SUITABILITY OF THE MABC CHECKLIST IN THE IDENTIFICATION OF 10 TO 12 YEAR OLD CHILDREN WITH DCD IN THE NORTH WEST PROVINCE

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To my supervisor, Dr. A.E. Pienaar, my family and friends: thank you for your loving support and never-ending patience on my journey to success. Special thanks to Professor Steyn for his statistical advice and Mr Johan Blaauw for the language editing. Thank you also to the SWO for the bursary. I am ever grateful to you all.

Whether you believe you can,
or whether you believe you can't,
you're absolutely right.
-Henry Ford

The Author
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INTRODUCTORY SUMMARY

In the area of assessing motor problems, no single test is yet considered the "gold standard". The *Movement Assessment Battery for Children* (MABC), developed by Henderson and Sugden (1992), uses two methods for the purpose of assessing motor problems: a motor performance test battery (MABC-T) and a checklist (MABC-CL) and the latter is also the focus of this study. The aim of this study was firstly to examine the suitability of the MABC checklist as a screening device in the identification of different motor problem areas. A second aim was to examine whether class teachers in the North West Province of South Africa are reliable in using the MABC checklist as a screening tool for Developmental Co-ordination Disorder (DCD) and if so, what questions showed the highest relationships with DCD.

For the first aim of the study, Model C and state-subsidized class teachers from 22 different schools were engaged in obtaining results for the MABC performance test and the MABC checklist for a total of four hundred and forty nine North West Province children of four different ethnic origins: white (n=67), black (n=338), Coloured (n=23) and Indian (n=21) children participated in this study. For the second aim of the study, ninety-four boys and girls between the ages of 9 and 12 years were chosen to participate in the study. After the children had been evaluated on the MABC-T, class teachers were asked to complete the standard MABC-CL for each of the children. These scores were then compared to the scores obtained in the MABC-T. One month after the MABC-CL had been returned, a second checklist was sent to each class teacher (first aim subjects only) of a random selection of children (n=85) as a measure of test-retest reliability. The teachers (second aim subjects only) evaluated the questions and their ability to assess them, and hence agreed unanimously only to complete sections 1 and 5 of the standard MABC-CL for each of the children. Detailed instructions on the use of the MABC-CL together with an accompanying letter explaining the purpose of the checklist was given to the teachers beforehand. Descriptive statistics, item- and factor analyses (Cronbach alpha, Eigen values and communalities), correlation matrices and stepwise regression analyses were calculated using *Statistica for Windows*. The level of significance was set at $p<0,05$.

The results regarding the first aim of the study suggested that the MABC-CL had good test-retest reliability and identified children with DCD to a limited degree. The effects of increasing task difficulty within the MABC-CL differed from other studies and the state-subsidized teachers from schools before had more difficulty in completing the checklist compared to the Model C teachers. The results regarding the second aim of the study suggested that the teachers had sufficient knowledge to complete sections 1 and 5 of the MABC-CL, and that they were rated as a reliable source in the assessment and screening of DCD in a country like South Africa with its own particular schooling conditions. Certain questions in section 1, however, need better explanation to ensure proper assessment, which in turn might increase the reliability of the MABC-CL even further. DCD children experienced greater difficulties in all of the questions of sections 1 and 5 of the MABC-CL, when compared to the non-DCD group. From the results it seems as though children with severe DCD to a higher degree experience problems with questions related to disorganized behaviour, tasks which are dependent on bilateral co-ordination, handwriting and other fine motor abilities. The variance among DCD children is explained more by overall behavioural problems, compared to the total group where handwriting ability showed the highest contribution to the variance.

From the results obtained, it can be concluded that further research needs to be done concerning the reliability and validity of the MABC-CL, and teachers within a South African context need to be educated in the use of the checklist to ensure reliable results. It is recommended that the content of the complete MABC-CL needs to be revised when considering the completion of such a checklist by class teachers only.

Keywords: [assessing, motor problems, Movement Assessment Battery for Children, checklist, suitability, screening, class teachers, Developmental Co-ordination Disorder]

TABLE OF CONTENTS

LIST OF TABLES

Table Page

CHAPTER 2

CHAPTER 3

-List of Tables (cont.)-

LIST OF ABBREVIATIONS

AB1-4	Age band one to four
ADD	Attention Deficit Disorder
ADHD	Attention Deficit Hyperactivity Disorder
AJPHERED	African Journal for Physical-, and Health Education, Recreation and Dance
AR	At risk
BOT	Bruininks-Oseretsky Test
DCD	Developmental Co-ordination Disorder
DCDQ	Developmental Co-ordination Questionnaire
GMOS	Groningen Motor Observation Scale
IQ	Intelligence Quotient
KTK	Körperkoordinations Test für Kinder
MABC	Movement Assessment Battery for Children
MABC-T	Movement Assessment Battery for Children-Performance Test
MABC-CL	Movement Assessment Battery for Children-Checklist
MCC	Motor Competence Checklist
MND	Minimal Neurological Dysfunction
MP	Movement problem
PU for CHE	Potchefstroom University for Christian Higher Education
SQT	The School Questionnaire for Teachers
THUSA BANA	Transition and Health during Urbanisation in South African Children
TOMI	Test of Motor Impairment

1. PROBLEM STATEMENT AND PURPOSE OF INVESTIGATION

1.1. Introduction

Developmental Co-ordination Disorder (DCD) describes children who have difficulties in performing co-ordinated movements, which difficulty is not explicable by mental retardation or any known psychiatric or physical disorder (Dussart, 1994:81,83; Wright & Sugden, 1996a:357). The incidence of soft neurological signs has been related to the motor difficulties experienced by these children, even though DCD is not linked to any neurological anomaly (Visser *et al.*, 1998:604). The difficulties experienced by these children are further not explicable in terms of a generalised delay in development (Dussart, 1994:81). A diagnosis is only made if the impairment significantly interferes with routine activities of daily life or with academic achievement (Wright & Sugden, 1996a:357). The prevalence of school-aged children with DCD has been estimated around 5-10% (Wright & Sugden, 1996a:358), and a higher prevalence of DCD has generally been reported in boys than girls (Sugden &

Sugden, 1990:331). The manifestations of this disorder have been given many titles, with the term "clumsy" being the most prevalent.

Motor competence is an important determinant of a child's educational progress and general development. The long-term primary and associated problems faced by children with DCD, often cause them to lag behind their peers in all or some functional skills (e.g. writing), which greatly reduces their level of participation in everyday school activities. Non-participation causes the child to fall even further behind his peers and often the child begins to develop feelings of failure and depression (Smyth & Anderson, 2000:390). Furthermore, the movement difficulties together with the social, emotional, behavioural and academic concomitants experienced during childhood normally continue to have an effect into teenage and adult years (Sugden & Sugden, 1990:331; Wright & Sugden, 1996a:358). Early detection therefore plays a vital role in the well-being of the child, as early intervention might prevent later academic and behavioural problems. Evidence also suggests that a high percentage of DCD may be due to a maturational delay of motor skills or inadequate learning experiences, and labelling a child as clumsy may be harmful, as early diagnosis need not indicate a life-long disability (Wright *et al.*, 1994:156; Piek & Edwards, 1997:56).

1.2. Problem statement

In the area of assessing motor problems, no single test is yet considered the "gold standard" and a variety of procedures ranging from very informal checklists (Dussart, 1994; Crawford *et al.*, 2001; Smits-Engelsman *et al.*, 2001) to fully standardised tests are being used (Smits-Engelsman *et al.*, 1998:700). The *Movement Assessment Battery for Children* (MABC), developed by Henderson and Sugden (1992), which is also the focus of this study, uses two methods for this purpose: a motor performance test battery (MABC-T) and a checklist (MABC-CL) (Wright *et al.*, 1994:150; Wright & Sugden, 1996a:360; Piek & Edwards, 1997:58). The motor performance test is used world-wide with great success. The primary focus of the MABC-CL is the assessment and management of movement skill problems within an educational setting (Wright *et al.*, 1994:152). Although suitable for therapists, it is designed mainly for use by primary school teachers in order to identify clumsy children, as well as the nature of the existing movement difficulty (Wright *et al.*, 1994:152). Dussart (1994:84) stated that the checklist might be a useful preliminary filter for use by teachers who wish to identify children at

risk of DCD, before undergoing the lengthy MABC-T. By using the MABC-CL the teacher is therefore able to see a picture of the child's difficulties unfolding in relation to the school environment (Wright & Sugden, 1996a:360).

Several studies have been done concerning the suitability of the MABC-CL. Mon-Williams and Wann (1994:176) stated that the checklist sometimes identifies children with problems who appear to be functioning normally on the standardised MABC-T. However, Sugden and Sugden (1990:338,339) found that with the more severe problems there is a good agreement between the checklist and the MABC-T. In a study done by Dussart (1994:84), it was also possible to see relationships between checklist scores and DCD. Cross-cultural and socio-economic differences among children, however, seem to have an effect on the reliability and validity of the checklist. The checklist norms and items do not seem to be appropriate for all cultures and need to be updated for use in different countries according to Miyahara *et al.* (1998:681).

Teacher insight and knowledge are also important aspects when considering the usefulness of the MABC-CL. Where teachers were given precise instructions on how to complete the checklist (Mon-Williams & Wann, 1994:176), a high correlation between the teachers' assessments and the MABC was found and the teachers confirmed the use of the checklist as being user friendly (Wright *et al.*, 1994:152). In other studies, teachers experienced difficulties in completing the checklist, since the movements or activities were not commonly performed within their schools and the checklist items seemed inappropriate (Wright *et al.*, 1994:151). When special arrangements were made for the teachers to observe the children in the situation required, Wright and Sugden (1996b:1104) found that they were more lenient towards the younger children but had higher expectations of the older children and in part started to compare children's performances.

Mon-Williams *et al.* (1994:171) pointed out the need for teachers using the checklist to have the children for both classroom activities and physical activities, or for class and physical education teachers to combine their knowledge when the students did not have one teacher for both activities (Piek & Edwards, 1997:57). According to these researchers, physical education teachers appear to identify children with, or at risk of having DCD, better than class teachers, who do not have experience with the children within a changing environment and where the motor control problems are overshadowed by the child's behavioural problems. Piek and Edwards (1997:61) further suggested that the difficulty level of the content of the first four checklist subsections varied, depending on which

teacher assessed the child. Class teachers placed section three after section four, while physical education teachers rated the difficulty from one to four. Only when the environment was stable did both the teachers agree on the scores. Sugden and Sugden (1990:332) emphasised the importance of the use of a contextual setting as a basis for using the checklist, and of observing the child in everyday activities and not within an artificially created situation.

It has been suggested in the literature that a correlation exists between a child's motor performance (Section 1 to 4) and his/her behavioural profile (Section 5) of the MABC-CL, and that this relationship may increase with age (Sugden & Sugden, 1990:344; Wright *et al.*, 1994:153). Dussart (1994:82) also proposed that the results of the child's behaviour could be grouped to give one overall problem of behaviour. Seeing that the information obtained from section five of the checklist adds to the child's movement difficulties, it therefore counts as useful knowledge when considering a remedial program. Also, Wright and Sugden (1996a:357,358) confirmed the finding on the checklist of heterogeneity within the DCD group and concluded that although these children are generally impaired overall, it is possible to find deficits that are highly specific. The difficulties seen within the DCD group are not common to all children and Wright and Sugden (1996a:358) found four identifiable subtypes of DCD which help to determine particular intervention strategies and teaching methods that are more effective for certain groups than others. In a study done by Mon-Williams *et al.* (1996:180), the motor competence checklist was used to classify the subjects with DCD into the specific subtypes.

Placing the above literature findings in a South African context, the following comes to mind. Seeing that the South African culture, population diversity as well as socio-economic conditions differ greatly from the American culture on which the MABC was standardised, it is possible that the checklist norms and items might need adjustment for use with South African children. For the purpose of this study first world but mainly third world children of the North West Province with low socio-economic status will be assessed. One needs to gain insight into what degree the environment (school and sport activities) in which children grow up, influences motor development, and whether the checklist items mirror the child's everyday activities. Also, a teacher's contribution in ensuring reliable checklist results is of utmost importance.

The question arises whether South African teachers in the North West Province have sufficient knowledge concerning the completion of the checklist, knowing that the North West Province has the highest percentage of untrained teachers in South Africa, as statistics from the South African Education

Board have shown (Joubert, 2001). With the ever-decreasing number of physical education teachers in the South African school system, the question also arises whether the class teacher has sufficient knowledge concerning the child's motor performance in order to interpret the questions in the checklist correctly. It might therefore be necessary to equip the teachers with instructions on the use of the checklist in order to present more reliable results. The analyses and interpretation of these results might bring better insight into the motor problems of children.

Hence, the research questions that need to be answered with this study are, firstly, if the checklist is a suitable tool in the identification of a South African sample representing 10 to 12 year old children of the North West Province with DCD. Secondly, can teacher education and training possibly enhance the use of the checklist as an identification tool for children with DCD in the North West Province? Thirdly, if checklist suitability is established, can different problem areas related to DCD be identified among children living in the North West Province of South Africa? The answers derived from these questions may help establish the suitability of the checklist as a screening device in schools to identify children "at risk" of DCD in the North West Province at an early stage, without the use of the lengthy MABC-T. Early intervention, which may follow the results of the checklist, may minimise the long-term effects of DCD. Therefore, knowing the different problem areas that exist within the DCD group may lead to more effective teaching methods and remedial programs in order to positively enhance the child's performance in everyday activities. If teachers indeed need education regarding the use of the checklist, it might be necessary to review the checklist items in order to make the checklist more user-friendly.

1.3. Objectives

The aims of the study are:

1.3.1. to determine the suitability of the MABC-CL for use among 10 to 12 year old children in the North West Province,

1.3.2. to determine whether enhancing the knowledge of the teachers can improve the suitability of the MABC-CL in identifying 10 to 12 year old children in the North West Province with DCD, and

1.3.3. to determine whether the checklist is useful in the identification of different problem areas among 10 to 12 year old children in the North West Province.

1.4. Hypotheses

This study is based on the following hypotheses:

1.4.1. The MABC-CL is a suitable method of identifying DCD among 10 to 12 year old children of the North West Province.

1.4.2. Training of teachers and improving their knowledge enhances the suitability of the MABC-CL in the identification of 10 to 12 year old children of the North West Province with DCD.

1.4.3. The MABC-CL is useful in the identification of different problem areas among 10 to 12 year old children of the North West Province.

1.5. Structure of dissertation

This dissertation is written in article format and comprises four chapters. The problem statement, purposes and hypotheses of the study are presented in chapter one. In chapter two, a summary of the literature regarding the relevance of the MABC-CL in the identification of children with DCD is discussed. Chapters three and four are presented in article format and consist of a complete explanation of the methodology used, as well as a discussion of the results. Chapter three analyses the first aim of the study and will be submitted for publication to the African Journal for Physical-, and Health Education, Recreation and Dance (AJPHERED). Chapter four analyses the last aims of the study and will be submitted for publication to the Journal of Human Movement Studies. The articles were finalised according to the guidelines (see Appendix) provided by each journal, and therefore might differ from a technical point of view from the rest of the dissertation (especially references and reference lists). Also, each chapter has its own reference list. Finally, the summary, conclusions and suggestions for further research are presented in chapter five. The MABC-CL is protected by copyright and therefore not included in the appendix.

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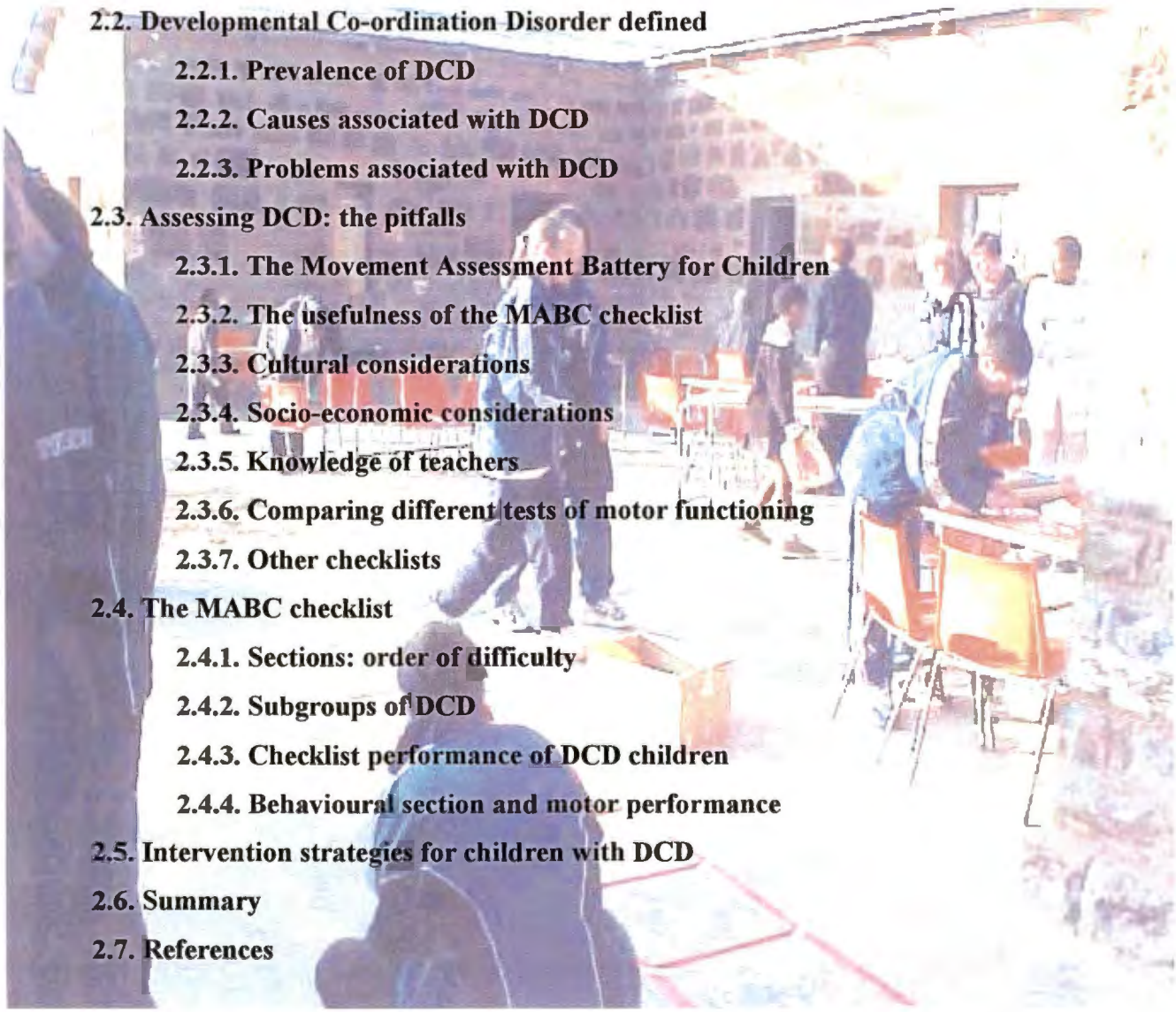
2. THE RELEVANCE OF THE MABC CHECKLIST IN THE IDENTIFICATION OF DCD



2.1. Introduction

The Movement Assessment Battery for Children (MABC) (Henderson & Sugden, 1992) has been the topic of discussion in many research articles. Much literature is available concerning the motor performance test of the MABC (Mon-Williams *et al.*, 1994; Mon-Williams *et al.*, 1996; Wright & Sugden, 1996; Piek & Edwards, 1997; Miyahara *et al.*, 1998; Rösblad & Gard, 1998; Smits-Engelsman *et al*, 1998; Chow *et al.*, 1999; Crawford *et al.*, 2001; Tan *et al.*, 2001; Wiart & Darrah, 2001), but very little research has been documented concerning the MABC checklist (MABC-CL). This highlights the fact that the MABC-CL is still relatively unexplored and leaves many areas for discussion.

For this particular study, literature regarding the usefulness of checklists in the identification of children with Developmental Co-ordination Disorder (DCD) has undergone detailed investigation and is inevitable for the aims of this study. Whether the MABC-CL can act as a useful screening device within schools of the North West Province of South Africa in identifying "at risk" children at an early stage without using the lengthy MABC motor test (MABC-T) needs to be answered. Even though the checklist seems to be a useful screening device for children with DCD, there are a few pitfalls that need to be considered. Cultural and socio-economic differences as well as teacher knowledge seem to affect the checklist's validity and reliability. Teaching conditions, learning climates and related factors influencing education within South African schools differ greatly from those elsewhere in the world. Therefore devices such as the MABC-CL, which was standardized on an American population, might not be as useful in South Africa as in other countries. A thorough literature survey was therefore conducted on matters that might influence the validity of the checklist in a country like South Africa and will hence be documented in this literature survey.

Furthermore, in achieving the third aim of the study, a comprehensive study of the checklist sections was necessary in order to investigate if different subtypes exist within the DCD group. If this is the case, knowledge of such subtypes may lead to more effective teaching methods and remedial programs in order to enhance the child's performance in everyday activities. Literature with regard to research in this area was therefore explored and will also be discussed in this literature survey. Before commencement of the detailed discussion hereafter, the definition and

prevalence of DCD will be set out and the causes of and problems associated with DCD briefly discussed.

2.2. Developmental Co-ordination Disorder Defined

Developmental co-ordination disorder (DCD) is the term used to describe children with a marked impairment in the development of motor co-ordination and movement skills that is not explicable on the basis of mental retardation or any known psychiatric, neurological or physical disorder (Dussart, 1994:81; Wright & Sugden, 1996a:357). The difficulties experienced by these children are further not explicable in terms of a generalised delay in development (Dussart, 1994:81). The diagnosis is only made if this impairment significantly interferes with routine activities of daily life or with academic achievement. The manifestations of this disorder have been given many titles, with the term "clumsy" being the most prevalent. The term "clumsy" will henceforth be used interchangeably with the term DCD in the literature review that follows below.

2.2.1. Prevalence of DCD

Children with DCD often lag behind their peers in all or some functional skills (e.g. writing), which greatly reduce their level of participation in everyday school activities. The movement difficulties together with the social and emotional concomitants experienced during childhood normally continue to have an effect into teenage and adult years (Sugden & Sugden, 1990:331 and Wright & Sugden, 1996a:358). In a study done by Wright and Sugden (1996b:1102), the Singaporean teachers reported an even greater prevalence and increasing severity of DCD with increasing age of the children. The prevalence of school-age children with DCD has been estimated around 5-10%, taking into account that DCD is not as easily defined as several other disorders, such as cerebral palsy (Wright & Sugden, 1996a:358). A higher prevalence of DCD has been reported in boys than in girls (Sugden & Sugden, 1990:331), although some studies have reported an equal distribution among boys and girls (Dussart, 1994:84). In a study done by Crawford *et al.* (2001:38), there were significantly more females than males in the DCD group, indicating that the test used may differentiate by sex. A general though not consistent finding has been that the boy-girl ratio is around three to one.

Piek and Edwards (1997:59) identified 18% of the children tested on the MABC as having moderate to severe movement co-ordination difficulties. This rate was congruous with the 19% reported by Keogh (1968), as cited by Piek and Edwards (1997:59), but differed greatly from those reported by several other researchers (Gubbay, 1975; Sovik & Maeland, 1986 & Maeland, 1992). However, the incidence rate was lowered by 10% when only the severely clumsy children were considered. The criteria for determining the levels of clumsiness thus need to be specified when reporting the prevalence of clumsiness. Other reported prevalences at the 10% cut-off point around the world, as cited by Wright and Sugden (1996b:1103), include the following: Australia, 6,7% (Gubbay, 1975); Singapore, 2,8% (Wright & Sugden, 1996); UK, 5% (Henderson & Hall, 1982 & Sugden & Sugden, 1991); Nigeria, 5,9% (Iloeje, 1987) and the Netherlands, 2,7% (van Dellen *et al.*, 1990). This suggests the use of the more lenient 15th percentile as cut-off criterion, in order to not overlook any DCD cases.

2.2.2. Causes associated with DCD

Even though DCD is not linked to any neurological disorder, several studies (Hadders-Algra *et al.*, 1986, as cited by Visser *et al.*, 1998:576; Iloeje, 1987; Losse *et al.*, 1991 and Volman & Geuze, 1998) have reported that many children with DCD exhibit signs of central nervous system dysfunction, albeit minor. A high incidence of so-called "minor" or "soft" neurological signs as well as specific signs may be related to the motor difficulties found in these children. This could imply that most clumsy children do not have macroscopic anomalies of the brain, but dysfunction at the microscopic level of the nervous system, with abnormalities in the neurotransmitter or receptor systems, for example (Hadders-Algra, 2000:707).

It has been reported by Visser *et al.* (1998:604) that the incidence of signs of minimal neurological dysfunction (MND) tends to decrease with the onset of puberty. The decrease in the occurrence of signs of MND suggests a transformation in the central nervous system or brain development, which might be beneficial for children with DCD. Some children with DCD thus seem to profit from the growth spurt, possibly because of enhanced maturation of some parts of the central nervous system during puberty. Another study, however, mentioned that the growth spurt with its accompanying changes in physical characteristics has a negative effect on motor competence (Hadders-Algra, 2000:711).

2.2.3. Problems associated with DCD

Children with DCD have been found to have certain problems that are not necessarily all present in the same individual. Sensory and especially visual and kinaesthetic problems have been mentioned (Lord & Hulme, 1988 as cited by Sugden & Sugden, 1990:330; Mon-Williams, 1994:170 and Wright & Sugden, 1996a:158, 359). Laszlo and Bairstow (1983), as cited by Mon-Williams (1994:170), and Sugden and Sugden (1990:330) have argued strongly that kinaesthetic dysfunction is the major underlying problem for children with DCD, whereas others have placed more emphasis on visual perceptual problems as the key deficit. Although simple ophthalmic problems do not appear to explain the motor difficulties in children with DCD, a gross visual deficit is likely to contribute to movement problems and ophthalmic examination of children with this problem is therefore a prerequisite (Mon-Williams, 1996:182). Children diagnosed as having DCD are also slow but not inaccurate in the process of response selection. They have difficulty remembering visual patterns over a brief time lapse, but have no problems with immediate recall. They seem to be inconsistent in controlling temporal aspects of their movements and are imprecise in finger aiming tasks.

Children with DCD show more inconsistent patterns of responding than control children do (Smyth & Mason, 1998:680). Several researchers have suggested problems in spatial prediction as a cause of their motor problems, which cause them to often bump into and drop things (Levebre & Reid, 1998:306). They also have considerable difficulties with ball-related activities due to disturbances in visual perception and/or movement control, or a general lack of experience (Hoare, 1994 as cited by Levebre & Reid, 1998:299). Children with DCD have great difficulty with drawing and writing (Smits-Engelsman *et al.*, 2001), and even if they do learn to write legibly, it is often too slow to be really useful (Dussart, 1994:81).

DCD is often accompanied by speech problems too, which make it difficult for the children to interact with their playmates. Others are distractible and show an inability to organise their behaviour. Sugden and Sugden (1990:329) suggested that a clumsy child does not understand what needs to be done (gnosis) and/or has difficulties in planning the movement (praxis). Slowness of information processing in clumsy children contributes to their slower movement performance (Van Dellen & Geuze as cited by Sugden & Sugden, 1990:330). Clumsy children

also seem to fall at the lower end of the normal IQ range, as reported by Smyth and Mason (1997:1024). Furthermore, motor problems are frequently described in association with attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD), and it has been estimated that 50% of all ADHD children have some type of motor dysfunction (Barkely, 1990) as cited by Pereira *et al.* (2001:478) and Crawford *et al.* (2001:32).

The above-mentioned problems often attract ridicule from the child's peers and leave the child with feelings of failure and depression, which result in further withdrawal from playground and school activities (Smyth & Anderson, 2000). Non-participation causes the child to fall even further behind his peers and often the child begins to develop serious behavioural problems and a low or over-inflated self-concept (Dussart, 1994:81 & Smits-Engelsman *et al.*, 1998:700).

2.3. Assessing DCD: the pitfalls

Motor competence is an important determinant of a child's educational progress and general development. The ability to write legibly and with adequate speed becomes a prerequisite for notes taking and examination performances, as well as for more general literacy skills (Smits-Engelsman *et al.*, 1998:700). In the area of assessment, however, no single perceptual-motor test is yet considered the "gold standard" and a variety of procedures ranging from very informal checklists to fully standardised tests are being used (Smits-Engelsman *et al.*, 1998:700). There is very little information available regarding the appropriateness of these tests, especially for children of different ethnicity, and it is therefore important to examine the suitability of any instrument that was developed in countries far removed from each another. Motor development can to some extent be shaped by cultural demands and the kinds of activities children engage in are likely to differ between countries (Rösblad & Gard, 1998:712). In addition, the cut-off points have not been consistent between instruments, resulting in a large variability in the rate of DCD reported (Piek & Edwards, 1997:56). The need for an effective screening device for DCD has been emphasised by many and is most certainly a topic for discussion.

2.3.1. The Movement Assessment Battery for Children

The Movement Assessment Battery for Children (MABC), developed by Henderson and

Sugden in 1992 (Wright *et al.*, 1994:152 & Wright & Sugden, 1996a:360), is one of the most recent diagnostic tools developed and used to identify clumsy children. The standardised test was founded on normative data collected in the UK, Canada and the USA, with the final version being standardised on 1000 American children (Smits-Engelsman *et al.*, 1998:700, 701). The MABC consists of a criterion-referenced checklist (MABC-CL), a normative-referenced motor performance test (MABC-T), and guidelines for remediation. The MABC-T has been shown to have moderate to good validity and reliability (Wright & Sugden, 1996a:361; Crawford *et al.*, 2001:31; Smits-Engelsman *et al.*, 2001:168; Tan *et al.*, 2001:170). From the validity and reliability studies done by Henderson and Sugden (1992:191), the test-retest reliability at any age was found to be r = 0,75 and inter-tester reliability was found to be r = 0,70. The correlation between the MABC-T and the MABC-CL was found to be r = 0,66 ($p<0,001$).

The performance test, which evolved from the Test of Motor Impairment (TOMI) developed in 1972 (Wright & Sugden, 1996a:360), is administered individually and assesses the child's movement abilities. A total of 32 items are divided into four sets of eight, each intended for use with children of specific ages. The first set of items, labelled Age Band 1 (AB1), is designed for use with four to six year old children, the second set, AB2 for seven and eight year olds, the third for nine and ten year olds and the fourth for children eleven years and older. Within each age band the structure of the test is identical: it consists of three tests of *Manual Dexterity*, two tests of *Ball Skills*, and three tests of *Static and Dynamic Balance* (Miyahara *et al.*, 1998:683). A total impairment score is derived from performance in these three sections, which can then be compared to scores of the child's age-related peers. Total scores falling below the fifth percentile are considered indicative of a definite motor problem, while scores between the fifth and 15th percentile suggest a degree of difficulty experienced that is borderline, but needs further monitoring (Smits-Engelsman *et al.*, 1998:702). All scores above the 15th percentile are considered to be in the normal range.

The primary focus of the MABC-CL, derived from the Motor Competence Checklist (MCC), is the assessment and management of movement skill problems within educational settings. Although suitable for therapists, it is designed mainly for use by primary school teachers in order to identify clumsy children, as well as the nature of the existing movement difficulty (Wright *et al.*, 1994:152). Dussart (1994:84) stated that the checklist might be a useful

preliminary filter for use by teachers who wish to identify children with DCD. By using the MABC-CL the teacher is able to see a picture of the child's difficulties unfolding in relation to the school environment (Wright & Sugden, 1996a:360).

The checklist contains 60 items grouped into five sections (see Table 1). The responses to each of the questions in sections 1-4 (movement skills) are scored on a four-point scale: (0) "Very Well", (1) "Just OK", (2) "Close" and (3) "Not Close". There are three response alternatives for section five (behavioural section) that refer to the frequency with which the child displays certain behaviour: (0) "Rarely", (1) "Occasionally" and (2) "Often". Scores of each subsection are totalled, and scores in excess of 35 are used to indicate Developmental Co-ordination Disorder (DCD) among children eight years and older (AR= at risk and MP= movement problem). The higher the score therefore, the more difficulties the child experiences.

TABLE 1. MABC checklist: sections and scoring

Checklist Section	***12 Questions in each section***	***Scored 0 (good) to 3***
Section 1:	child stationary, environment stable (e.g. manipulative tasks such as writing)	**Total motor score** **Max. score/section = 36**
Section 2:	child moving, environment stationary (e.g. walking to pick up a stationary object)	
Section 3:	child stationary, environment moving (e.g. catching a ball)	**Classifications:**
Section 4:	child moving, environment moving (e.g. running to catch a ball)	

	OK*	AR*	MP*
6y	<60	60+	90+
7y	<50	50+	75+
8y	<35	35+	55+
9y	<35	35+	50+

Section 5:	behavioural profile (e.g. fearfulness)	low, medium, high

*OK= no movement problem; AR= at risk, moderate DCD; MP= movement problem, severe DCD

2.3.2. Usefulness of the MABC checklist

The usefulness of the MABC-CL as an assessment instrument has been explored in several countries. The data obtained from a Singaporean sample of 7- and 8-year-olds (Wright *et al.*, 1994:150) compared favourably with data from the United Kingdom: age and gender differences were similar and the checklist identified 15,6% of children as having movement problems or being at risk. The slight differences in motor performance between the two

countries, however, showed that motor development is not just a matter of maturation but also of the child's learning experiences. Furthermore, there seems to be a good agreement between the checklist and the motor test results of the MABC for children with more severe problems (Sugden & Sugden, 1990:339) as suggested by Mon-Williams (1994:176). However, the checklist identifies some children who are not confirmed by the MABC-T.

2.3.3. Cultural considerations

The Oseretsky test, conducted in Russia in 1923, had to undergo many changes and adaptations for use in other countries, emphasising the need to continually update item selection and normative data in order to be true to different cultures (Miyahara *et al.*, 1998:681). Even though the checklist together with the MABC-T showed to be a workable research tool in several countries (Sugden & Sugden, 1990:337; Dussart, 1994:81 & Wright *et al.*, 1994:153), it was nevertheless suggested that several items in both the instruments needed modification.

European studies evaluating the generalisability of the MABC norms have suggested that these are satisfactory, in contrast to a normative study conducted in the Far East, where it was suggested that the norms might need adjustment for use in Hong Kong (Miyahara *et al.*, 1998:690). American children were found to perform better overall compared to the Japanese children, except for the dynamic balance section (Miyahara *et al.*, 1998:679). American children learn a system of writing that requires the production of a fluent line, whereas Japanese writing systems require discrete strokes. This explains why the American children had less difficulties in completing the flower trail compared to Japanese children, who found cutting easier than drawing. The fact that Japanese children engage in unicycling possibly explains their better dynamic balance.

Smits-Engelsman *et al.* (1998:705) compared the *Körperkoordinations Test für Kinder* (KTK), a test commonly used in the Netherlands to diagnose motor development problems, to the MABC. From the results of this study it was suggested that the norms for the MABC needed little adjustment for use with Dutch children, whereas the KTK was likely to overestimate the number of children with difficulties. Chow *et al.* (1999:61) found the MABC to be an acceptable and easy instrument to administer to Hong Kong Chinese children. However, cross-

cultural differences were found on some items, highlighting the need to establish specific group norms that can serve as a valid guide for classifying Chinese children with motor impairment. Chinese children were found to perform significantly better overall and on items contained in the manual dexterity and dynamic balance sections, whereas American children were better at the projection and reception of moving objects. A possible explanation for the above finding is that Chinese children learn to use a writing implement at three years of age and are coached on the use of chopsticks from as early as two years of age. American children again are introduced to ball games much earlier than Chinese children are. The opportunities for gross motor play in Hong Kong are very limited and proficiency in gross motor skills is not valued nearly as much as competency in fine motor skills and academic achievement.

Rösblad and Gard (1998:717) also found that the MABC norms might need little adjustment for use with Swedish children, but that the cultural differences between the USA and Sweden did not affect motor performance. The Swedish children performed better on the one-leg (non-preferred) balance skill and rolling ball skill when compared to the American children. Their better balance skill can be explained by the fact that they often engage in skiing as a winter sport.

It was further noted that cross-cultural differences could shed light on the degree to which the environments (school curriculum or sport activities) in which children grow up might influence motor development. The MABC has been shown to include items that fail to link to everyday task performance (Tan *et al.*, 2001:178). Miyahara *et al.* (1998:692) also made very interesting conclusions and suggestions in his study of a sample of Japanese children: even though the Japanese children performed better in some of the MABC motor tests, they still had poorer overall performances compared to the American children. This finding could only be explained by means of the cultural bias of item selection. The need for entirely new norms was addressed, seeing that the current norms are not suitable for the Japanese population. It cannot be assumed therefore that test items that are discriminative in a given country and culture will apply across other cultures (Tan *et al.*, 2001:179). Out-of-date norms and inclusion of culturally inappropriate items would compromise any test's sensitivity and discriminability and hence validity. Unicycling, for example, would be a more appropriate test of dynamic balance for Japanese children who perform exceptionally well on the existing test. Equally, higher manual

dexterity norms would be more appropriate when evaluating a Chinese child's manual dexterity skills.

Seeing that the South African culture, population diversity and socio-economic conditions differ greatly from the American culture on which the MABC was standardised, it is possible that the checklist norms and items might need adjustment for use with South African children. For the purpose of this study, first-world but mainly third-world children of the North West Province with low socio-economic status will be assessed, highlighting the fact that these children might have poorer movement skills due to inadequate movement experiences and/or different movement activities common to their culture, when compared to American children, for example.

2.3.4. Socio-economic considerations

Environmental factors as well as socio-economic and cultural differences play a role in motor development (Wright *et al.*, 1994:150). Children brought up in rural environments differ greatly from children brought up in cities. Children from impoverished social environments usually receive quantitatively less stimulation than children with a better social background (Hadders-Algra, 2000:711). Occupational grouping, however, is becoming an increasingly unreliable indicator of socio-economic class due to the growing number of single-parent families (Dussart, 1994:84).

2.3.5. Knowledge of teachers

Several studies (Dussart, 1994:82 & Mon-Williams, 1994:176; Wright *et al.*, 1994:153) have shown teachers' judgements of the MABC-CL to be accurate and reliable, while others (Sovik & Maeland, 1986 as cited by Dussart, 1994:81) have found a low correlation between teachers' ratings and motor performance. Henderson and Sugden (1992) and Smits-Engelsman *et al.* (1998) as cited by Smits-Engelsman *et al.* (2001:168) found a 62-100% agreement in classification between different evaluators and a 90-96% agreement of classification of motor performance between two measurements at a two-week interval respectively. Even though the checklist is quick and easy to use, the teacher may only pay attention to part of the child's

behaviour, which obviously is more of a problem in a busy classroom. In a study done by Smyth and Mason (1997:1026), some teachers were unwilling to use the checklist, either because of the time involved, or because the age of the children made some of the checklist items inappropriate in the teacher's view. With the necessary discussions concerning the use of the checklist from the researcher, the problem was however solved. In a study done by Wright *et al.* (1994:151), the teachers had difficulties in completing the checklist, since the movements or activities were not commonly performed within their schools. Thirty percent of the teachers were unable to comment upon the children's ability to use blocks, beads or puzzle pieces, and nearly 50% were unable to answer whether the child could ride moving vehicles such as pedal cars, scooters or bikes (Wright *et al.*, 1994:155). Another study (Wright & Sugden, 1996b:1104) found that teachers in Singapore were relatively accepting of difficulties in the younger children but had higher expectations of the older children and in part started to compare children's performances. The guidelines and instructions accompanying the checklist thus need to be tightened to counter this.

In a study done by Mon-Williams and Wann (1994:171), the teachers had to make special arrangements to observe the children in the situations required for Sections 2, 3 and 4 of the checklist. Several studies (Piek & Edwards, 1997:57) pointed out the need for teachers using the checklist to have the children for both classroom activities and physical activities or for class and physical education teachers to combine their knowledge when the students did not have one teacher for both activities. The physical education teacher but not the class teacher may detect children who are affected by a moving environment, as the class teacher interacts with the child primarily in a stationary environment and movement problems may be overshadowed by the child's behavioural problems. The physical education teachers were found to score the children's performance on section 3 and 4 much higher than class teachers, who have less experience with what children in a moving environment do. The class teacher may still detect children who perform poorly on all levels of the checklist, as they would score poorly on the first, and possibly second section.

Piek and Edwards (1997:60) found that class teachers only detected 25% of all DCD cases, compared to physical education teachers who identified 47%. This suggests that the two types of teachers may be using different criteria for determining the movement status of the child. Class teachers, however, appeared to detect more children who seem to have a deficit in all

contexts, indicating kinaesthetic problems. Even though the physical education teachers were more successful in identifying clumsy children, both class and physical education teachers did not have more than a 50% success rate in detecting DCD using the checklist. This demonstrates that a large number of children were left unidentified (Sovik & Maeland, 1986 as cited by Piek & Edwards, 1997:60; Maeland, 1992; Keogh *et al.*, 1997). Still, a significant correlation was established between the MABC performance score and checklist.

Teacher insight and knowledge thus form an important aspect when considering the usefulness of the MABC-CL. With the ever-decreasing number of physical education teachers in the South African school system, together with the highest number of unqualified teachers in the North West Province, the question arises whether the class teacher has sufficient knowledge concerning the child's motor performance in order to interpret the questions on the checklist correctly. The type of school participating, DCD awareness in schools, the amount of information concerning the checklist and DCD given to the teachers beforehand, inter-observer-reliability and teacher-child enthusiasm may certainly play a role as far as checklist reliability is concerned (Dussart, 1994:81,84).

2.3.6. Comparisons between different tests of motor functioning

Crawford *et al.* (2001:43) and Dewey and Wilson (2001:18) showed that different measures of motor functioning did not consistently identify children as DCD or non-DCD. The study showed low levels of agreement between the Bruininks-Oseretsky Test (BOT) and the MABC in identifying children with DCD. Such lack of agreement among measures used to identify children with DCD indicates that investigations are needed that examine which characteristics of these measures may influence who is classified as having DCD. The question that needs to be answered is, do different tests identify distinctly different types of children? Therapists should be aware of the possibility that BOT under-identifies DCD and that the MABC may penalise children with attention problems, who find the test more difficult. Further findings suggested that when two or more motor measures consistently identify a child with DCD, a more severe motor problem or the presence of other developmental learning problems are indicated. It was also mentioned that standardised tests may be limited in their ability to identify DCD because they do not evaluate the quality of the movement. Information from standardised

tests combined with a picture of the child's functional performance may increase the likelihood that DCD will be accurately identified. Judgement-based assessments and observations are necessary to augment standardised tests and to confirm the presence of a motor problem. According to Crawford *et al.* (2001:48), no one test, however, can accurately identify DCD children or replace the clinical reasoning of multiple sources of information. Smits-Engelsman *et al.* (2001:164) further mentioned that norm-referenced tests are not sensitive or specific enough to measure the effects of intervention.

The reliability and validity studies reported in the MABC manual are based primarily on the TOMI, despite the significant change in the scoring system that occurred with the revisions from the TOMI to the MABC (Wiart & Darrah, 2001:283). Even though the authors of the MABC state that the checklist can be used for screening, two studies that were completed after the MABC had been published (Wright & Sugden, 1996a,b & Piek & Edwards, 1997) did not support the validity of the checklist as a discriminative tool, as the checklist and the performance test did not identify the same group of children. Furthermore, the sensitivity and specificity of the MABC in the identification of children with motor co-ordination difficulties as well as the reliability of the scoring system have not been well evaluated.

2.3.7. Other checklists

The Developmental Co-ordination Questionnaire (DCDQ) is a newly developed measure that assesses parents' perceptions of their children's motor skills (Crawford *et al.*, 2001:32). This parent report measure is designed to distinguish children who have motor problems (as measured by standardised tests) from children without motor problems. The suggested cut-off scores indicate the presence of DCD, suspected DCD or no DCD. An impairment score of 53 or less was used in the study done by Crawford *et al.* (2001:32) to indicate DCD. Initial analysis indicated a high internal consistency (alpha (□) = 0,87–0,88), but no additional studies have been completed to date. In terms of its validity, scores on the DCDQ have been found to correlate significantly with scores on the BOT (r = 0,46–0,54) and the MABC (r = -0,59). In the study of Crawford *et al.* (2001:32), the test correctly classified 68% of the total sample of children with and without DCD.

The highest agreement correlated for chance was found between the DCDQ and the BOT Full Battery Composite (0,441) and the BOT Gross Motor Composite (0,407) (Crawford *et al.*, 2001:42). Furthermore, low levels of agreement were found between the BOT and the DCDQ for DCD children; however, the opposite was found for non-DCD children (Crawford *et al.*, 2001:450). Children whose diagnosis of DCD was confirmed by the DCDQ and the MABC were more likely to meet the criteria for ADHD (Crawford *et al.*, 2001:42). It has been suggested that the DCDQ is most useful as a tool to screen out those children who do not have motor problems, as an adjunct to standardised testing. However, the relationship between this test and functional performance is not yet clear.

In a study done by Dussart (1994), *a two-level checklist* (labelled A & B), which could be completed by a class teacher with minimum guidance, was used. The checklist is based on a

TABLE 2. The two-level checklist

Box A	Upset by failure (eyes water, shows reluctance)
Shows poor balance, falls easily	Complains of pain, nausea or headache
Appears to be poorly co-ordinated	***Often thirsty, often drinking**
Has difficulty speaking clearly	Timid, gets flustered when urged
Has problems with writing and drawing	Lethargic, hard to interest
Has difficulty sequencing activities	Doesn't correct errors
Is emotionally tense when working (bunches, perspires and fumbles)	Gets locked into repetitive behaviour. i.e. rocking
	Tries to change tasks and makes them harder
Is emotionally immature	Hyperactive
Tends to play with younger children	Overestimates own ability
Lacks persistence	Impulsive, doesn't think ahead
Shows frustration at errors	Slapdash
Fidgets and/or squirms	Impatient of detail
Has limited concentration span	Has temper tantrums
Box B (when 4 or more ticks in Box A)	Seeks physical contact, caresses from teacher
Joints and limbs feel slack	Demands help needlessly
Does as little writing and drawing as possible	Left out of other children's games
Takes a long time to get dressed	Often bullied or in fights
Takes a long time to eat a meal	Stays out of playground action
Confuses left and right	Is the child right (R) or left (L) handed?
Has a problem with reading	Does the child have ear problems?
Talks a lot	Does the child have epilepsy?
Uses talk to cause delays	Does the child have obesity?
Overacts to extraneous noise	Does the child have anorexia?
Interrupts instructions with irrelevant questions	Does the child have any other physical disability?
Daydreams, looks around, eyes wander	Any other observations?
Wanders around the classroom	

wide range of behavioural symptoms, some of which might indicate problems other than DCD. Level A is meant to act as an alerting device for DCD, while level B provides more extensive detail on the child with problems (Dussart, 1994:81). Four ticks on level A was set as the criterion for proceeding to level B. After several revisions, the final version of the checklist consisted of 12 level A symptoms and 31 level B symptoms (45 items). A control factor was inserted in the level B list in order to identify any false positives (see*): there is no evidence of any association between DCD and excessive thirst. A slight overlap between the level A and B symptoms allowed assessment of the effect of different wording of some of the symptoms. Concurrent validity was established by showing a statistically significant relationship at $P<0,01$ between the TOMI scores and the checklist score. When the 12 items making up level A were considered separately from the total scores this relationship was strengthened even further ($P<0,001$) (Dussart, 1994:82). It was further found that the checklist produced a significant number of false positives, which might have included children with other problems. Eighteen ticks on the whole checklist was found to represent a possible TOMI of six and would trigger the need for a full TOMI (Dussart, 1994:83). Although the symptoms of the checklist were not formally arranged into groups, the results could be so grouped, for example problems relating to concentration (Dussart, 1994:83).

The School Questionnaire for Teachers (SQT), developed by Smits-Engelsman *et al.* in 1995 (Smits-Engelsman *et al.* 2001:167), is based on the teacher's assessment of a child's handwriting proficiency. The scale has seven items that measure several different aspects of writing, such as the form of the letters, the presentation of the written work, the continuity of the hand, the exertion required for writing and the fluency of the hand. In addition, three items are included that ask for information on the child's spelling, general learning performance and general motor skills (Smits-Engelsman *et al.*, 2001:167). The questionnaire does not provide a definition of "normal" so that each teacher has to use his or her implicit norm of what a child of a particular age ought to be able to do. The teachers provide the assessments on a five-point scale (internal consistency, $\square = 0,93$). When at least four of the items 1, 2, 3, 5, 6, and 10 are scored below average the child is regarded as definitely experiencing writing problems. Classification with the SQT has been shown to be comparable to results yielded by the Groningen Motor Observation Scale (82%), or a general motor test (the KTK, 86%) (Smits-Engelsman *et al.*, 2001:168).

In a South African study done by Pienaar (1994), another checklist, based on the questionnaire of Gubbay (1978), was completed by teachers and used in order to obtain data regarding the motor difficulties experienced by children. The checklist is meant for use with teachers and consists of 12 questions (see Table 3), and each question is rated on a scale from one to five: 1= far below average/age level, 2= insufficient, 3= average, 4= above average/age level and 5= way above average/age level (Pienaar, 1994:222). These questions are similar to the questions in Section 5 of the MABC-CL. Pienaar (1994:196) identified children with motor problems with the Pyfer Neurological Test and found an agreement between this test and the checklist. This checklist was, however, not developed to identify children with motor problems but rather to supply additional information on children with motor problems, in order to improve their intervention programmes.

TABLE 3. Another checklist based on the questionnaire of Gubbay (1978)

	Scored 1-5
1. Does the child display good interaction with his/her peers?	
2. Does the child display normal behaviour regarding cooperation and obedience towards the teacher?	
3. How would you evaluate the child's level of self-confidence?	
4. How would you evaluate the child's ability to concentrate when compared to the average child of the same age?	
5. How would you evaluate the time needed for a child to start and finish a task when compared to an average child?	
6. Does the pupil tend to be fidgety in class?	
7. How does the pupil's letter forming and neatness of handwriting compare to the average pupil?	
8. If you had to give an indication of the child's cognitive/intellectual ability on a scale, where would you place the child?	
9. Is the pupil unnecessarily clumsy compared to the average pupil?	
10. Is the child popular amongst his/her peers?	
11. Does the child like to participate in physical, in other words gross motor activities?	
12. Is there any additional information that you as a teacher could provide regarding the child's progress and behaviour at school?	

The Groningen Motor Observation Scale (GMOS) is a motor performance questionnaire intended for use with teachers or parents (Visser *et al.*, 1998:578, Leemrijse *et al.*, 2000:249). The GMOS is used as a checklist to select children "at risk" of DCD. The checklist contains 20

items describing a wide range of movement skills, each of which is rated on a four-point scale. GMOS raw scores are then converted into deciles, with higher scores indicating worse performance.

2.4. The MABC checklist

The different subsections of the MABC-CL vary in difficulty and have been researched in order to identify different subgroups of DCD. Knowing the different DCD groups that exist allows for more individualized remedial programmes and a better understanding of certain problem areas within the DCD group.

2.4.1. Sections: order of difficulty

Originally the order of difficulty of the content of the sections was expected to be 1, 2, 3 and then 4, with the content of section 4 being the most difficult. A consistent finding was obtained from several studies; however, rating section 1 as having the lowest scores, indicating the smallest percentage of difficulties, followed in order by sections 2, 4 and 3 (Sugden & Sugden, 1990:339). A possible explanation for the above finding could be that the items in section 4 are in a natural context with both the body and environment moving, thus creating a holistic situation making the task easier than some of the more artificial ones in section 3. Piek and Edwards (1997:61) suggested that the difficulty level also varied, depending on which teacher assessed the child. Class teachers rated the section difficulty of 1, 2 and 3 as being of equal status and 4 as the most difficult section. Physical education teachers, on the other hand, rated the section difficulty as 1, 2 and then 3 and 4 being equally the most difficult sections.

2.4.2. Subgroups of DCD

Hoare (1994), as cited by Wright and Sugden (1996a:359), investigated the differences within the DCD group and concluded that although these children are generally impaired overall, they are a heterogeneous group with highly specific deficits and therefore specific teaching methods should be applied (Sugden & Keogh, 1990; Gubbay as cited by Sugden & Sugden, 1990:330; Davidson & Williams, 2000 & Macnab *et al.*, 2001). A child classified as being at risk from an

overall score may have a hidden difficulty in that classification that needs to be addressed. Some children may only have a visual contribution to their movement dysfunction rather than a generalised perceptual dysfunction. It has been found that children who have problems on all four sections of the MABC-CL probably have difficulties with kinaesthetic tasks (Laszlo *et al.*, 1988 as cited by Sugden & Sugden, 1990:342). Similarly, high scores on sections 3 and 4 indicate that adding temporal demands involving visual processing in the form of anticipation and prediction confirms their general difficulties (Lord & Hulme, 1988 as cited by Sugden & Sugden, 1990:342). Those children who showed a low score on section 1 compared to the other three sections appear to be comparatively competent on tasks that are spatially and temporally predictable.

In a study done by Mon-Williams *et al.* (1996:180), the motor competence checklist was used to classify the subjects with DCD into the specific subtypes. Nevertheless, it is of the utmost importance to identify such children as early as possible in order for any teaching strategy to be successful (Dussart, 1994:81). Kaplan *et al.* (1998:485) suggested that non-typical brain development is an underlying condition that can be expressed in a child in many different ways, including DCD, and that research should be focusing on symptoms rather than syndromes. A similar argument could be made for DCD to focus on skill deficits rather than on subtypes.

2.4.3. Checklist performance of DCD children

In a study done by Wright and Sugden (1996a:363), the children with DCD had higher mean scores on the MABC-CL than their matched controls, which means a poorer overall performance. Section 4 (child moving/environment stable) of the checklist most clearly separated children with and without DCD, with section 1 (child stationary/environment stable) becoming part of the discriminate function at the second step. The children with DCD scored twice as high (18 points) on section 4 of the checklist compared to the non-DCD group (9 points). The tasks in section 4 of the checklist are the most complex of all the sections.

The manual dexterity section had the greatest discriminatory power concerning the performance test. The inclusion of section 1 in the discriminatory function is therefore no surprise, for the tasks in this section are closely linked to those in the manual dexterity section. The conclusion

can be drawn that children with DCD differed most from their well-co-ordinated peers when they were required to move in a changing environment and when they were asked to manipulate their hands at speed or with accuracy (Wright & Sugden, 1996a:364). Rösblad and von Hofsten (1994), as cited by Wright and Sugden (1996a:368), reported that slower movements are the consequence of the poor planning ability of DCD children, who appear to deal with problems after they occur rather than anticipating problems ahead of time or at an early stage were they are easier to handle. The children with DCD replace anticipatory monitoring with feedback monitoring, which makes movements both slower and more variable.

2.4.4. Behavioural section and motor performance

Wright *et al.* (1994) suggested a link between the child's behavioural profile and motor performance, and that this relationship may increase with age. The information obtained from section 5 of the MABC-CL adds to the developing picture of the child's movement difficulties and is useful when considering remedial treatment. In a study done by Dussart (1994:82), it was proposed that the results of the child's behaviour could be grouped to give one overall problem of behaviour. Sugden and Sugden (1990:344) also found a moderately strong relationship between the two divisions, namely sections 1 to 4 and section 5, of the checklist.

2.5. Intervention strategies for children with DCD

In a study done by Davidson and Williams (2000), it was concluded that DCD intervention, consisting of combined sensory integration and perceptual motor training, is likely to be ineffective at 12-month follow-up. Significant improvements were found only for fine motor skills and visual-motor integration. Research elsewhere has shown that untreated children would not be expected to demonstrate deterioration. Sims *et al.* (1996) as cited by Davidson and Williams (2000) showed an improvement in untreated controls using the Test of Motor Impairment (TOMI), while Polatajko *et al.* (1995) as cited by Davidson and Williams (2000) found no significant change in score on the TOMI among controls in process-oriented approaches to DCD. It has been suggested, however, that children with DCD benefit from treatment, whatever the specific components of the treatment, and that some children need longer treatment periods than others (Leemrijse *et al.*, 2000:256). Hadders-Algra (2000:712) concluded that intervention therapies for children with motor

dysfunction at an early age should focus on the provision of variable sensory-motor experiences and a shift to the provision of ample opportunities for active practice with increasing age. Leemrijse *et al.* (2000:256) concluded that children with DCD did better on rhythm-integration than sensory-integration intervention.

2.6. Summary

Five to ten percent of all school-aged children are diagnosed with DCD and most often lag behind their peers in all or some functional skills, due to a marked impairment in the development of the child's motor co-ordination. The criteria for determining the levels of clumsiness thus need to be specified when reporting the prevalence of clumsiness. The incidence of DCD together with its accompanying secondary problems shows that children suffering from this condition need help in the form of intervention. This literature review aims to provide more insight with regard to the use of the checklist among teachers in order to help in the identification of children with DCD.

From the literature review it is obvious that the usefulness of the MABC-CL, which is the focus of this study, remains questionable. Even though the checklist seems to be a useful screening device for children with DCD, there are a few pitfalls that need to be considered. The aspect of cultural differences among children has received much attention and seems to be one of the greatest issues regarding the validity and reliability of the checklist. The checklist items and norms don't seem to be appropriate for all cultures and seem to need modification. In this respect one needs to think in terms of South African children and the kind of activities they participate in. This in turn might give a better indication of the activities that should be included in the checklist. Environmental factors as well as socio-economic differences also play a role in motor development (Wright *et al.*, 1994:150). Children from impoverished social environments usually receive quantitatively less stimulation than children with a better social background (Hadders-Algra, 2000:711). Seeing that mainly third-world children were tested in this study, the effect of fewer stimulation opportunities might have an influence on their motor development.

Teacher knowledge is another important aspect which has been shown to influence the usefulness of the checklist. Research indicated that physical education teachers have greater insight in

completing the checklist than class teachers do, which can be explained by their greater knowledge and background of physical education. Within the South African context, this is definitely an important aspect to consider, regarding the fact that physical education teachers are no longer employed at schools. Many teachers are also found to have difficulties in answering some of the checklist questions, and it might therefore be necessary to choose items that are easily observable within a classroom context.

Even though the authors of the MABC state that the checklist can be used for screening, two studies that were completed after the MABC had been published (Wright & Sugden, 1996a,b and Piek & Edwards, 1997), did not support the validity of the checklist as a discriminative tool, as the checklist and the performance test did not identify the same group of children. Crawford *et al.* (2001:43) and Dewey and Wilson (2001:18) showed that different measures of motor functioning did not consistently identify children as DCD or non-DCD. According to Crawford *et al.* (2001:48), no one test can accurately identify DCD children or replace the clinical reasoning of multiple sources of information. Smits-Engelsman *et al.* (2001:164) further mentioned that norm-referenced tests are not sensitive or specific enough to measure the effects of intervention.

The subsections of the MABC-CL have also undergone detailed investigation in previous research papers. With regard to the difficulties of the checklist sections, consistent findings was obtained from several studies rating section 1 as having the lowest scores and therefore being the easiest section, followed in order by sections 2, 4 and 3. The level of difficulty was also found to vary according to which teacher (class or physical education teacher) assessed the child. Researchers have highlighted the existence of subgroups of DCD, emphasising the heterogeneity of this group and the importance of implementing particular teaching methods. Section 4 (child moving/environment stable) of the checklist was found most clearly to separate children with and without DCD, with the DCD child performing poorer on all four the sections of the checklist. Section 5 of the checklist, namely the behavioural section, has also been shown to add to the developing picture of the child and shows a definite correlation with the child's motor performance. Therefore, it seems as if each section of the checklist can help to understand the overall picture of the DCD child and his/her particular problems. This again could lead to better and more appropriate intervention strategies. It has been suggested that children with DCD benefit from treatment, whatever the specific components of the treatment (Leemrijse *et al.*, 2000:256).

With this literature study as a background, chapter three will present the results of the analyses of the suitability of the checklist in the North West Province.

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ARTICLE 1: SUITABILITY OF THE MABC CHECKLIST IN THE IDENTIFICATION OF 10 TO 12 YEAR OLD CHILDREN WITH DCD IN THE NORTH WEST PROVINCE

ABSTRACT

The aim of this study was to examine the suitability of the MABC checklist as a screening device in the identification of different problem areas. Model C and state-subsidized class teachers from 22 different schools were engaged in obtaining results for the MABC performance test and the MABC checklist for a total of four hundred and forty nine North West Province children of four different ethnic origins: white (n=67), black (n=338), Coloured (n=23) and Indian (n=21) children participated in this study. The Movement Assessment Battery for Children (MABC; Henderson & Sugden, 1992) was used for the assessment and classification of children with Developmental Co-ordination Disorder (DCD), consisting of a motor performance test (MABC-T) and a checklist (MABC-CL). After the children had been evaluated on the MABC-T, class teachers were asked to complete the standard MABC-CL for each of the children. These scores were then compared to the scores obtained in the MABC-T. One month after the MABC-CL had been returned, a second checklist was sent to each class teacher of a random selection of children (n=85) as a measure of test-retest reliability. Descriptive statistics, item- and factor analyses (Cronbach alpha, Eigen values and communalities) and correlation matrices were calculated using *Statistica for Windows*. The level of significance was set at $p<0,05$. The results suggested that the MABC-CL had good test-retest reliability and identified children with DCD to a limited degree. The effects of increasing task difficulty within the MABC-CL differed from other studies. The state-subsidized class teachers had more difficulty in completing the checklist compared to the Model C teachers. From the results obtained, it can be concluded that further research needs to be done concerning the reliability and validity of the MABC-CL, and teachers within a South African context need to be educated in the use of the checklist to ensure reliable results.

[Keywords: suitability, MABC checklist, screening, identification, Model C teachers, state subsidized teachers, 10 to 12 year old children, DCD, North West Province, reliability, South African context]

[Abbreviations: DCD: Developmental Co-ordination Disorder; MABC: Movement Assessment Battery for Children; MABC-T: Movement Assessment Battery for Children – Performance Test; MABC-CL: Movement Assessment Battery for Children – Checklist]

INTRODUCTION

The condition of Developmental Co-ordination Disorder (DCD) is a continuously growing interest in many countries among researchers. The manifestations of this disorder have been given many titles, with the term "clumsy" being the most prevalent. It has been estimated that 5–10% of all school-aged children are diagnosed with DCD (Wright & Sugden, 1996). Motor competence is an important determinant of a child's educational progress and general development. The ability to write legibly and with adequate speed becomes a prerequisite for note taking and examination performance, as well as for more general literacy skills (Smits-Engelsman *et al.*, 1998). Children with DCD, however, have difficulty performing co-ordinated movements and often lag behind their peers in all or some functional skills (e.g. writing). This greatly reduces their level of participation in everyday school activities. The movement difficulties together with the social, emotional and academic concomitants experienced during childhood normally continue to have an affect into teenage and adult years (Sugden & Sugden, 1990 & Wright & Sugden, 1996).

In the area of assessment, no single test is yet considered the "gold standard" and an effective screening device for DCD needs to be established. The Movement Assessment Battery for Children (MABC) (Henderson & Sugden, 1992) is the most widely used instrument with regard to the motor difficulties experienced by children. The MABC consists of a criterion-referenced checklist (MABC-CL), a normative-referenced motor performance test (MABC-T), and guidelines for remediation. The primary focus of the MABC-CL is the assessment and management of movement skill problems within an educational setting. Although suitable for therapists, it is designed mainly for use by primary school teachers in order to identify clumsy children, as well as the nature of the existing movement difficulty (Wright *et al.*, 1994).

The MABC-T was founded on normative data collected in the UK, Canada and the USA, with the final version being standardised on 1 000 American children (Smits-Engelsman *et al.*, 1998). However, motor development can to some extent be shaped by cultural demands and the kinds of activities children engage in are likely to differ from country to country (Rösblad & Gard, 1998). Besides cultural differences, environmental factors as well as socio-economic differences also play a role in motor development (Wright *et al.*, 1994). In addition, the cut-off points have not been consistent between instruments, resulting in a large variability in the incidence of DCD reported (Piek & Edwards, 1997). Also, the knowledge of teachers who have to complete the questionnaire regarding

children's motor development plays an important role as far as the reliability of the MABC-CL is concerned.

The specific aim in this study is to determine the suitability of the MABC-CL, completed by the teachers, in identifying children of the North West Province with DCD. This may help establish the suitability of the MABC-CL as a screening device in schools in identifying children "at risk" in the North West Province at an early stage, without the use of the lengthy MABC-T. Early intervention, which may follow the results of the MABC-CL, can minimise the long-term effects of DCD. This may also lead to more effective teaching methods and remedial programs in order to positively enhance the child's performance in everyday activities.

METHOD OF RESEARCH

Research design

A cross-sectional research design was used as the research method. The study formed part of the *Thusa Bana* multi-disciplinary research project (*Thusa* = Transition and Health during Urbanisation in South Africa; *Bana* = children) of the Faculty of Health Sciences of the Potchefstroom University for Christian Higher Education (PU for CHE) and was approved by the Ethics Committee (project number OOM10).

Subjects

In collaboration with a bio-statistician from the PU for CHE, a random sample of 44 schools was selected from a list of all the schools in the North West Province of South Africa. The sample was stratified for region (five regions in the Province), gender (male/female), type of school (high school/primary school) and predominant ethnic group. The stratification was based on the estimated number of pupils in each ethnic group. A random sample of 10-15 year old children (16 per age group: eight boys and eight girls) was selected from the class lists of the selected schools. Only the 10-12 year old boys and girls (N=449) from primary schools (n=22) were selected for this study and for 18,9% (n=85) the MABC-CL was completed twice for test-retest validity purposes. The nature and the scope of the study were explained to the children beforehand and written consent was granted by their parents for them to participate. Table 1 gives a detailed outline of the age, gender and race of the subjects included in this study. Two thirds of the children came from formerly disadvantaged schools and from

very remote rural areas. As the North West is considered the province with the highest percentage of unqualified teachers (Joubert, 2001), their knowledge and experience concerning the assessment of a child's motor development was classified according to the type of school at which they were teaching. Teachers appointed at former Model C schools were considered better qualified than teachers from state-subsidized schools.

TABLE 1. The number of children per age, gender and ethnic group used for testing and retesting purposes.

Age	Male				Female				Total
(year)	White	Black	Coloured	Indian	White	Black	Coloured	Indian	(N)
10	11	41	5	2	11	54	4	5	133
11	11	56	5	3	10	56	4	4	149
12	14	72	3	5	10	59	2	2	167
Total	36	169	13	10	31	169	10	11	**449**
♣10	0	7	5	2	2	9	3	5	33
♣11	0	6	4	0	2	10	4	0	26
♣12	2	11	1	1	2	8	1	0	26
♣Total	2	24	10	3	6	27	8	5	**85**

♣= Retest

Procedure

The Movement Assessment Battery for Children (MABC) (Henderson & Sugden, 1992), consisting of a motor performance test (MABC-T) and a checklist (MABC-CL), was used for this study. The MABC-T was administered individually and assesses the child's movement abilities. It consists of three tests of *Manual Dexterity*, two tests of *Ball Skills*, and three tests of *Static and Dynamic Balance*. A total impairment score is derived from performance in these three sections, which can classify the child as having DCD or not. Performance lower than the 15th percentile was scored as moderate DCD and below the 5th percentile as severe DCD. The MABC-T has shown to have moderate to good validity and reliability (Wright & Sugden, 1996a; Crawford *et al.*, 2001; Smits-Engelsman, 2001; Tan *et al.*, 2001). From the validity and reliability studies done by Henderson and Sugden (1992), the test-retest reliability at any age was found to be r=0,75 and inter-tester reliability was found to be r=0,70.

The MABC-CL measures a child's movement within the environment and should preferably be completed by the child's class teacher or parent. It contains 60 items grouped into five sections: Child Stationary/Environment Stable; Child Moving/Environment Stable; Child Stationary/Environment

Moving; Child Moving/Environment Moving; and a Behavioural Component. The responses to each of the questions in sections 1-4 are scored on a four-point scale: (0) "Very Well", (1) "Just OK", (2) "Close" and (3) "Not Close". There are three response alternatives for section five that refer to the frequency with which the child displays the behaviour: (0) "Rarely", (1) "Occasionally" and (2) "Often". Scores of each subsection are totalled, and scores in excess of 35 are regarded to indicate Developmental Co-ordination Disorder (DCD) (Table 1, Chapter 2). The correlation between the MABC-T and the MABC-CL was found to be $r=0,66$ where $p<0,001$ (Henderson & Sugden, 1992).

After the child had been evaluated on the MABC-T, the class teachers were asked to complete the MABC-CL for each of the children tested on the MABC-T. The class teacher, indicated by the child as being his or her guardian teacher, completed the MABC-CL. The checklists were left with the teachers for approximately two weeks, after which they had to be returned to the headmaster, who then posted it back to the researchers in pre-addressed envelopes. No instructions other than an accompanying letter explaining the purpose of the MABC-CL were given beforehand, and no cut-off points were specified, in order to minimize bias. The total checklist score was then compared to the score obtained by the child in the MABC-T. One month after the MABC-CL had been returned (to avoid duplication of memory), a second MABC-CL was sent to each class teacher of a random selection of children from the total group as a measure of test-retest reliability. Checklists considered faulty were discarded.

Statistical Analysis of the Data

The *Statistica for Windows* computer package of the PU for CHE (Statsoft Inc, 1999) was used for all data processing. Descriptive statistics were calculated by means of the mean (M), standard deviation (SD) and maximum (max) and minimum (min) values. The statistical significance was set at a p-level of $\leq 0,05$. For reliability purposes, the Cronbach alpha, Eigen values and communalities were calculated by using item and factor analysis. Extraction was obtained by means of principal components. Interrelationships (r) were calculated by means of correlation matrices.

RESULTS

Class teachers from 22 different schools were engaged in obtaining results for the MABC-T and the MABC-CL for a total of 448 children (217 boys and 231 girls). Different steps were followed to analyse the suitability of the MABC-CL. The first step was to determine the validity and reliability of

the MABC-CL as a screening device, by doing a test-retest analysis of the teachers in completing the checklists. Secondly, an item analysis of each of the five sections was performed as a first step towards identifying whether the teachers were competent and reliable in completing these sections, after which construct validity of each section was determined. Thirdly, relationships between the MABC-CL and MABC-T were established in order to determine if the two instruments identify the same problem areas and children, and lastly the mean scores for children classified without DCD, with moderate and with severe DCD were compared.

TABLE 2. A correlation matrix (R) of the different variables of the MABC-CL during testing (N=449) and retesting [n=85 (all subjects); n=5 (Model C subjects only)]

Variable	R CSES	R CMES	R CSEC	R CMEC	R CLBP	R CLTot	R CS ES	R CMES	R CSEC	R CMEC	R CLBP	R CLTot
	All Subjects (n=85)						Subjects from model C schools (n=5)					
T CS ES	0.72*						0.80					
T CM ES	0.66*	0.62*					0.49	0.67				
T CS EC	0.60*	0.60*	0.68*				0.43	0.71	0.73			
T CM EC	0.63*	0.62*	0.62*	0.67*			0.73	0.84	0.85	0.85		
T BP	0.39*	0.35*	0.38*	0.40*	0.67*		0.43	0.23	0.21	0.21	0.98*	
T CL Total	0.68*	0.64*	0.62*	0.66*	0.42*	0.69*	0.85	0.86	0.86	0.87	0.27	0.87

* = p≤ 0,05; T=Test; R=Retest; Correlation= ,1= low; Correlation= ,3= moderate; Correlation= ,5= high (Cohen, 1988)

With regard to the test-retest reliability of the teachers completing the MABC-CL, Table 2 shows the results. According to the significant relationships found for each of the variables as shown in Table 2, the MABC-CL proved to be a reliable tool to use. This indicates that the teachers completed the second MABC-CL in approximately the same manner as the first MABC-CL, which had been completed a month earlier. Section 1 of the MABC-CL and the checklist score showed the highest (r=0,72) and second highest (r=0,69) test-retest reliability respectively, followed by the behavioural score (r=0,67). When only the results obtained for the teachers of Model C schools were considered, higher test-retest correlations were found for all the sections.

The results of the item analysis and construct validity are presented in Tables 3–8. Table 3 shows the results of the item analysis of each section for the total group (N=448). Question 7 (cut/draw/trace with precision) of section 1, which mainly assesses manual dexterity competency where the child and the environment are stable, showed the lowest overall correlation (r=0,32) with the total of section 1, while question 8 (form letters, numbers, shapes) showed the highest correlation with the

total of section 1 (r=0,75). Even though question 7's correlation with the total of section 1 is low when compared to the other questions, it is not low enough to warrant rejection of the question. It can be assumed that the teachers relied on observational skills rather than on facts to assess question 7, therefore substantiating the reliability of teachers in this regard. However, a Cronbach alpha value (a technique used in estimating reliability of multiple trial tests; Thomas & Nelson, 1996) of 0,89 indicates that the content of section 1 of the MABC-CL has good internal consistency, although to a lesser degree than the rest of the sections (Table 3).

TABLE 3. Summary of the item analysis of sections 1 to 5 of the MABC-CL multiple trial for the total group (N=448)

CL Section and Questions	Item - Total Correlation	Alpha if deleted	CL Section and Questions	Item - Total Correlation	Alpha if deleted	CL Section and Questions	Item - Total Correlation	Alpha if deleted
CL S1 Q1	0.58	0.88	CL S2 Q1	0.64	0.92	CL S3 Q1	0.99	1.00
CL S1 Q2	0.65	0.87	CL S2 Q2	0.68	0.92	CL S3 Q2	0.99	1.00
CL S1 Q3	0.66	0.87	CL S2 Q3	0.70	0.92	CL S3 Q3	0.99	1.00
CL S1 Q4	0.70	0.87	CL S2 Q4	0.70	0.92	CL S3 Q4	0.99	1.00
CL S1 Q5	0.73	0.87	CL S2 Q5	0.75	0.92	CL S3 Q5	0.99	1.00
CL S1 Q6	0.73	0.87	CL S2 Q6	0.75	0.92	CL S3 Q6	0.99	1.00
CL S1 Q7	0.32	0.93	CL S2 Q7	0.67	0.92	CL S3 Q7	0.99	1.00
CL S1 Q8	0.75	0.87	CL S2 Q8	0.73	0.92	CL S3 Q8	0.99	1.00
CL S1 Q9	0.65	0.87	CL S2 Q9	0.66	0.92	CL S3 Q9	0.99	1.00
CLS1Q10	0.71	0.87	CLS2Q10	0.65	0.92	CLS3Q10	0.99	1.00
CLS1Q11	0.74	0.87	CLS2Q11	0.66	0.92	CLS3Q11	1.00	1.00
CLS1Q12	0.65	0.87	CLS2Q12	0.64	0.92	CLS3Q12	0.99	1.00
CL S4 Q1	0.99	1.00	CL S5 Q1	0.99	1.00			
CL S4 Q2	0.99	1.00	CL S5 Q2	0.99	1.00			
CL S4 Q3	0.99	1.00	CL S5 Q3	0.99	1.00			
CL S4 Q4	0.99	1.00	CL S5 Q4	0.99	1.00			
CL S4 Q5	0.99	1.00	CL S5 Q5	0.99	1.00			
CL S4 Q6	1.00	1.00	CL S5 Q6	0.99	1.00			
CL S4 Q7	0.99	1.00	CL S5 Q7	0.99	1.00			
CL S4 Q8	0.99	1.00	CL S5 Q8	0.99	1.00			
CL S4 Q9	0.99	1.00	CL S5 Q9	0.99	1.00			
CLS4Q10	1.00	1.00	CLS5Q10	0.99	1.00			
CLS4Q11	0.99	1.00	CLS5Q11	0.99	1.00			
CLS4Q12	0.99	1.00	CLS5Q12	0.99	1.00			

Cronbach alpha: 0,885001 (Section 1); Cronbach alpha: 0,925302 (Section 2); Cronbach alpha: 0,999081 (Section 3); Cronbach alpha: 0,999021 (Section 4); Cronbach alpha: 0,998889 (Section 5)

Section 2 involves situations where the child needs to move competently within a stable environment. Questions 1 (walking while avoiding collision) and 12 (understanding of directional commands) of section 2, which assess mainly ambulatory and spatial orientation skills, showed the lowest correlations (r=0,64) with the total of section 2, while questions 5 (hop in controlled manner on

either foot) and 6 (jump across/over obstacles) showed the highest correlations with the total of section 2 (r=0,75). Again it can be assumed that questions 1 and 12 of section 2 are not as easily observable within a class situation and that the teachers merely guessed the children's capabilities in this regard. However, a Cronbach alpha value of 0,93 (Table 3) for this section indicates good internal consistency.

Sections 3 and 4 involve activities where the child is stationary and the environment is changing, or where the child is moving and the environment is changing. The questions in these sections are provided with examples that mainly involve motor activities. Section 5 evaluates behavioural problems related to motor difficulties. Results obtained for the completed sections 3 to 5 of the MABC-CL showed very high correlations with the totals of each section. The Cronbach alpha values of 1,00 for sections 3 to 5 indicate that these sections have near perfect internal consistency. These values seemed unrealistic, as literature (Mon-Williams *et al.*, 1994 & Wright *et al.*, 1994) indicates that teachers considered these sections more difficult to assess than the first two sections. To evaluate this suspicion, it was decided to obtain a separate item analysis for the assessment of the subjects of the former Model C schools (or former white schools where only qualified teachers could be appointed) (Table 4), and the remaining subjects who came from predominantly disadvantaged and rural communities, where the qualifications and the knowledge of the teachers with regard to the questions asked are more doubtful (Table 5), and to compare these results. The results obtained for the teachers from state schools, considered less knowledgeable and qualified (Table 5), substantiate what the researchers suspected (discussion follows later).

Table 4 shows that question 1 (put on and take off articles of clothing) of section 1 had the lowest correlation (r=0,48) with the total of section 1, while question 10 (use blocks, beads, puzzle pieces) showed the highest correlation with the total of section 1 (r=0,80). Changing clothing is not as easy assessable as the manual dexterity-related questions of this section and the teachers assumingly have to rely more on observational skills and not so much on facts, thus substantiating the reliability of teachers in this regard. Even though question 1's correlation with the total of section 1 is lower when compared to the other questions, it is not low enough to warrant rejection of the question. Furthermore, a Cronbach alpha value of 0,92 indicates that the content of section 1 has good internal consistency, and compared to the 0,89 value of all the subjects (Table 3) and 0,87 of Table 5 (state-subsidized schools), this value was also higher. Table 5 (less qualified teachers) indicates question 7 (cut, draw, trace with precision) to have the lowest overall correlation (r=0.30) (many of these schools do not have appropriate equipment, like scissors, tracing paper and colouring pencils, which complicates the

assessment of this question), while question 8, which assesses everyday tasks in the classroom (forming letters, numbers and shapes), showed the highest correlation with the total of section 1 (r=0,75).

In spite of the low correlation of question 7, it was not low enough to warrant rejection of the question. Furthermore, the Cronbach alpha value of 0,87 (Table 5) indicates that the content of section 1 of the MABC-CL has good internal consistency, though to a lesser degree than the rest of the sections. Both groups of teachers are therefore considered to be able to interpret the questions, although the more qualified teachers are considered to be more correct.

TABLE 4. Summary of an item analysis of sections 1 to 5 of the MABC-CL multiple trial for the Model C school subjects (n=56)

CL Section and Questions	Item - Total Correlation	Alpha if deleted	CL Section and Questions	Item - Total Correlation	Alpha if deleted	CL Section and Questions	Item - Total Correlation	Alpha if deleted
CL S1 Q1	0.48	0.92	CL S2 Q1	0.66	0.95	CL S3 Q1	0.64	0.95
CL S1 Q2	0.72	0.91	CL S2 Q2	0.61	0.95	CL S3 Q2	0.64	0.95
CL S1 Q3	0.53	0.92	CL S2 Q3	0.86	0.95	CL S3 Q3	0.82	0.94
CL S1 Q4	0.70	0.92	CL S2 Q4	0.90	0.94	CL S3 Q4	0.85	0.94
CL S1 Q5	0.76	0.91	CL S2 Q5	0.90	0.94	CL S3 Q5	0.66	0.95
CL S1 Q6	0.64	0.92	CL S2 Q6	0.84	0.95	CL S3 Q6	0.75	0.94
CL S1 Q7	0.70	0.91	CL S2 Q7	0.80	0.95	CL S3 Q7	0.76	0.94
CL S1 Q8	0.74	0.91	CL S2 Q8	0.87	0.94	CL S3 Q8	0.85	0.94
CL S1 Q9	0.74	0.91	CL S2 Q9	0.68	0.95	CL S3 Q9	0.84	0.94
CLS1Q10	0.80	0.91	CLS2Q10	0.74	0.95	CLS3Q10	0.82	0.94
CLS1Q11	0.74	0.91	CLS2Q11	0.81	0.95	CLS3Q11	0.85	0.94
CLS1Q12	0.69	0.91	CLS2Q12	0.58	0.95	CLS3Q12	0.66	0.95
CL S4 Q1	0.95	0.93	CL S5 Q1	0.45	0.85			
CL S4 Q2	0.58	0.93	CL S5 Q2	0.61	0.84			
CL S4 Q3	0.55	0.93	CL S5 Q3	0.60	0.84			
CL S4 Q4	0.62	0.93	CL S5 Q4	0.53	0.84			
CL S4 Q5	0.76	0.93	CL S5 Q5	0.24	0.86			
CL S4 Q6	0.90	0.92	CL S5 Q6	0.69	0.83			
CL S4 Q7	0.72	0.93	CL S5 Q7	0.77	0.82			
CL S4 Q8	0.83	0.92	CL S5 Q8	0.60	0.87			
CL S4 Q9	0.83	0.92	CL S5 Q9	0.55	0.84			
CLS4Q10	0.77	0.93	CLS5Q10	0.72	0.83			
CLS4Q11	0.75	0.93	CLS5Q11	0.65	0.83			
CLS4Q12	0.61	0.93	CLS5Q12	0.41	0.85			

Cronbach alpha: 0,921543; Cronbach alpha: 0,952234; Cronbach alpha: 0,947241; Cronbach alpha: 0,933361; Cronbach alpha: 0,853886

Questions 1 (walking and avoiding collision) and 10 (throwing an object into a container) of section 2 showed the lowest correlations (r=0,63) with the total of section 2, while question 6 (jump over/across obstacles) showed the highest correlation (r=0,73). Section 2 has a Cronbach alpha value of

0,92, which indicates good internal consistency. Results obtained for the completed sections 3 to 5 of the MABC-CL showed very high correlations with the totals of each section. The Cronbach alpha values of 1,00 for sections 3 to 5 indicate that these sections have near perfect internal consistency. It is quite obvious how similar the item analysis results for the total group and the group excluding the assessments of teachers from Model C schools are. Seeing that both of these groups have shown sections 3 to 5 of the MABC-CL to have very high correlations and near perfect Cronbach alpha values, it does pose the question whether these results may well reflect on teacher knowledge. It seems as though the teachers just gave up and simply completed the questionnaires without truly assessing the children.

The results obtained for the teachers of the Model C schools only with regard to section 2 (Table 4) seem to be more realistic concerning the correlation and Cronbach alpha values, which

TABLE 5. Summary of an item analysis of sections 1 to 5 of the MABC-CL multiple trial for the subjects not attending former Model C schools (n=392)

CL Section and Questions	Item - Total Correlation	Alpha if deleted	CL Section and Questions	Item - Total Correlation	Alpha if deleted	CL Section and Questions	Item - Total Correlation	Alpha if deleted
CL S1 Q1	0.58	0.87	CL S2 Q1	0.63	0.92	CL S3 Q1	0.99	1.00
CL S1 Q2	0.63	0.87	CL S2 Q2	0.68	0.91	CL S3 Q2	0.99	1.00
CL S1 Q3	0.66	0.86	CL S2 Q3	0.68	0.91	CL S3 Q3	0.99	1.00
CL S1 Q4	0.69	0.86	CL S2 Q4	0.67	0.91	CL S3 Q4	1.00	1.00
CL S1 Q5	0.72	0.86	CL S2 Q5	0.72	0.91	CL S3 Q5	0.99	1.00
CL S1 Q6	0.72	0.86	CL S2 Q6	0.73	0.91	CL S3 Q6	0.99	1.00
CL S1 Q7	0.30	0.93	CL S2 Q7	0.64	0.91	CL S3 Q7	0.99	1.00
CL S1 Q8	0.75	0.86	CL S2 Q8	0.71	0.91	CL S3 Q8	0.99	1.00
CL S1 Q9	0.64	0.87	CL S2 Q9	0.66	0.91	CL S3 Q9	1.00	1.00
CLS1Q10	0.70	0.86	CLS2Q10	0.63	0.92	CLS3Q10	0.99	1.00
CLS1Q11	0.73	0.86	CLS2Q11	0.64	0.91	CLS3Q11	1.00	1.00
CLS1Q12	0.65	0.87	CLS2Q12	0.66	0.91	CLS3Q12	0.99	1.00
CL S4 Q1	0.99	1.00	CL S5 Q1	0.99	1.00			
CL S4 Q2	0.99	1.00	CL S5 Q2	0.99	1.00			
CL S4 Q3	0.99	1.00	CL S5 Q3	0.99	1.00			
CL S4 Q4	0.99	1.00	CL S5 Q4	0.99	1.00			
CL S4 Q5	0.99	1.00	CL S5 Q5	0.99	1.00			
CL S4 Q6	1.00	1.00	CL S5 Q6	0.99	1.00			
CL S4 Q7	1.00	1.00	CL S5 Q7	0.99	1.00			
CL S4 Q8	0.99	1.00	CL S5 Q8	0.99	1.00			
CL S4 Q9	0.99	1.00	CL S5 Q9	0.99	1.00			
CLS4Q10	1.00	1.00	CLS5Q10	0.99	1.00			
CLS4Q11	0.99	1.00	CLS5Q11	0.99	1.00			
CLS4Q12	0.99	1.00	CLS5Q12	1.00	1.00			

Cronbach alpha: 0,877736; Cronbach alpha: 0,920133; Cronbach alpha: 0,999133; Cronbach alpha: 0,999094; Cronbach alpha: 0,999075

indicates that these teachers have more knowledge to assess the children using the questions of the MABC-CL. For these teachers, question 12 (understanding of directional commands) showed the lowest correlation (r=0,58) with the total of section 2, while questions 4 (skip or gallop) and 5 (hop in controlled manner on either foot) showed the highest correlations with the total (r=0,90). It is difficult evaluating a child's directionality within a classroom, and again the teachers would have to rely more on observational skills rather than factual certainty. Section 2 has the highest Cronbach value of all the sections (0,95) and is therefore considered the section with the best internal consistency.

With regard to section 3 (Table 4), questions 1 (passing objects down a line) and 2 (maintaining a stable position within a group activity) showed the lowest correlations (r=0,64) with the total of section 3, while questions 4 (catching a ball with two hands), 8 (rolling a ball for a moving child to stop or catch), and 11 (turning a rope with sufficient force and accuracy) showed the highest correlations with the total of section 3 (r=0,85). A Cronbach alpha value of 0,94 for Section 3 of the MABC-CL indicates good internal consistency when used by teachers of Model C schools.

Question 3 (ride moving vehicles) of section 4 (Table 4) showed the lowest correlation (r=0,55) with the total of section 4 (this question is somewhat confusing as it could refer to pedal cars, tricycles and scooters, and this skill is not easily assessed within a classroom setting), while question 1 (move around the classroom while avoiding collision) showed the highest correlation. A Cronbach alpha value of 0,93 for section 4 of the MABC-CL indicates good internal consistency. It was also found the most difficult by other studies.

Question 5 (impulsive) of section 5 (Table 4) showed the lowest correlation (r=0,24) with the total of section 5, whereas question 7 (disorganized, confused) showed the highest correlation (r=0,77). A Cronbach alpha value of 0,85 for section 5 of the MABC-CL indicates good internal consistency, although to a lesser degree when compared to the other sections. Section 5 assesses behavioural aspects, all of which are not necessarily always present in one child.

Tables 6 (Eigen values) and 7 (Communalities) show the results obtained for determining construct validity (degree to which a test measures a hypothetical construct; usually established by relating to test results in some behaviour; Thomas & Nelson, 1996) for Model C and state subsidized schoolteachers respectively. These results are considered to indicate good construct validity, with sections 3 and 4 showing the highest construct validity of all the sections. Of the three factors that were

identified for section 1, factor 1 explained 55,6% of the variance, while factor 2 (12,2%) and 3 (8,6%) had low contributions to the variance. High intercorrelations between the items of section 2 might explain why no factors were identified for this section. One factor for section 3 explaining 65,2% of the variance was identified, with its thus having the highest construct validity of all the sections. The first factor identified for section 4 explained 58,7% of the variance, while the second factor explained 10,9% of the variance. Three factors were identified for the last section of the MABC-CL, of which factor 1 explained 41,3%, factor 2 explained 18,2% and factor 3 explained 9,6% of the variance. In all the sections, factor 1 explained a high percentage of the variance; therefore it can be assumed that all the sections had good construct validity. When the group representing the state-subsidized schools was considered, similar results to those of the total group (Table 3) were found. This substantiates the above findings obtained with the item analysis.

TABLE 6. Eigen values

	Model C Schools (n=56)				Sate Subsidized Schools (n=392)			
CL Section	Step	Eigen val.	% Total variance	Cumul. %	Step	Eigen val.	% Total variance	Cumul. %
1	1	6.7	55.6	55.6	1	6.5	53.8	53.8
	2	1.5	12.2	67.8	2	1.1	9.4	63.3
	3	1.0	8.6	76.4				
2	-	-	-	-	1	6.4	53.4	53.4
					2	1.1	9.4	62.9
3	1	7.8	65.2	65.2	1	11.9	99.1	99.1
4	1	7.0	58.7	58.7	1	11.9	99.0	99.0
	2	1.3	10.9	69.6				
5	1	5.0	41.3	41.3	1	11.9	99.0	99.0
	2	2.2	18.2	59.6				
	3	1.1	9.6	69.1				

Seeing that the teachers from the state-subsidized schools were not considered competent in assessing sections 3–5 of the MABC-CL, their results were excluded from the following analysis. Only the results obtained from the teachers of the Model C schools will therefore be used in the discussions that follow.

Table 8, which shows the intercorrelations, shows moderate but non-significant correlations between the CL total and the subsections and MABC-T. The CL total showed moderately significant correlations with manual dexterity (r=0,28), ball skills (r=0,35) and with the MABC total (r=0,33). The

balance subsection showed a lower correlation with the CL total (r=0,22), as well as with the other sections. Section 1 of the CL showed a moderate correlation (r=0,29) with the manual dexterity total, ball skills with sections 4 and 5, and the MABC total with section 4 of the CL. These results indicate a moderate relationship between the totals of the two instruments.

TABLE 7. Communalities

CL Section and Question	r Model C subjects (n=56)	R State Subs. subjects (n=391)	CL Section and Question	r Model C subjects (n=56)	R State Subs. subjects (n=391)	CL Section and Question	r Model C subjects (n=56)	R State Subs. subjects (n=391)
S1:Q1	0.66	0.73	S2:Q1	-	0.76	S3:Q1	0.48	0.99
S1:Q2	0.69	0.72	S2:Q2	-	0.78	S3:Q2	0.50	0.99
S1:Q3	0.80	0.73	S2:Q3	-	0.77	S3:Q3	0.72	0.99
S1:Q4	0.66	0.57	S2:Q4	-	0.54	S3:Q4	0.79	0.99
S1:Q5	0.82	0.64	S2:Q5	-	0.61	S3:Q5	0.50	0.99
S1:Q6	0.66	0.63	S2:Q6	-	0.64	S3:Q6	0.62	0.99
S1:Q7	0.86	0.34	S2:Q7	-	0.62	S3:Q7	0.63	0.99
S1:Q8	0.87	0.73	S2:Q8	-	0.61	S3:Q8	0.78	0.99
S1:Q9	0.80	0.59	S2:Q9	-	0.61	S3:Q9	0.78	0.99
S1:Q10	0.84	0.69	S2:Q10	-	0.59	S3:Q10	0.74	0.99
S1:Q11	0.75	0.68	S2:Q11	-	0.50	S3:Q11	0.78	0.99
S1:Q12	0.77	0.56	S2:Q12	-	0.52	S3:Q12	0.50	0.99
CL Section and Question	r Model C subjects (n=56)	R State Subs, subjects (n=391)	CL Section and Question	r Model C subjects (n=56)	R State Subs, subjects (n=391)			
S4:Q1	0.62	0.99	S5:Q1	0.77	0.99			
S4:Q2	0.76	0.99	S5:Q2	0.73	0.99			
S4:Q3	0.47	0.99	S5:Q3	0.76	0.99			
S4:Q4	0.44	0.99	S5:Q4	0.49	0.99			
S4:Q5	0.84	0.99	S5:Q5	0.71	0.99			
S4:Q6	0.87	0.99	S5:Q6	0.63	0.99			
S4:Q7	0.62	0.99	S5:Q7	0.71	0.99			
S4:Q8	0.76	0.99	S5:Q8	0.82	0.99			
S4:Q9	0.78	0.99	S5:Q9	0.76	0.99			
S4:Q10	0.77	0.99	S5:Q10	0.70	0.99			
S4:Q11	0.81	0.99	S5:Q11	0.55	0.99			
S4:Q12	0.62	0.99	S5:Q12	0.67	0.99			

* = p ≤ 0,05 ; T=Test; R=Retest; Correlation= 0,1= low; Correlation= 0,3= moderate; Correlation= 0,5= high (Cohen, 1988)

A comprehensive analysis of the results obtained with the MABC-CL, as shown in Table 9, demonstrates a higher than expected prevalence of Developmental Co-ordination Disorder (DCD) in comparison with other studies that have been done (5-10%) (Wright & Sugden, 1996a:358). Eleven (19,64%) of the 56 children were identified by the MABC-CL as having moderate (n=7) to severe (n=4) movement co-ordination difficulties. The higher mean scores in all the subsections of these children classified with DCD, and the higher means derived by the severe DCD group compared to the

moderate group, indicate a greater degree of performance difficulties among them. Also, it is possible that the present incidence overestimated the prevalence of motor co-ordination problems, as borderline cases (moderate DCD group, n=7) were included in the sample of clumsy children.

TABLE 8. Intercorrelations (R) between the different variables of the MABC-CL and subtests of the MABC-T for Model C subjects only (N=56)

CL Section	MD Total	Ball skills Total	Balance Total	MABC Total	MABC Class,
CL CS ES	0.29				
CL CM ES	0.18	0.14			
CL CS EM	0.25	0.24	0.13		
CL CM EM	0.27	0.34	0.19	0.31	0.24
CL BP	0.10	0.27	0.06	0.13	0.07
CL Total	0.28	0.35	0.22	0.33	0.23

* = p < 0,05

If only the children classed with severe DCD are considered (n=4), the prevalence rate is significantly lower (7,14%). However, 35,0% (n=100) was classified with DCD with the MABC-T, which indicates that the teachers, who are considered more knowledgeable in using the checklist for the classification of DCD children, were unable to identify nearly half of these children identified with the MABC-T by their observation of their motor competency. From the results it is clear that the relationship between the MABC-CL and the MABC-T (r=0,33), is lower than was indicated in the literature (r=0.66) (Henderson & Sugden, 1992:191). There seems to be a good agreement between the checklist and the motor test results of the MABC for children with more severe problems (Sugden & Sugden, 1990:339 & Sugden & Sugden, 1992 as cited by Mon-Williams, 1994:176). However, the checklist identifies some children who are not confirmed by the MABC-T.

The relatively high rate of children identified with the MABC-CL as having DCD can most probably be due to several reasons: insufficient knowledge of class teachers, especially with regard to the questions asked about children's motor performance, or a higher percentage of motor co-ordination difficulties among the white North West children in comparison with children in other countries. These discrepancies with incidences reported in the literature suggest that the criteria for determining the levels of clumsiness need to be clearly specified when reporting the prevalence of clumsiness.

Sugden and Sugden (1992), compilers of the MABC-CL, assumed children's scores on the checklist to increase from section 1 to 4, because of increasing demands with regard to their motor competency. Results of several other studies (Wright & Sugden, 1994), however, did not agree with the above-mentioned pattern and showed the order to be sections 1, 2, 4 and then 3. In this study, the order

TABLE 9. Descriptive information on the different subsections of the MABC-CL for the Model C subjects only

MABC-CL Score	Classification	N	M	D♣	SD	Min	Max
Subsection (CS, ES)	Total group	56	4.04	17.78	4.79	0.00	21.00
	Moderate DCD ¤	7	8.57	9	4.20	0.00	12.00
	Severe DCD ¤¤	4	13.25		5.74	8.00	21.00
Subsection 2 (CM, ES)	Total group	56	5.84	19.70	5.38	0.00	18.00
	Moderate DCD¤	7	10.29		4.54	0.00	12.00
	Severe DCD¤¤	4	15.25	9	2.50	12.00	18.00
Subsection 3 (CS, EC)	Total group	56	5.07	20.36	5.08	0.00	19.00
	Moderate DCD¤	7	11.43		0.53	11.00	12.00
	Severe DCD¤¤	4	14.00		3.37	12.00	19.00
Subsection 4 (CM, EC)	Total group	56	5.23	21.23	5.27	0.00	23.00
	Moderate DCD¤	7	11.71		1.38	10.00	14.00
	Severe DCD¤¤	4	14.75	9	5.56	11.00	23.00
Subsection 5 (BP)	Total group	56	9.41	21.66	5.42	1.00	21.00
	Moderate DCD¤	7	16.57		3.95	9.00	21.00
	Severe DCD¤¤	4	14.50	5	3.42	11.00	19.00
MABC-CL total score	Total group	56	20.46	81.08	18.00	0.00	79.00
	Moderate DCD¤	7	44.29		4.57	36.00	48.00
	Severe DCD¤¤	4	57.25	37	14.50	50.00	79.00

CS, ES=Child Stationary/Environment Stable; CM, ES=Child Moving/Environment Stable; CS, EC=Child Stationary/Environment Changing; CM,EC=Child Moving/Environment Changing; BP=Behavioural Profile
¤= Total MABC-CL score ≥ 35, ¤¤= Total MABC-CL score ≥ 50;♣= Added mean calculated between the DCD group and total group

of difficulty according to the scores obtained in the MABC-CL varied from all the above, with the order being 1, 3, 4, and 2 for the total group (M=4,04, 5,07, 5,23, 5,84); 1, 2, 3, and 4 for the moderate DCD group (M=8,51, 10,29, 11,43, 11,71) and 1, 3, 4, and 2 for the severe DCD group (13,25, 14,00, 14,75, 15,25, Table 9). The first section identified the least problems among the children, which is in accordance with all the other studies, followed by sections 3 and 4, while section 2 indicated the most movement difficulties (child moving, environment stable). For the moderate DCD group, however, the

order of difficulty was in accordance with Sugden and Sugden's (1992) finding, namely from section 1 to 4.

The results in Table 9 regarding differences between children with and without DCD further showed that section 5 and then 4 most clearly distinguished between children with DCD and children without motor co-ordination difficulties (point difference=21,66, 21,23). This finding correlates with a study done by Wright and Sugden (1994), where section 4 was shown to distinguish most clearly children with and without DCD.

DISCUSSION

From the results presented with regard to the reliability of the MABC-CL, the following surfaced: The class teachers of the different schools were found to experience difficulty in the completion of the MABC-CL and several checklists were incomplete or completed incorrectly (only scoring 1's or use of tracing paper), especially among the teachers from the state-subsidized schools. This might be explained by a lack of knowledge concerning several MABC-CL items, or simply a lack of time or motivation. Similarly, in a study done by Smyth and Mason (1997), some teachers were unwilling to complete the checklist, either because of the time required, or because the age of the children made some of the checklist items inappropriate in the teacher's view. The teachers were also found to experience greater difficulty with the items involving motor activities, since physical education teachers are no longer part of the school curriculum and class teachers do not have sufficient knowledge on the topic.

In a study done by Wright *et al.* (1994), the teachers also had difficulty completing the checklist, since the movements or activities were not commonly performed within their schools. In this study, thirty percent of the teachers were unable to comment upon the children's ability to use blocks, beads or puzzle pieces, and nearly 50% were unable to answer whether the child could ride moving vehicles such as pedal cars, scooters or bikes, according to Wright *et al.* (1994). In a study done by Mon-Williams *et al.* (1994), the teachers had to make special arrangements to observe the children in the situations required for Sections 2, 3 and 4 of the checklist. Several studies (Piek & Edwards, 1997) also pointed out the need for teachers using the checklist to have the children for both classroom activities and physical activities or for class and physical education teachers to combine their knowledge when the students did not have one teacher for both activities. All of these problems may

also have been experienced by teachers in our study, as all the subjects were between 9 and 12 years of age, and many of the items were not relevant to this age group, especially in disadvantaged communities where certain apparatus is not as readily available. This suggests that the two sets of teachers may have used different criteria for determining the movement status of the child.

CONCLUSIONS

According to the results of this study, the MABC-CL is useful in the identification of children with DCD in the North West Province, but cannot be used effectively by all teachers in the North West Province, for various reasons. Most of the teachers who were asked to complete the checklists had little or no qualifications or physical education background, making it hard to interpret and assess the children on the checklist concerning these aspects of their development. These results suggest that it could be useful in future research to educate the teachers better by explaining the importance and procedure of the MABC-CL correctly beforehand, as well as to ensure that they have sufficient knowledge concerning the contents of the MABC-CL and the assessing thereof. It was obvious that teachers from public/state-subsidized schools had more difficulty completing the MABC-CL than teachers from Model C schools, once again because of a lack of knowledge and information. If the MABC-CL has to be completed by such teachers, extra attention should be paid to assure that they know how to use the tool correctly. It is further recommended that only sections 1 and 5 of the MABC-CL should be used in the assessment of children with motor difficulties, as these two sections have been shown to have the best validity and reliability, and class teachers have more knowledge concerning the items in these sections. It would also solve the problem of timesaving, as many teachers have found the completion of the checklist too time-consuming. It might also be necessary to examine what questions exactly cause the teachers the most difficulty and revise the checklist accordingly.

Teacher insight and knowledge are thus an important aspect when considering the usefulness of the MABC checklist. With the ever-decreasing number of physical education teachers in the South African school system, together with the fact that in the North West Province the highest number of unqualified teachers are employed in posts for which they are not trained (Joubert, 2001), the question arises whether the class teacher has sufficient background and knowledge concerning the child's motor development and performance in order to interpret questions of this nature on the checklist correctly. The appropriateness of the checklist items regarding cultural differences, type of school participating, DCD awareness in schools, the amount of information concerning the checklist and DCD given to the

teachers beforehand, inter-observer reliability and teacher-child enthusiasm may certainly play a role what checklist reliability concerns (Dussart, 1994).

It is therefore recommended that further research be done concerning the reliability and validity of the MABC-CL, concerning the discriminating power of the different subsections and concerning the differences between qualified and less qualified teachers in completing the MABC-CL, especially among disadvantaged populations. This might help give a better insight into the results obtained so far with the MABC-CL. It is also recommended that adaptations should be made to the MABC-CL for use in the North West Province, due to cultural, ethnic and gender differences. Despite these caveats, it appears that the MABC-CL might still act as a useful pointer to a child with DCD or some other disability, thus allowing the teacher to focus on the child's particular needs in the class, allow further testing and act as a research screening instrument.

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ARTICLE 2: RELIABILITY OF CLASS TEACHERS USING THE MABC CHECKLIST FOR DCD SCREENING

SUMMARY

The aim of the study was to examine whether class teachers in the North West Province of South Africa are reliable in using the MABC checklist as a screening tool for Developmental Co-ordination Disorder (DCD) and if so, what questions showed the highest relationships with DCD. Ninety-four children between the ages of 9 and 12 years participated in this study. The Movement Assessment Battery for Children (MABC) (Henderson & Sugden, 1992) was used for the assessment and classification of children with DCD, consisting of a motor performance test (MABC-T) and a checklist (MABC-CL). After the child had been evaluated on the MABC-T, class teachers were asked to complete the MABC-CL. They evaluated the questions and their ability to assess them, and hence agreed unanimously only to complete sections 1 and 5 of the standard MABC-CL for each of the children. Detailed instructions on the use of the MABC-CL together with an accompanying letter explaining the purpose of the checklist was given to the teachers beforehand. Descriptive statistics, item and factor analyses (Cronbach alpha, Eigen values and communalities), correlation matrices and stepwise regression analyses were calculated using *Statistica for Windows*. The level of significance was set at a p-level of < ,05. The results suggested that the teachers had sufficient knowledge to complete sections 1 and 5 of the MABC-CL, and that they were rated as a reliable source in the assessment and screening of DCD in a country like South Africa with its own particular schooling conditions. Certain questions in section 1, however, need better explanation to ensure proper assessment, which in turn might increase the reliability of the MABC-CL even further. We recommend that the content of the complete MABC-CL needs to be revised when considering the completion of such a checklist by class teachers only. DCD children experienced greater difficulties in all of the questions of sections 1 and 5 of the MABC-CL, when compared to the non-DCD group. From the results it seems as though children with severe DCD to a higher degree experience problems with questions related to disorganized behaviour, tasks which are dependent on bilateral co-ordination, handwriting and other fine motor abilities. The variance among DCD children is explained more by overall behavioural problems, compared to the total group where handwriting ability showed the highest contribution to the variance.

[Keywords: class teachers, North West Province, South Africa, reliable, MABC checklist, screening, DCD, relationships, 9 to 12 year old children, detailed instructions, further research]

[Abbreviations: DCD: Developmental Co-ordination Disorder; MABC: Movement Assessment Battery for Children; MABC-T: Movement Assessment Battery for Children – Performance Test; MABC-CL: Movement Assessment Battery for Children – Checklist]

INTRODUCTION

Five to ten percent of all school-aged children are diagnosed as having Developmental Co-ordination Disorder (DCD) (Wright & Sugden, 1996). These children have a marked impairment in the development of motor co-ordination and movement skills that is not explicable by mental retardation or any known psychiatric, neurological or physical disorder (Dussart, 1994; Wright & Sugden, 1996). In addition, their difficulties are not explicable in terms of a generalised delay in development (Dussart, 1994). The diagnosis is only made if this impairment significantly interferes with routine activities of daily life or with academic achievement. The manifestations of this disorder have been given many titles, with the term "clumsy" being the most prevalent.

Identifying such children at an early stage is of the utmost importance, seeing that early intervention could possibly improve the child's motor performance and hence school performance. In the area of assessment, however, no single perceptual-motor test is yet considered the "gold-standard" and a variety of procedures ranging from very informal checklists to fully standardised tests are being used (Smits-Engelsman *et al*, 1998). The Movement Assessment Battery for Children (MABC), developed by Henderson and Sugden in 1992, is one of the most recent diagnostic tools developed and used to identify clumsy children. The MABC consists of a criterion-referenced checklist (MABC-CL), a normative-referenced motor performance test (MABC-T), and guidelines for remediation. The primary focus of the MABC-CL is the assessment and management of movement skill problems within an educational setting. Although suitable for therapists, it is designed mainly for use by primary school teachers in order to identify clumsy children, as well as the nature of the existing movement difficulty (Wright *et al.*, 1994).

Completion of such a checklist may pose problems in different countries affecting its reliability. Except for the socio-economic and cultural differences between countries, teacher knowledge is also an aspect of concern. Several studies (Dussart, 1994; Mon-Williams, 1994 & Wright *et al.*, 1994) have shown teachers' judgements of the MABC-CL to be accurate and reliable, while others (Sovik & Maeland, 1986 as cited by Dussart, 1994) found a low correlation between teachers' ratings and motor performance. Several studies (Piek & Edwards, 1997) also highlighted the need for teachers who use the checklist to have the children for both classroom activities and physical activities, or for class and physical education teachers to combine their knowledge when the students do not have one teacher for both activities. Teacher insight and knowledge is thus an important aspect when considering the usefulness of the MABC-CL in an educational setting. Furthermore, education within South African

schools is influenced by teaching conditions, learning climates and related factors that differ greatly from elsewhere in the world. Also, the ever-decreasing number of physical education teachers in the South African school system, together with the high number of unqualified teachers in the North West Province (Joubert, 2001), may pose a problem regarding the use of the checklist.

The main purpose of this study was therefore to examine the effect of teacher knowledge and training on the reliability of the MABC-CL in screening 9 to 12 year old North West children for DCD.

METHOD OF RESEARCH

Research design

A cross-sectional research design was used as the research method. The study formed part of a multi-disciplinary research project of the Health Sciences Faculty of the Potchefstroom University for Christian Higher Education (PU for CHE) and was approved by the Ethics Committee (project number OOM07).

Subjects

All the 9-12 year old boys (n=62) and girls (n=32) of the Bert's Bricks Primary School, situated 22 km outside Potchefstroom in the North West Province, were selected for this study. Of these subjects, 26 were nine years old (17 male, 9 female), 20 were 10 years old (13 male, 7 female), 29 were 11 years old (17 male, 12 female) and 19 were 12 years old (15 male, 4 female). The nature and the scope of the study were explained to the children beforehand and written consent was given by the parents for them to participate.

Procedure

The Movement Assessment Battery for Children (MABC) (Henderson & Sugden, 1992), consisting of a motor performance test (MABC-T) and a checklist (MABC-CL), was used for the purpose of this study. The MABC-T was administered individually and assesses the child's movement abilities. It consists of three tests of *Manual Dexterity*, two tests of *Ball Skills*, and three tests of *Static and Dynamic Balance*. A total impairment score is derived from performance in these three sections, which can classify the child as having DCD or not. Performance lower than the 15th percentile was scored as moderate DCD and below the 5th percentile as severe DCD. The MABC-T has been shown to

have moderate to good validity and reliability (Sugden, 1996a; Smits-Engelsman, 2001; Tan *et al.*, 2001; Wright & Crawford *et al.*, 2001). From the validity and reliability studies done by Henderson and Sugden (1992), the test-retest reliability at any age was found to be r=0,75 and inter-tester reliability was found to be r=0,70.

The MABC-CL measures a child's movement within the environment and should preferably be completed by the child's class teacher or parent. It contains 60 items grouped into five sections: Child Stationary/Environment Stable; Child Moving/Environment Stable; Child Stationary/Environment Moving; Child Moving/Environment Moving, and a Behavioural Component. The responses to each of the questions in sections 1-4 are scored on a four-point scale: (0) "Very Well", (1) "Just OK", (2) "Close" and (3) "Not Close". There are three response alternatives for section five that refer to the frequency with which the child displays the behaviour: (0) "Rarely", (1) "Occasionally" and (2) "Often". The scores of each subsection are totalled together, and scores in excess of 35 are used to indicate Developmental Co-ordination Disorder (DCD). The correlation between the MABC-T and the MABC-CL was found to be r=0,66 ($p<0,001$) (Henderson & Sugden, 1992).

After each child had been evaluated on the MABC-T, class teachers (n=5) were asked to complete the MABC-CL for each of the children tested on the MABC-T. After a short meeting had been held with the teachers in which to explain the use of the checklist, it was left with the teachers for approximately two weeks, after which it was collected from the school. Detailed instructions on the use of the checklist together with an accompanying letter explaining the purpose of the checklist was also given beforehand and no cut-off marks were specified in order to minimise bias. Checklists considered faulty were discarded and could therefore not be used for the study.

Statistical Analysis of the Data

The *Statistica for Windows* computer package of the PU for CHE (Statsoft Inc., 2001) was used for all data processing. Descriptive statistics were calculated by means of the mean (M), standard deviation (SD) and maximum (max) and minimum (min) values. The statistical significance was set at a p-level of $\leq 0,05$. For reliability purposes, the Cronbach alpha, Eigen values and communalities were calculated by using item and factor analysis. Extraction was obtained by means of principal components. Interrelationships (r) were calculated by means of correlation matrices. A stepwise regression analysis was used and practical significance of the results was calculated for R^2 using the following equation: $R^2 / (1-R^2)$.

RESULTS

To clarify whether the checklist can be used as a suitable screening device in identifying 9 to 12 year old North West children with DCD, this study aimed to determine whether class teachers are reliable in completing the MABC-CL. If the MABC-CL proved to be a reliable tool, a second purpose was to determine which of the questions in the checklist showed the highest relationships with DCD.

The teachers of the Bert's Bricks Primary School were unable, and to a degree unwilling, to complete the full checklist due to a lack of knowledge concerning several checklist items as well as a lack of time. The teachers found that several of the items on the checklist were difficult and, according to them, impossible to observe in the child, especially the items of sections 2 to 4 of the checklist. This reaction was, however, not uncommon. In a study done by Smyth and Mason (1997), some teachers were unwilling to complete the MABC-CL, either because of the time involved, or because the age of the children made some of the checklist items inappropriate in the teacher's view. In another study done by Mon-Williams *et al.* (1994), the teachers had to make special arrangements to observe the children in the situations required for sections 2, 3 and 4 of the checklist.

In the study of Wright *et al.* (1994), the teachers also had difficulty completing the MABC-CL, since the movements or activities were not commonly performed within their schools. The researchers reported that thirty percent of the teachers were unable to comment on the children's ability to use blocks, beads or puzzle pieces, and nearly 50% were unable to answer whether the child could ride moving vehicles such as pedal cars, scooters or bikes. Several studies (Piek & Edwards, 1997) also pointed out the need for teachers using the checklist to have the children for both classroom activities and physical activities, or for class and physical education teachers to combine their knowledge where students do not have one teacher for both activities. This suggests that the two types of teachers may be using different criteria for determining the movement status of the child.

However, the Bert's Bricks teachers, who were class teachers with no physical education background, felt competent to complete sections 1 and 5 of the MABC-CL. Section 1 mainly assesses a child's manual dexterity abilities, which teachers felt they had enough knowledge of because a great deal of a child's day is spent using these kinds of activities/skills in the classroom. Section 5 includes broad behavioural aspects, of which they also felt they had enough knowledge to be able to assess them

properly. A mutual decision between the teachers and the researcher was therefore made only to complete sections 1 and 5 of the checklist.

Results were obtained for the three groups classified with the MABC-T (without DCD, moderate and severe DCD) for a total of 94 children (62 boys and 32 girls). Descriptive information of the children in each of these groups (44 without DCD, 30 with moderate DCD and 20 with severe DCD) is presented in Table 1.

TABLE 1. Descriptive information on the different subsections of the MABC-T

MABC Subsection	Classification	N	M	SD	Min	Max
Manual Dexterity Total	Total group	94	5.23	3.87	0.00	14.50
	Without DCD□	44	3.82	2.92	0.00	10.00
	Moderate DCD□□	30	4.65	3.80	0.00	12.00
	Severe DCD□□□	20	9.23	3.17	3.00	14.50
Ball Skills Total	Total group	94	1.13	1.96	0.00	9.00
	Without DCD□	44	0.24	0.82	0.00	5.00
	Moderate DCD□□	30	1.25	1.50	0.00	5.50
	Severe DCD□□□	20	2.93	2.92	0.00	9.00
Balance Total	Total group	94	4.25	3.61	0.00	13.00
	Without DCD□	44	2.05	3.08	0.00	13.00
	Moderate DCD□□	30	6.23	3.18	0.00	10.00
	Severe DCD□□□	20	6.10	2.44	1.50	9.00
MABC Total	Total group	94	10.60	5.56	0.00	31.00
	Without DCD□	44	6.10	3.05	0.00	17.00
	Moderate DCD□□	30	12.10	1.39	10.00	14.00
	Severe DCD□□□	20	18.25	3.90	14.50	31.00

MD Tot=Manual Dexterity Total, BS Tot=Ball Skill Total; Bal Tot=Balance Total
□=MABC score <10; □□=MABC score □10<13.5; □□□=MABC score >13.5

Item reliability of the MABC-CL (section 1 and 5) was analysed as a first step towards identifying whether the teachers were reliable in completing these sections. Results obtained from this item analysis of the questions are presented in Table 2. Question 4 of section 1 (demonstrate competence in personal hygiene) showed the lowest correlation with the total of this section (r=0,35), while question 9 (pick up small objects) showed the highest correlation with the total of section 1 (r=0,83). Personal hygiene is not as frequently associated with the manual dexterity-related questions in this section and teachers will therefore have to rely more on observational skills and not so much on facts to assess this aspect of a child. However, even though question 4's correlation with the total of section 1 was low compared to the other questions, it is not low enough to warrant rejection. Also, a Cronbach alpha (a technique used in estimating reliability of tests) (Thomas & Nelson, 1996) value of

0,92 indicates that the content of section 1 (question 1 to 12) of the MABC-CL has a good internal consistency.

TABLE 2. Summary of the item analysis of section 1 and 5 of the MABC-CL multiple trial

CL Section 1 and Questions	Item-Total Correlation	Alpha if deleted	CL Section 5 and Questions	Item-Total Correlation	Alpha if deleted
S1:Q1	0.58	0.92	S5:Q1	0.43	0.88
S1:Q2	0.64	0.91	S5:Q2	0.64	0.86
S1:Q3	0.67	0.91	S5:Q3	0.24	0.89
S1:Q4	0.35	0.93	S5:Q4	0.60	0.87
S1:Q5	0.71	0.91	S5:Q5	0.41	0.88
S1:Q6	0.81	0.91	S5:Q6	0.63	0.86
S1:Q7	0.80	0.91	S5:Q7	0.72	0.86
S1:Q8	0.72	0.91	S5:Q8	0.53	0.87
S1:Q9	0.83	0.91	S5:Q9	0.55	0.87
S1:Q10	0.73	0.91	S5:Q10	0.81	0.85
S1:Q11	0.74	0.91	S5:Q11	0.60	0.87
S1:Q12	0.69	0.91	S5:Q12	0.74	0.86
Cronbach alpha: 0,919721			Cronbach alpha: 0,878080		

Results obtained for the completed section 5 of the checklist (Table 2) show that questions 1 (overactive), 3 (timid) and 5 (impulsive) showed the lowest correlations with the total of section 5 (r=0,43, r=0,24, r=0,41). Question 10 (assessing the child's persistence) showed the highest correlation with the total of section 5 (r=0,81). A Cronbach alpha value of 0,88 indicates that section 5 of the MABC-CL also has a good internal consistency, although to a lesser degree than section 1.

TABLE 3. Eigen values

Section 1				Section 5		
	Eigen value	% Total variance	Cumulative %	Eigen value	% Total variance	Cumulative %
1	6.8	56.8	56.8	1 5.4	44.6	44.6
2	1.4	12.0	68.7	2 1.7	14.4	59.1
				3 1.0	8.4	67.4

Table 3 (Eigen values) and 4 (Communalities) show the results obtained for determining construct validity. Two factors were identified for section 1, of which factor 1 explained 56,8% of the variance and factor 2, 12,0%. Three factors were identified among the behavioural variables, in which factor 1 explained 44,6% of the variance. These results are considered to indicate good construct

validity (degree to which a test measures a hypothetical construct; usually established by relating to test results to some behaviour; Thomas & Nelson, 1996) for the two subsections analysed.

TABLE 4. Communalities

A: CL Section 1 and Questions	r	B: CL Section 5 and Questions	r
S1:Q1	0.66	S5:Q1	0.71
S1:Q2	0.55	S5:Q2	0.65
S1:Q3	0.56	S5:Q3	0.67
S1:Q4	0.73	S5:Q4	0.61
S1:Q5	0.65	S5:Q5	0.71
S1:Q6	0.74	S5:Q6	0.65
S1:Q7	0.76	S5:Q7	0.79
S1:Q8	0.61	S5:Q8	0.48
S1:Q9	0.82	S5:Q9	0.44
S1:Q10	0.79	S5:Q10	0.77
S1:Q11	0.77	S5:Q11	0.81
S1:Q12	0.62	S5:Q12	0.80

To determine possible relationships between the questions of sections 1 and 5 of the MABC-CL and the subsections of the MABC-T, interrelationships between the two measuring instruments were calculated. Table 5 indicates low to moderately significant correlations between the checklist questions of sections 1 and 5 and the subsections of the MABC-T. The correlations were found to be higher for the DCD group than for the total group. Section 1 showed the highest overall correlations with the manual dexterity total of the MABC-T (questions 5 to 10) for the DCD group, compared to the other groups. Questions in this section are designed mainly to assess manual dexterity problems, which the results substantiate. Questions 7 and 8 of section 1 (forming letters, numbers and basic geometric shapes) showed the highest correlation with the Manual Dexterity total of the MABC-T. Section 5 showed the highest correlations with the MABC total for the DCD group, indicating that behavioural problems can have adverse effects on children's overall motor proficiency. Question 11 of section 5 (upset by failure) was the only question that correlated significantly with the Ball Skills total. This might indicate that the anxiety that comes from failure especially influences ball skills performance. Question 4 of section 1 (demonstrating competence in personal hygiene) showed the highest correlation with the Balance total (DCD group), followed by question 3 of section 5 (timidity) (total group). It is obvious that a child who is fearful of activities like jumping and climbing and who does not want to

move fast will have problems balancing. Question 7 (disorganized, confused) and the total of section 5 showed the highest correlation with the MABC total.

TABLE 5. A correlation matrix (R) of sections one and five of the MABC checklist and the MABC motor test for the DCD sample (n=50)

CL Section and Question	MD Total		Ball Skills Total		Balance Total		MABC Total	
	Total group	DCD group	Total group	DCD group	Total group	DCD group	Total group	DCD group
S1:Q1	-0.03	0.10	0.15	0.25	0.03	0.15	0.06	**0.35***
S1:Q2	-0.09	-0.02	0.02	-0.00	0.04	0.02	-0.03	-0.01
S1:Q3	0.01	-0.04	0.08	0.01	0.07	-0.02	0.08	-0.05
S1:Q4	-0.05	-0.01	0.08	0.13	0.09	**0.28***	0.05	0.27
S1:Q5	0.02	0.07	0.04	0.04	-0.03	0.01	0.01	0.11
S1:Q6	0.16	0.26	0.09	0.05	-0.02	-0.15	0.13	0.20
S1:Q7	**0.23***	**0.29***	0.16	0.10	0.01	-0.15	**0.22***	0.26
S1:Q8	**0.24***	**0.38***	0.19	0.13	0.06	-0.13	**0.28***	**0.38***
S1:Q9	0.09	0.22	0.14	0.09	0.15	-0.11	**0.21***	0.21
S1:Q10	0.11	0.13	0.14	0.18	0.05	-0.07	0.16	0.20
S1:Q11	0.14	0.18	0.05	-0.01	0.05	-0.11	0.14	0.11
S1:Q12	0.08	0.17	0.10	0.10	0.04	-0.11	0.12	0.16
S1: Tot	0.11	0.19	0.13	0.11	0.06	-0.05	0.16	0.23
S5:Q1	**0.23***	**0.33***	0.03	0.11	-0.15	-0.16	0.07	**0.28***
S5:Q2	-0.05	0.07	-0.01	-0.00	0.10	0.09	0.03	0.14
S5:Q3	-0.04	0.03	0.05	-0.06	**0.21***	0.03	0.13	0.02
S5:Q4	0.05	0.16	-0.03	-0.11	-0.03	-0.10	0.01	0.03
S5:Q5	**0.28***	**0.31***	0.08	0.08	0.01	0.02	**0.22***	**0.38***
S5:Q6	**0.22***	0.24	0.04	0.07	-0.12	-0.08	0.09	0.25
S5:Q7	0.09	0.17	0.17	0.27	0.08	0.09	0.18	**0.40***
S5:Q8	0.07	0.17	0.07	0.06	0.07	0.02	0.12	0.22
S5:Q9	0.05	0.16	0.14	0.22	-0.02	0.02	0.08	**0.31***
S5:Q10	0.18	0.27	0.17	0.23	0.02	-0.04	0.20	**0.39***
S5:Q11	0.05	0.07	**0.24***	**0.36***	-0.01	0.01	0.11	**0.28***
S5:Q12	0.12	0.17	0.09	0.24	-0.06	0.06	0.08	**0.36***
S5: Tot	0.16	**0.28***	0.13	0.19	0.01	-0.01	0.17	**0.40***
S1+S5	0.15	0.28	0.09	0.09	0.00	-0.08	0.13	**0.29***

MD Tot=Manual Dexterity Total, BS Tot=Ball Skill Total; Bal Tot=Balance Total
*= p□0,05, Correlation= ,1= low; Correlation= 0,3= moderate; Correlation= 0,5= high (Cohen, 1988)

A comprehensive analysis of the children's results obtained to the questions of section 1 of the MABC-CL and its relationship with DCD are shown in Table 6.

TABLE 6. Descriptive information on subsection one of the MABC-CL

Checklist Section and Questions	Classification	N	M	SD	Min	Max
S1:Q1	Total group	94	0.19	0.42	0.00	2.00
(put on/take off	Without DCD□	44	0.20	0.41	0.00	1.00
clothing)	Moderate DCD□□	30	0.10	0.31	0.00	1.00
	Severe DCD□□□	20	0.30	0.57	0.00	2.00
S1:Q2	Total group	94	0.33	0.61	0.00	3.00
(Stand on one leg)	Without DCD□	44	0.30	0.55	0.00	2.00
	Moderate DCD□□	30	0.47	0.73	0.00	3.00
	Severe DCD□□□	20	0.20	0.52	0.00	2.00
S1:Q3	Total group	94	0.30	0.55	0.00	2.00
(Tie shoelaces)	Without DCD□	44	0.18	0.39	0.00	1.00
	Moderate DCD□□	30	0.43	0.63	0.00	2.00
	Severe DCD□□□	20	0.35	0.67	0.00	2.00
S1:Q4	Total group	94	0.70	0.95	0.00	3.00
(Personal hygiene)	Without DCD□	44	0.75	0.97	0.00	3.00
	Moderate DCD□□	30	0.63	0.93	0.00	3.00
	Severe DCD□□□	20	0.70	0.98	0.00	3.00
S1:Q5	Total group	94	0.62	0.67	0.00	3.00
(Good posture)	Without DCD□	44	0.61	0.62	0.00	2.00
	Moderate DCD□□	30	0.67	0.76	0.00	3.00
	Severe DCD□□□	20	0.55	0.69	0.00	2.00
S1:Q6	Total group	94	0.52	0.62	0.00	2.00
(Holding instruments)	Without DCD□	44	0.48	0.51	0.00	1.00
	Moderate DCD□□	30	0.53	0.73	0.00	2.00
	Severe DCD□□□	20	0.60	0.68	0.00	2.00
S1:Q7	Total group	94	0.70	0.75	0.00	3.00
(Cut, draw, trace)	Without DCD□	44	0.55	0.59	0.00	2.00
	Moderate DCD□□	30	0.70	0.84	0.00	3.00
	Severe DCD□□□	20	1.05	0.83	0.00	3.00
S1:Q8	Total group	94	0.78	0.74	0.00	3.00
(Letters, numbers,	Without DCD□	44	0.61	0.62	0.00	2.00
shapes)	Moderate DCD□□	30	0.77	0.77	0.00	3.00
	Severe DCD□□□	20	1.15	0.81	0.00	3.00
S1:Q9	Total group	94	0.45	0.68	0.00	3.00
(Pick up objects)	Without DCD□	44	0.32	0.52	0.00	2.00
	Moderate DCD□□	30	0.50	0.82	0.00	3.00
	Severe DCD□□□	20	0.65	0.75	0.00	2.00
S1:Q10	Total group	94	0.60	0.82	0.00	3.00
(Blocks, beads,	Without DCD□	44	0.50	0.76	0.00	3.00
puzzle)	Moderate DCD□□	30	0.67	0.88	0.00	3.00
	Severe DCD□□□	20	0.70	0.86	0.00	3.00
S1:Q11	Total group	94	0.47	0.74	0.00	3.00
(Turn and hand out	Without DCD□	44	0.36	0.61	0.00	2.00
pages)	Moderate DCD□□	30	0.53	0.86	0.00	3.00
	Severe DCD□□□	20	0.60	0.82	0.00	3.00
S1:Q12	Total group	94	0.59	0.77	0.00	3.00
(Recognize body	Without DCD□	44	0.48	0.66	0.00	3.00
parts)	Moderate DCD□□	30	0.63	0.93	0.00	3.00
	Severe DCD□□□	20	0.75	0.72	0.00	2.00
S1: Tot	Total group	94	6.21	6.13	0.00	28.00
	Without DCD□	44	5.34	4.89	0.00	16.00
	Moderate DCD□□	30	6.63	7.13	0.00	28.00
	Severe DCD□□□	20	7.50	6.95	0.00	24.00

CL: S1:Q1= Checklist Section 1 Question 1 etc; □=MABC score <10; □□=MABC score □10<13,5; □□□=MABC score >13,5

From the total of section 1 it is clear that children with moderate DCD (6,63) and those with severe DCD (7,50) experience more problems with the assessed items than those without DCD (M=5.34). Question 1 (put on and take off articles of clothing without assistance) indicated the smallest percentage of difficulties in all the groups (without DCD, moderate DCD, severe DCD), followed in order by questions 3, 2, 9, 11, 6, 12, 10, 5, 4 and 7, and 8 being the most difficult task (forming letters, numbers and basic geometric shapes that are accurate and legible). According to the means derived in Table 6, children experienced more difficulty with the tasks assessed in questions 6 to 11, with an increase in the severity of DCD, with questions 9 and 8 showing the highest discriminative ability between the groups. However, in questions 1 to 5 this pattern was not as clear and the following explanations could be given for this tendency. Putting on and taking off articles of clothing without assistance (question 1), as well as tying shoelaces, buckling a belt or fastening a zipper or buttons (question 3) are skills that can possibly be acquired or adapted by the ages of 9 to 12 years, despite the child's level of DCD. However, children in the severe DCD group clearly experienced the most problems with both these skills. It is clear that the teachers might have more knowledge concerning questions 6 to 11 and that more specific instructions on scoring or suggestions of how to approach questions 1 to 5 should be given to them.

A comprehensive analysis of the results obtained with section 5 of the MABC-CL, as shown in Table 7, demonstrates that question 8 indicated the smallest differences (overestimates own ability, tries to change tasks to make them more difficult, tries to do things too fast), followed in order by questions 11, 12, 9, 3, 5, 4, 2, 10, 1, 7, and 6 showing the largest difference (distractibility). The tasks posed greater difficulty to the child, with an increase in the severity of DCD. Children in the moderate and without DCD groups did not differ as much, but the severe DCD group clearly showed more behavioural problems to all the questions, with the exception of questions 2 and 3. It might be that behaviour such as passiveness (question 2) and timidity (question 3) are not as easily assessed in the classroom setting as during play. Wright *et al.* (1994) suggested a link between the child's behavioural profile and motor performance, and that this relationship may increase with age. The information obtained from section 5 of the MABC-CL adds to the developing picture of the child's movement difficulties and will definitely be useful when considering remedial treatment. In a study done by Dussart (1994) it was proposed that the results of the child's behaviour could be grouped to give one overall problem of behaviour.

TABLE 7. Descriptive information on subsection five (behavioural aspects) of the MABC-CL

Checklist Section and Questions	Classification	N	M	SD	Min	Max
S5:Q1 (overactive)	Total group	94	0.67	0.79	0.00	2.00
	Without DCD□	44	0.66	0.78	0.00	2.00
	Moderate DCD□□	30	0.50	0.73	0.00	2.00
	Severe DCD□□□	20	0.95	0.95	0.00	2.00
S5:Q2 (passive)	Total group	94	0.59	0.72	0.00	2.00
	Without DCD□	44	0.57	0.73	0.00	2.00
	Moderate DCD□□	30	0.63	0.76	0.00	2.00
	Severe DCD□□□	20	0.55	0.67	0.00	2.00
S5:Q3 (timid)	Total group	94	0.55	0.68	0.00	2.00
	Without DCD□	44	0.43	0.70	0.00	2.00
	Moderate DCD□□	30	0.67	0.66	0.00	2.00
	Severe DCD□□□	20	0.65	0.67	0.00	2.00
S5:Q4 (tense)	Total group	94	0.57	0.71	0.00	2.00
	Without DCD□	44	0.57	0.73	0.00	2.00
	Moderate DCD□□	30	0.57	0.73	0.00	2.00
	Severe DCD□□□	20	0.60	0.68	0.00	2.00
S5:Q5 (impulsive)	Total group	94	0.56	0.73	0.00	2.00
	Without DCD□	44	0.45	0.70	0.00	2.00
	Moderate DCD□□	30	0.43	0.57	0.00	2.00
	Severe DCD□□□	20	1.00	0.86	0.00	2.00
S5:Q6 (distractible)	Total group	94	1.03	0.71	0.00	2.00
	Without DCD□	44	1.02	0.73	0.00	2.00
	Moderate DCD□□	30	0.90	0.66	0.00	2.00
	Severe DCD□□□	20	1.25	0.72	0.00	2.00
S5:Q7 (disorganized)	Total group	94	0.81	0.75	0.00	2.00
	Without DCD□	44	0.77	0.74	0.00	2.00
	Moderate DCD□□	30	0.67	0.71	0.00	2.00
	Severe DCD□□□	20	1.10	0.79	0.00	2.00
S5:Q8 (overestimates own ability)	Total group	94	0.40	0.64	0.00	2.00
	Without DCD□	44	0.36	0.57	0.00	2.00
	Moderate DCD□□	30	0.33	0.66	0.00	2.00
	Severe DCD□□□	20	0.60	0.75	0.00	2.00
S5:Q9 (underestimates own ability)	Total group	94	0.54	0.65	0.00	2.00
	Without DCD□	44	0.57	0.62	0.00	2.00
	Moderate DCD□□	30	0.43	0.62	0.00	2.00
	Severe DCD□□□	20	0.65	0.75	0.00	2.00
S5:Q10 (lacks persistence)	Total group	94	0.65	0.71	0.00	2.00
	Without DCD□	44	0.59	0.66	0.00	2.00
	Moderate DCD□□	30	0.57	0.73	0.00	2.00
	Severe DCD□□□	20	0.90	0.79	0.00	2.00
S5:Q11 (upset by failure)	Total group	94	0.50	0.68	0.00	2.00
	Without DCD□	44	0.48	0.66	0.00	2.00
	Moderate DCD□□	30	0.50	0.68	0.00	2.00
	Severe DCD□□□	20	0.55	0.76	0.00	2.00
S5:Q12 (no pleasure from success)	Total group	94	0.52	0.73	0.00	2.00
	Without DCD□	44	0.57	0.76	0.00	2.00
	Moderate DCD□□	30	0.40	2.00	0.00	2.00
	Severe DCD□□□	20	0.60	0.75	0.00	2.00
S5: Tot	Total group	94	7.40	5.58	0.00	20.00
	Without DCD□	44	7.05	5.61	0.00	18.00
	Moderate DCD□□	30	6.60	5.47	0.00	20.00
	Severe DCD□□□	20	9.40	5.47	1.00	19.00

CL: S5:Q1= Checklist Section 5 Question 1 etc; □=MABC score <10; □□=MABC score □10<13,5; □□□=MABC score >13,5

From the results of this study it seems as though children with severe DCD experience problems to a much higher degree with the content assessed in questions 7 (cut, draw trace) and 8 (letters, numbers, shapes) of section 1 and with behavioural aspects assessed by questions 1 (overactive), 5 (impulsive), 7 (disorganized) and 10 (lacks persistence) of section 5.

In an analysis of the stepwise contribution of the 24 questions in sections 1 and 5 of the checklist to the MABC total of the total group, a 21,6% contribution to the variance, which has moderate practical significance (ES=0,3), was found for 9 questions. The MABC total therefore seems to differentiate most between the three groups with regards to the nine items listed in Table 8. In the DCD group, 12 questions explained 66,7% of the variance. In the analysis for the total group (n=94) as seen in Table 8, question 8 of section 1 (forming letters, numbers and shapes) entered first into the regression analysis and made a contribution of 7,7% to the total variance. Behavioural aspects also contributing to the variance were impulsiveness, timidity and tenseness, distractibility and disorganized behaviour, while posture, balance and cutting, drawing and tracing of section 1 also entered the regression analyses. All the questions, except for question 8 of section 1 and question 5 of section 5, showed moderate practical significance.

The skill of forming letters (handwriting ability) differentiates most with regard to the MABC total in the total group. Furthermore, difficulty with other fine motor tasks, such as cutting, drawing and tracing and maintaining good posture as well as behavioural aspects like impulsiveness, timidity, tenseness, disorganized and distractible behaviour also contributed to the variance in the group. The picture that we see unfolding here actually closely resembles the definition and description of children with DCD.

When only the DCD group (n=50) was analysed (Table 8), question 7 of section 5 (disorganized/confused, difficulty in planning a sequence) explained the highest percentage of the variance found among DCD children (16,0% of the variance). Findings of Peters and Wright (1999) substantiate that DCD children have low organisational skills and have problems with decision making. This was followed in order by question 1 of section 1 (put on and take off articles of clothing without assistance), question 3 of section 1 (tying shoelaces), question 12 of section 5 (apparently unable to get pleasure from success) and lastly question 8 of section 1 (letters, numbers, shapes). Of the checklist variables that entered the regression analysis, only question 7 of section 5 and question 1 of section 1 showed moderate practical significance.

More section 1 questions entered this regression analysis when compared to the results of the regression analysis of the total group. This could be explained by the fact that the questions in section 1 of the MABC-CL, which assess mainly manual dexterity skills, pose greater difficulty especially to the child with severe DCD than to the non-DCD child. Tying shoelaces, changing clothes and maintaining personal hygiene contributed greatly to the variance found in the DCD group (steps 3, 2 and 10). This indicates that children with severe DCD are overall less co-ordinated in their everyday lifestyle and also have trouble with age-specific personal tasks like maintaining personal hygiene. These findings are in accordance with those of Missuina and CanChild (1999) and Peter and Wright (1999), who indicate that tasks which need co-ordinated motor action and require constant feedback from the eyes like cutting, tying of shoelaces and fastening of buttons pose real difficulty to the DCD child. Handwriting ability (forming letters) and cutting and drawing also entered the regression analysis,

TABLE 8. A stepwise contribution of sections one and five of the MABC-CL to the MABC total for the total group (N=94) and the DCD group (n=50)

Step	MABC Total	R^2	Change R^2	p-value	ES
Total group (n=94)					
1.	S1:Q8 (letters, numbers, shapes)	0.077	0.077	0.007*	-
2.	S5:Q5 (impulsive)	0.105	0.028	0.095	-
3.	S1:Q5 (good posture)	0.134	0.029	0.086	0.155□
4.	S5:Q3 (timid)	0.148	0.014	0.233	0.174□
5.	S1:Q2 (one-leg balance)	0.166	0.018	0.170	0.199□
6.	S5:Q4 (tense)	0.181	0.015	0.216	0.220□
7.	S5:Q10 (disorganized)	0.194	0.014	0.233	0.241□
8.	S1:Q7 (cut/draw/trace)	0.204	0.010	0.312	0.256□
9.	S5:Q6 (distractible)	0.216*	0.012	0.254	-
DCD group (n=50)					
1.	S5:Q7 (disorganized)	0.160	0.160	0.004*	0.190□
2.	S1:Q3 (tying shoelaces)	0.264	0.104	0.013*	-
3.	S1:Q1 (put on/take off clothing)	0.424	0.160	0.001*	0.190□
4.	S1:Q8 (letters, numbers, shapes)	0.475	0.051	0.042*	-
5.	S5:Q4 (tense)	0.513	0.038	0.071	-
6.	S5:Q12 (no pleasure from success)	0.566	0.053	0.027*	-
7.	S5:Q6 (distractible)	0.596	0.030	0.086	-
8.	S5:Q2 (passive/hard to interest)	0.611	0.015	0.216	-
9.	S1:Q7 (cut/draw/trace)	0.633	0.022	0.127	-
10.	S1:Q4 (personal hygiene)	0.644	0.011	0.278	-
11.	S5:Q1 (overactive/squirms and fidgets)	0.654	0.010	0.292	-
12.	S5:Q3 (timid)	0.667**	0.013	0.238	-

□=ES²□0,15=moderate practical value; □□=ES²□0,35=high practical value; □= ES= 0,276; □□= ES= 2,003
*= p□0,05

although contributing to a lesser degree to the variance than the above-mentioned tasks, which need more co-ordinated efforts (steps 4 and 9). It is therefore not surprising that a child who experiences all this difficulty in his everyday life as well as in school where manual dexterity skills are used for at least 50% of the day, (Missuina & CanChild, 1999) will be more tense, show no pleasure from success and be timid (steps 5,6 and 12). A higher level of passiveness (step 8) and distractibility (step 7) are therefore also not surprising among children with severe DCD. From these results it can be concluded that poor handwriting ability in combination with behavioural problems can differentiate a possible candidate for the diagnosis of DCD from others, while behavioural problems and poor handwriting ability in combination with difficulty with more specific bilateral co-ordinated tasks like tying shoelaces can discriminate even further between the degree of DCD a child experiences.

CONCLUSIONS

In spite of limitations such as a relatively small sample of subjects (N=94) included in this study and that only sections 1 and 5 of the MABC-CL were completed by the teachers, the results obtained provide valuable insight with regard to the aims of this study. Item analysis of the questions of sections 1 and 5 of the MABC-CL showed high Cronbach alpha values for section 1 (.92) and for section 5 (.87), indicating good internal consistency of the content of these sections. Also, factor analysis indicated good construct validity for both subsections of the MABC-CL. Moderate but significant correlations were further found between the questions of sections 1 and 5 of the checklist and the subsections of the MABC-T. The questions in section 1 had the highest correlation with the manual dexterity subsection of the MABC-T, while the correlations found for behavioural problems suggest that behaviour has a more widespread influence on motor proficiency tasks in general.

The DCD group (moderate and severe), when compared to the non-DCD group of children, experienced more difficulties in all of the questions of sections 1 and 5 of the MABC-CL. Furthermore, children in the severe DCD group received higher means for all the behavioural aspects and had much poorer specific manual dexterity skills with regard to cutting and drawing. They were also much more impulsive, disorganised and lacking in persistence, compared to children classified in the group with moderate and the group without DCD. Manual dexterity problems are generally indicated by researchers to be a problem in most DCD children (Dussart, 1994; Wright & Sugden, 1996; Smits-Engelsman, 2001), and are often found to accord with behavioural problems (Wright *et al.*, 1994). Knowledge derived from the questions in the checklist assessing this kind of skill and behaviour can

therefore be sufficient information to serve as an indication that the MABC-T should be added for further screening.

Also, it is clear that the children in this study, as was also found for the children in the Thusa Bana study living in this province (Lombard & Pienaar, 2003, in preparation), experienced the most difficulties with the manual dexterity tasks. It is therefore concluded that these two sections of the checklist, when completed by knowledgeable teachers, are sufficient for screening purposes, and that it might be a waste of time to ask the teachers to complete the whole checklist. However, question 4, and to a lesser degree question 2, in section 1, which the teachers felt competent to comment on, were not clear enough, and in section 5 an item such as passiveness is not as easily assessable within the classroom setting, and ratings are most probably subject to the teacher's own opinion.

It is therefore recommended that teachers be supplied with additional information and suggestions on how to approach each of these questions in order to achieve more consistent results between the evaluators. However, it is recommended that in situations similar to those in this study, sections 1 and 5 of the MABC-CL are sufficient to act as a screening device to detect children who suffer from DCD, but that teachers should receive more information on the questions that were not as clear. Special attention should also be given to educating teachers in the use of the other sections as well. The appropriateness of the checklist items, type of school participating, DCD awareness in schools, inter-observer-reliability and teacher-child enthusiasm may certainly play a role as far as checklist reliability is concerned, and should also be taken into consideration when deciding on the use of screening tools such as the MABC-CL for screening purposes.

With regard to whether some questions might be more indicative of DCD than others, stepwise regression analyses showed that some of the questions in sections 1 and 5 contributed more to the variance in the group than others. In the total group, poor handwriting ability (forming letters, numbers and shapes) explained 7,7% of the total variance found in the MABC total. In the DCD group, disorganized behaviour showed high discriminative ability, implying that behavioural problems increase with an increase in the severity of DCD. Children with severe DCD seem to be disorganized, tense children who are unable to get pleasure from success and who have problems with bilateral co-ordination tasks, as well as with fine motor abilities like handwriting and cutting, drawing and tracing tasks. They are also, although to a lesser degree, hard to interest, overactive (move constantly when they have to listen to instructions), distractible, impulsive and timid children.

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5. SUMMARY, CONCLUSIONS AND FURTHER RESEARCH

5.1. Summary

With this study, a preliminary investigation of the suitability of the Movement Assessment Battery for Children (MABC-CL) (Henderson & Sugden, 1992) for use with South African children, and more specifically 10 to 12 year old children of the North West Province, has been described. The problem statements, aims, hypotheses and research questions of the study are presented in Chapter 1.

A discussion of the literature relevant to the research is presented in Chapter 2. From the literature it is clear that the MABC test was standardised on a sample of American children representing the general population of children in the United States. European studies (Rösblad & Gard, 1998; Smits-Engelsman *et al.*, 1998) evaluating the generalisability of the norms have suggested

that these are satisfactory (Miyahara *et al.*, 1998). In contrast, a normative study conducted in the Far East (Chow *et al.*, 1999) suggested that the norms might need adjustment for use in Hong Kong (Miyahara *et al.*, 1998). Also, teacher insight and knowledge have been shown to affect the usefulness of the MABC checklist. Several studies (Dussart, 1994:82; Mon-Williams, 1994:176; Wright *et al.*, 1994:153) have shown teachers' judgements of the MABC-CL to be accurate and reliable, while others (Sovik & Maeland, 1986 as cited by Dussart, 1994:81) found a low correlation between teachers' ratings and motor performance.

Besides a lack of time and/or motivation, poor teacher knowledge concerning the checklist items might explain this finding. Several studies (Piek & Edwards, 1997:57) pointed out the need for teachers using the checklist to have the children for both classroom activities and physical activities or for class and physical education teachers to combine their knowledge when the students do not have one teacher for both activities. This definitely poses a problem, seeing that physical education teachers are seldom employed in South African schools today, and the class teachers are left with insufficient knowledge to complete the checklist items involving motor tasks in particular. Thus it is clear that the MABC test and checklist norms may differ in countries other than the country where they were standardised, and that some teachers experienced difficulty in completing the checklist. Answers concerning the above aspects will help solve questions concerning the credibility of the MABC checklist for use in other countries like South Africa, and possibly give more insight into how to improve the reliability of the checklist. Answers to the above aspects will also clarify whether teachers are knowledgeable on the use of the checklist or whether they need to be educated before attempting to complete such a checklist.

The study is presented in article format. The results regarding the first aim of the study are presented in Chapter 3 (Article 1). The data were obtained from a random selection of 10 to 12 year old North West children from urban and rural environments (22 schools). The majority of subjects who were tested with the MABC-T and assessed by class teachers with the MABC-CL were selected from state-subsidised schools (n=392) with low socio-economic status and fewer educational experiences compared to subjects from Model C schools (n=56). Descriptive statistics, item and factor analyses (Cronbach alpha, Eigenvalues and communalities), correlation matrices and stepwise regression analyses were calculated using *Statistica for Windows*. The level of significance was set at $p< 0,05$. The results suggested that the MABC-CL had good test-retest reliability and identified children with DCD to a limited degree.

The effects of increasing task difficulty within the MABC-CL differed from other studies. Only the manual dexterity total of the MABC-T contributed significantly to the checklist total, although the result was not of any practical significance. Sections 1 and 5 of the MABC-CL rendered good results and were shown to be sufficient in screening children with DCD. It was also found that teachers appointed at Model C schools were more competent in their assessing abilities. From the results obtained, it was concluded that further research needs to be done concerning the reliability and validity of the MABC-CL, and that class teachers, especially those with no physical education background within a South African context, need specific training in the use of the checklist to ensure reliable results.

The second and third aims of the study were to determine whether class teachers, after they have been educated in the use of the checklist, are reliable in completing the MABC-CL, and if they were, what questions of the checklist showed the highest relationships with DCD. These results are presented in Chapter 4 (Article 2). The sample on which the research was conducted differs from the first sample. Here all the 9-12 year old boys (n=62) and girls (n=32) of the Bert's Bricks Primary School, situated 22 km outside Potchefstroom in the North West Province, were selected for this study. The teachers for 94 children completed sections 1 and 5 of the MABC-CL. Descriptive statistics, item and factor analyses (Cronbach alpha, Eigen values and communalities), correlation matrices and stepwise regression analyses were calculated using *Statistica for Windows*. The level of significance was set at a p-level of <0,05. The results suggested that the teachers had sufficient knowledge to complete sections 1 and 5 of the MABC-CL, and that they were rated as a reliable source in the assessment and screening of DCD in a country like South Africa with its own particular schooling conditions. Certain questions in section 1, however, need better explanation to ensure proper assessment, which in turn might increase the reliability of the MABC-CL even further. Question 4 (demonstrating competence in personal hygiene), and to a lesser degree question 2 (standing on one leg in a stable position), in section 1, which the teachers felt competent to comment on, were not clear enough, and in section 5 an item such as passiveness is not as easily assessable within the classroom setting, and ratings are most probably subject to the teacher's own opinion. It is therefore recommended that the content of the complete MABC-CL needs to be revised when considering the completion of such a checklist by class teachers only.

The results also showed that DCD children experienced greater difficulties in all of the questions of sections 1 and 5 of the MABC-CL, when compared to the non-DCD group. From the

results it appears as though children with severe DCD experience to a higher degree problems with questions related to disorganized behaviour, tasks which are dependent on bilateral co-ordination, handwriting and other fine motor abilities. They were also much more impulsive, disorganised and lacking in persistence, compared to children classified in the group with moderate and the group without DCD. The variance among DCD children was also explained more by overall behavioural problems, compared to the total group where handwriting ability showed the highest contribution to the variance.

Furthermore, children in the severe DCD group received higher means for all the behavioural aspects and had much poorer specific manual dexterity skills with regard to cutting and drawing. Knowledge derived from the questions in the checklist (sections 1 and 5) assessing this kind of skill and behaviour can therefore be sufficient information to serve as an indication that the MABC-T should be added for further screening. It was therefore concluded that these two sections of the checklist, when completed by knowledgeable teachers, are sufficient for screening purposes, and that it might be a waste of time to ask the teachers to complete the whole checklist.

5.2. Conclusions

The conclusions of this study are made with regards to the set hypotheses.

5.2.1. Hypothesis 1: The MABC-CL is a suitable method of identifying DCD among 10 to 12 year old children of the North West Province.

The results obtained concerning the above hypothesis showed that the MABC checklist is a suitable method of identifying DCD among the North West children, although to a limited degree. Teachers (some more than others) were found to experience difficulty in the completion of the checklist and some of the items and sections were difficult to assess within a classroom situation. It was also found that the Model C teachers were better able to assess the children on these two sections than the teachers from state-subsidised schools in poorer communities who were less knowledgeable regarding a child's motor development. Some teachers (state-subsidised schools) lack more knowledge than others, especially concerning a child's motor development, and they need more detailed instructions on the use of the checklist.

Hypothesis 1 can therefore only be accepted partially, seeing that all the teachers are not consistent in their evaluations of the checklist items and some of the items are less suitable for use with children of the North West Province.

5.2.2. Hypothesis 2: Training of teachers and improving their knowledge enhances the suitability of the MABC-CL in the identification of 10 to 12 year old children of the North West Province with DCD.

Results indicated that sections 1 and 5 were sufficient in the identification of DCD, when a teacher has the necessary background, and are useful in the screening of children suffering from DCD. However, some items still caused difficulty and attention should therefore be given to improving their assessment.

Hypothesis 2 can only be accepted partially, seeing that section 2 to a lesser degree, but 3 and 4 of the checklist in particular were still considered inappropriate even after the teachers received training on the use of the checklist. Sections 1 and 5 are however, sufficient for DCD screening purposes.

5.2.3. Hypothesis 3: The MABC-CL is useful in the identification of different problem areas among 10 to 12 year old children of the North West Province.

From the results obtained from the stepwise regression analysis, it was possible to separate some of the questions in sections 1 and 5 that contributed more to the variance in the group than others. In the DCD group, disorganized behaviour showed high discriminative ability, implying that behavioural problems increase with an increase in the severity of DCD. Children with severe DCD seem to be disorganised, tense children who are unable to get pleasure from success and who have problems with bilateral co-ordination tasks, as well as with fine motor abilities like handwriting and cutting, drawing and tracing tasks. They are also, although to a lesser degree, hard to interest, overactive (move constantly when they have to listen to instructions), distractible, impulsive and timid children. It therefore appears that the MABC-CL might act as a useful pointer to a child with DCD or some other disability, thus allowing the teacher to focus on the child's particular needs in the class, and may allow further testing and act as a research screening instrument.

Hypothesis 3 can therefore be accepted, as it was possible to identify certain problem areas specific to DCD children. By using sections 1 and 5 of the checklist together with the MABC performance test, it is thus possible to screen for DCD without the use of the other sections.

5.3. Recommendations

Results for the first part of the study suggest that it could be useful in future research to educate the teachers better by explaining the importance and procedure of the MABC-CL correctly beforehand, as well as to ensure that they have sufficient knowledge concerning the contents of the MABC-CL and the assessing thereof. If the MABC-CL has to be completed by such teachers, extra attention should be paid to assure that they know how to use the tool correctly. It is further recommended that only sections 1 and 5 of the MABC-CL should be used in the assessment of children with motor difficulties, especially in circumstances similar to those found in the North West province, as these two sections have been shown to have the best validity and reliability, and class teachers have more knowledge concerning the items in these sections. It would also solve the problem of timesaving, as many teachers have found the completion of the checklist too time-consuming.

Even though researchers attempt to optimise the generalisability of the results obtained from the study, all studies have their limitations, thereby decreasing the generalisation of the results. If further studies are planned in this area of research, the following are recommended to enhance the research:

5.3.1. Checklist sections 3 and 4 were considered difficult to assess. Also, certain questions of section 1 and 5 were also not as clear as they could have been. Further research in this area is therefore recommended.

5.3.2. This study clearly indicated that some teachers had poorer ability to assess the children than others. It is therefore recommended that further research needs to be done concerning the reliability and validity of teachers in using the MABC-CL, especially among disadvantaged populations.

5.3.3. The appropriateness of the checklist items regarding cultural and ethnical differences, type of school participating, DCD awareness in schools, the amount of information concerning the checklist and DCD given to the teachers beforehand, inter-observer-reliability and teacher-child

enthusiasm may certainly play a role as far as checklist reliability is concerned. Further research with the focus on these factors is therefore recommended.

5.3.4. Some of the schools were located in very remote areas, making communication and follow-up extremely difficult. If better communication were possible between the researcher and the teachers, some problems could have been minimised. Better methods of communication is therefore recommended.

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APPENDICES

A. **THUSA BANA: Tally Card**

B. **Letter 1**

C. **Letter 2**

D. **The African Journal for Physical, Health Education, Recreation and Dance (AJPHERED) –Guidelines for Contributions**

E. **Journal of Human Movement Studies –Guidelines for Contributions**

A

THUSA BANA PROJECT

Subject

Name: _____ **Nr.**_____ **Gender:** _____

		Check/ Signature
Station 1	**Recruitment Demographic Questionnaire**	
Station 2	**Blood Pressure**	
Station 3	**Anthropometrics**	
Station 4	**Anthropometrics: Clothing**	
Station 5	**Psychological Questionnaire A**	
Station 6	**Dietary Questionnaire: 24 Hour**	
Station 7	**Motor Development A**	
Station 8	**Psychological Questionnaire B**	
Station 9	**Eating Habits**	
Station 10	**Family Circumstances and HIV TRM**	
Station 11	**Physical Activity**	
Station 12	**Motor Development B**	
Station 0	**Back to Station 1**	

B

August 2002

Subject: RESEARCH PROJECT (Thusa Bana): PU for CHE

Dear Teacher

You are probably aware of the research being done by the Potchefstroom University at various schools. We need specific information concerning the children from someone who has known them for a longer period. In this regard, we therefore need your assistance to evaluate the children.

We would appreciate it if you could complete the enclosed **Checklist** for each child listed, which would enable us to get a more complete evaluation with respect to his/her motor development. The checklist has been designed to identify children with motor developmental problems. We foresee minimum complications in the completion of the forms, as the children have been randomly chosen for the project and will not necessarily experience all of the problems.

We value your interest as teacher most highly and kindly request that the attached forms be completed within 3 days after reception and returned to the principal who has undertaken to forward the forms back to us.

We thank you for your valuable time and co-operation in this regard. This research is being undertaken with regard to the development of the children and you can be assured that each child will be left with a positive experience.

Any further inquiries can be addressed to Ms Imke Lombard, Tel 083 307 2814.

Yours sincerely,

Dr AE Pienaar
(Research Co-ordinator)

C

August 2002

Subject: RESEARCH PROJECT (Thusa Bana): PU for CHE

Dear Teacher

Thank you that we can once again make use of your valuable collaboration in our research project. A small percentage of the children, for whom you have already completed a checklist, have to be evaluated a second time. This is necessary in order to determine the validity and reliability of the checklist and your contribution in this regard is crucial for the success of this research project. A time period of at least 3 days has to elapse after the completion of the first checklist, before completing the second checklist.

Thank you once again for your co-operation in this regard.

Any further inquiries can be addressed to Ms Imke Lombard, Tel 083 307 2814.

Yours sincerely,

Dr AE Pienaar
(Research Co-ordinator)

D

THE AFRICAN JOURNAL FOR PHYSICAL, HEALTH EDUCATION, RECREATION AND DANCE (AJPHERED)

Guidelines for Contributions

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Allow the rest of the world to learn more about the practices of the disciplines in Africa.

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E

JOURNAL OF HUMAN MOVEMENT STUDIES

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