's alpha of 0.94, indicating a very good construct validity regarding the revised MABC-Checklist-2. A previous study using

the original MABC Checklist regarding construct validity found that the more complex motor sections of the MABC-Checklist are the more difficult they are.

Schoemaker *et al. (*2008:191) confirm that the MABC-Checklist-2 is a valid and reliable screening instrument for identification of children with DCD. Many validity results in the literature are based on the original MABC-Checklist. Further studies regarding the validity of the revised MABC-Checklist-2 are needed. Although Schoemaker *et al.* (2008:191) are of opinion that the MABC-Checklist-2 is a valid and reliable screening instrument, it is clear that the concurrent validity in previous research show conflicting results. The question therefore arises whether the MABC-Checklist-2 is a valid screening tool, specifically when observing the agreement between the MABC-2 Performance Test and the MABC-Checklist-2.

2.7.6.1.2 Reliability of the MABC-Checklist-2

There has been limited research on the reliability of the revised MABC-Checklist-2 (Brown & Lalor, 2009:94). According to Henderson *et al.* (2007:154), reliability of the new MABC-Checklist-2 can be an overlap of the previous MABC-Checklist's reliability. The original MABC-Checklist was found to be a reliable instrument due to its degree of homogeneity among test items (Schoemaker *et al.,* 2003:436).

The constancy of children's scores on the original MABC-Checklist was previously examined. Two groups with an average age of 7 years and 9 years were evaluated on the test-retest correlation, which scored good for 7 years (0.91) and suitable at 9 years (0.77) (Henderson *et al.,* 2007:155). In another study, Schoemaker *et al.* (2003:431) obtained a test-retest rating of 0.96 which is sufficiently high and proposes a good reliability. One study which specifically explored the reliability of the second edition MABC-Checklist-2 found that the internal consistency of the items of the Checklist were very worthy (Shoemaker *et al*., 2012:371).

Overall, these studies suggest that the reliability of the MABC-Checklist-2 is acceptable. However, more studies regarding the test-retest reliability and internal consistency for the MABC-Checklist-2 is needed (Brown & Lalor, 2009:97). The test instructions were also changed to ensure that one designated individual is responsible for the completion of the whole MABC-Checklist-2 (Henderson *et al.,* 2007:155). Henderson *et al.* (2007:155) also explain that the individual should seek help when uncertainty regarding any of the items arises.

2.8 Research findings on assessment of Developmental Coordination Disorder

Research identifies various diagnostic tests to assess children with DCD (Slater *et al.,* 2010:176). The two most frequent tests used to assess these children are the Movement Assessment Battery for Children (MABC) and the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) (Chen, Tseng, Hu & Cermak, 2009:1368). According to Gibbs *et al.* (2007:536), the MABC is the preferred assessment tool in the field of diagnosing DCD. Slater *et al.* (2010:176) agree, stating that the MABC gives proper scores. There is however still no gold standard (Schoemaker *et al.,* 2008:197).

Even though the MABC measures specific motor skills, the test fails to document the daily functional impact of the problem and to identify different children, depending on the test characteristics (Dewey & Wilson, 2001:14; Wuang *et al.,* 2012:160). In addition, researchers questioned whether motor questionnaires completed by parents or teachers may be a valuable alternative (Schoemaker *et al.,* 2006:668). The MABC-Checklist and Developmental Coordination Disorder Questionnaire (DCDQ) are screening tools used for the identification of DCD. However, conflicting results with regard to the questionnaires are found (Schoemaker *et al.,* 2006:668). Barnett (2008:118) suggests that these screening tools perform poorly in actually identifying children with movement difficulties in comparison to the MABC Performance Test. Various findings with regard to the MABC-Checklist are explained in the following paragraphs.

Faught, Cairney, Hay, Veldhuizen, Missiuna and Spironello (2008:179) find that the MABC-Checklist-2 demonstrates moderate power in identifying children with movement difficulties. A previous study by Shoemaker *et al.* (2003:425) found that the original MABC-Checklist varied considerably with the results of the MABC Performance Test and in agreement with this finding, Green *et al.* (2005:7) discovered that the original MABC-Checklist achieved poor response in identifying children with motor difficulties and did not assist in identifying the children who would need more help. According to Junaid, Harris, Fulmer and Carswell (2000:162) the original MABC-Checklist reports low results (43%) when it is used to identify DCD. A recent investigation of the relationship between the MABC-Checklist-2 and the scores of the MABC-2 Performance Test reveals that only 16 out of 59 children with motor difficulties were identified (Ellinoudis *et al.,* 2009:288). However, the original MABC-Checklist is seen as a good screening tool due to the broad range of motor skills it measures (Schoemaker *et al.,* 2003:3). Junaid *et al.* (2000:162) revealed that the independent use of the MABC-Checklist could not be accurate, because children at risk for motor difficulties based on the MABC Performance Test were not identified.

According to Missiuna *et al.* (2011:550) parents and teachers also play a role in completing these screening tools and several instruments make use of parent and teacher completed questionnaires. It is found that teachers are particularly important in screening for motor coordination problems (Faught *et al.,* 2008:178). Faught *et al.* (2008:178) state that teachers have an advantage to other professionals as they can observe children in different play situations and school activities. However, an investigation into the relationship between the scores on the MABC-Checklist-2 and the scores on the MABC-2 Performance Test reveals that educators have low ability in recognising children with motor difficulties (Ellinoudis *et al.,* 2009:290). This can be due to teachers not being involved in teaching physical education classes and only observe the children in the classroom (Shoemaker *et al.,* 2008:198). There have however been established that physical education teachers could be more experienced in observing children within a changing environment (Piek & Edwards, 1997:65).

Tsang, Stagnitti and Lo (2010:234) are of the opinion that a home context screening is very important and find that parents can help identify children with mild motor impairment when using the DCDQ. Missiuna *et al.* (2011:550) agree and reveal that parent reports correlate well with clinical measures for DCD. In addition, a study found that children with low MABC scores are not identified by the parents with the DCDQ as children who struggle with motor skills (Missiuna *et al.,* 2011:557). According to Engel-Yeger, Rosenblum and Josman (2010:93) parents with an educational background can identify the level of their child's motor performance, but parents with no educational background struggle to see limitations.

It is clear that controversies exist between the screening tools used and appropriate people to administer these tests. The different methodologies make it difficult to reach conclusions on effectiveness of various assessment tools and the people who administer them (Faught *et al.,* 2008:178). Together with the right assessment tool, the correct interventions are required to help these children.

2.9 Treatment and Intervention of Developmental Coordination Disorder

Children with DCD do not outgrow this disorder and it is retained into adult life, preventing them from performing important activities in daily life (Missiuna *et al.,* 2006:510). According to Gibbs *et al.* (2007:537) early intervention will enable the child to overcome some of the difficulties and to adopt strategies to manage motor problems later in life. Hillier (2007:9) agrees with Gibbs *et al.* (2007:537) that intervention for children with DCD repeatedly demonstrates positive results across heterogeneous studies. Thus, the appropriate measures to help children with DCD will enable health practitioners to manage individuals with DCD effectively (Slater *et al.,* 2010:171).

Over the past years several different intervention programmes have been applied to meet the needs of children with DCD (Barnett, 2008:123). These intervention programmes can roughly be divided into two main intervention approaches, namely the bottom-up and top-down approach (Barnhart *et al.,* 2003:725). The bottom-up approach

is defined as the process where the sensory input system is evaluated and skill tests are used to see which deficits are an indication (Auxter *et al.,* 2010:G-3). Top-down approaches, on the other hand, focus on the end of the skill sequence rather than what is taught next (Auxter *et al.,* 2010:144). A summary of the two approaches are illustrated in Table 2.3.

Table 2.4: Summary of Bottom-Up versus Top-Down Approaches

Approach	Theoretical Basis	Examples
Bottom-up	Focus is on remediating underlying deficits through selective transmittal of sensory information, which the central nervous system interprets and organizes into the development of an appropriate movement strategy	Sensory integration therapy Process-oriented treatment Perceptual motor training
Top-down	Emphasis is on cognitive or problem-solving skills to select and implement the most appropriate strategies for successful task performance	Task-specific intervention Cognitive approaches (cognitive orientation to daily occupational performance)

Adapted from: Barnhart *et al.*(2003:726).

Previously the bottom-up approach treatments for children with DCD included sensory integration intervention, process-oriented treatment, perceptual motor training and combinations of the above (Mandich, Polatajko, Macnab & Miller, 2001:55). In addition the top-down approached treatments for children with DCD include task specific intervention and cognitive approaches (Mandich *et al.,* 2001:61). Each approach of intervention programme is briefly explained in the following paragraphs.

2.9.1 Bottom up

2.9.1.1 Sensory integration intervention

Sensory integration intervention provides the appropriate sensory stimulation to promote adaption and higher cortical learning to the child (Mandich *et al.,* 2001:56). According to Davidson and Williams (2000:497) the sensory integration intervention programme includes sensory stimulation and adaptive responses according to the child's neurological needs and involves full body movements which focus on vestibular, proprioceptive and tactile stimulation. As previously stated, children with DCD struggle with motor skills, and according to Pless and Carlsson (2000:383), children who find it difficult to execute a motor skill represent sensory-motor problems, which can be treated with a sensory integration intervention programme. Despite the finding of Pless and Carlsson (2000:283), various studies found the sensory integration intervention not to have such an accurate affect in improving children with DCD (Davidson & Williams, 2000:498; Mandich *et al.,* 2001:58).

2.9.1.2 Process-oriented treatment

The process-oriented programme focuses on treatment of kinesthetic problems (Mandich *et al.,* 2001:59) and deficits in processes assumed to underlie poor motor coordination (Schoemaker *et al.,* 2003:155). According to Sugden (2007:468) the goal of this approach is to remedy some underlying process deficit with intervention targeted at a neural structure which will be seen in a number of everyday tasks that this process underlies. In addition, Sugden and Chambers (1998:141) previously pointed out that the process-oriented approach should have two effects: first, to improve the basic processes which help to perform simple skills in a short period of time and second, to provide the necessary abilities for the gradual acquisition of complex skills.Despite the effects it supposed to present, there is, however, not much evidence to show that this approach is effective (Schoemaker *et al.,* 2003:156).

2.9.1.3 Perceptual motor training

The main goal of a perceptual motor training programme is to provide the child with a broad range of experiences with sensory and motor tasks which improve their motor ability (Mandich *et al.,* 2001:60). The perceptual-motor approach requires a child to perform fine and gross motor activities in order to perform skills in optimal functioning (Auxter *et al.,* 2010:156). Research by Davidson and Williams (2000:498) indicate improvement in children with DCD; however, further research is required to determine how much improvement occurs.

2.9.2 Top-down

2.9.2.1 Task-specific intervention

A task-specific approach is a task being taught directly without emphasising the underlying processes, but rather the tasks that are causing the child's difficulties (Sugden & Chambers, 1998:140). Furthermore, the task-specific approach aims to improve specific tasks through practice (Gibbs *et al.,* 2007:537) and focuses directly on the functional skills a child experiences problems with (Schoemaker *et al.,* 2003:155). Mandich *et al.* (2001:62) suggest that direct teaching of the task can only take place by breaking the task up in steps and smaller units. The skill should also be taught directly and generalised to a variety of environments (Auxter *et al.*, 2010: G-18). Teachers, however, vary in how they teach these tasks. Some focus more on behavioural methods and others focus more on cognitive and contextual approaches (Sugden & Chambers, 1998:143). According to Missiuna *et al.* (2003:36), task-specific intervention has previously beeneffective. This view is shared by Pless and Carlsson (2000:397), indicating that task-specific intervention is recommended.

2.9.2.2 Cognitive approach

A cognitive approach includes various programmes. According to Mandich *et al.* (2001:63) programmes can consist of problem solving and information processing. The cognitive approach concentrates on developing sensory modalities involved in motor performance (Gibbs *et al.,* 2007:537). The cognitive approach has been renamed as ecological intervention, which incorporates more recent theoretical and empirical evidence from motor development and extends in two ways: firstly, intervention is in a more family, community and ecological setting and secondly, the intervention places more emphasis on the actual control of movement using ideas from information processing and dynamic systems (Sugden, 2007:469).

2.9.3 Other aspects on treatment and intervention

Another approach, according to Gibbs *et al.* (2007:537), is to focus on improving aspects of self-esteem rather than the core problem of coordination where children obtain psychological support and learn how to cope with their motor impairments. In addition to intervention approaches it is important that appropriate professionals work with children with DCD.

Parents, paediatricians and other health and educational professionals play an important role in the treatment and intervention of DCD. Occupational therapists are involved for self-care difficulties, organisational problems, handwriting and difficulty participating in play activities. Physical therapists are involved in more severe motor impairments, including problems with balance and strength as well as delays in the development of gross motor skills and safety issues. The speech/language pathologists are responsible for receptive and expressive language delays and articulation problems. The psychologists can assist with co-morbid conditions such as attention- or learning problems, hyperactivity and learning disabilities whereas educators can help with functional difficulties in the classroom as well as to promote learning and social integration (Missiuna *et al.,* 2006:510).

These professionals need to consider a number of key points when interpreting intervention with children: Firstly they need to remember that services should be child and family centred. Secondly, they need to involve other professionals to assess. Thirdly, the end goal of the intervention should focus on being more functional. Fourthly, participation should be the goal of intervention. Fifthly, they need to consider how to address transfer and generalise issues, and finally the future of the children with DCD needs to be taken into consideration (Sugden *et al.,* 2008:181). Another recommendation includes that interventions should be based on relevant daily living activities (Sugden, 2006:8). The WHO suggests that the intervention should be directed towards remediation of impairment, reducing activity limitations and improving participation (Missiuna *et al.,* 2003:36).

It is clear that various intervention approaches and recommendations exist. It is important that the most suitable programme is eventually chosen to bring out the best in every child with DCD.

2.10 Conclusion

Chapter 2 focused on various aspects with regard to DCD. It is clear that children with DCD have numerous motor difficulties. Even though the cause of DCD is still unclear, the right assessment tools are important to identify these children as soon as possible. The MABC-2 Performance Test indicated differences in its validity and reliability. However with previous research it is clear that the MABC-2 Performance Test is a reliable and valid tool for the assessment of movement difficulties. The MABC-Checklist-2 on the other hand indicated many controversies with regard to its validity and reliability which showed low agreement percentages between the teachers completed MABC-Checklist-2 and the MABC-2 Performance Test. Many results were found on the original MABC-Checklist and further studies with regard to the revised MABC-Checklist-2 are needed. Previous studies also explained that the MABC-Checklist-2 only consist of moderate power to identify children with movement difficulties. Studies also found controversies with regard to the ability of the teachers to

identify children with motor difficulties by using the MABC-Checklist-2. There are also confusion with regard to the agreement between the MABC-2 Performance Test and the MABC-Checklist-2. Some research indicate a positive agreement between the MABC-2 Performance Test and the MABC-Checklist-2 and others show a low agreement. The assessment tools also show to many controversies and further research needs to be done. As a result the appropriate people together with the suitable screening tools can contribute to earlier interventions and improve the quality of life of these children.

2.11 References

AMERICAN PSYCHIATRIC ASSOCIATION APA. 2000. *Diagnostic and statistical manual of mental disorders.* (4th text revision ed.). Washington, DC: American Psychiatric Association. pp. 449-450.

AUXTER, D., PYFER, J., ZITTEL, L. & ROTH, K. 2010. *Principles and methods of adapted physical education and recreation*. (11thed). Boston: McGraw Hill.

BAECHLE, T.R. & EARLE, R.W. 2008. *Essentials of strength training and conditioning.* (3rd ed). Champaigne, IL.: Human Kinetics.

BARNETT, A.L. 2008. Motor assessment in developmental coordination disorder: from identification to intervention. *International Journal of Disability, Development and Education,* 55(2):113-129.

BARNETT, A.L. 2011. Motor impairment in extremely preterm or low birth weight children. *Developmental Medicine & Child Neurology*, 53(1):9-10.

BARNHART, R.C., DAVENPORT, M.J., EPPS, S.B. & NORDQUIST, V.M. 2003. Developmental coordination disorder. *Physical Therapy,* 83(8):722-731.

BO, J. & LEE, C. 2013. Motor skill learning in children with developmental coordination disorder. *Research in Developmental Disabilities,* 34(6):2047-2055.

BURNS, Y.R., DANKS, M., O'CALLAGHAN, M.J., GRAY, P.H., COOPER, D., POULSEN, L. & WATTER, P. 2009. Motor coordination difficulties and physical fitness of extremely-low-birthweight children. *Developmental Medicine &Child Neurology,* 51(2):136-142.

BRUININKS R.H. & BRUININKS, B.D. 2005. *Bruininks-Oseretsky Test of Motor Proficiency Manual.*(2nd ed). Minneapolis: Pearson Assessments.

BROWN, T. & LALOR, A. 2009. The Movement Assessment Battery for children second edition (MABC-2): a review and critique. *Physical and Occupational Therapy in Pediatrics,* 29(1):86-103.

CAIRNEY, J., MISSIUNA, C., VELDHUIZEN, S. & WILSON, B. 2008. Evaluation of the psychometric properties of the developmental coordination disorder questionnaire for parents (DCD-Q): results form a community based study of school-aged children. *Human Movement Science,* 27(6):932-940.

CAIRNEY, J., SCHMIDT, L.A., VELDHUIZEN, S., KURDYAK, P., HAY, J. & FAUGHT, B.E. 2008. Left-handedness and developmental coordination disorder.*The Canadian Journal of Psychiatry,* 53(10):696-699.

CAIRNEY, J. & STREINER, D.L. 2011. Using relative improvement over chance (RIOC) to examine agreement between tests: three case examples using studies of developmental coordination disorder (DCD) in children. *Research in Developmental Disabilities,* 32(10):87-92.

CAIRNEY, J., VELDHUIZEN, S., KURDYAK, P., MISSIUNA, C., FAUGHT, B.F. & HAY, J. 2012. Evaluating the CSAPPA subscales as potential screening instruments for developmental coordination disorder. *Archives of Disease in childhood,* 92(11):987-991.

CARDOSO, A.A. & MAGALHAES, L.C. 2012. Criterion validity of the motor coordination and dexterity assessment – MCDA for 7-and 8-years old children. *Revista Brasileira de Fisioterapia,* 16(1):16-22.

CARSLAW, H. 2011. Developmental coordination disorder. *Innovait,* 4(2):87-90.

CHEN, Y., TSENG, M., HU, F. & CERMAK, S.A. 2009. Psychosocial adjustment and attention in children with developmental coordination disorder using different motor tests. *Research in Developmental Disabilities,* 30(6):1367-1377.

CIVETTA, L.R. & HILLIER, S.L. 2008. The developmental coordination disorder questionnaire and movement assessment battery for children as a diagnostic method in Australian children. *Pediatric Physical Therapy,* 20(1):39-46.

DAVIDSON, T. & WILLIAMS, B. 2000. Occupational therapy for children with developmental coordination disorder: a study of the effectiveness of a combined sensory integration and perceptual-motor intervention. *British Journal of Occupational Therapy,* 63(10):495-499.

DE KLEINE, M.J.K., NIJHUIS-VAN DER SANDEN, M.W.G. & DEN OUDEN, A.L. 2006. Is paediatric assessment of motor development of very preterm and low-birthweight children appropriate? *Paediatric Assessment of Motor Development,* 95(10):1202-1208.

DEWEY, D. & WILSON, B.N. 2001. Developmental coordination disorder: What is it? *Physical & Occupational Therapy in Pediatrics,* 20(2):5-27.

DEWEY, D., CREIGHTON, D.E., HEATH, J.A., WILSON, B.N., ANSEEUW-DEEKS, D. & CRAWFORD, S.G. 2011. Assessment of developmental coordination disorder in children born with extremely low birth weights. *Developmental Neuropsychology,* 36(1):42-56.

DIAMOND, A. 2000. Close interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex. *Child Development,* 71(1):44-56.

DUNFORD, C., MISSIUNA, C., STREET, E. & SIBERT, J. 2005. Children's perceptions of the impact of developmental coordination disorder on activities of daily living. *British Journal of Occupational Therapy,* 68(5):207-214.

ELLINOUDIS, T., KYPARISIS, M., GITSAS, K. & KOURTESIS, T. 2009. Identification of children aged 7-12 with developmental coordination disorder by physical education teachers using the test "movement assessment battery for children". *Hellenic Journal of Physical Education and Sport Science,* 29(3):288-306.

ELLINOUDIS, T., EVAGGELINOU, C., KOURTESSIS, T., KONSTANTINIDOU, Z., VENETSANOU, F. & KAMBAS, A. 2011. Reliability and validity of age band 1 of the Movement Assessment Battery for Children - Second Edition. *Research in Developmental Disabilities,* 32:1046-1051.

ENGEL-YEGER, B., ROSENBLUM, S. & JOSMAN, N. 2010. Movement assessment battery for children (M-ABC): establishing construct validity for Israeli children. *Research in Developmental Disabilities,* 31(1):87-96.

FAUGHT, B.E., CAIRNEY, J., HAY, J., VELDHUIZEN, S., MISSIUNA, C. & SPIRONELLO, C.A. 2008. Screening for motor coordination challenges in children using teacher ratings of physical ability and activity. *Human Movement Science,* 27(2):177-189.

FEI, C. & OLSEN, J. 2011. Prenatal exposure to perfluorinated chemicals and behavioral or coordination problems at age 7 years. *Environmental health perspectives,* 119(4):573-578.

GALLAHUE, D.L. & OZMUN, J.C. 2006. *Understanding motor development: infants, children, adolescents, and adults.* New York: McGraw-Hill.

GEUZE, R.H. 2005. Postural control in children with developmental coordination disorder. *Neural Plasticity,* 12(2-3):183-196.

GIAGAZOGLOU, P., KABITSIS, N., KOKARIDAS, D., ZARAGAS, C., KATARTZI, E. & KABITSIS C. 2011. The movement assessment battery in Greek preschoolers: the impact of age, gender, birth order, and physical activity on motor outcome. *Research in Developmental Disabilities,* 32(6):2577-2582.

GIBBS, J., APPLETON, J. & APPLETON, R. 2007. Dyspraxia or developmental coordination disorder? Unraveling the enigma. *Archives of Disease in Childhood,* 92(6):534-539.

GILLBERG, C. & KADESJO, B. 2003. Why bother about clumsiness? The implications of having developmental coordination disorder (DCD). *Neural Plasticity,* 10(1-2):59-68.

GOYEN, T.A. & LUI, K. 2009. Developmental coordination disorder in “apparently normal” school children born extremely preterm. *Archives of Disease in Childhood,* 94(4):298-302.

GREEN, D., BISHOP, T., WILSON, B.N., CRAWFORD, S., HOOPER, R., KAPLAN, B. & BAIRD, G. 2005. Is questionnaire-based screening part of the solution to waiting lists for children with developmental coordination disorder? *British Journal of Occupational Therapy,* 68(1):2-10.

HENDERSON, S.E. & SUGDEN, D.A. 1992. *Movement Assessment Battery for Children.* London: Harcourt Assessment.

HENDERSON, S.E. & HENDERSON, L. 2003. Toward an understanding of developmental coordination disorder: terminological and diagnostic issues. *Neural Plasticity,* 10(1-2):1-13.

HENDERSON, S.E., SUGDEN, D.A. & BARNETT, A.L. 2007. *Movement Assessment Battery for Children-2* (2nd ed.) London: Harcourt Assessment.

HILLIER, S. 2007. Intervention for children with developmental coordination disorder: A systematic review. *The Internet Journal of Allied Health Sciences and Practice,* 5(3):1-11.

HOARE, D. & LARKIN, D. 1991. *Coordination problems in children*. Belconnen, ACT: National Sports Research Centre, Australian Sports Commission.

IVRY, R.B. 2003. Cerebellar involvement in clumsiness and other developmental disorders. *Neural Plasticity,* 10(1-2):141-153.

JUNAID, K.A. 1998. *Teachers' use of the M-ABC Checklist to identify children with motor difficulties*.Vancouver: University of British Columbia. (MSc dissertation).

JUNAID, K., HARRIS, S.R., FULMER, A. & CARSWELL, A. 2000. Teachers' use of the M-ABC Checklist to identify children with motor difficulties. *Pediatric Physical Therapy,* 12(4):158-163.

KIRBY, A. 2010. Developmental coordination disorder. *British Journal of Hospital Medicine,* 71(10):571-575.

LINGAM, R., HUNT, L., GOLDING, J., JONGMANS, M. & EMOND, A. 2009. Prevalence of developmental coordination disorder using the DSM-IV at 7 years of age: a UK population based study. *Pediatrics,* 123(4):e693-e701.

LINGAM, R., JONGMANS, J., ELLIS, M., HUNT, L.P., GOLDING, J. & EMOND, A. 2012. Mental health difficulties in children with developmental coordination disorder. *Pediatrics,* 129(4):e882-e891.

MANDICH, A.D., POLATAJKO, H.J., MACNAB, J.J. & MILLER, L.T. 2001. Treatment of children with developmental coordination disorder: what is the evidence? *Physical & Occupational Therapy in Pediatrics,* 20(2/3):51-68.

MANDICH, A., BUCKOLZ, E. & PLATAJKO, H. 2003. Children with developmental coordination disorder (DCD) and their ability to disengage ongoing attentional focus:more on inhibitory function. *Brain and Cognition,* 51(3):346-356.

MARTIN, C.M., PIEK, J.P. & HAY, D. 2006. DCD and ADHD:a genetic study of their shared aetiology. *Human Movement Science*, 25(1):110-124.

MARTINI, F.H. & BARTHOLOMEW, E.F. 2003. *Essentials of anatomy and physiology.* (3rd ed). Upper Saddle River, NJ: Prentice Hall.

MARTINI, R., ST-PIERRE, M. & WILSON, B.N. 2011. French canadian cross-cultural adaptation of the developmental coordination disorder questionnaire'07:DCDQ-FC. *Canadian Journal of Occupational Therapy,* 78(5):318-327.

MARUFF, P., WILSON, P., TREBILCOCK, M. & CURRIE, J. 1999. Abnormalities of imagined motor sequences in children with developmental coordination disorder. *Neuropsychologia,* 37(11):1317-1324.

MISSIUNA, C., GAINES, B.R. & POLLOCK, N. 2002. Recognizing and referring children at risk for developmental coordination disorder: role of the speech-language pathologist. *Journal of Speech-language Pathology and Audiology,* 26(4):172-179.

MISSIUNA, C. 2003. Children with developmental coordination disorder: at home and in the classroom. *Can child,* 1-12.

MISSIUNA, C., RIVARD, L. & BARLETT, D. 2003. Early identification and risk management of children with developmental coordination disorder. *Pediatric Physical Therapy,* 15(1):32-38.

MISSIUNA, C., GAINES, B., SOUCIE, H. & MCLEAN, J. 2006. Parental questions about developmental coordination disorder: A synopsis of current evidence. *Pediatric Child Health,* 11(8):507-512.

MISSIUNA, C., CAIRNEY, J., POLLOCK, N., RUSSELL, D., MACDONALD, K., COUSINS, M., VELDHUIZEN, S. & SCHMIDT, L. 2011. A staged approach for identifying children with developmental coordination disorder from the population. *Research in developmental disabilities,* 32(2):549-559.

MON-WILLIAMS, M.A., WANN, J.P. & PASCAL, E. 1999. Visual-proprioceptive mapping in children with developmental coordination disorder. *Developmental Medicine & Child Neurology,* 41(4):247-254.

O'HARE, A. & KHALID, S. 2002. The association of abnormal cerebellar function in children with developmental coordination disorder and reading difficulties. *Dyslexia,* 8(4):234-248.

PETERS, J.M. & HENDERSON, S.E. 2008. Understanding developmental coordination disorder and its impact on families: the contribution of single case studies. *International Journal of Disability, Development and Education,* 55(2):97-111.

PIEK, J.P. & EDWARDS, K. 1997. The identification of children with developmental coordination disorder by class and physical education teachers. *British Journal of Educational Psychology,* 67(1): 55-67.

PIEK, J.P. & DYCK, M.J. 2004. Sensory-motor deficits in children with developmental coordination disorder, attention deficit hyperactivity disorder and autistic disorder. *Human Movement Science,* 23(3-4):475-488.

PIENAAR, A.E. 2004. Developmental co-ordination disorder in an ethno-racially diverse African nation: should norm of the MABC be adjusted. *Journal of Human Movement Studies,* 47:075-092.

PLESS, M. & CARLSSON, M. 2000. Effects of motor skill intervention on developmental coordination disorder: a meta-analysis. *Adapted Physical Activity Quarterly,* 17(4):381-401.

POLATAJKO, H.J. & CANTIN, N. 2006. Developmental coordination disorder (Dyspraxia): an overview of the state of the art. *Seminars in Pediactic Neurology*, 12(4):250-258.

RAYNOR, A.J. 2001. Strength, power, and coactivation in children with developmental coordination disorder. *Developmental Medicine & Child Neurology,* 43(10):676-684.

RIVARD, L.M., MISSIUNA, C., HANNA, S. & WISHART, L. 2007. Understanding teachers' perceptions of the motor difficulties of children with developmental coordination disorder (DCD). *British Journal of Eucational Psychology,* 77(3):633-648.

RIVARD, L., MISSIUNA, C., MCCAULEY, D. & CAIRNEY, J. 2012. Descriptive and factor analysis of the developmental coordination disorder questionnaire (DCDQ'07) in a population-based sample of children with and without developmental coordination disorder. *Child Care, Health and Development,* 40(1):1-8.

RODGER, S., WATTER, P., MARINAC, J., WOODYATT, G., ZIVIANI, J. & OZANNE, A. 2007. Assessment of children with developmental coordination disorder (DCD): motor, functional, self-efficacy and communication abilities. *New Zealand Journal of Physiotherapy,* 35(3):99-109.

RODGER, S., ZIVIANI, J., WATTER, P., OZANNE, A., WOODYATT, G. & SPRINGFIELD, E. 2003. Motor and functional skills of children with developmental coordination disorder: a pilot investigation of measurement issues. *Human Movement Science,* 22(4-5):461-478.

SCHOEMAKER, M.M., NIEMEIJER, A.S., REYNDERS, K. & SMITS-ENGELSMAN, B.C.M. 2003. Effectiveness of Neuromotor Task Training for Children with Developmental Coordination Disorder: A Pilot Study. *Neural Plasticity,* 10(1-2):155-163.

SCHOEMAKER, M.M., SMITS-ENGELSMAN, B.C.M. & JONGMANS, M.J. 2003. Psychometric properties of the Movements Assessment Battery for Children-Checklist as a screening instrument for children with a developmental co-ordination disorder. *British Journal of Education Psychology,* 73(3):425-441.

SCHOEMAKER, M.M., FLAPPER, B., VERHEIJ, N.P., WILSON, B.N., REINDERS-MESSELINK, H.A. & DE KLOET, A. 2006. Evaluation of the developmental coordination disorder questionnaire as a screening instrument. *Developmental Medicine & Child Neurology,* 48(8):668-673.

SCHOEMAKER,M.M., FLAPPER, B.C.T., REINDERS-MESSELINK, H.A. & DE KLOET, A. 2008. Validity of the motor observation questionnaire for teachers as a screening instrument for children at risk for developmental coordination disorder. *Human movement science,* 27(2):191-199.

SCHOEMAKER, M.M., NIEMEIJER, A.S., FLAPPER, B.C.T. & SMITS-ENGELSMAN, B.C.M. 2012. Validity and reliability of the Movement Assessment Battery for Children-2 Checklist for children with and without motor impairments. *Developmental Medicine and Child Neurology,* 54(4):368-375.

SHERWOOD, L. 2007. *Human physiology from cells to systems.*(6th ed). Pacific Grove, CA.:Brooks/Cole.

SLATER, L.M., HILLIER, S.L. & CIVETTA, L.R. 2010. The clinimetric properties of performance based gross motor tests used for children with developmental coordination disorder: a systematic review. *Pediatric Physical Therapy,* 22(2):170-179.

SUGDEN, D.A. & CHAMBERS, M.E. 1998. Intervention approaches and children with developmental coordination disorder. *Pediatric Rehabilitation,* 2(4):139-147.

SUGDEN, D.A. 2006. *Leeds consensus statement 2006: Development coordination disorder as a specific learning difficulty.*[online]. Available at: http://www.dcd-uk.org/index.html (Economic Science Research Council Seminar series 2004-2005).

SUGDEN, D.A. 2007. Current approaches to intervention in children with developmental coordination disorder. *Developmental Medicine & Child Neurology,* 49(6):467-471.

SUGDEN, D., KIRBY, A. & DUNFORD, C. 2008. Issues surrounding children with developmental coordination disorder. *International Journal of Disability, Development and Education,* 55(2):173-187.

THOMAS, J.R., NELSON, J.K. & SILVERMAN, S.J. 2011. *Research methods in physical activity.*(6th ed). Champaigne, IL.: Human Kinetics.

TSANG, K.L., STAGNITTI, K. & LO, S.K. 2010. Screening children with developmental coordination disorder: the development of the caregiver assessment of movement participation. *Children's Health Care,* 39(3):232-248.

TSENG, M., FU, C., WILSON, B.N. & HU, F. 2010. Psychometric properties of a Chinese version of the developmental coordination disorder questionnaire in community based children. *Research in Developmental Disabilities,* 31(1):33-45.

ULRICH, D.A. 2000. *Test of gross motor development: examiner's manual*. (2nd ed). Austin, Tex: Pro-Ed.

VENETSANOU, F., KAMBAS, A., ELLINOUDIS, T., FATOUROS, I., GIANNAKIDOU, D. & KOURTESSIS, T. 2011. Can the Movement Assessment Battery for Children-test be the "gold standard" for the motor assessment of children with developmental coordination disorder? *Research in Developmental Disabilities,* 32(1):1-10.

WATEMBERG, N., WAISERBERG, N., ZUK, L. & LERMAN-SAGIE, T. 2007. Developmental coordination disorder in children with attention-deficit-hyperactivity disorder and physical therapy intervention. *Developmental Medicine & Child Neurology,* 49(12):920-925.

WESSELS, Y., PIENAAR, A.E. & PEENS, A. 2008. Geslags- en rasverskille by 6- en 7-jarige kinders met ontwikkelingskoördinasieversteurings ("DCD") in leerverwantevaardighede en ADHD. *Tydskrif vir Geesteswetenskappe,* 48(4):493-504.

WILSON, P.H. & MCKENZIE, B.E. 1998. Information processing deficits associated with developmental coordination disorder: a meta-analysis of research findings. *Journal of Child Psychology and Psychiatry,* 39(6):829-840.

WILSON, P.H. 2005. Practitioner review: approaches to assessment and treatment of children with DCD: an evaluative review. *Journal of Child Psychology and Psychiatry,* 46(8):804-823.

WILSON, B.N., KAPLAN, B.J., CRAWFORD, S.G. & ROBERTS, G. 2007. The developmental coordination disorder questionnaire (DCDQ). Available: http://www.dcdq.ca/ [Cited May 2012].

WILSON, B.N., CRAWFORD, S.G., GREEN, D., ROBERTS, G., AYLOTT, A. & KAPLAN, B.J. 2009. Psychometric properties of the revised developmental coordination disorder questionnaire. *Physical & Occupational Therapy in Pediatrics,* 29(2):182-202.

WORLD HEALTH ORGANIZATION (WHO). 1992. *The ICD-10 classification of mental and behavioural disorders: Clinical descriptions and diagnostic guidelines*.(10th ed.).Geneva: World Health Organization.

WUANG, Y., SU, J. & SU, C. 2012. Reliability and responsiveness of the movement assessment battery for children-second edition test in children with developmental coordination disorder. *Developmental Medicine & Child Neurology,* 54(2):160-165.

ZOIA, S., BARNETT, A., WILSON, P. & HILL, E. 2006. Developmental coordination disorder: current issues. *Childcare, Health and Development,* 32(6):613-618.

ZWICKER, J.G., MISSIUNA, C. & BOYD, L.A. 2009. Neural correlates of developmental coordination disorder: A review of hypotheses. *Journal of Child Neurology,* 24(10):1273-1281.

ZWICKER, J.G., MISSIUNA, C., HARRIS, S.R. & BOYD, L.A. 2012. Developmental coordination disorder: a review and update. *European Journal of Paediatric Neurology,* 16(6):573-581.

CHAPTER 3

Research Methodology

3.1 Introduction

This chapter describes the quantitative research that was designed to investigate the objectives stated in Chapter 1. A description of the instrument that was used is given, and the procedure for measurement is discussed. In preparation for this dissertation, literature was collected from electronic databases such as Kovsiekat, Pubmed, EbscoHost (Academic Search Elite and Medline), academic journals and textbooks.

3.2 Study design

This study was done using sampling data in a quantitative research method (i.e. questionnaire). The Movement Assessment Battery for Children second edition Performance Test (MABC-2) was conducted by Kinderkineticists in training who were familiar with the testing procedure to identify Grade 1 learners with motor difficulties. Kinderkineticists in training will be referred to as the therapists. The Movement Assessment Battery for Children second edition Checklist (MABC-Checklist-2) was completed by parents and teachers to identify motor difficulties in children. Due to copyright statements the MABC-2 and MABC-Checklist-2 will not be included in the Appendix. The motor difficulties (green-/amber-/red zone) of the MABC-2 Performance Test and the motor difficulties (green-/amber-/red zone) of the MABC-Checklist-2 completed by the (i) parents and (ii) teachers were compared to determine if there is an agreement between the measurements.

3.3 Study participants

Twelve schools were approached to participate in this research project and a stratified sample method was used. Six schools agreed to participate. These schools are located in the Bloemfontein area in the Free State province of South Africa. Completion of an informed consent form by the parents was required for the child to participate in the study **(Appendix C)**. The consent form together with the MABC-Checklist-2 was sent home to the parents to be completed as part of the study. The teachers of the Grade 1 learners were also requested to complete the MABC-Checklist-2.

Three hundred and twenty three (n=323) learners in Grade 1 (ages vary from 5 to 8 years, SD=5.4) took part in the study. The study consists of boys (n=140) and girls (n=183) of various ethnic groups (Caucasian: n=193, 6.5 years, SD=0.55; Black: n=120, 6.2 years, SD=0.4; Mixed race: n=9, 6.4 years, SD=0.5; and Hispanic: n=1). Three hundred and twenty three (n=323) parents completed the MABC-Checklist-2 and three hundred and eleven (n=311) MABC-Checklists-2 were completed by 23 female teachers

of which 21 were Caucasian and 2 were black. Twelve of the MABC-Checklist-2 that was completed by the teachers was incomplete and could not be used in the study.

3.4 Measurement

The Movement Assessment Battery for Children was used to determine the 323 children's motor competence (Henderson, Sugden & Barnett, 2007:4). The instrument comprises of two parts: (i) a MABC-2 Performance Test that requires the performance of a series of motor tasks, and (ii) the MABC-Checklist-2 that can be used by parents, teachers and other professionals in identifying children with DCD (Henderson, Sugden and Barnett, 2007:4). The MABC-2 and the MABC-Checklist-2 are frequently used to apply criteria A and B of the diagnostic criteria for DCD (Henderson *et al.,* 2007:7). This means that children identified with a risk of motor difficulties or significant movement difficulties by the MABC-2 Performance Test can be classified with probable DCD. Therapists conducted the MABC-2 Performance Test to determine the motor competence of the learners. The parents and teachers of the learners were requested to complete the MABC-Checklist-2.

3.4.1 Movement Assessment Battery for Children Performance Test (MABC-2 Performance Test)

The MABC-2 Performance Test is a standardised test used to identify children with motor performance impairments and children with DCD. The MABC-2 Performance Test is divided into three age bands to use for children of different ages. The age band consists of eight age-specific test items, grouped under three components: manual dexterity, aiming and catching, as well as balance (Henderson *et al.,* 2007:114). A standard score is provided for each year group between 4 and 16, and for half-year groups between 3 and 4 years. For the three components and the total of the three components of the test, standard scores and percentiles are presented (Henderson *et al.,* 2007:4). A percentile indicates the percentage of children in the standardisation sample who obtained a score less than or equal to a given raw score. The percentile

vary from 1-99 and 50 indicates the median performance (Henderson *et al.,* 2007:83). Two cut-off points are used in the MABC-2 Performance Test and can be interpreted in terms of a traffic light system. Interpretation of scores is illustrated in Table 3.1.

Table 3.1: Interpretation of total test scores for the MABC-2 Performance Test

Traffic Zone	Cut of point	Zone description
Green Zone	> 15th percentile	Normal range
Amber Zone	6 – 15th percentile	At risk and needs to be monitored
Red Zone	≤ 5th percentile	Indication of definite motor problem

Adapted from (Henderson *et al.,* 2007:4)

The cut-off points for this study can be understood as follows: at or below the 5th percentile is classified as definite motor difficulty; between the 6th and 15th percentile is classified as risk of or moderate motor difficulty; and above the 15th percentile is classified as no motor difficulty. The standard score on the other hand provide the clearest indication of a child's performance. The standard scores are transformed of a distribution of raw scores and if the standard score is 3 or less the child will need help. A score of 1 or more can put the child into an at risk category (Henderson *et al.,* 2007:84). The higher the score the superior the child's motor abilities.

Therapists that were familiar with the testing procedure conducted the MABC-2 Performance Test. Each therapist was responsible for one subtest to ensure consistency across the study.

3.4.2 Movement Assessment Battery for Children Checklist (MABC-Checklist-2)

The MABC-Checklist-2 is designed to identify children with movement difficulties (Henderson *et al.* 2007:114). The MABC-Checklist-2 can be completed by parents, teachers and professionals, and consists of three sections. Sections A and B address complex interactions between the child and his or her physical environment. Section C concentrates on non-motor factors that may affect the child's movement (Henderson et

al., 2007:92). Section A focus on movement in a static and/or predictable environment for example fastening a button whereas Section B focus on dynamic movement and/or unpredictable environment for example a ball coming towards you as well as running among others on the playground (Henderson *et al.,* 2007:92). For each of the statements in each section there are four alternative responses that describe how well the child deals with the task (very well=0, just ok=1, almost=2 and not close =3). If there is a item not completed in section A and section B, the remaining four items in that section will determine the score. For example if the scores are consistently positive (0 or 1) the child gets a 1 and if it is negative (2 or 3) the child gets a 2. If the scores are mixed you give the benefit of the doubt and give a 1 (Henderson *et al.,* 2007:94). The scores are summed to a total score and placed on a traffic light system. The green zone indicates "no motor difficulty", amber indicates "at risk or moderate motor difficulty" and red shows "definite motor difficulty". In contrast to the MABC-2 Performance Test, high scores represent poor performance. For this study the parents and teachers completed the MABC-Checklist-2 for each child. Table 3.2 illustrate the interpretation of scores of the MABC-Checklist-2.

Table 3.2: Interpretation of total test scores for the MABC-Checklist-2

Traffic Zone	Cut-off point	Zone description
Green Zone	< 85th percentile	Normal range
Amber Zone	85th – 94th percentile	At risk and needs to be monitored
Red Zone	≥ 95th percentile	Indication of definite motor problem

Adapted from: (Henderson *et al.,* 2007:176)

In order to reach the aim of this study the total test score result of the MABC-2 Performance Test was compared with the total score result of the MABC-Checklist-2 completed by the parents and teachers. These findings are explained in Chapter 4.

3.5 Methodological and measurement errors

Errors were minimised by using the same therapist for each of the sub tests. The therapists were familiar with the general procedures of the standardised testing. Each therapist was responsible for one subtest to ensure consistency across the study. To minimise errors further, each participant was tested with the same testing materials. The testing materials supplied by the designers of the MABC were used (Henderson*et al.,* 2007:13). Calculations of the MABC-2 Performance Test and MABC-Checklist-2 were conducted professionally according to the standardised procedures of each instrument.

3.6 Analysis of the data

The researcher captured the data from the questionnaires electronically on a data form using Microsoft Excel. A statistician using SAS Version 9.2 analysed the data further. Frequencies and percentages were calculated for categorical data. Medians and percentiles were calculated for numerical data. The measure of agreement with help from the *Kappa (k)*-coefficient were used to explore the aim. The coefficient is known as Cohen's Kappa and it measures inter-judge agreement (Howell, 2007:167) which provides information regarding the reliability of the assessments. The researcher decided in an arbitrary way to indicate a code 1 for the group not identified with motor difficulties (no motor difficulties), code 2 for moderate motor difficulties and code 3 for definite motor difficulties. The sign of the correlation coefficient can be ignored due to the three codes that been chosen in an arbitrary way. A negative correlation only indicates that the average of the group with code 3 is smaller than the group with code 1, while a positive correlation indicates the opposite.

The practical significance of the results was also investigated in order to provide findings on the practical importance of the significant statistical results which were found with the research. As standard of practical significance, the effect size will be calculated. According to Steyn (1999:7) the p explain the kappa coefficient but for this study the

term rho (*r*) will be used. The following guideline values need to be used when the effect size is interpreted (Steyn, 1999:8):

r=0.1: small effect
r=0.3: medium effect
r=0.5: large effect

The agreed effect sizes were calculated when the statistical significant results (on the 1%- of 5%-level) were found.

3.7 Ethics

The Ethics Committee of the Faculty of Health Sciences at the University of the Free State (ECUFS57/2012) approved the study before it commenced and the learners were recruited from schools. Initially 12 schools were targeted to take part in the research project. A stratified sampling method was used where six primary schools in Bloemfontein, Free State Province, South Africa, agreed to participate. The Department of Basic Education **(Appendix A)** and the principals of each school **(Appendix B)** received consent forms and gave permission for the research to be conducted on the school premises during the life orientation periods. After permission from the schools was obtained, letters requesting informed consent from the parents **(Appendix C)** and the children **(Appendix D)** were given to the children to take home, as well as a copy of the MABC-Checklist-2 to be completed by the parents/guardian. The letter contained all the necessary information with regard to the study. Completion of the informed consent form was required for the child to participate. All children in the identified classes were considered for inclusion in the study. Exclusion criteria included a child in the age group outside the expected range from 5-8 years, where parental permission was not obtained or had not been completed fully and lastly where parents had indicated that they would be relocating. Children with medical illnesses and neurological problems were also excluded from the study.

3.8 Limitations of the study

Various limitations occur regarding the MABC-Checklist-2. Children were from different economic groups. The children, schools and parents with low economic status did not have access to swimming pools or bicycles. For this reason parents and teachers could not complete the MABC-Checklist-2 in full or accurately as certain questions related to swimming and cycling. The parents and teachers who took part in the study were not specifically taught how to complete the MABC-Checklist-2. Incomplete checklists were received back and could not be used. Another limitation was that teachers felt that they could not answer questions regarding the children's physical environment. Teachers only observe the children in class. Many schools have special education professionals who work with them during physical education classes.

3.9 Conclusion

Chapter 3 focused on the various measurements used to determine the aim stated in Chapter 1. Participants in the study were identified and the ethical considerations of the research study were reached. Limitations that occur during the study were explained. Chapter 4 presents a complete overview of the results obtained in this study.

3.10 References

HENDERSON, S.E., SUGDEN, D.A. & BARNETT, A.L. 2007. *Movement Assessment Battery for Children-2* (2nd ed.). London: Harcourt Assessment.

HOWELL, D. C. 2007. Statistical methods for psychology. Belmont, CA: Thomson Wadsworth.

STEYN, H.S. 1999. Praktiesebeduidendheid: die gebruik van effekgroottes. Potchefstroom: Publikasiebeheerkomitee, PU vir CHO.

CHAPTER 4

Results and Discussion

4.1 Introduction

In this study data was gathered regarding Grade 1 learners' motor performance using the MABC-2 Performance Test and the MABC-Checklist-2. The parents' perception of their child's motor performance as well as the teachers' perception of the Grade 1 learners' motor performance was also collected using the MABC-Checklist-2. The results of the aim in Chapter 1 are reported in this chapter, followed by a discussion of the findings. The general information of the participants in this study will be discussed first.

4.2 General information

General information conducted in this study includes participants with different ages, gender, and ethnic groups. The total number of participants in the study was 323 Grade 1 learners (n=323) and consisted of 56.76% girls (n=183) and 43.34% (n=140) boys. Various ethnic groups participated in the study. The majority of the children were Caucasian (59.75%), 37.15% was Black, 2.79% was Mixed race and 0.31% was Hispanic. The median age was 6 years 8 months, which means that 50% of children were younger than 6 years 8 months and 50% were older. The interquartile ranged from 6 years 5 months to 7 years 1 month. The lower quartile falls on the 25th percentile indicating that 75% of children were older than 6 years 5 months, whereas the upper quartile refers to the 75th percentile indicating 25% of children were older than 7 years 1 month. The youngest child taking part in the study was 5 years 8 months and the oldest child was 8 years 4 months.

The parents of each child were asked to complete the MABC-Checklist-2. A total of 323 parents completed the MABC-Checklist-2. The class teachers of each child taking part in this study were also asked to complete the MABC-Checklist-2. A total of 323 Checklists were completed by the teachers. Twelve MABC-Checklists-2 had to be excluded because more than three items in one section were omitted. Twenty-three (23) teachers participated in the study. The frequency procedures of each result are discussed next.

4.3 Frequency procedure of the MABC-2 Performance Test

The MABC-2 Performance Test was conducted by the therapists to determine the motor performance of the Grade 1 learners. The total score of the MABC-2 Performance Test was categorised into a traffic light system, red zone indicate severe motor difficulties, amber zone indicate moderate motor difficulties and the green zone indicate no motor difficulties. The distribution of the children in the various categories with regard to motor performance is presented in Figure 4.1.

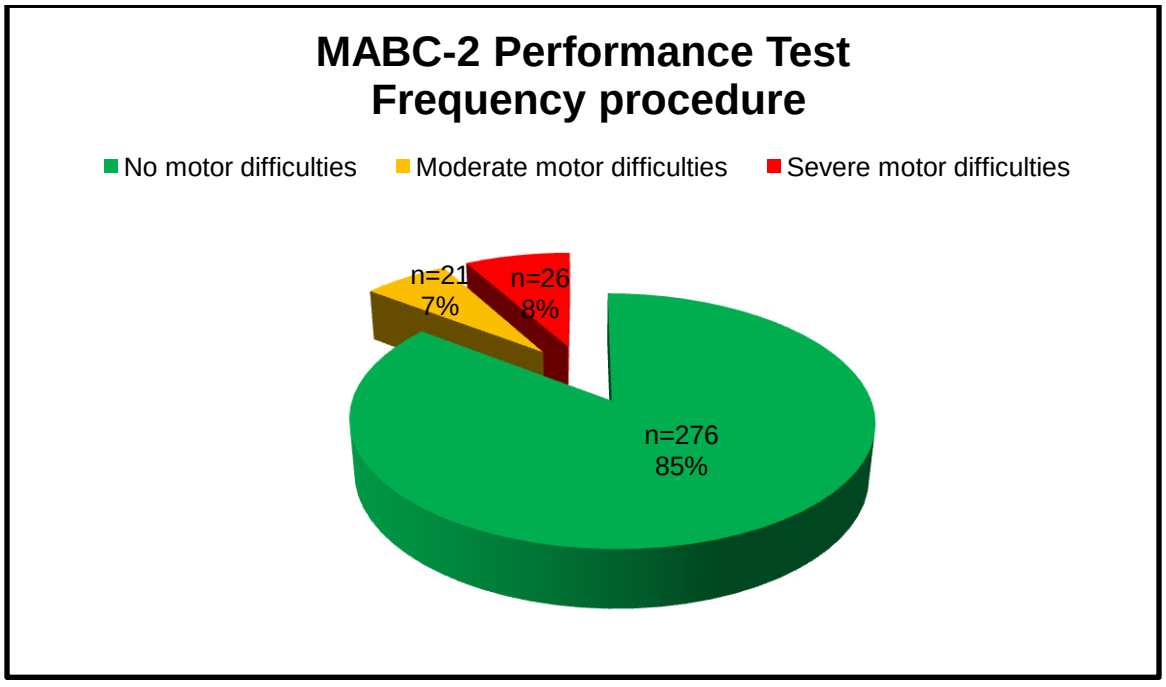

Figure 4.1: Distribution of children based on the norms of the MABC-2 Performance Test

Figure 4.1 indicates that 85% of the children are in the green zone and show no motor difficulties. Figure 4.1 indicates that a total of 15% show motor difficulties with 7% in the amber zone (moderate motor difficulties) and 8% in the red zone (severe motor difficulties).

4.4 Frequency procedure of the MABC-Checklist-2

The MABC-Checklist-2 was completed by the parents and teachers. The total score was categorised into a traffic light system: green, amber and red. The frequency procedure of the MABC-Checklist-2 for parents is presented in Figure 4.2 and for teachers in Figure 4.3.

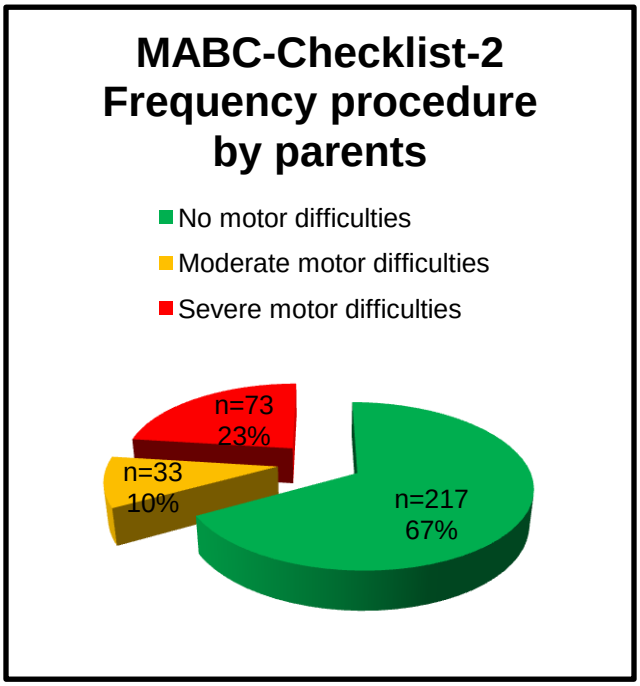

Figure 4.2: Distribution of children based on the norms of the MABC-Checklist-2 by parents

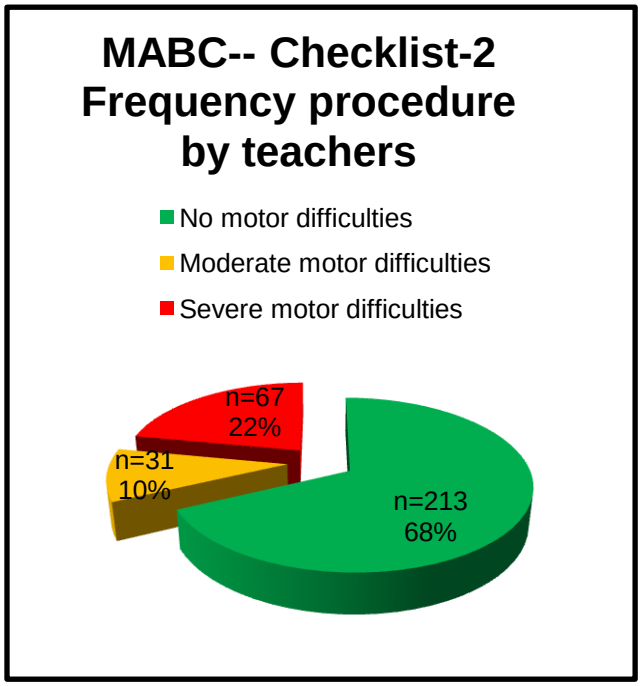

Figure 4.3: Distribution of children based on the norms of the MABC-Checklist-2 by teachers

Parents identified 67% of the children having no motor difficulties (green zone), 23% with severe motor difficulties(red zone) and 10% with moderate motor difficulties (amber zone). Of the 311 MABC-Checklists-2 completed by the teachers, 68% were

categorised with no motor difficulties (green zone), 22% with severe motor difficulties (red zone) and 10% with moderate motor difficulties (amber zone).

4.5 Results

The Kappa *(k)*-coefficient was used to determine the agreement between identifying of motor difficulties with the MABC-2 Performance Test and the identifying of motor difficulties with the MABC-Checklist-2 when completed by (i) their parents as well as (ii) their teachers.

This coefficient provides information with regard to the agreement between the two assessments. The higher the coefficient (whether it is a negative or a positive value), the greater the agreement between the two reviews. In order to understand the results in Table 4.1 and Table 4.2 it is important to understand the term sensitivity and specificity as used in this study. Sensitivity refers to the ability of the parents and teachers using the MABC-Checklist-2 to correctly identify children with moderate (amber zone) and severe (red zone) motor difficulties, which was also identified by the MABC-2 Performance Test (Schoemaker, Smits-Engelsman & Jongmans, 2003:430; Ellinoudis, Kyparisis, Gitsas & Kourtesis, 2009:291). High sensitivity indicates that the MABC-Checklist-2 consistently identifies children with motor difficulties whereas a low sensitivity indicates that the MABC-Checklist-2 fails to identify children with motor difficulties (Junaid, 1998:35). According to the norms of the American Psychological Association, 80% sensitivity is preferable (APA, 1985 cited in Schoemaker *et al.,* 2003:430).

Specificity on the other hand refers to the ability of the parents and teachers using the MABC-Checklist-2 to correctly identify children with no motor difficulties (green zone) which was also identified by the MABC-2 Performance Test (Ellinoudis *et al.,* 2009:291). The preferred specificity according to the American Psychological Association is preferable 90% (APA, 1985 cited in Schoemaker, Niemeijer, Flapper & Smits-Engelsman, 2012:370).

In Table 4.1 and Table 4.2 the sensitivity and specificity values are presented using the 5th and 15th percentile as cut-off points for the MABC-Checklist-2 and the 5th and 15th percentile as cut-off points for the MABC-2 Performance Test. However, slight differences became apparent when the 5th and 15th percentiles were used as cut-off criterion for the MABC-2 Performance Test. Therefore the 15th percentile seemed to give the best results as presented below. The sensitivity, which is the percentage of children with motor problems as indicated by the MABC-2 Performance Test, and who is correctly identified by the MABC-Checklist-2, was also the highest when the 15th percentile was used as cut-off criterion for the MABC-Checklist-2. The specificity, which is the percentage of children without motor problems on the MABC-2 Performance Test and who had good scores on the MABC-Checklist-2, indicates that the MABC-Checklist-2 is best observed when the 15th percentile is used as cut-off criterion. Therefore, for the analyses below all the children with severe motor difficulties and moderate motor difficulties were combined into one group (motor difficulties) and children without motor difficulties were combined into the second group (no motor difficulties).

4.5.1 Results of the MABC-2 Performance Test and the parent completed MABC-Checklist-2

The results with regard to the degree of agreement in identifying motor difficulties between the MABC-2 Performance test by the therapist and the MABC-Checklist-2 by the parents, is presented in Table 4.1. The cut-off criterion of the 15th percentile are presented in Table 4.2

Table 4.1: Inter-judge agreement on motor difficulties between the MABC-2 Performance Test and MABC-Checklist-2 completed by the parents

MABC Checklist Parents	MABC Performance Test			
	No motor difficulties	Moderate motor difficulties	Severe motor difficulties	Total
No motor difficulties	197 (71.4%)	11	9	217
Moderate motor difficulties	27	2 (9.5%)	4	33
Severe motor difficulties	52	8	13 (50.0%)	73
Total	276	21	26	323

* The totals of the MABC-Checklist-2 are displayed across the row and the totals for the MABC-2 Performance test are displayed down the column

(*k*)-coefficient = 0.143; p=0.000)

Effect size = 0.240 (medium)

Table 4.2: 15th percentile cut-off criterion between the MABC-2 Performance Test and the MABC-Checklist-2 when completed by parents

	Moderate and Severe motor difficulties	No motor difficulties
MABC-2 Performance Test	47	276
MABC-Checklist-2	15	197

The following discussion will provide an understanding regarding the findings in Table 4.1. and Table 4.2.

4.5.2 Sensitivity of the MABC-2 Performance Test and the parent completed MABC-Checklist-2

The results in Table 4.1 firstly indicates that 21 of the children were identified with moderate motor difficulties by the MABC-2 Performance Test, while 2 (9.5%) of these children were also identified by parents using the MABC-Checklist-2. Secondly the results show that of the 26 children who were identified with severe motor difficulties by the MABC-2 Performance Test, 13 (50.0%) were also identified with severe motor difficulties by the parents using the MABC-Checklist-2. In table 4.2 the 15th percentile as the cut-off point indicates that out of the 47 children identified with motor difficulties (moderate motor difficulties n=21 and severe motor difficulties n=26) by the MABC-2 Performance Test, a total of 15 of these children were also identified with motor difficulties (moderate motor difficulties n=2 and severe motor difficulties n=13) by the parent completed MABC-Checklist-2 indicating a sensitivity of 31.9% (15/47).

4.5.3 Specificity of the MABC-2 Performance Test and the parent completed MABC-Checklist-2

When analysing the results in Table 4.1 and Table 4.2 there were 276 children identified with no motor difficulties with the MABC-2 Performance Test whereas 197 (71.4%) of these children were also identified without motor difficulties with the MABC-Checklist-2 completed by parents. Therefore the specificity between the MABC-2 Performance Test and the parent completed MABC-Checklist-2 is 71.4% (197/276) which indicate a good agreement with regard to the identification ability of no motor difficulties between the MABC-2 Performance test and the MABC-Checklist-2 completed by parents.

4.5.4 Agreement of the MABC-2 Performance Test and the parent completed MABC-Checklist-2

The calculated (*k)*-coefficient of 0.143 is significant on the 1%-level and provides a small effect size which indicates that the findings are of small practical importance. The *(k)*-coefficient of 0.143 indicates that only 14.3% agreement between the two identifications are present after correcting for chance. These findings prove that the agreement of the two assessments is low. This can especially be observed within the two moderate motor difficulty groups where an inadequate agreement is present between the two assessments. Out of the 21 children identified with moderate motor difficulty children (according to the MABC-2 Performance Test), the parents identified 11 (52.4%) of the children with no motor difficulties and 8 (38.1%) of the children with severe motor difficulties according to the MABC-Checklist-2.

4.5.5 Results of the MABC-2 Performance Test and the teacher completed MABC-Checklist-2

The results with regard to the measure of agreement in the identifying of motor difficulties between the MABC-2 Performance Test by therapists and identifying motor difficulties with the MABC-Checklist when completed by teachers, is presented in Table 4.3 as well as Table 4.4. It is important to note that of the total of 323 performance tests completed as previously illustrated in figure 4.1, only 311 MABC-2 Performance tests was used in table 4.2 due to the fact that 12 MABC-Checklists-2 was not completed by the therapists. In order to determine an agreement each child's MABC-Checklist-2 was compared to his or her MABC-2 Performance test.

Table 4.3: Inter-judge agreement on motor difficulties between MABC Performance Test and MABC Checklist of teachers

MABC Checklist Teachers	MABC Performance Test			
	No motor difficulties	Moderate motor difficulties	Severe motor difficulties	Total
No motor difficulties	193 (72.6%)	11	9	213
Moderate motor difficulties	24	4(19.0%)	3	31
Severe motor difficulties	49	6	12 (50.0%)	67
Total	266	21	24	311

* The totals of the MABC Checklist are displayed across the row and the totals for the MABC Performance test are displayed down the column

(*k*)-coefficient = 0.161; p=0.000)

Effectsize = 0.228 (medium)

Table 4.4: 15th percentile cut-off criterion between the MABC-2 Performance Test and the MABC-Checklist-2 when completed by teachers

	Moderate and Severe motor difficulties	No motor difficulties
MABC-2 Performance Test	45	266
MABC-Checklist-2	16	193

4.5.6 Sensitivity of the MABC-2 Performance Test and teacher completed MABC-Checklist-2

Table 4.3 shows that 21 of the children were identified with moderate motor difficulties by the MABC-2 Performance Test, while 4 (19.0%) of these children were also identified with moderate motor difficulties with the MABC-Checklist-2 as completed by the

teachers. The results further indicate that out of the 24 children identified with severe motor difficulties, 12 (50.0%) were also identified with severe motor difficulties by the teacher completed MABC-Checklist-2. In table 4.4 the 15th percentile as the cut-off show that out of the 45 children identified by the MABC-2 Performance Test with motor difficulties (moderate motor difficulties n=21 and severe motor difficulties n=24) a total of 16 of these children were also identified with motor difficulties (moderate motor difficulties n=4 and severe motor difficulties n=12) by the teacher completed MABC-Checklist-2 indicating a sensitivity of 35.6% (16/45).

4.5.7 Specificity of the MABC-2 Performance Test and teacher completed MABC-Checklist-2

Analysis of the results in Table 4.3 and Table 4.4 shows that when using the MABC-2 Performance Test, there were 266 children identified with no motor difficulties, whereas 193 (72.6%) of these children were also identified without motor difficulties by the MABC-Checklist-2 when completed by the teachers. Therefore the specificity between the MABC-2 Performance Test and the teacher completed MABC-Checklist-2 is 72.6% (193/266) which indicate a good agreement with regard to the identification of no motor difficulties.

4.5.8 Agreement of the MABC-2 Performance Test and the teacher completed MABC-Checklist-2

The calculated *(k)*-coefficient of 0.161 is on the 1%-level significant and the value provides a small effect size which means that the findings are of small practical importance. The *(k)*-coefficient of 0.161 reveals that there is only 16.1% agreement between the two identifications after correcting for chance. This finding shows that the agreement between the two assessments is low. As observed by the parents completed MABC-Checklist-2, the teacher completed MABC-Checklist-2 also indicates an inadequate agreement in the moderate motor difficulty category for the two assessments. Of the 21 children identified with moderate motor difficulty (according to

the MABC-2 Performance Test), the teachers identified 11 (52.4%) of the children with no motor difficulties and 6 (28.6%) of these children with severe motor difficulties by using the MABC-Checklist-2.

4.6 Discussion of results

The aim of this study was to determine the agreement between identifying motor difficulties with the MABC-2 Performance Test and the identifying of motor difficulties with the MABC-Checklist-2 when completed by (i) their parents as well as (ii) their teachers.

It is important to note that literature and research on the MABC-Checklist-2 when completed by parents, is limited. No research was found on the sensitivity, specificity and agreement between the parents completed MABC-Checklist-2 and the MABC-2 Performance Test. Thus no differences and comparisons could be made regarding previous research when the MABC-Checklist-2 is completed by the parents. The sensitivity of the present study is 31.9% and the specificity is 71.4%, which demonstrate a low ability from the parents to identify children with motor difficulties and a higher ability to identify children with no motor difficulties. The present study findings indicate that the agreement between the MABC-Checklist-2 when completed by the parents and the MABC-2 Performance Test is low (14.3%).

There are, however, previous findings on the sensitivity, specificity and agreement of the MABC-Checklist-2 when completed by the teachers. It is important to note that limited research is available. It is also important to take note that the current study used the second edition of the MABC (2007); however, previous findings on the original MABC (1992) are also discussed. The second edition will be referred to as MABC-2 Performance Test and MABC-Checklist 2. Findings with regard to the teacher completed MABC-Checklist-2 are discussed in the following paragraphs.

4.6.1 Discussion on the sensitivity of the MABC-2 Performance Test and the teacher completed MABC-Checklist-2

The results in the current study indicated that the teacher completed MABC-Checklist-2 identified 16 of the 45 children acknowledged by the MABC-2 Performance Test with moderate- and severe motor difficulties (under the 15th percentile). This demonstrates a sensitivity of 35.6%. In addition, a previous study by Piek and Edwards (1997:59) using the original MABC found a lower sensitivity of 25.0%. This means that the teacher completed MABC-Checklist only identified moderate and severe motor difficulties in 8 out of 32 children detected by the MABC Performance Test. Ellinoudis *et al.* (2009:289) also found a lower sensitivity (27.1%) than the current study, indicating that the teacher completed MABC-Checklist-2 in their study identified 16 of the 59 children observed by the MABC-2 Performance Test with moderate- and severe motor difficulties. In contrast with the current study, a study by Junaid (1998:35) on the original MABC found an even lower sensitivity of 14.3%, implying that the MABC-Checklist failed to identify children with poor scores on the MABC Performance Test.

In contrast with the mentioned studies, Henderson and Sugden (1992:216) found a higher sensitivity of 43.8% on the original MABC, which means that the MABC Performance Test in their study identified 16 children with moderate- and severe motor difficulties and the teacher identified 7 of the 16 with moderate- and severe motor difficulties using the MABC Checklist. Green *et al.* (2005:6) used the original MABC in their study and support the findings of Henderson and Sugden (1992:216), indicating a sensitivity of 44%. A more recent study in Germany using the second edition MABC found similar results with a sensitivity of 41% (Schoemaker *et al.,* 2012:373). In contrast with the mentioned studies which found low to medium sensitivity of the MABC-Checklist ranging from 14.3%-44%, Shoemaker *et al.* (2003:437) found an extremely high sensitivity of 80% in their study in the Netherlands with the original MABC-Checklist.

It is clear that the low sensitivity found in the present study proves that teachers using the MABC-Checklist did not identify all the children with motor difficulties. Ellinoudis *et al.* (2009:306) also agree with these findings, indicating that the MABC-Checklist-2 completed by teachers fail to identify all the children who have motor difficulties. Junaid, Harris, Fulmer and Carswell (2000:163) also emphasise the lack of sensitivity when the original MABC-Checklist was compared to the MABC Performance Test in their study. It can therefore be concluded that the MABC-Checklist-2 according to this study is not a suitable tool for teachers to use in screening children for DCD.

4.6.2 Discussion on the specificity of the MABC-2 Performance Test and the teacher completed MABC-Checklist-2

Results of the present study with regard to the MABC-Checklist-2 of the teachers to correctly identify children without motor difficulties (specificity) show high agreements. There were 27.4% children incorrectly identified with motor difficulties by the teacher's completed MABC-Checklist-2 which the MABC-2 Performance Test did not support. This result indicates a specificity of 72.6% between the MABC-Checklist-2 of the teachers and the MABC-2 Performance Test when viewing the no motor difficulty category, and is in agreement with findings on the original MABC by Green *et al. (*2005:6) with a specificity of 74%. In addition, Ellinoudis *et al.* (2009:291) found a higher specificity indicating a percentage of 81.6% while Schoemaker *et al.* (2012:373) established an even higher specificity of 88% using the second edition MABC. A study in the Netherlands found a very high specificity of 90% on the original MABC indicating a substantially good agreement between the MABC Performance Test and MABC-Checklist when specifically identifying children with no motor difficulties (Schoemaker *et al.,* 2003:437). This is meaningful in a way that if the teacher identifies the child with no motor difficulty using the MABC-Checklist, he/she can almost be sure that the MABC Performance Test would agree. These results show that the MABC-Checklist-2 of the teacher has a high specificity agreement to identify an average percentage of children with no motor difficulties, if compared to the MABC-2 Performance Test..

4.6.3 Discussion on the agreement of the MABC-2 Performance Test and the teacher completed MABC-Checklist-2

An overall analysis of the agreement between the MABC-2 Performance Test and the MABC-Checklist-2 showed that the MABC-Checklist-2 completed by teachers has a low agreement of 16.1% with the MABC-2 Performance Test in identifying the same children with and without motor difficulties. Comparing the present study with the research by Ellinoudis *et al.* (2009:308) and Green *et al.* (2005:6), the agreement between the MABC-2 Performance Test and the MABC-Checklist-2 of the teachers in all three studies is low with a (*k)*-coefficient of 0.16 in the present study and 0.14 in both studies by Ellinoudis *et al.* (2009:308) and Green *et al.* (2005:6) respectively. Another study in a Dutch and Flemish sample by Shoemaker *et al.* (2012:371) also indicated a low agreement with a Kappa value of 0.28 using the revised version of the MABC.

However, numerous previous studies found higher agreement percentages between the teacher completed MABC-Checklist-2 and the MABC-2 Performance Test. Research carried out by Schoemaker *et al.* (2012:371) found a high percentage agreement of 80%, whereas a previous study on the original MABC test by Schoemaker *et al.* (2003:438) observed an average percentage of 69% for 6-year old children, a lower percentage of 35% for 7-year old children and a high percentage of 63% for 8-year old children. Junaid (1998:414) on the other hand found a more average agreement on the original MABC with an agreement of 51%, and at the same time Piek and Edwards (1997:60) demonstrated a 50% agreement between the original MABC Performance Test and the MABC Checklist.

The lack of agreement between the MABC-2 Performance Test and the MABC-Checklist-2 in the present study has been found to be an on-going problem. According to Junaid *et al.* (2000:162) the independent use of the original MABC Checklist is inadvisable, as the Checklist does not identify a child with motor difficulties based on the MABC Performance Test. Faught, Cairney, Hay, Veldhuizen, Missiuna and Spironello (2008:178) indicate that previous studies using teachers' reports have produced

conflicting results. Schoemaker, Flapper, Reinders-Messelink and De Kloet (2008:191) previously argued whether teachers and clinicians would identify the same group of children, and Missiuna *et al.* (2011:550) indicate that teachers' results using screening tools differ from each other and from the clinicians. The original and revised MABC-Checklist is therefore not the most adequate screening tool for teachers to identify children with motor difficulties. The MABC-Checklist-2 therefore cannot help in early identification of children with DCD to enable early intervention and to help the child to overcome some of the difficulties (Gibbs, Appleton & Appleton, 2007:537).

4.7 Conclusion

The findings in the present study show a 14.3% agreement between the MABC-2 Performance Test and the MABC-Checklist-2 completed by parents and at the same time a 16.1% agreement between the MABC-2 Performance Test and the MABC-Checklist-2 when completed by teachers. Therefore, the ability of the parents and teachers using the MABC-Checklist-2 to correctly identify children with motor difficulties was found to be low. It is clear that the MABC-Checklist-2 completed by the teachers has a slightly higher agreement with the MABC-2 Performance Test than the MABC-Checklist-2 completed by parents. Consequently, it is too premature to conclude that the teachers are better able to rate motor performance than parents when using the MABC-Checklist-2. It is also unclear in previous studies, due to limited findings, whether parents play a role in identifying children with motor problems when specifically completing the MABC-Checklist-2. Therefore using a parent completed MABC-Checklist-2 prior to assessment as means of identifying motor difficulties is still unknown. The low agreement found in the study places the sensitivity of the MABC-Checklist-2 for identifying children with motor difficulties into question.

In conclusion, the MABC-Checklist-2, when completed by parents and teachers, is not a suitable screening tool to use in identifying children with motor difficulties. It can therefore be suggested to use both the MABC-2 Performance Test and the MABC-Checklist-2. Only when the child fails both, can the child be identified with motor

difficulties and possible DCD. Another interesting aspect to take note of was that the scores between the checklists completed by the parents and teachers showed similarity. Further research should also be conducted with regard to this similarity. The debate continues regarding the most suitable screening tool to identify children with DCD and to find the most accurate instrument.

4.8 References

ELLINOUDIS, T., KYPARISIS, M., GITSAS, K. & KOURTESIS, T. 2009. Identification of children aged 7-12 with developmental coordination disorder by physical education teachers using the test “movement assessment battery for children”. *Hellenic Journal of Physical Education and Sport Science,* 29(3):288-306.

FAUGHT, B.E., CAIRNEY, J., HAY, J., VELDHUIZEN, S., MISSIUNA, C. & SPIRONELLO, C.A. 2008. Screening for motor coordination challenges in children using teacher ratings of physical ability and activity. *Human Movement Science,* 27(2):177-189.

GIBBS, J., APPLETON, J. & APPLETON, R. 2007. Dyspraxia or developmental coordination disorder? Unraveling the enigma. *Archives of disease in childhood,* 92(6):534-539.

GREEN, D., BISHOP, T., WILSON, B.N., CRAWFORD, S., HOOPER, R., KAPLAN, B. & BAIRD, G. 2005. Is questionnaire-based screening part of the solution to waiting lists for children with developmental coordination disorder? *British Journal of Occupational Therapy,* 68(1):2-10.

HENDERSON, S.E. & SUGDEN, D.A. 1992. *Movement Assessment Battery for Children.* London: Harcourt Assessment.

JUNAID, K.A. 1998. *Teachers’ use of the M-ABC Checklist to identify children with motor difficulties*. Vancouver: University of British Columbia. (MSc dissertation).

JUNAID, K., HARRIS, S.R., FULMER, A. & CARSWELL, A. 2000. Teachers’ use of the M-ABC Checklist to identify children with motor difficulties. Pediatric Physical Therapy, 12(4):158-163.

MISSIUNA, C., CAIRNEY, J., POLLOCK, N., RUSSELL, D., MACDONALD, K., COUSINS, M., VELDHUIZEN, S. & SCHMIDT, L. 2011. A staged approach for identifying children with developmental coordination disorder from the population. *Research in Developmental Disabilities,* 32(2):549-559.

PIEK, J.P. & EDWARDS, K. 1997. The identification of children with developmental coordination disorder by class and physical education teachers. *British Journal of Educational Psychology,* 67(1): 55-67.

SCHOEMAKER, M.M., SMITS-ENGELSMAN, B.C.M. & JONGMANS, M.J. 2003. Psychometric properties of the Movements Assessment Battery for Children-Checklist as a screening instrument for children with a developmental co-ordination disorder. British Journal of Education Psychology, 73(3):425-441.

SCHOEMAKER,M.M., FLAPPER, B.C.T., REINDERS-MESSELINK, H.A.& DE KLOET, A. 2008. Validity of the motor observation questionnaire for teachers as a screening instrument for children at risk for developmental coordination disorder. *Human Movement Science,* 27(2):191-199.

SCHOEMAKER, M.M., NIEMEIJER, A.S., FLAPPER, B.C.T. & SMITS-ENGELSMAN, B.C.M. 2012. Validity and reliability of the Movement Assessment Battery for Children-2 Checklist for children with and without motor impairments. *Developmental Medicine & Child Neurology,* 54(4):368-375.

CHAPTER 5

Conclusions and Recommendations

5.1 Summary

The aim of this study was to determine the agreement between identifying motor difficulties with the MABC-2 Performance Test and the identifying of motor difficulties with the MABC-Checklist-2 when completed by (i) their parents as well as (ii) their teachers.

Chapter 1 provided a brief introduction and outline of the problem statement which underpins the research question and aim, and forms the basis of the study. Chapter 2 focused on an overview of DCD from relevant literature. The chapter introduced the research topic by means of an introduction, followed by common terminology, prevalence, characteristics, diagnosis, assessments and interventions. Chapter 3 described the research methodology according to the research design, participants, measurement instruments, procedures and analysis of the results. Chapter 4 included the results found in the study as well as the discussion thereof. Chapter 5 presents the conclusion and recommendations.

5.2 Conclusion

The first part of the aim was to determine the agreement between identifying motor difficulties with the MABC-2 Performance Test and identifying children with motor difficulties with the MABC-Checklist-2 when completed by parents.

The results indicated that the agreement between the MABC-2 Performance Test and the parent completed MABC-Checklist-2 with regard to the identifying of moderate and severe motor difficulties were only 31.9%. The agreement between the MABC-2 Performance Test and the parent completed MABC-Checklist-2 regarding the identification of no motor difficulties was 71.4%. The overall agreement between the MABC-2 Performance Test and the parent completed MABC-Checklist-2 was 14.3%, indicating that the agreement between the two assessments when used by parents is low.

The second part of the aim was to determine the agreement between identifying motor difficulties with the MABC-2 Performance Test and identifying motor difficulties with the MABC-Checklist-2 when completed by teachers.

The agreement between the MABC-2 Performance Test and the teacher completed MABC-Checklist-2 regarding identifying moderate- and severe motor difficulties was only 35.6%. The agreement between the MABC-2 Performance Test and the teacher completed MABC-Checklist-2 regarding identifying no motor difficulties were 72.6%. The overall agreement between the MABC-2 Performance Test and the teacher completed MABC-Checklist-2 was 16.1%, indicating a low agreement between the two assessment tools when used by teachers.

The results of the evaluation of parent and teacher completed MABC-Checklists-2 for identifying motor difficulties, and specifically DCD in children, indicated inadequate degrees of agreement with the MABC-2 Performance Test. The conclusion can be made that parents and teachers cannot use only the MABC-Checklist-2 to identify children with motor problems. The MABC-2 Performance Test should be conducted in

conjunction with the MABC-Checklist-2 for correctly identifying children with motor difficulties. It is therefore also clear that only using the MABC-Checklist-2 to identify children with DCD is insufficient for screening children, and that the MABC-2 Performance Test needs to be used accordingly to confirm the identification.

From the conclusion, the following recommendations can be provided:

5.3 Recommendations for further studies

- Due to the lack of research on the MABC-Checklist-2 when completed by parents, further studies should be conducted, specifically focusing on the parents completing the MABC-Checklist-2.
- Outdated and limited studies regarding the MABC-Checklist-2 completed by teachers should be replaced by more recent studies using the second edition checklist.
- The conflicting results regarding the MABC-Checklist-2 when completed by teachers also show the necessity of conducting more research.
- According to this study the agreement between the MABC-2 Performance Test and the MABC-Checklist-2 is low in South Africa and therefore revising the assessment tool for this country should be considered.
- The study population was recruited from the same province and the results could not be generalised for the country or larger countries, therefore a study on a larger population in various provinces and countries should be conducted.
- The present study has demonstrated the need for continuing research to identify efficient and effective assessment tools.
- When future studies using the MABC-Checklist-2 are conducted, parents and teachers should receive a detailed explanation on completing the MABC-Checklist-2 to ensure better results.
- As mentioned in the literature, previous studies by Faught, Cairney, Hay, Veldhuizen, Missiuna and Spironello (2008:178) and Schoemaker, Flapper, Reinders-Messelink and De Kloet (2008:191) indicated that studies using parents'

and teachers' reports have produced conflicting results. The current study indicates low agreement in the identification of motor difficulties by parents and teachers when using the Checklist. Thus it is still not clear whether the MABC-Checklist-2 is the best to use and whether parents and teachers need to be involved in screening a child. Therefore, future studies using parents' and teachers' reports to identify motor difficulties and DCD should be conducted to find the most suitable screening tool to identify children with DCD.

5.4 References

FAUGHT, B.E., CAIRNEY, J., HAY, J., VELDHUIZEN, S., MISSIUNA, C. & SPIRONELLO, C.A. 2008. Screening for motor coordination challenges in children using teacher ratings of physical ability and activity. *Human Movement Science,* 27(2):177-189.

SCHOEMAKER, M.M., FLAPPER, B.C.T., REINDERS-MESSELINK, H.A. & DE KLOET, A. 2008. Validity of the motor observation questionnaire for teachers as a screening instrument for children at risk for developmental coordination disorder. *Human Movement Science,* 27(2):190-199.

APPENDIX A

Permission form for the Department of Education

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS·UV
HUMANITIES
GEESTESWETENSKAPPE

205 Nelson Mandela ave. / rl.
Park West, Bloemfontein 9301
P.O. Box / Posbus 339
Bloemfontein 9300
South Africa / Suid Afrika

T: +27(0)51 401 3000
F: +27(0)51 447 5211

www.ufs.ac.za

16 April 2012

MR. R.S. MALOPE
Head of Department of Education
Department of Education
BLOEMFONTEIN
9301

Dear Mr. R.S. Malope

RESEARCH TITLE: SCREENING TOOLS FOR DEVELOPMENTAL COORDINATION DISORDER IN GRADE 1 LEARNERS

Hereby I (Alretha Buys) would like permission to conduct research at twelve primary schools in Bloemfontein. The purpose of the research project will be to determine the ability of parents and teachers in the early identification of possible coordination problems when using a Checklist. No research indicates whether South African parents and teachers have the ability in the early identification of possible coordination problems could be found.

Data will be collected through the help of parents, teachers and Kinderkineticists. Parents will complete the Movement Assessment Battery for Children-2 Checklist (MABC Checklist) about parents' perceptions of their child's motor abilities. Teachers will also complete the MABC Checklist, one month after school commenced. Questionnaires will take parents and teachers approximately 20 minutes to complete.
In addition, Kinderkineticists will determine children's motor abilities using a standardized measuring instrument.

Feedback will be provided to parents regarding their children's motor skills. There is no cost associated with testing and feedback of results.

The principals of each school in Bloemfontein, granted permission for the participation of their learners in this project and will receive a parental informed consent form to be completed by their legal guardians and each learner will receive a minor's consent form to be completed.

There are no risks involved in participation in this study.

I trust that my application will meet your approval.

……
ALRETHA BUYS
(RESEARCHER)
0514012467
buysama@ufs.ac.za

……
MONIQUE DE MILANDER
(SUPERVISOR)
0514019342
demilanderm@ufs.ac.za

APPENDIX B

Principal informed concent form

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS·UV HUMANITIES GEESTESWETENSKAPPE

205 Nelson Mandela ave. / rl.
Park West, Bloemfontein 9301
P.O. Box / Posbus 339
Bloemfontein 9300
South Africa / Suid Afrika

T: +27(0)51 401 3000
F: +27(0)51 447 5211

www.ufs.ac.za

3 April 2012

The Principal of the School

Hereby I (Alretha Buys) would like permission to conduct research at your primary school in Bloemfontein. The purpose of the research project will be to determine the role that parents and teachers may play in the early identification of possible coordination problems when using a specific questionnaire. No research showing whether South African parents and teachers have a role to play in the early identification of possible coordination problems could be found.

Data will be collected through the help of parents, teachers and Kinderkineticists. Parents will complete a questionnaire which includes a coordination questionnaire about parents' perceptions of their child's motor abilities. Teachers will also complete the questionnaire. The questionnaires will take parents and teachers approximately 20 minutes to complete.

In addition, Kinderkineticists will determine children's motor abilities using a standardized measuring instrument. The motor abilities test of the children will take place during the Life-Orientation period; therefore no time out of the children's learning will be lost. Complete feedback will be provided to parents regarding their children's motor skills. There is no cost associated with testing and feedback of results.

Thus, we will need permission from the principals of each school. The research will be conducted at the school premises in the Life orientation periods and therefore will not hinder any constructive learning time of the participants.
Procedure of the research:

As soon as permission is given from the schools involved the parents need to give their informed consent. There will be two forms:

1. The informed consent form.
2. The motor proficiency questionnaire.

We also need the assistance of the teachers, this includes:

1. The motor proficiency questionnaire.
2. A complete class list.

The Schools involved will in turn be rewarded with the following:

1. All the children who are allowed to take part in the research will undergo a motor proficiency assessment.
2. All the children who are allowed to take part in the research will receive an individual report with the results of the test.

Kind regards

…….

Alretha Buys
Department of Exercise and Sport Sciences
051 401 2467
(Researcher)

CONSENT FORM FOR RESEARCH PROJECT

SCREENING TOOLS FOR DEVELOPMENTAL COORDINATION DISORDER IN GRADE ONE LEARNERS

I, _____, principal of _____ (Shool's name), give permission that the research may be conducted at the school. I am aware that the information supplied by completing the questionnaires, will be analysed to determine motor abillities of the children and teachers perceptions of the children's motor skills and the ability of parents' and teachers' in the early identification of motor problems when using the specific questionnaire.

The researcher will take precautions to ensure that the identities of participants remain anonymous and that all information is kept confidential.

_____ _____

Principal **Date**

_____ _____

Researcher's Signature **Date**

APPENDIX C

Parents informed concent form

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS·UV
HUMANITIES
GEESTESWETENSKAPPE

205 Nelson Mandela ave. / rl.
Park West, Bloemfontein 9301
P.O. Box / Posbus 339
Bloemfontein 9300
South Africa / Suid Afrika

T: +27(0)51 401 3000
F: +27(0)51 447 5211

www.ufs.ac.za

9 April 2012

INFORMATION DOCUMENT

SCREENING TOOLS FOR DEVELOPMENTAL COORDINATION DISORDER IN GRADE 1 LEARNERS

Studies in America and Europe have shown that 5-6% of children encounter motor difficulties with a boy to girl ratio of 2:1. Developmental Coordination Disorder (DCD) affects children's performance of functional motor tasks necessary for success in children's daily lives, in activities at home, free play and school. Children do not out grow this disorder, and to take preventive and rehabilitative action, specialized intervention programs are implemented.

Negative influences associated with this disorder are, for example, physical health problems such as obesity, leading to the withdrawal from activities, which further leads to social, emotional and academic problems. Other contributing problems associated with DCD are Attention Deficit Hyperactivity Disorder (ADHD), speech and language impairments, and visual-motor problems.

The purpose of the research project will be to determine the role that parents and teachers may play in the early identification of possible coordination problems. No research showing whether South African parents and teachers have a role to play in the early identification of possible coordination problems could be found.

Data will be collected through the help of parents, teachers and Kinderkineticists. Parents will complete one questionnaire. The Movement Assessment Battery for

Children-2 Checklist (MABC Checklist) about parents' perceptions of their child's motor abilities will be used. Teachers will also complete the MABC Checklist, one month after school commenced. Questionnaires will take you (the parent) and the teachers approximately 20 minutes to complete. In addition, Kinderkineticists will determine children's motor abilities using a standardized measuring instrument. Feedback will be provided to you regarding your child's motor skills. There is no cost associated with testing and feedback of results.

This information is vital in order to determine whether parents and teachers have a role to play in the early identification of coordination problems. Kinderkineticists involved in the development of the young child will be able to evaluate the results to help make the correct recommendations regarding intervention and the awareness of this disorder among parents and teachers.

Your participation in this research project is greatly appreciated, but remains voluntary. The researcher undertakes to keep all personal information confidential. The results of this research study will be used for presentations at national and international conferences and for publication of articles in medical journals.

Contact details of the researcher:

.....
Alretha Buys
051 401 2467
buysama@ufs.ac.za

CONSENT FORM TO PARTICIPATE IN RESEARCH PROJECT

Please return all relevant forms back to school no later than Monday 16 of April 2012, whether completed or not.

SCREENING TOOLS FOR DEVELOPMENTAL COORDINATION DISORDER IN GRADE 1 LEARNERS

I, _____, parent / guardian of _____ (child's full name and surname) _____ (date of birth), give permission that he / she may participate in the research project. I am aware that the information supplied by completing the questionnaires, will be analysed to determine parents' perceptions of their child's motor skills and the ability of parents' in the early identification of motor problems.

The researcher will take precautions to ensure that the identities of participants remain anonymous and that all information is kept confidential.

_____ _____

Parent / Guardian **Date**

_____ _____

Researcher's Signature **Date**

APPENDIX D

Child assent form

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA
UFS·UV HUMANITIES GEESTESWETENSKAPPE

205 Nelson Mandela ave. / rl.
Park West, Bloemfontein 9301
P.O. Box / Posbus 339
Bloemfontein 9300
South Africa / Suid Afrika

T: +27(0)51 401 3000
F: +27(0)51 447 5211

www.ufs.ac.za

9 April 2012

CHILD ASSENT FORM

You are being asked to take part in a research study being done by the University of the Free State. In this study, we are interested to know more about your motor proficiency. We have asked your parent or caregiver whether it is OK for you to participate, but now we want to see if it is OK with you.

If you decide to take part in this study, you will be asked to perform a variety of physical activities such as catching a ball, jumping and throwing activities. This will take about 30 minutes to do. Also, we would like to ask your parents about your motor abilities. All the information we collect will be kept secret. We will not use your name so everything will remain private.

By signing this you are showing that you understand what is going to be happening and have asked any questions you may have about the research. You can also ask questions later if you cannot think of them now. Signing this form does not mean that you have to finish the study you can pull out from the study at any time without explaining why.

_____ _____

Child's signature Date