DEVELOPMENT OF A CHECKLIST FOR USE WITH THE "CLINICAL OBSERVATIONS OF GROSS MOTOR ITEMS" TOOL TO REFINE OBSERVATIONS OF DYSFUNCTION

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Occupational Therapy.

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DECLARATION

I, Louisa M Jordaan, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Occupational Therapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

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ABSTRACT

Introduction

Appropriate motor coordination is a prerequisite for most occupational tasks (Summers, et al., 2008) (Case-Smith & O'Brian, 2010). Young children develop motor coordination over a period of years (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012). This can be observed in the development of gross motor skills such as jumping, hopping, skipping etc. (Case-Smith & O'Brian, 2010). Delays in the development of motor coordination can thus have an effect on a child's development in all other aspects of their life (Gallahue, et al., 2012).

Problem

There is a need in South Africa for a cost-effective standardised tool to evaluate motor coordination in children in a valid and reliable way. Currently standardised tools must be imported from the United States of America (USA) or the United Kingdom (UK) and may not be suitable for South African children. An evaluation tool for motor coordination does exist in South Africa, but its current scoring depends in part on the experience and skill set of the professional to judge the quality of movement during a movement task and its psychometric properties have not been explored.

Aim

This study aimed to identify salient behavioural characteristics that separate children with typical motor coordination development and mild to severe motor coordination dysfunction from each other on the items of the Clinical Observations of Gross Motor Items (COGMI) (SAISI, 2004), in order to provide recommendations to improve the reliability and standardization of the scoring of this tool in the 5 year 0 months – 5 years 11 months age group.

Method

A quantitative, comparative, descriptive, cross-sectional study design was used, with a total of 23 children in this age group. The participants were divided into a typical motor coordination (green) group and a mild to severe motor coordination dysfunction (red) group. They were videoed while performing 15 of the 18 items of the COGMI. These video recordings were analysed using movement analysis to determine specific behaviours which identify function and dysfunction in this age group.

Results

From the observations which could be seen when using the COGMI, clusters could be identified. As the COGMI focuses on coordination of movement rather than postures, the starting and finishing position were discarded and further analysis was only done on the movement component of items. The observations made during the movement portion of items on the COGMI were divided into observations made of the upper limbs, the lower limbs, head, neck and core. Comparisons were made between the two groups and looked at the salient behavioural characteristics that determine function and dysfunction in the age group of five year old children.

Conclusion

Throughout this study it was very clear that this specific age group presents with a lot of variability due to the fact that they are still developing in their gross motor skills and are not yet proficient in fundamental skills. Using these characteristics a checklist of behaviours was developed, which can be used in combination with the COGMI scoring sheet.

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Gross Motor skills - Gross Motor (physical) skills are those which require whole body movement and which involve the large (core stabilising) muscles of the body to perform everyday functions, such as standing, walking, running, and sitting upright (Case-Smith & O'Brian, 2010).

Dysfunction - Abnormality or impairment in the operation of a specified bodily organ or system (Case-Smith & O'Brian, 2010).

Motor Coordination - Motor coordination is the combination of body movements created with the kinematic (such as spatial direction) and kinetic (force) parameters that result in intended actions (Everett & Kell, 2010).

Motor overflow - Motor overflow refers to the involuntary movements which may accompany the production of voluntary movements (Gallahue, et al., 2012).

LIST OF ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
COGMI	Clinical Observations of Gross Motor Items
DCD	Developmental Coordination Disorder
FMS	Fundamental Motor Skills
HPCSA	Health Professional Council of South Africa
MABC-2	Movement Assessment Battery for Children 2nd Edition
SAISI	South African Institute for Sensory Integration

CHAPTER 1 INTRODUCTION

1.1 INTRODUCTION TO STUDY

Appropriate motor coordination is a prerequisite for most occupational tasks (Summers, et al., 2008) (Case-Smith & O'Brian, 2010). Personal management tasks such as feeding and dressing; educational tasks such as writing and leisure tasks such as sports all require appropriate motor coordination (Summers, et al., 2008) (Case-Smith & O'Brian, 2010). Young children develop motor coordination over a period of years where movement becomes increasingly more complex, accurate and energy efficient (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012). This can be observed in the development of gross motor skills such as jumping, hopping, skipping as well as throwing and catching a ball (Case-Smith & O'Brian, 2010). Delays in the development of motor coordination can thus have an effect on a child's development in all other aspects of their life, and can have long-term effects on a child's self-esteem and self-efficacy as they become aware of the difference in their own performance compared to that of their peers (Gallahue, et al., 2012).

Occupational therapists are involved in the evaluation and treatment of children with motor coordination problems in order to ensure good participation in all occupational performance areas (Miller, et al., 2001) (Gibbs, et al., 2007). However, evaluation can be a complex task requiring the therapist to understand the interaction of multiple factors. Standardised evaluation methods have become the gold standard when attempting to evaluate and understand a child's problems (Case-Smith & O'Brian, 2010) (Venetsanou, et al., 2011). Yet occupational therapists face many challenges in choosing and using appropriate tools in diverse contexts and environments such as is found in South Africa.

Within the global occupational therapy community, the most commonly used standardised evaluation tools, used to evaluate children with motor coordination problems are the Movement Assessment Battery for Children-Test (M-ABC-2) (Venetsanou, et al., 2011) and the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) (Miller, et al., 2001). These two tests were both developed within the United Kingdom (UK) and the United States of America (USA) and have been standardised on populations within the UK, USA and Canada (Deitz, et al., 2007) (Brown & Lalor, 2009) (Ellinoudis, et al., 2011) (Venetsanou, et al., 2011). These tests have shown good reliability and validity and have rigorous scoring procedures to ensure the validity of the evaluation process. However, both these tests require administration in English, have extensive equipment kits that must be bought from the publisher and must be imported to South Africa at great cost (Deitz, et al., 2007) (Brown & Lalor, 2009). These tests are therefore neither cost-efficient nor easy to obtain,

and are not always appropriate to the situations in which South African occupational therapists work. A final criticism of these assessment tools is that they usually measure whether a child can perform a skill or not (the outcome of the motor skill) rather than the quality of movement while achieving the skill (Brown & Lalor, 2009) (Cools, et al., 2009). This is known as product-oriented assessment. While knowing whether a child can perform a skill or not can be an important starting point, it is often the quality of the movement that can provide indications of subtle motor coordination problems that may cause problems later in a child's life.

Observation is also one of the appropriate evaluation tools that occupational therapists can use (Case-Smith & O'Brian, 2010). Detailed observation of children in their daily occupations can provide the therapist with rich information on how motor coordination is influencing the child in everyday life (Summers, et al., 2008) (Gallahue, et al., 2012). Quality of movement, motor competence and motor co-ordination of fundamental motor skills are the building blocks for activities later in life, where more advanced movements are required and are hence an important aspect to assess as early as possible. Literature has emphasised that motor development, the process through which a child gains movement skills, is a crucial factor which influences a person's quality of life as well as participation in daily occupational tasks and global functioning (Sangster, et al., 2005) (Case-Smith & O'Brian, 2010) (Colella & Morano, 2011) (Hsieh, et al., 2013). Thus it is important to not only assess the outcome of motor skills, but also the how of movement or quality of movement. This is known as process-oriented assessment.

One of the problems with observational tools, however, is that they require skill and experience and does not provide as reliable a method of evaluation as a standardised product-oriented evaluation tool, as different therapists may obtain different results despite observing the same situation. Skilled observation is particularly difficult for the novice evaluator or newly qualified therapist who does not yet have much experience to rely on (Case-Smith & O'Brian, 2010).

With this research study the researcher focused on the importance of assessing quality of movement when assessing children's motor development, and how the movement is performed rather than on the outcome of movement. In other words: - to be more process-oriented in assessing motor development rather than product-oriented.

In South Africa, budgetary constraints and the diverse non-English speaking population results in less use of standardised evaluation tools like the MABC-2 and more reliance on skilled observations.

The Clinical Observations of Gross Motor Items (COGMI) is an evaluation tool developed by the South African Institute of Sensory Integration that makes use of skilled observations of movement tasks (SAISI, 2004). The tool does not require specialised equipment, is easy to obtain, is inexpensive and was developed on South African children (SAISI, 2004). The tool is commonly used by therapists in many different contexts and environments to evaluate children's motor coordination and development of fundamental motor skills such as skipping or hopping. By using this tool the therapist is required to make a judgement on the quality of that movement in order to give the movement a score of one to five. The tool is not standardised, however, and though the manual consists of general developmental guidelines, the scoring depends on the skill of the therapist to judge the quality of movement observed. The COGMI is thus a process-oriented assessment tool with a standardized administration protocol, but that relies on skilled observations and judgements of quality from the administrator. The psychometric properties of this tool have not to date been explored. Thus there is a real possibility that the tool measures the skill of the therapist in observation rather than the true ability or disability of the child being evaluated (SAISI, 2004).

Therefore, therapists in South Africa are currently using a process-oriented assessment tool. However, process-oriented assessment tools can be very daunting to use by novice therapists due to the fact that the novice therapists might not be as skilled in making observations as is required, as well as the fact that evaluations based on quality of performance are very subjective in nature.

Also keeping in mind that early childhood and the pre-school years form a sensitive age period for motor development and the development of fundamental motor skills (Chambers & Sugden, 2002) (Cools, et al., 2009) (Colella & Morano, 2011) (Rosa, et al., 2013), the researcher felt it necessary to use the COGMI assessment tool, which is a process-oriented tool used on 5 year old children in this research study. With this study the researcher therefore aimed to identify salient behavioural characteristics that separate children with normal motor coordination development, mild motor coordination dysfunction and severe motor coordination dysfunction from each other on the items of the COGMI, SAISI 2004 in order to make recommendations to improve the specificity and sensitivity of this observational evaluation tool, as well as to improve this commonly used assessment tool's qualitative ability. The researcher aimed for the COGMI to be more process-oriented especially in assisting novice evaluators in making appropriate process-oriented judgements. The COGMI is focussed on assessing gross motor coordination, and thus the focus of this study was on gross motor coordination.

As a result, it is necessary to embark on a process of research to ultimately standardise this tool in South Africa in order to create a valid and reliable tool for our context.

1.2 PROBLEM STATEMENT

There is a need in South Africa for a cost-effective standardised tool to evaluate motor coordination in children in a valid and reliable way. There is also a need to move towards process-oriented assessment tools that evaluate not only the outcome of a skill, but also the quality of movement. Currently standardised tools must be imported from the USA or the UK and may not be suitable for South African children. These tools are also exclusively product-oriented assessments. An evaluation tool for assessing the quality of motor coordination does exist in South Africa, but its current scoring depends in part on the experience and skill set of the professional to judge the quality of movement during a movement task and its psychometric properties have not been explored.

1.3 PURPOSE OF THE STUDY

The purpose of this study is to identify salient behavioural characteristics that separate children with normal motor coordination development from those with motor coordination dysfunction on the items of the COGMI, SAISI 2004 in order to provide recommendations to improve the specificity and sensitivity of this observational evaluation tool, especially to assist novice evaluators.

1.4 AIM OF THE STUDY

To develop a checklist with behavioural descriptors (observations) for the five point scale of the COGMI to use in combination with the COGMI to identify motor coordination function and dysfunction in children between the ages of 5 years 0 months and 5 years 11 months.

1.5 OBJECTIVES OF THE STUDY

a) Determine the observations that can be made when using the COGMI with children between the ages of 5 years 0 months and 5 years 11 months.
b) Compare observations from children between the ages of 5 years 0 months and 5 years 11 months with typical motor coordination and those with motor coordination dysfunction to identify the salient behavioural characteristics that will determine function or dysfunction.
c) Develop a checklist of these observations to accompany scoring criteria.

1.6 JUSTIFICATION FOR THE STUDY

Standardising of scoring is the first step in developing the COGMI into a valid and reliable tool for the South African population that is affordable and easy to use in our context. Once a checklist

with behavioural descriptors has been developed to identify function and dysfunction of motor coordination, the scoring of this tool can be standardised, the psychometric properties can be further explored to ensure validity and reliability. Standardisation is necessary in the long run to justify to the funders of therapy, whether it is medical funds, parents themselves or the government; why a child needs therapy and also to be able to explain what specific therapy and level of intensity of therapy a child is in need of.

CHAPTER 2: REVIEW OF LITERATURE

2.1 INTRODUCTION

Throughout literature it is evident that motor development, the process through which a child gains movement skills, is a crucial factor that influences a person's quality of life as well as participation in daily occupational tasks and global functioning (Sangster, et al., 2005) (Cools, et al., 2009)(Case-Smith & O'Brian, 2010)(Colella & Morano, 2011) (Hsieh, et al., 2013). Literature also revealed an increased awareness during the last decade towards the important role of motor ability and motor activity in a child's overall development and health, especially when a child's motor ability is delayed (Colella & Morano, 2011) (Piek, et al., 2012). Children with learning difficulties like Dyslexia, Attention deficit hyperactivity disorder (ADHD), Anxiety disorders and Autism, as well as developmental difficulties like, Developmental coordination disorder (DCD), commonly experience motor performance delays which contribute negatively to all areas of occupational performance (Sangster, et al., 2005) (Barnard & Franzsen, 2008) (Piek, et al., 2012) (Rintala & Loovis, 2013).

Occupational therapists are involved in the evaluation and treatment of children with motor coordination problems in order to ensure good participation in all occupational performance areas (Miller, et al., 2001) (Goldstand, et al., 2005) (Rodger & Ziviani, 2006). Occupational therapists working in the field of paediatrics therefore make use of motor evaluation tools to evaluate the motor performance of these children in order to provide treatment that will enhance the child's occupational performance and health holistically (Barnard & Franzsen, 2008). However, evaluation can be a complex task requiring the therapist to understand the interaction of multiple factors. Standardised evaluation methods have become the gold standard when attempting to evaluate and understand a child's problem (Case-Smith & O'Brien, 2010) (Venetsanou, et al., 2011). Yet occupational therapists face many challenges in choosing and using appropriate tools in diverse contexts and environments such as is found in South Africa. Norms on standardised tests may not apply to South African children as literature shows variation in developmental norms across different countries and cultures (Mayson, et al., 2007) (Van Jaarsveld, et al., 2012). Consequently, the use of observations made during evaluation of a child has become a critical evaluation tool for occupational therapists in South Africa and across the world.

This literature review will thus focus on motor development, the role of occupational therapists in early identification of difficulties (dysfunction) and the evaluation tools used by occupational

therapists for evaluating motor development as well as the expectations of motor development for children between the age of 5 years 0 months and 5 years 11 months.

2.2 WHY MOVEMENT IS IMPORTANT

Movement is part of everyday life. Everything that we do, whether it is playing or working or just having fun involves movement. Multiple studies done by Goddard and Hyland (1998) as well as Wolff (1999) concluded that motor skill development, in other words the development of movement, plays an important role in cognitive development and that delays in motor development can be associated with deficits in perceptual skills. The studies also concluded that motor skill development is often linked to developmental problems in other areas. In the study done by Goddard and Hyland (1998) they identified significant differences in the early development of children who presented with reading and writing difficulties in relation to the control group. The children presenting with learning difficulties showed a history of early developmental delays regarding balance and motor skills. In Wolff's study done in 1999 on dyslexic children he discovered that 90% of those with motor coordination difficulties also appeared to be presenting with motor speech difficulties (Portwood, 2004) (Rodger & Ziviani, 2006). Motor coordination development as well as the development of fundamental skills and motor activity forms an essential part of promoting health, as it contributes to the balanced development of physical, emotional, cognitive and social characteristics. Motor activity can therefore also be seen as a crucial method of disease prevention (Colella & Morano, 2011) (Gallahue, et al., 2012) (Bardid, et al., 2016). Fundamental movement patterns are basic patterns of behaviour that can be observed and should develop during the early childhood years. These skills have value throughout life and are important components of daily living for children as well as adults (Gallahue, et al., 2012).

Delays in the development of movement or motor coordination can thus have an effect on a child's development in all other aspects of their life. Delays in the development of motor coordination can also have long-term effects on a child's self-esteem and self-efficacy as they become aware of the difference in their own performance compared to their peers (Gallahue, et al., 2012) (Bardid, et al., 2016). Therefore, it can be seen that the diagnosis of delayed motor development does hold vast implications for the child's functioning later in life. It is, in that regard, of utmost importance to be able to assess and identify these delays in motor development and fundamental motor skills as early as possible as it may have significant impact on a child's and adult's holistic functioning (Miller, et al., 2001) (Sangster, et al., 2005) (Bardid, et al., 2016).

2.3 MOTOR DEVELOPMENT

Motor development is commonly characterised by the occurrence and achievement of a series of motor milestones, however, it is a far more complex maturational process (Barnard & Franzsen, 2008) (Case-Smith & O'Brian, 2010) (Kakebeeke, et al., 2013). Haywood & Getchell stated in 2001 that motor development can also be seen as "the sequential, continuous age-related process whereby movement behaviour changes" (Rintala & Loovis, 2013). Motor development can therefore be seen as a dynamic process in which new forms of motion emerge and through which a child acquires movement skills (Cools, et al., 2009) (Colella & Morano, 2011) (Kakebeeke, et al., 2013).

The changes in movement behaviour include gross motor development with locomotor and object control skills as basic components, in other words, the big movements of the body like skipping, hopping, throwing and kicking a ball (Case-Smith & O'Brian, 2010) (Colella & Morano, 2011) (Rintala & Loovis, 2013) (Baghurst & Mwavita, 2014).

For developing children the preschool period is a sensitive time for the development of fundamental motor skills (i.e. running, jumping, kicking, catching, throwing etc.) which is also the foundational movements for more specialised skills (Chambers & Sugden, 2002)(Cools, et al., 2009) (Colella & Morano, 2011) (Rosa, et al., 2013). According to Gallahue et al (2012), children of 5 to 7 years of age fall into the fundamental movement phase of motor development. This phase of motor development is a period when the young child actively explores and experiments with the movement potential of his body. The child discovers how to perform a variety of stabilizing, locomotor and manipulative movements, in isolation as well as in combination with each other. By developing fundamental patterns of movement, children learn how to respond to various stimuli with motor control and movement competence (Gallahue, et al., 2012).

Young children develop motor coordination over a period of years where movement becomes increasingly more complex, accurate and energy efficient (Case-Smith & O'Brien, 2010) (Gallahue, et al., 2012). Appropriate motor coordination and the mastery of some of the fundamental motor skills is a prerequisite for most occupational tasks and daily functioning as well as participation in later physical activities (Summers, et al., 2008) (Cools, et al., 2009) (Case-Smith & O'Brien, 2010) (Rosa, et al., 2013). Personal management tasks such as feeding and dressing, educational tasks such as writing, and leisure tasks such as sports all require appropriate motor coordination (Rodger & Ziviani, 2006) (Summers, et al., 2008) (Barnard & Franzsen, 2008) (Case-Smith & O'Brian, 2010).

The question one may now ask is what exactly are fundamental motor skills and how does it develop. Like mentioned above walking, running, galloping, jumping, hopping, leaping, sliding, catching, throwing, kicking, rolling, striking a ball, dribbling etc. are all examples of fundamental motor skills. Fundamental motor skills are the foundational movements or precursor patterns for more specialized skills and can be seen as the ABC of movement (Colella & Morano, 2011) (Chow & Louie, 2013) (Bardid, et al., 2016). Fundamental motor skills continue to be refined and perfected during a person's entire life span (Colella & Morano, 2011). Gross movement skills are necessary to move around through space (locomotion), to have more control over your muscles in opposition to gravity (stability) as well as to be able to control the body as well as objects when exploring the environment at an early age (Gallahue, et al., 2012). As life progresses well-developed gross movement skills helps an individual to function more smoothly (Cools, et al., 2009). In order to develop proficiency in fundamental skills, a child must develop sufficient balance, locomotive skills and body coordination skills. These will be discussed in more detail below.

2.3.1. Development of Balance

Throughout the discussions around the question why movement is important as well as around the development of movement and the fundamental motor skills, it became clear to the researcher that the development of balance also plays a very important role in the everyday life of a person. Balance can be defined according to Gallahue et al. (2012) and Case-Smith (2010) as the ability to maintain one's equilibrium in relation to the force of gravity and can be static or dynamic (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012). Static balance is the ability of the body to maintain equilibrium in a stationary position, like balancing on one foot where dynamic balance refers to the ability of the body to maintain equilibrium when moving from one point to another, like walking on a balance beam (Gallahue, et al., 2012). All movement patterns and movement in general have balance as the basic component (Everett & Kell, 2010). Movement is only possible if the body provides a stable but mobile base, and for this stable base we need core stability (Everett & Kell, 2010). Core stability develops when a person works their abdominal muscles and back extensors against gravity (Case-Smith & O'Brian, 2010) (Everett & Kell, 2010). Balance development starts from birth and continue to improve with age (Bundy, et al., 2002) (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012). According to Gallahue et al. (2012) there is a linear trend in the development of static as well as dynamic balance towards improved performance from age 2 to 12 years of age (Gallahue, et al., 2012). One's balancing ability is influenced by visual, tactile-kinaesthetic and vestibular stimulation (Bundy, et al., 2002) (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012).

2.3.2. Development of Locomotive and Body Coordination skills

The development of locomotion starts as early as 9-12 months, if one look at the development of walking. Running is one of the earliest emerging fundamental motor skills starting around the age of 18-22 months of age (Gallahue, et al., 2012). According to literature, at the age of 4-5 years children are proficient in running as an example of locomotion. According to Gallahue, et al. (2012) fundamental movement skills develop in the following sequential stages: the initial stage, the emerging elementary stage and the proficient stage. Firstly, the Initial Stage which is typically the locomotor, manipulative, and stability movements of the 2-3-year-old child. When looking at these stages it is clear that in the initial stages there is a lot of balancing present where the arms are still very high and gradually as the child moves through the development stages the arms move closer to the body. In the initial stage the movement is also still very non-rhythmical and reciprocal movements are not yet present. Thereafter, the Emerging Elementary Stage – this stage involves gaining greater motor control and rhythmical coordination of fundamental motor skills. This can ordinarily be seen in the 3-5-year old child. In the emerging stage we see that reciprocal movements are starting to develop although motor overflow may also still be present due to the fact that the skills are still developing and are not yet consolidated at this stage. Motor overflow refers to the involuntary movements which may accompany the production of voluntary movements like sticking out of tongue or flexion and extension of fingers and it shows the effort the child is putting in to be able to do a certain action. Lastly, the Proficient Stage – this stage is characterized by mechanically efficient, coordinated, and controlled performances (Gallahue, et al., 2012). One also expects to see motor competence to perform a wide range of motor skills in the proficient stage. In this study the focus will be on the emerging stage and the transition from the emerging elementary stage to the proficient stage of fundamental movement skill development due to the fact that the population of this study is between 5 years 0 months and 5 years 11 months of age.

The development of locomotion and locomotor skills can therefore also be divided into these three stages. However, the emerging stage may, for some fundamental movement skills, be further divided into two stages. Refinement in the quality of movement of the motor skills take place in these emerging stages, for example if one take a look at running; initial runners run with a wide stride and arms high in the air (high guard), but over time the stride width becomes narrower, until it reaches shoulder width apart in stages three and four. The arms also drop to middle guard in stage two and by stage three the arms are straight and next to the body (Gallahue, et al., 2012). If one looks at the fundamental movement skills specific to this study and the developmental sequences of locomotion regarding the upper and lower limbs, for example, galloping, the stages can be explained as follows:

Galloping: Stage One – Initial stage: It is a rhythmically uneven run where the trail leg crosses in front of leading leg, during the airborne phase.

Stage Two – Emerging stage: The trail leg is stiff with a choppy rhythm. The hips are often oriented sideways and the vertical component is exaggerated.

Stage Three – Emerging stage: Presents with a rhythmical pattern, smooth actions and a moderate tempo. The feet remain close to the ground and the hips are oriented forward.

Stage Four – Proficient stage: The lead leg stays in front with the hips front facing. The trail leg lands beside or slightly behind the leading leg, with feet remaining close to the surface. The knees are flexed slightly while in flight (Gallahue, et al., 2012). It is clear from the observations stated above that the focus is on the lower limbs when looking at gallop.

To further explain the developmental sequences of locomotion, with other fundamental motor skills specific to this study, one may look at hopping, skipping and long jump; for example, hopping.

Hopping: Stage One – Initial stage: The non-support foot is in front or to the side with the thigh parallel to the floor. The support leg and knee are pulled up. The hands are shoulder height (90 ˚ Abduction of arms) and the arms are bilateral, high, and out to side.

Stage Two – Emerging stage: non-support knee is flexed with knee held in front of body and foot behind support leg. Small knee and ankle extension as well as bi-lateral arm action is visible. The arms swing upwards and out to side in a winging action.

Stage Three – Emerging stage: The non-support thigh is vertical with the foot behind the support leg. The knee is flexed. The non-support leg pumps slightly but very little force production is visible. The support leg extends on take-off and flexes quickly on landing. Bi-lateral arm action is visible where the arms pump up and down together in front of the body.

Stage Four – Proficient stage: The non-support leg is bent and the knee pumps forward and backward in strong pendular action. The weight transfer from landing to take-off on support foot is a smooth action. Arm opposition with swing leg is also visible with the arm on the opposite side of the swing leg moves in opposition. The arm on the other side is variable. Only later the arms swing in opposition to the swing leg (Gallahue, et al., 2012). These observations indicate that balance are still developing due to the fact that the arms starts out high and gradually comes closer to the body.

Skipping is another example: **Stage One – Initial stage:** Ineffective arm actions are visible. The arms move in unison, pumping up and down, resulting in a high vertical component on the hop. The legs presents with an ipsilateral pattern where one side skips and the other side just steps.

Stage Two – Emerging stage: The arms provide the body lift resulting in an excessive vertical component. The arms move forward together at first and then break into semi-opposition and the legs presents with an alternating flat-footed step-hop pattern. This is a skipping pattern that has a flat-footed landing.

Stage Three – Proficient stage: Arm actions are reduced with hands below shoulders. The arms swing loosely in opposition to the non-support leg. There is a limited vertical component present. The support foot is near surface on hop and the legs presents with an alternating ball of foot step-hop pattern. Landing is on the ball of the foot and the taking off is from the toes (Gallahue, et al., 2012). In the literature of Gallahue et al. (2012) they only talk about the three stages in developing skipping.

The last example is long jump: **Stage One – Initial stage:** The arms are stationary or after take-off they may wing out to the sides and are used as brakes. The arms may also present with a large vertical component. The child tries to jump but rather takes one step with one foot and the knee presents with little preparatory flexion. Legs are not extended when in flight. **Stage Two – Emerging stage:** The arms start at the sides and then swing forward or sideways and act as wings. There is still a large vertical component present. The jump starts with knee extension and legs are near extension when in flight.

Stage Three – Emerging stage: The arms swing backwards and then move forward with elbows in front of trunk at take-off. Hands go to head height but never go above head. Knee extension is visible with take-off and fully extend when in flight.

Stage Four – Proficient stage: The arms swing forwards, backwards and then forward at take-off. There is complete arm and leg extension visible at take-off, with hands above the head. The arms are also extended in the flight phase as well as the landing and follow-through phase. Knee and hip flexion is visible prior to take-off. The heel lift and is followed by knee extension at take-off. Upon landing, the thighs are parallel to the surface and the heel reaches forward to touch the surface first (Gallahue, et al., 2012).

Although fundamental movement skills develop in a certain sequence like discussed above we also need to keep in mind that we work with individuals living in an environment where there are a lot of factors that can influence the development of these skills. These influencing factors will be discussed in the next section.

2.3.3. Factors influencing the development of fundamental motor skills

The development of these skills is highly variable from person to person due to the fact that it is related to the growth and maturity of each child and is influenced by the practice opportunity,

encouragement, motivation, social-economic status, lifestyles and environments within which each child is reared (Cools, et al., 2009) (Colella & Morano, 2011) (Gallahue, et al., 2012) (Kakebeeke, et al., 2013) (Chow & Louie, 2013) (Bardid, et al., 2016). For example, Chow & Louie found in their study done in 2013 that a larger play area which is an environmental factor does influence the development of fundamental motor skills positively (Chow & Louie, 2013). The main method by which children develop fundamental motor skills is through gross motor play, however the environments in which today's children are raised is so complex that they are constantly being warned to avoid situations and are taught not to touch (Gallahue, et al., 2012). They therefore tend to miss many of the opportunities like climbing trees, walking fences and jumping streams, for example. The assumption can be made that when a child does not receive encouragement and practice opportunities, or lacks motivation to participate in gross motor play his development of fundamental motor skills will be influenced negatively. Thus children who have had lots of opportunity to practice fundamental motor skills through gross motor play, as well as the space to do so may develop faster than their peers. Many children grow up in large cities or are living in small apartments without large gardens. These settings, together with cramped day-care centres do not encourage or promote learning through movement (Gallahue, et al., 2012). When a child follows a more sedentary lifestyle by watching more television of playing more computer games, which is more common these days, or does not have environmental infrastructures like big play areas or a school supporting a sensori-motor program during school hours, the development of these fundamental motor skills may not be optimal. Practice opportunities and following an active lifestyle influence the development of fundamental motor skills positively. The fact that the population of this study is in the transition phase and may present with motor overflow is another contributing factor to the variability seen in this population.

Knowledge of motor development provide occupational therapists with a guide which assist them to determine whether a child's development is on par and if intervention is needed, and it also plays a role in the goal setting and planning of intervention for children who presents with delayed motor development (Barnard & Franzsen, 2008) (Case-Smith & O'Brian, 2010).

2.4 MOTOR DYSFUNCTION

Motor dysfunction or impairment may be categorized as a disorder itself, ranging from severe impairment seen in conditions such as cerebral palsy, to relative mild impairment as seen in Developmental Coordination Disorder (DCD) (Piek, et al., 2012), however, children with a variety of developmental disabilities presents with delayed motor skill development (Rintala & Loovis, 2013). Motor dysfunction is not only diagnosed by the complete lack of a fundamental motor skills,

but also more subtle analysis of quality of movement is important for the identification of potential motor dysfunction. According to the Clinical Observations (Adapted from J. Ayres), children who presents with motor coordination problems may present with problems such as inadequate development of reciprocal flexion and extension of the trunk, with limited rotary movements. For example – protruding abdomen, lordosis, anterior pelvic tilt, hips externally rotated, knees locked in hyper extension, and winging scapulae. They may also presents with undifferentiated movement synergies, like righting reactions and protective reactions predominate instead of more mature equilibrium reactions, as well as prolonged stabilization by fixing where they tend to co-contract proximally to provide fixation for distal movement. This does not serve as a good background for controlled differentiated movement patterns. Furthermore they may also presents with a lack of isolated movement patterns due to the presence of mass movement; e.g., an inability to keep the wrist on the surface while writing, with the movement being at the shoulder. Children with motor coordination problems may also present with an inability of the two sides of the body to function independently. Thus delayed bi-lateral integration as well as impaired midline crossing occurs. Another characteristic of children with motor coordination problems is in automatic postural control and alignment against gravity. This often results in the child sitting slumped at the desk with his/her head supported on non-dominant hand. Lastly children with motor coordination problems may also presents with excessive movements (SAISI, 2005). These listed problems are often also observations that can be made by occupational therapists during evaluation sessions together with observations of clumsiness, impaired coordination, impaired motor planning, poor posture, and poor hand writing abilities and these children often have a history of delayed milestones.

From literature it was evident that early identification of motor developmental difficulties, and referral to appropriate services, is extremely important as it can maximise developmental outcomes, prevent the long-term effect of impaired motor function and ensure that the child receives the appropriate support before commencing school (Sangster, et al., 2005) (Kakebeeke, et al., 2013) (Mayson, et al., 2007) (Chambers & Sugden, 2002) (Piek, et al., 2012) (Bardid, et al., 2016). However, if one takes the information given above on the importance of normal or appropriate motor development and one looks at the variability of motor coordination development as well as the various presentations of motor development difficulties, it is clear that identification in addition to defining motor coordination problems is not an easy task.

Due to the variability in the rate of acquisition of motor development in preschool children and the fact that specific movement mistakes may still be present and considered normal in specific age groups performing specific tasks, for example the presence of excessive arm movements in the 5 year 0 months to 5 years 11 months age group when performing kneel-walking backwards, the question that comes to mind is to what extent the variability can be considered normal and when does abnormality or dysfunction start (SAISI, 2004) (Kakebeeke, et al., 2013).

Motor competence or the ability to perform a wide range of motor skills is reflected during preschool years by a child's proficiency in fundamental motor skills (Bardid, et al., 2016). For that reason identification of motor development delays in the preschool stage of a person's life or early identification may maximize developmental outcomes. The best chance to influence a child's developmental outcome positively is to identify the delays as early as possible (Mayson, et al., 2007). Keeping this statement in mind as well as the fact that it is more difficult to identify children with milder delays as it is to identify children with significant delays, it may be the children with milder delays that will benefit the most from early intervention services (Mayson, et al., 2007) (Piek, et al., 2012). When children with milder delays, although more difficult to identify, receive the correct intervention as early as possible, not only motor skills will improve but health, academic and psychosocial problems associated with poor motor ability will be reduced (Piek, et al., 2012).

2.4.1 THE ROLE OF OCCUPATIONAL THERAPISTS IN EARLY IDENTIFICATION OF MOTOR DIFFICULTIES (DYSFUNCTION)

Throughout literature it is clear that motor difficulties have a severe negative impact on a child's competence in everyday activities (occupational performance areas), which may lead to a decrease in participation in these activities and ultimately impacts negatively on a child's quality of life. As a result, a multi-disciplinary approach, which occupational therapy is part of, is needed when treating children with motor coordination difficulties (Sangster, et al., 2005) (Miller, et al., 2001). Occupational therapists focus their management of a patient on all the occupational performance areas in everyday life and aim to improve a child's engagement in a balanced, health-promoting way across all these occupational performance areas (Rodger & Ziviani, 2006) (Case-Smith & O'Brian, 2010). Occupational therapists are also seen as specialists in analysing activities and have a unique and holistic perspective to determine the required skills necessary to perform a specific activity (Case-Smith & O'Brian, 2010). Activity analysis is defined as the process used by occupational therapists to addresses the typical demands of an activity and the range of skills involved in its performance (Case-Smith & O'Brian, 2010). By making use of activity analysis the

occupational therapists are investigating what is influencing the occupational performance of the child. Therefore it can be said that occupational therapists treat a patient holistically towards competence in all the spheres of life and by using activity analysis not only to focus on what a patient or child can do or not do, but also focus on how a patient or child performs an action.

Intervention is thus of utmost importance, but for intervention to be effective, children need to be accurately and consistency identified and evaluated (Chambers & Sugden, 2002). Children are commonly referred to occupational therapists due to delayed gross motor development, handwriting difficulties, concentration difficulties and/or perceptual difficulties (Case-Smith & O'Brian, 2010) (Rodger & Ziviani, 2006) (Miller, et al., 2001).

2.4.2 Evaluation tools

Different evaluation tools have been developed to evaluate motor competence. These evaluation tools can be described as product-oriented and process-oriented evaluation tools. Product-oriented evaluation tools focus on the outcome of motor skills and look at aspects such as distance, number of attempts taken to successfully execute a motor task, etc., whereas process-oriented evaluation tools focus on how motor skills are performed by looking at the movement patterns (Bardid, et al., 2016) (Logan, et al., 2016). Process-oriented evaluation tools therefore describe the quality of movement, look at motor competence from a developmental perspective and differ in their complexity to administer due to the number of skills included, number of performance criteria for each skill and whether or not performance can be observed (Bardid, et al., 2016) (Logan, et al., 2016). These types of evaluation tools reveal aspects of a motor skill that have been poorly developed and therefore can assist in more specific intervention plans (Bardid, et al., 2016). Process-oriented evaluation tools help define or determine product-oriented evaluation tools.

Within the global occupational therapy community, the most commonly applied standardised evaluation tools used to evaluate children with motor coordination problems are the Movement Assessment Battery for Children-Test (M-ABC-2) which can be classified as a product-oriented evaluation tool (Venetsanou, et al., 2011) (Logan, et al., 2016) and the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP) (Miller, et al., 2001) which can also be classified as a product-oriented evaluation tool. These two tests were both developed within the UK and the USA and have been standardised on populations within the UK, USA and Canada (Brown & Lalor, 2009) (Deitz, et al., 2007) (Venetsanou, et al., 2011) (Ellinoudis, et al., 2011). These tests have shown good reliability and validity and have rigorous scoring procedures to ensure the validity of the evaluation process. However, both these tests require administration in English, have extensive equipment kits that

must be bought from the publisher and must be imported to South Africa at a great cost (Deitz, et al., 2007) (Brown & Lalor, 2009). Thus, these tests are neither cost-efficient nor easy to obtain and are not always appropriate to the situations in which South African occupational therapists work.

The Health Professions Council of South Africa (HPCSA) guidelines for good practice in the Health Care Professions, general ethical guidelines prescribe that Health Care practitioners should act in the best interests of patients (HPCSA, 2008) and that includes the use of evaluation tools that have been proven to be fair and just, to the South African population (Van Jaarsveld, et al., 2012). Taking this statement from the HPCSA into consideration as well as the fact that the most commonly used standardised evaluation tools utilized to evaluate children with motor coordination problems are not standardised on the South-African population, has not yet been proven to be fair and just to this population and requires administration in English exclusively, the use of these evaluation tools might not always be in the best interests of the patients seen by occupational therapists in South Africa.

Furthermore, if one looks at the fact that both these tests mentioned above are product-oriented evaluation tools which focus on whether a child can perform a certain task or not, and one thinks about the fact that occupational therapists focus their evaluation on activity analysis and how a child performs a certain task and not so much on whether a child can successfully perform a certain task or not, taking the problems listed earlier from J. Ayres into consideration, it also supports the fact that the use of these two tests might not always be in the best interest of the patients seen by occupational therapists. The qualitative value of evaluation should always be considered when working with developing children. Children may have the ability to do a specific task, but still display problems in performing the task.

Almost half of the occupational therapists in South Africa focus on treating children with learning and developmental difficulties, of which motor development difficulties are a part (Barnard & Franzsen, 2008). However, budgetary constraints and the diverse non-English speaking population of South Africa results in less use of standardised evaluation tools like the MABC-2 and more reliance on skilled observations.

2.4.3. Observation as an evaluation tool

Observation is an appropriate evaluation tool that occupational therapists can use (Case-Smith & O'Brien, 2010). Skilled observation is a non-standardized method which was developed by therapists to obtain objective data on the quality, frequency and duration of the child's

performance, the uniqueness of the child and provides rich information as well as possible reasons for the delayed or deficient performance (Case-Smith & O'Brian, 2010) (Kramer & Hinojosa, 2009). Detailed observation of children in their daily occupations can provide the therapist with valuable information on how motor coordination is influencing the child in everyday life and serves as a powerful assessment tool (Gallahue, et al., 2012) (Summers, et al., 2008) (Kramer & Hinojosa, 2009). Therefore, it is clear that observation as an evaluation tool can be classified as a process-oriented evaluation tool. However, as occupational therapists we value the qualitative information from evaluation as much, if not more, than the quantitative scores, but observations can be very subjective and tend to be more evidence based in our profession, so we need numbers or quantitative information as well (Bruwer & Carly, 2015).

The COGMI is an evaluation tool developed by the South African Institute of Sensory Integration (SAISI) that makes use of skilled observations of movement tasks (SAISI, 2004). This tool can therefore be classified as a process-oriented evaluation tool. The tool is commonly used by therapists in many different contexts and environments to evaluate children's motor coordination when they are participating in common gross motor movements such as skipping or hopping. The tool does not require specialised equipment, is easy to obtain, is inexpensive and was developed with South African children in mind (SAISI, 2004). The tool is not standardised, however, and though the manual consists of general developmental guidelines, the scoring depends on the skill of the therapist to judge the quality of movement observed. The psychometric properties of this tool have not to date been explored. With regards to that, there is a real possibility that the tool measures the skill of the therapist in observation rather than the true ability or disability of the child being evaluated (SAISI, 2004). As mentioned above, process-oriented evaluation tools are difficult to use due to the fact that observations depends on the skill of the therapist and are not very objective in nature.

Observation as an evaluation tool does hold some disadvantages as it requires skill and experience and does not provide as reliable a method of evaluation as a standardised evaluation tool as different therapists may obtain different results despite observing the same situation. Skilled observation is particularly difficult for the novice evaluator or newly qualified therapist who does not yet have much experience to rely on (Case-Smith & O'Brian, 2010). Therapists with little experience in the use of observations may not recognize key behaviours or patterns of behaviours and the meaning of those behaviours in relation to the environment and the demands of the task (Case-Smith & O'Brian, 2010). Observations and the interpretations of the observations by the

therapists are being influenced by their personal expertise and judgement and are therefore more subjective rather than objective.

For this reason the researcher is aiming with this research project to identify prominent behavioural characteristics which can be compiled into a checklist. This checklist is to be used in combination with the COGMI evaluation tool. By using this checklist in combination with the COGMI the researcher aims to eliminate the subjectivity of observations made by therapists and aims to improve the reliability of the COGMI evaluation tool.

2.4.4 Tool development

There are numerous steps in constructing and standardizing an assessment tool which are aimed at ensuring the tool is valid (measures what it says it measures) and reliable (produces the same scores every time it is administered) (Kielhofner, 2006) (Creswell, 2009). Casteleijn summarized tool development into seven steps, namely:

"1. Determine what is to be measured.

2. Final selection of domains.

3. Scale development and validation.

4. Format of instrument.

5. Guidelines for use of instrument.

6. Administer to sample.

7. Evaluate reliability and validity; optimise scale and items." (Casteleijn, 2012).

The development and validation of the scale used within an assessment tool is vitally important to ensure both the validity and the reliability of the tool (Kielhofner, 2006) (Creswell, 2009) (Casteleijn, 2012). If a measurement scale is vague or poorly defined, different clinicians using the tool may come to incorrect conclusions regarding the construct (construct validity) being measured and may interpret scores and findings differently (reliability) (Kielhofner, 2006) (Casteleijn, 2012). The COGMI has undergone some of the steps as described by Casteleijn. The construct has been defined (gross motor skills), the domains have been selected, the scale developed, the tool formatted and guidelines for use developed in the form of a manual (SAISI, 2004). However, the scale of measurement is still in a format that allows for variability in interpretation which decreases

both the construct validity as well as the reliability of the tool. Furthermore, not enough research has been done to investigate and refine the psychometric properties of the COGMI. Thus before a full-scale study into sensitivity and specificity, test-retest reliability, inter-rater reliability and internal consistency can be undertaken, the scale of measurement needs to be refined and developed in order to ensure construct validity, which became the focus of this study.

2.5 CONCLUSION

As it is evident in literature that poor motor ability has an impact on all spheres of life, hence influencing all occupational performance areas negatively, there is a possibility that children presenting with delayed motor development may present with obesity in addition to problems in academic, social and emotional functioning (Piek, et al., 2012). Early identification of motor impairment is crucial as it is needed in order to provide appropriate intervention to supply children and their families with the support they need and deserve, to improve motor skills and also to prevent or reduce health, academic and psychosocial problems related to poor motor ability in order for these children to fully participate in society (Piek, et al., 2012) (Mayson, et al., 2007).

In order to be able to identify motor developmental difficulties as early as possible it is of utmost importance to determine which evaluation tool is the most appropriate to use in the specific context. Developing a checklist for use with the COGMI evaluation tool, the tool most commonly used and developed in South Africa for South African children, to refine observations of dysfunction is crucial and will assist therapists in making the correct decision when choosing an evaluation tool.

CHAPTER 3: METHODOLOGY

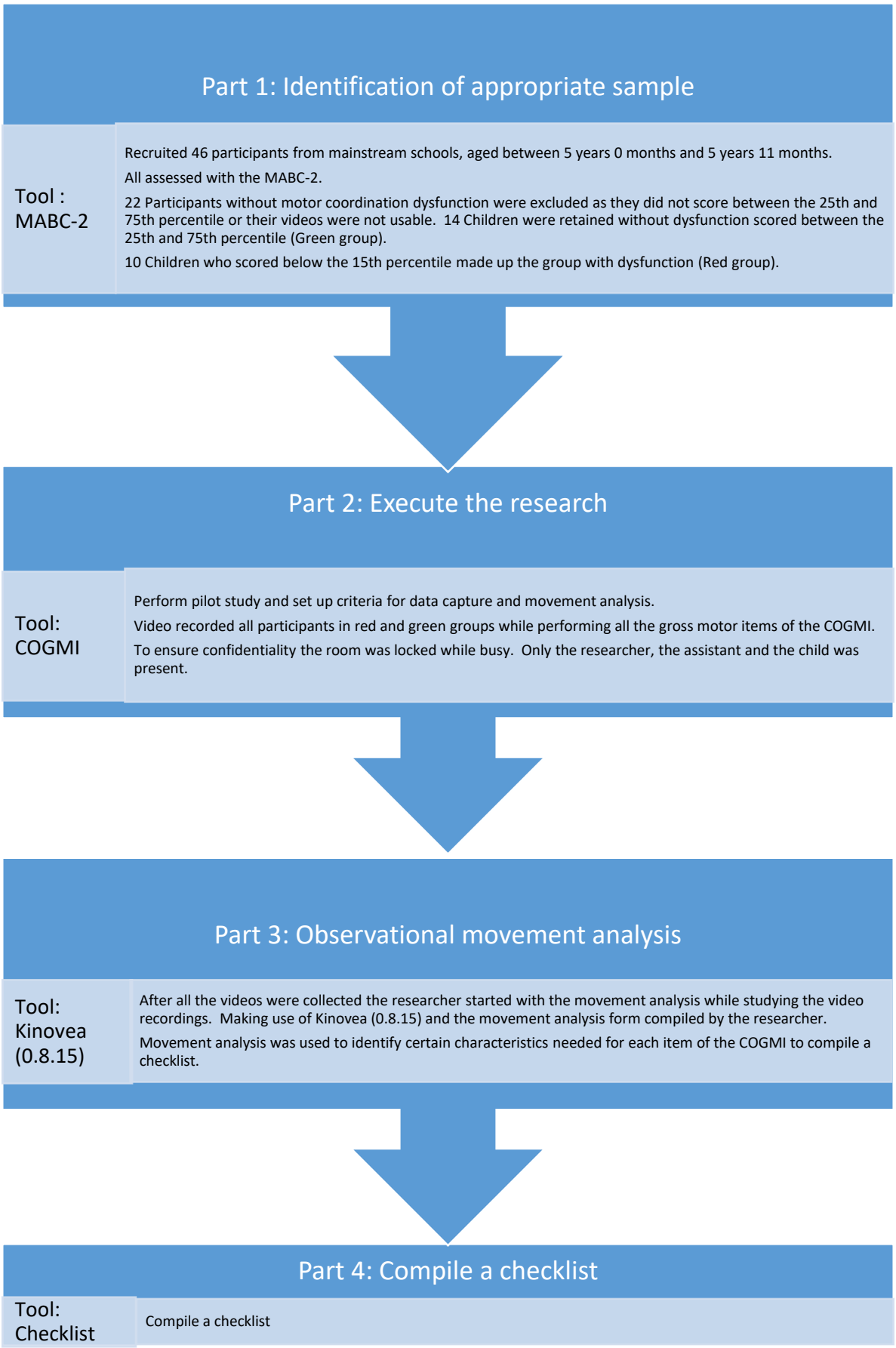
The purpose of this study was to develop a checklist with behavioural descriptors for the five point scale of the COGMI assessment to be used in combination with the COGMI. This chapter will describe the research design and processes followed in order to achieve this purpose, particularly how the steps of tool development were implemented.

3.1 RESEARCH DESIGN

This study made use of a quantitative, comparative, descriptive, cross-sectional study design. This design was chosen in order to develop a checklist of behavioural descriptors for the five point scale used to score the COGMI and is step three in the tool development phase as described by Casteleijn (Casteleijn, 2012). Step three is focused on scale development and validation. The researcher wanted a detailed description of observations of behaviour, which can be made in two separate groups. Furthermore, she aimed to identify the indicators of function and dysfunction. As a result a comparative, descriptive design was used. This design was needed in order to compare the observations of the two groups, as well as to gain descriptive observations of behaviour that could be used in developing the criteria for the five point scale of the COGMI, which was the aim and purpose of this study. In addition a cross sectional design was used to collect data. Primarily because it is the best design when comparing different types of people, in terms of a dependent variable that can be measured immediately (Kielhofner, 2006) (Gallahue, et al., 2012). Data collection happened at one point in time. Change in behaviour over time was not important in this study. Therefore a cross-sectional study design was utilized. This design would best suit the development of the checklist of behavioural descriptors for the five point scale of the COGMI to improve its validity.

This research project had four main parts associated with different procedures and research tools summarized in table 3.1. These four parts were to firstly identify an appropriate sample, by recruiting children from local primary schools and testing them on the MABC-2. The second part was to execute the research by videoing the administration of the COGMI on the identified sample. The third part was to analyse the videos using detailed observational movement analysis, and finally the fourth part was to develop the checklist of behavioural descriptors. The testing of the psychometric properties of this checklist was outside the scope of this research and will be tested in future research projects. Each of these four parts will be discussed below along with their associated tools and procedures.

Table 3-1: Research process



3.2 RESEARCH LOCATION

The research was carried out at primary schools in the Orkney and Klerksdorp area. Of the four participating primary schools three schools were public and one private. Two of the schools were parallel medium schools, one was an English medium school and one was an Afrikaans medium school. Permission to undertake the research there was requested and received from the relevant principals as well as from the Department of Education in the North-West Province.

3.3 POPULATION AND SAMPLE

The population for the study consisted of mainstream grade R/0 learners in the Orkney and Klerksdorp area, North-West Province. These learners were from public as well as private schools. This specific population was chosen by the researcher due to the fact that she does provide services to these schools. This population of 5 year 0 months to 5 years 11 months old children also show variability in gross motor movement as their gross motor skills are not consolidated (Chambers & Sugden, 2002) (Cools, et al., 2009) (Colella & Morano, 2011) (Rosa, et al., 2013) and thus provides the most challenge in interpreting the five point scale of the COGMI. The researcher also needed mainstream learners to be able to identify indicators of function and dysfunction that were needed to develop the checklist with behavioural descriptors for the five point scale of the COGMI. Parents of children in the grade R/0 classes at participating schools were approached for their child to participate in the study. During the informed consent process, the parents were asked whether their children were currently receiving any occupational therapy or physiotherapy or had received any in the past.

3.3.1. Identification of appropriate sample

3.3.1.1. Sampling strategy:

(a) Planned sampling strategy:

Initially it was intended to use a purposive sampling technique in this study as the researcher wanted to target prospective participants with specific characteristics for each group. The ethnicity of the participants and their first language were not regarded as a selection criterion. The researcher initially wanted three groups of children, between the ages of 5 years 0 months and 5 years 11 month. The three groups; namely, typically developing children, children identified as having mild motor coordination dysfunction and children identified as having severe motor coordination dysfunction would consist of 10 children each. The researcher aimed to sample the participants purposefully 50% male and 50 % female to represent the normal population distribution. The total sample would consist of 30 children, with ten children in each group.

Table 3-2: Planned sampling strategy

Total Sample = 30					
No motor coordination dysfunction = 10		Mild motor coordination dysfunction = 10		Severe motor coordination dysfunction = 10	
Male = 5	Female = 5	Male = 5	Female = 5	Male = 5	Female = 5

Unfortunately during the recruitment phase of the study it became clear that the researcher would not be able to adhere to the above mentioned criteria and would not be able to fill the sample size of 30 children, 10 children in each group. The inclusion and exclusion criteria and sample size was therefore adjusted.

(b) Actual sample strategy:

A stratified, purposive sampling technique was employed thereafter to select participants for the study. The children were enrolled on a consecutive enrolment method as informed consent was obtained from the parents, children were assessed using the MABC-2. This was to determine their level of motor coordination function and to enrol them into the different groups until the desired group numbers were obtained. All parents were thanked for their interest and feedback on their child's performance was given in writing. The researcher also indicated further assessment when necessary.

Due to the enrolment method used the researcher assessed more normal children than required to accumulate the sample size. In the selected population 46 children assessed with the MABC-2 only three children with severe motor coordination dysfunction and only seven children with mild motor coordination dysfunction could be identified. The researcher therefore amended the groups from three groups of 10 children each to only two groups, namely the red (mild and severe motor coordination dysfunction) and the green group (typically developing children). The difference between these groups for motor coordination was confirmed using the Mann-Whitney U test. These were determined by using the following inclusion and exclusion criteria.

3.3.1.2. Sample Inclusion and Exclusion Criteria

Inclusion criteria:

Typical Motor Coordination (Green Group)	Mild to Severe Motor Coordination Dysfunction (Red Group)
Age: Between the ages of 5 years 0 months and 5 years 11 months in Grade R/0	
Gender: Equal distribution of males and females in each group	
Score between the 25th percentile and 75th percentile	Score at the 15th percentile and below.

Exclusion criteria:

Children with and without motor dysfunction	Children with typical motor coordination:
Children with any diagnosed medical conditions at the time of the study, such as genetic disorders, central nervous system lesions, muscular dystrophy or amputation, which can influence motor coordination, were excluded from the study.	Children, who had had previous intervention such as Occupational Therapy or Physiotherapy regarding motor coordination problems, were also excluded from the study.

In total a number of 46 children were assessed using the MABC-2. 0ne child was used for the pilot study and 21 children were excluded from the sample, due to different reasons, as listed below:

- Two children were excluded from the video sample due to the fact that their percentile ranks were above the 75th percentile (more than one standard deviation above the norm).
- Six children were used when recording the videos, yet their videos were excluded from the sample due to environmental factors, such as poor lighting on the videos.
- Thirteen children were excluded from the video sample due to the fact that the group they were placed in (the typical motor coordination group) was already full.

3.3.1.3. Final sample recruited for this study:

The researcher strategically chose the 14 children of the green group to video record, taking the percentile ranks of participants as well as their gender into consideration. The children whose scores on the MABC -2 fell between the lower and upper quartile ranks from the 25th to the 75th percentile were chosen.

All 10 children of the red group whose scores on the MABC -2 fell below 15th percentile were video recorded. Sadly, the video recording of one of the children in the severe motor coordination dysfunction group was deleted in the transferring process from the video camera to the computer. The participants were also purposefully sampled 48% male (11 male participants) and 52% female (12 female participants) to be sure of representing the normal population distribution. The total sample consisted of 23 children, with 14 children in the group with typical motor coordination and nine children in the group with mild to severe motor coordination dysfunction.

Table 3-3: Final sample recruited

<table>
<tr><td colspan="4">Total Sample = 23</td></tr>
<tr><td colspan="2">Typical motor coordination= 14</td><td colspan="2">Mild to severe motor coordination dysfunction = Nine</td></tr>
<tr><td>Male = 7</td><td>Female = 7</td><td>Male = 4</td><td>Female = 5</td></tr>
<tr><td colspan="2"><u>Percentile rank of participants</u>
25th percentile = 5 participants
37th percentile = 3 participants
50th percentile = 2 participants
63rd percentile = 3 participants
75th percentile = 1 participant</td><td colspan="2"><u>Percentile rank of participants</u>
15th percentile = 5 participants
9th percentile = 2 participants
5th percentile = 2 participants</td></tr>
</table>

3.4. RESEARCH INSTRUMENTS

3.4.1. Sampling Tool: Movement Assessment Battery for Children 2nd edition (MABC-2)

The MABC-2 was used to categorise participants' motor coordination (Appendix A). The MABC-2 was developed to identify and describe motor performance impairment in children between the ages of three and 17 years and was standardised in Canada, the USA and the UK. It consists of two parts: the Performance Test and the Checklist (which is a parent self-report checklist). Only the Performance Test was used in this study and consists of a series of fine and gross motor tasks grouped in three categories: Manual Dexterity, Aiming and Catching, and Balance. The norms are provided for three age bands (3 years 0 months to 6 years 11 months, 7 years 0 months to 10 years 11 months and 11 years 0 months to 16 years 11 months) (Brown & Lalor, 2009) (Venetsanou, et al., 2011). The MABC-2 is considered a reliable tool with a test-retest correlation of 0.8 and inter-rater reliability exceeding 0.7 (Henderson, et al., 2007) (Piek, et al., 2012). Content validity was

established by input from a panel of experts. The panel was unanimous that the MABC-2 contents were representative of the motor domain it was intended to evaluate. Thus the content validity appears to be reasonable (Brown & Lalor, 2009). The test manual also reported section and total test standard score correlations as evidence that the three sections of the Performance Test measure related, but distinct motor skills.

The scoring of the MABC-2 takes qualitative data as well as quantitative data into consideration. After presenting each task to the child, a practice phase is given at each task. In the manual dexterity and balance sections the child gets two trials for each task. The best effort is transferred to the front cover, where the raw scores are converted to a scaled score (a score with a mean of 10 and standard deviation of three). At the aiming and catching section the child is presented with 10 trials, where the total of correct or successful trials is transferred to the front cover. The qualitative data is optional but useful in planning the intervention program.

The MABC-2 test makes use of a traffic light system to determine whether a child has movement dysfunction or not. This system is based on percentiles.

Table 3-4: The traffic light system

Child's score	**Total test score**	**Percentile range**	**Description**
Red	Up to and including 56	At or below the 5th percentile	Denotes a significant movement difficulty
Orange	Between 57 and 67 inclusive	Between the 5th and the 15th percentile inclusive	Suggests the child is at risk of having a movement difficulty; monitoring required
Green	Any score above 67	Above the 15th percentile	No movement difficulty detected

A study in 2000 by Wilson et al. showed that the MABC-2 test can successfully be used to diagnose Development coordination dysfunction (DCD). During the study of Wilson et al. they asked teachers to identify children with below average motor coordination. Twenty-four children were referred, of which 20 children obtained a score on the MABC-2 below the 15th percentile. The control group selected by the same teachers from the same classes consisted of children with average motor

coordination all scored above the 20th percentile. This shows that the MABC-2 is able to identify children with movement dysfunction (Henderson, et al., 2007).

The aim of this study was to identify observations for function and dysfunction in order to develop the checklist with behavioural descriptors for the five point scale of the COGMI, therefore taking the above mentioned study into consideration it explains why the researcher decided to make use of the MABC-2 to initially assess the children in assisting the process of dividing them into the two groups. Taking into consideration that the population of this study does not all make use of English as their first language the MABC-2 was specifically used by the researcher in this study due to the fact that the test does not rely only on English instructions but relies predominantly on demonstrations as instructions. Another reason for using the MABC-2 in this study was that the test is simple to administer and has cross-cultural validity (Cools, et al., 2009).

3.4.2. Tool under investigation: Clinical Observations of Gross Motor Items (COGMI)

The COGMI which was compiled by SAISI in 2004 was examined, and consists of 18 observational items that test a child's gross motor functioning (Appendix B). Minimal equipment is needed and includes a 20cm ball, a 43 cm ball, a tennis ball, a therapy mat (approximately 1.75m) and tape on the floor. The test is administered by demonstrating a movement such as hopping, skipping, or throwing and catching a ball and the observer is required to make a judgement on the quality of that movement in order to give the movement a score of one to five. The current five point scoring system is an ordinal scale based on opinion of movement, but the categories on the scale are not described in a way that allows good discrimination of performance in different age group (SAISI, 2004).

Table 3-5: Five Point scoring system of COGMI

Score	Description
1	Totally unable, even after practising,
2	Makes an attempt but achieves only part, even after practising
3	Able, poor control, not well integrated
4	Good, slight inconsistencies and lacks some integration and
5	Very good control, good integration, executes with ease

The complete assessment form is in Appendix B. It is also essential to make detailed observations of movement as well as quality of movement. Dysfunction is determined when a child presents with cluster of scores of one and two, with some threes and isolated fours and fives. Where the child obtained largely fours and fives, some threes and isolated ones and twos it is likely that they are functioning at an age appropriate level (SAISI, 2004). General trends of motor development across the age bands are stipulated in the manual, but these guidelines have not been rigorously analysed (an example of these trends of development can be found in Appendix C). The problem with the current scoring is that there is a developmental process embedded within the scoring and requires the therapist to remember that five – "very good control, good integration, executes with ease" may still contain some movement mistakes if this is appropriate for the age group. Thus scoring depends largely on the interpretation of these observations by each therapist evaluating a child and could thus be influenced by the level of experience and expertise of the therapist. The psychometric properties of this tool have not been explored to date, and thus this tool cannot yet be regarded as a standardised tool. By defining the behaviours for each scoring category this research will contribute to eventual standardisation.

It was decided by the researcher to discard items 12 to 16 due to those items being common skills learned at school (Case-Smith & O'Brian, 2010) (Chow & Louie, 2013). The focus of the researcher was not on ball skills, as there is a lot of information available in the literature. Items such as kneel-walking and ipsi-lateral stride jumps are not common skills learned and performed at school and therefore the researcher kept these skills in the study.

3.4.3. Analysis tool: Video Recordings and Observational movement analysis

Observational movement analysis was used to analyse each step of each item that is expected of the children according to the COGMI. Two-dimensional video analysis was done using Kinovea (0.8.15) movement analysis software and through the researcher reviewing the video footage

under the guidance of a movement analysis expert. Human movement is complex and this complexity involves parameters such as mobility, stability, strength, coordination, endurance, posture, sequence of joint motion, initiation, control and stopping, voluntary and involuntary components, intentional and non-intentional movement, speed, direction, balance and equilibrium, excessive movements as well as patterned or isolated movements (Everett & Kell, 2010). Movement analysis may be defined as the subjective and objective measurements of the activity; its components and goals obtained (Everett & Kell, 2010). The following framework for observational movement analysis was used in this study: the starting position, the movement and the finishing position.

3.4.4. Movement analysis form

The researcher used the above mentioned parameters from the work of Everett & Kell in 2010, as well as the framework mentioned above, to compile a movement analysis form (Appendix E) which was used to analyse the video recordings. The body was divided in lower limbs, upper limbs, head and neck as well as trunk, as these sub-sections would focus the researcher's attention to specific areas while analysing the movement. These sub-sections could also be found in the work of Gallahue et al (Gallahue, et al., 2012). All the observations (normal or abnormal) made by the researcher were noted on this movement analysis form for each item, which the researcher compiled in accordance with the scoring sheet of the COGMI. A movement analysis expert was involved in this process as well as in the pilot study, to ensure correct analysis of the movement recorded.

3.5 RESEARCH PROCEDURE

3.5.1 Pilot study:

A pilot study was conducted to determine the correct way of data capturing and movement analysis. Benita Olivier, a movement analysis expert, was recruited from the University of the Witwatersrand Physiotherapy Department to consult on this project and assisted in the pilot study. The pilot study was conducted at one school with one child from the group with typical motor coordination. A procedural manual for setting up and video recording the COGMI were compiled after the pilot study to ensure uniform setup in each location in order to enhance the reliability of the study. This manual can be seen in Appendix D. The angle and number of video cameras was crucial as well as the ideal set up of the room. The data capturing was piloted at one of the participating schools on one child with the movement analysis expert's assistance. This included determining the best position for the video cameras, the number of video cameras needed and where the researcher and participant would be positioned during data capturing. It was

determined that three cameras would be sufficient. The following conclusions were made during the pilot study. The movement analysis form was used in the pilot study by both the researcher and the movement analysis expert to determine whether this was compiled correctly. No adjustments to the form were identified therefore it was accepted as compiled.

3.5.2 Research process

The study consisted of four parts during the execution of research process.

Part 1:

Step 1: Obtained clearance from the assessors group and ethical committee at the University of Witwatersrand.

Step 2: Obtained permission from the Department of Education in the North West Province and the principals of participating schools.

Step 3: Obtained permission from participants and their parents/guardians.

Step 4: Assessed participants with MABC-2 at the participating schools to determine groups.

Part 2:

Step 1: Researcher was trained in the use of the Kinovea (0.8.15), the movement analysis software.

Step 2: Researcher met with the movement analysis expert and discussed the procedure, data analysis and finalized arrangements for the pilot study.

Step 3: Pilot study was performed.

Step 4: Started video recording process by reading the standard introduction to each participant to inform exactly what is required of them.

Step 5: Each participant was asked to perform all the gross motor items of the COGMI while being video recorded. These evaluations took place between 8:30 and 12:00 in the mornings in a quiet empty room at the participating schools.

Step 6: To ensure confidentiality the room was locked while busy. Only the researcher, the assistant and the child was present.

Part 3:

Step 1: After all the videos were collected the researcher started with the movement analysis while studying the video recordings. Making use of Kinovea (0.8.15) and the movement analysis form compiled by the researcher.

Step 2: Movement analysis was used to identify certain characteristics needed for each item of the COGMI to develop a checklist with behavioural descriptors for the five point scale of the COGMI.

Part 4:

The final part in the research process was the development of a checklist with behavioural descriptors of these observations for the five point scale of the COGMI. This also formed the final objective of the study.

The first step in developing the checklist was to develop a list of general observations that could be made throughout the COGMI. The researcher used the five point scale of the COGMI to categorize the general observations that presented with statistically significant differences, while compiling the list of general observations.

The rest of the observations which showed statistically significant differences were then used to develop an item specific observation checklist which will accompany the COGMI, and which will allow for a more standardised scoring measure of 1-5.

3.6. DATA CAPTURING AND ANALYSIS

3.6.1 Data Capturing:

During the data capturing stage of this study the researcher videoed all 23 participants included in the final sample, while performing the items of the COGMI.

3.6.2 Data Analysis:

Two-dimensional video analysis was used in this study to do the movement analysis. Kinovea (0.8.15) movement analysis software was used in the data analysis. This software was also used with the video obtained in the pilot study. The video footage was reviewed by the researcher, the movement analysis expert and the researcher's supervisor in order to pilot the movement analysis procedure. The results were compared and discussed in order to ensure that the procedure was done in a reliable manner.

The data analysis process will be discussed under the headings of the objectives of the study.

Objective 1 – Determine the observations that can be made when using the COGMI with children between the ages of 5 years 0 months and 5 years 11 months.

An in-depth movement analysis, where the researcher studied the video recordings at 40% real time speed, was used to analyse items one to 11 and items 17 and 18 of the COGMI. The researcher looks specifically at the upper limbs, the lower limbs, the head and neck as well as the core when analysing the movement. The movement analysis was also done in the starting position, the movement part as well as the finishing position of each item. During the movement analysis the researcher analysed the movements and sequences involved in performing a certain action (Creighton, 1992). These observations were noted on a movement analysis form which the researcher compiled in accordance with the scoring sheet of the COGMI. Through the movement analysis certain observations were identified for each child and each item of the COGMI involved in this study. This was noted together with the scoring of each child for each item. Observations were noted and not interpretations of the observations, for example if shoulder elevation was observed, shoulder elevation was noted and not associated movements or motor overflow.
During the movement analysis the researcher discovered that the video recordings from behind provided the same data as the camera in front and did not present with extra data, and therefore the researcher in consultation with her supervisor, discarded the back video recordings. The starting and finishing positions were analysed but the observations from these two positions were not used in the final checklist due to the fact that the children in the population of this study did not obviously assume starting and finishing positions, but rather transitioned directly into the action required for the items. Another reason was that the COGMI focuses on the quality of movement and not on static positions.

The observations which could be made in 80% or more of the items (13 out of 15 items) were then classified as general observations. These general observations were later used to compile a list of general observations that would accompany the checklist of observations as well as the scoring sheet of the COGMI.

The researcher also looked for clusters of observations while analysing the movement of the children performing the items of the COGMI. It was considered a cluster if the researcher saw the observation in three or more actions/items. These clusters of observations were made in groups of items related to the type of movement being performed in the item.

Objective 2 – Compare observations from children between the ages of 5 years 0 months and 5 years 11 months with typical motor coordination and those with motor coordination dysfunction to identify the salient behavioural characteristics that would determine function or dysfunction.

The forms of each child were compared in order to identify similarities and differences in observations. The percentages of appearance for all the observations of each item were determined. In other words the number of children presented with the same observation from one group. Observations that could be seen in 33% of the participants of the red group were allocated to the 1-score (Totally unable, even after practicing) of the scoring sheet of the COGMI. Observations that could be seen in 50% of the participants of the red group were allocated to the 2-score (Makes an attempt but achieves only part, even after practising) of the COGMI and observations that could be seen in 66% of the participants of the red group were allocated to the 3-score (Able, poor control, not well integrated) of the COGMI. Observations of the green group were also used and allocated as follows: Observations that could be seen in 100% of the participants of the green group were allocated to the 4-score (Good, slight inconsistencies and lacks some integration) of the COGMI and observations that could be seen in 50% of the participants of the green group were allocated to the 5-score (Very good control, good integration, executes with ease) of the COGMI.

These observations were further split into observations of dysfunction/movement mistakes and correct movement observations. The observations that were allocated to a 1-score, 2-score and 3-score were classified as observations of dysfunction/movement mistakes. The observations that were allocated to a 4-score were classified as correct movement observations. Observations that were allocated to a 5-score were classified as superior movement observations. It is, however, important to keep in mind that there will still be movement mistakes present under the 4-score, as these observations can be normal mistakes for children between 5 year 0 month and 5 year 11 months.

After allocating observations to the COGMI scoring system, the Chi-squares and significant differences in performance were determined by using VassarStats.net. The observations of the two groups were compared and the significant differences in performance were determined between the two groups.

The final objective of the study was to develop the checklist that will accompany the COGMI scoring criteria and is described below.

3.7 Ethical Considerations

This study obtained ethical approval from the University of Witwatersrand Ethics Committee for Research on Human Subjects, as well as approval by the Faculty of Graduate Study committee (Appendix L, M130929). Admission to the study was voluntary and participants (both parents and

children) were given the opportunity to withdraw from the study at any time without any consequences. A parent information sheet (Appendix F), containing the purpose of this study and research process, and a letter of informed consent (Appendix G), was sent to the parents of all the identified grade R/0 learners. Verbal/written assent was obtained from the participants themselves (Appendix H). It was clearly stated in the informed consent of the parents as well as in the assent of the children that the participants will be video recorded.
Permission to use the video recordings for educational purposes was also asked in the consent and assent forms.

A standard introduction (Appendix I) was read out loud to each participant at the start of the evaluation in order for the participants to be aware of the procedure of the evaluation and exactly what was required of them during the research. The evaluation forms as well as the video recordings was individually coded; e.g., 01, 02 in order to ensure confidentiality. Complete anonymity, however, was not possible as it was possible to identify children from the video footage.

The evaluation forms, analysis forms as well as the video recordings of each child was handled with extreme levels of confidentiality and after the completion of this study, stored in the locked archive room of the researcher's practice for six years. No-one other than the researcher will have access to these records and videos. After six years all records will be destroyed and videos deleted.
Feedback was given to all participating parents regarding their child's test results, and if necessary the children and parents were referred for therapeutic intervention.

CHAPTER 4: RESULTS

4.1. INTRODUCTION

This chapter will report on the results of the study under each objective. First the researcher will look at the observations which could be seen when using the COGMI. From these observations, clusters could be identified and this will then be looked at. The researcher will then also take a look at the comparisons which could be made from the two groups and look at the salient behavioural characteristics that will determine function and dysfunction in the age group of 5 year 11 months old children. Compiling the checklist from these observations will then be looked at. Screenshots from the videos will be used by the researcher to illustrate the video analysis process as well as to show the observations made during the movement phase.

4.2. DEMOGRAPHICS

The sample for the study consisted of mainstream grade R/0 learners in the Orkney and Klerksdorp areas, North-West Province. These learners were from public as well as private schools. The sample consisted of 23 learners between 5 years 0 months and 5 years 11 months of age. Males and females were equally represented in the study sample. The children were assessed with the MABC-2 by the researcher, and the total scores of the MABC-2 were used to determine the two groups; namely, the red group (mild and severe motor coordination dysfunction) and the green group (typically developing children).

Table 4.1 Demographics

Total Sample = 23									
Mild to severe motor coordination Dysfunction(Red) = 9					No motor coordination Dysfunction(Green) = 14				
Male = 4	Female = 5	Median of MABC-2 total scores	Percentile	Median of Age	Male = 7	Female = 7	Median of MABC-2 total scores	Percentile	Median of Age
Male = 44.4%	Female = 55.6%	7	16th percentile	5years 5months	Male = 50%	Female = 50%	9	37th percentile	5years 8months

Table 4.1 summarizes the demographic information of the two groups. The red group with motor coordination dysfunction consisted of nine children (39.1% of the total sample) and had a median MABC-2 score of 7 (16thpercentile). The green group with no motor coordination dysfunction consisted of 14 children (60.9% of total sample) and had a median MABC-2 score of 9 (37th percentile). The age and MABC-2 scores of the two groups were compared using a Mann-Whitney U (because of the small sample size non-parametric statistics were used). The groups were comparable in terms of age ($U=36$; $p>0.05$), but showed a statistically significant difference in motor coordination scores on the MABC-2 ($U=0$; $p<0.0001$).

The results will now be presented according to each objective.

4.3. OBJECTIVE 1 - DETERMINE THE OBSERVATIONS THAT CAN BE MADE WHEN USING THE COGMI WITH CHILDREN BETWEEN THE AGES OF 5 YEARS 0 MONTHS AND 5 YEARS 11 MONTHS.

Each item of the COGMI was analysed using video footage of the participants performing these items as described in chapter 3. During the analysis, it became clear that observations in the starting and finishing positions were very similar and thus will be reported together. Observations made during the movement component of the item will be reported in the categories used during the data collection process (namely, upper limbs, lower limbs, head and neck, and core).

4.3.1. Observations in starting and finishing positions

Table 4.2 presents all the observations that could be determined from the starting and finishing positions, and indicates in which items these observations were made.

Table 4.2 – Observations in starting and finishing positions

Position	Observation	Item1-Forward	Item1-Backwards	Item2	Item3-Right	Item3-Left	Item4	Item5	Item6	Item7	Item8	Item9	Item10	Item11	Item17	Item18	Total (x)	%	Total (xx)	%
START & FINISH	Transition from walking into performing item	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	0	0%	15	100%
	Shoulders :																			
	Retracted	xx	xx	x	xx	x	x	xx		xx	xx	x	x		x		6	40%	6	40%
	Depressed	xx		xx	xx	xx	xx	xx	xx	xx		x	x			x	3	20%	8	53%
	Elevated	xx		xx	xx	xx	xx	xx	xx	xx	x	x	xx	x		x	4	27%	9	60%
	Parallel to floor						x	xx	xx	xx	xx	xx	xx	xx	xx	xx	1	7%	9	60%
	Arms:																			
	Elbow flexion	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	0	0%	15	100%
	Neutral	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	x	xx	xx	xx	1	7%	14	93%
	Abduction	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	0	0%	15	100%
	Elbow extension							x			x	x		x			4	27%	0	0%
	Supination and pronation				x	x	x								x		4	27%	0	0%
	One arm in front or behind body	x	x	x	x	x	xx	x	xx	xx	xx	xx	xx	x	x	xx	8	53%	7	47%
	Hands:																			
	In midline	xx	xx	xx	xx	xx	xx	xx	x	xx	xx	xx	xx	xx	x	xx	2	13%	13	87%
	Flexion and Extension at wrist				x	x											2	13%	0	0%
	Flexion and Extension at fingers				x	x											2	13%	0	0%
	Knees:																			
	Flexion	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	x	x	xx	xx	xx	2	13%	13	87%
	Extension				x		xx				xx		x		x		3	20%	2	13%
	Legs:																			
	Neutral position	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	x	xx	xx	xx	14	93%	1	7%
	Weight bearing on one leg	x	x	x	x	x											5	33%	0	0%
	Feet:																			
	Feet inversion one or both feet	x															1	7%	0	0%
	Feet beyond shoulders		xx	x	x	x	x		x		x	x	x				8	53%	1	7%
	Stand on toes						x	x					x				3	20%	0	0%
	One foot in front	x	x		xx	xx	xx	x			xx				xx	xx	3	20%	6	40%
	Hip:																			
	Rotation	x	x	x	x	x	xx		x	x	x		x	x		x	11	73%	1	7%
	Head:																			
	Head in midline / Neutral position	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	0	0%	15	100%
	Eyes:																			
	Eyes focus on floor	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	0	0%	15	100%
	Eyes focus on horizon	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	0	0%	15	100%
	Neck:																			
	Lateral flexion	x	x	x	x	x	x	x			x	x	x	x	x		12	80%	0	0%
	Flexion / Extension of neck	x	x		x		x		x	x	x	xx	x	x	x		10	67%	1	7%
	Face turned to a side (rotation at the neck)	xx	xx	xx	xx	xx	xx	xx	x	xx	xx	xx	xx	xx	xx	xx	1	7%	14	93%
	Core:																			
	Trunk flexion	xx	x	xx	xx	xx	x	x	x	xx	x	xx	x	xx	x	x	8	53%	7	47%
	Lordosis	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	0	0%	15	100%
	Protruding belly	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	0	0%	15	100%
	Lateral flexion	xx			xx	x	xx	x	x	x	x	x	x				7	47%	3	20%
	Neutral position	xx	xx	xx	xx	xx	xx	x	xx	xx	xx	xx	xx	xx	xx	xx	1	7%	14	93%
	Anterior pelvic tilt	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	0	0%	15	100%
	Straight back		x										x				2	13%	0	0%
	Trunk rotation	xx		x		x	xx			xx		x	xx	xx	x	x	5	33%	5	33%
	Sway back	x			x		x	xx						x	x		5	33%	1	7%

Key: x – Start or finish position. xx – Both start and finish positions. – General observations observable in 80% or more of items.

The most obvious observation made in the starting and finishing position was that 5 year old children tend to transition directly into performing the item demonstrated to them and do not have an obvious starting position (Observation: transitions from walking into performing item). They also do not stop at the end of the item and thus also do not have an obvious finishing position (Observation: transitions from walking into performing item). The children do not move to the starting point and then stop, before performing the item, nor stop at the end, wait and then move away from the movement area. This observation was seen in all 15 items (100% of items) and in all 23 children (100% of sample). Because of the difficulty in identifying the starting and finishing position, it became difficult to objectively determine observations in this position, so there was a lot of variability in the data. As the COGMI focuses on coordination of movement rather than postures, it was decided to discard the starting and finishing position and only further analyse the movement component of items.

4.3.2. Observations made during movement in items

The following section will report on the observations made during the movement portion of items on the COGMI. These will be divided into observations made of the upper limbs, the lower limbs, head, neck and core.

4.3.2.1. Observations of upper limbs

Table 4.3 presents the observations of the upper limbs during the movement part of the items. All observations that occurred in 80% or more of the items (13 out of 15 items) were classified as general observations. As can be seen in the table, there were far fewer general observations during the movement portion of the item than in the starting and finishing position. Instead, there were clusters of observations made in groups of items related to the type of movement being performed in the item.

Table 4.3 – Observations of upper limbs

Observation	Item1-Forward	Item1-Backwards	Item2	Item3-Right	Item3-Left	Item4	Item5	Item6	Item7	Item8	Item9	Item10	Item11	Item17	Item18	Total	%
Shoulders :																	
Retracted	x	x	x											x		4	27%
Depressed	x		x	x	x	x	x	x		x	x			x		10	67%
Elevated	x	x	x	x	x	x	x	x		x	x		x	x	x	13	87%
Parallel to floor		x			x	x	x	x	x	x	x	x	x		x	11	73%
Arms:																	
Elbow flexion	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	15	100%
Neutral		x	x		x	x						x	x	x	x	8	53%
Abduction	x	x	x	x	x	x	x			x	x	x	x	x	x	13	87%
Elbow extension	x	x	x	x	x	x	x			x	x	x	x	x	x	13	87%
Supination and pronation	x	x	x	x	x	x	x			x	x		x	x	x	12	80%
Swing reciprocal	x	x	x													3	20%
Pump up & down / pump back & forth				x	x	x	x						x		x	6	40%
Swing out & up (winging)				x	x	x	x						x	x	x	7	47%
Behind back				x	x	x	x						x			5	33%
Semi-opposition				x	x	x	x									4	27%
High vertical component							x									1	7%
Controlled actions								x	x		x					3	20%
Un-controlled actions / unable / arms & legs not together										x	x					2	13%
Arms inactive										x	x					2	13%
Arms swing back & forth (with leg / before take-off / in flight / on landing)										x		x		x		3	20%
Slow movements / not fluent										x	x					2	13%
Hands:																	
In midline			x													1	7
Support on mat	x	x														2	13%
Flexion and Extension at wrist	x	x	x			x	x			x	x		x	x	x	10	67%
Flexion and Extension at fingers	x	x	x			x	x			x	x	x	x	x	x	11	73%
Slap leg with open / relaxed hands								x	x							2	13%
Slap leg with force								x	x							2	13%
Slap leg when already down								x	x							2	13%
Not ipsilateral / contra-lateral when needed								x	x	x						3	20%
Trap and roll ball with hands														x		1	7%

Key: - General observations observable in 80% or more of items.

The following observations were therefore classified as general observations and are highlighted in table 4.3: Arm abduction, elbow flexion and extension, shoulder elevation, supination and pronation of the forearm. These observations can also be seen in the photographs below. (Some photographs' quality might be poor due to the fact that the photograph is a screenshot taken from a video of movement). The observations below illustrate the description of the observation and are not being compared at this point.

Figure 1 - Arm abduction, elbow flexion and extension & shoulder elevation

Children from the red group:




Children from the green group:




Supination and pronation of the forearm is not easy to capture in screenshots from the movement videos due to quality issues

Clusters of observations can also be seen in table 4.3. Reciprocal movements of the arms as well as associated movements such as flexion at the wrists and fingers can be seen in item 1-Kneel-walking forwards and backwards as well as in item2-Heel-toe walking on line. These two items involve locomotion which can be defined as movement patterns that permits exploring through space, like walking, running, jumping, hopping, etc.

Items 3-Hopping, 4-Gallopping, 5-Skipping and items 11-Jumping sequence and 18-Jumping into consecutive squares, which all have an element of jumping or hopping in them, presents with arms pumping, arms in winging action as well as semi-opposition patterns. For item 8-Ipsilateral stride jump and Item 9-Star jumps the arms were uncontrolled by the children. Both these items have an element of jumping and hopping. These observations that could be seen in the clusters mentioned above will be illustrated in the photographs below.

Figure 2 – Swing reciprocal

Item 1 – Kneel-walking

Child from the red group

Child from the green group

Item 2 – Heel-toe walking on line

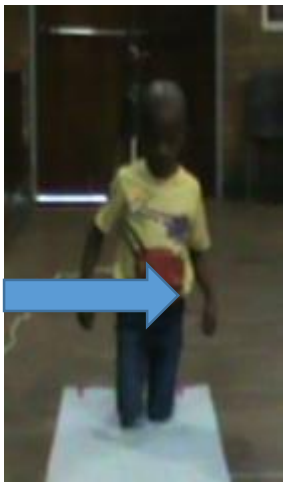
Child from the red group

Child from the green group

Figure 3 - Associated movements such as flexion at the wrists and fingers

Item 1 – Kneel-walking

Child from the red group



Child from the green group

Item 2 –Heel-toe walking on line

Child from the red group

Child from the green group

The arrows in figure 3 indicate the subtle associative movements that can be observed in these items.

Figure 4 - Arms pumping, arms in winging action, semi-opposition patterns

Item 3 - Hopping

Child from red group

Winging action

Child from green group

Arms pumping

Item 4 - Galloping

Child from red group

Semi-opposition

Child from green group

Semi-opposition

Figure 4 - Arms pumping, arms in winging action, semi-opposition patterns (Continue)

Item 5 – Skipping

Child from green group

Winging action

Child from green group

Arms pumping

Item 11 – Jumping sequence

Child from red group

Winging action

Child from green group

Winging action / Arms pumping

Item 18 – Jumping into consecutive squares

Child from red group

Winging action

Child from green group

Winging action / arms pumping

With figure 5 the researcher illustrates the sequence of these three observations of arms pumping, arms in winging action and semi-opposition patterns in one movement with the same child of the red group performing Item 5.

Figure 5 – Sequence of observations in one movement

Item 5 - Skipping

Semi-opposition

Winging action

Arms pumping

Uncontrolled arm movements:

This action is difficult to illustrate with photographs due to the fact that it is an uncontrolled movement where the child uses gravity to complete the movement, for example, during star jumps.

4.3.2.2. Observations of the lower limbs during the movement part of the COGMI.

Table 4.4 presents the observations of the lower limbs made during the movement part of the items. All observations that occurred in 80% or more of the items (13 out of 15 items) were classified as general observations.

Table 4.4 – Observations of the lower limbs during the movement part of the COGMI

Observation	Item1-Forward	Item1-Backwards	Item2	Item3-Right	Item3-Left	Item4	Item5	Item6	Item7	Item8	Item9	Item10	Item11	Item17	Item18	Total	%
Knees:																	
Flexion / Extension	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	15	100%
Knees beyond shoulder width	x	x														2	13%
Legs:																	
Swing leg inactive					x											1	7%
Swing leg pump back & forth				x	x											2	13%
Swing leg in front of body				x	x											2	13%
Abduction / adduction	x	x	x		x					x	x			x		7	47%
Slide leg over mat / Drag back leg forward		x	x			x										3	20%
Steps of one leg longer	x	x														2	13%
No half-kneeling	x	x														2	13%
Half-kneeling / four-feet kneeling	x	x														2	13%
Land on ball of feet				x	x		x			x	x		x			6	40%
Land flat foot					x	x	x				x		x			5	33%
Not full extension in air				x	x		x					x			x	5	33%
Give extra steps			x	x	x		x					x		x		6	40%
Leading leg stay in front / doesn't stay in front						x										1	7%
Not fluent / No rhythmical / unable							x			x	x		x	x		5	33%
Feet:																	
Feet inversion one or both feet	x	x	x													3	20%
Flexion / Extension of toes	x	x	x	x	x							x				6	40%
Plantar / Dorsiflexion				x	x	x		x						x	x	6	40%
Heel-toe touching ,< 5 steps			x													1	7%
Heel-toe touching all steps			x			x										2	13%
High vertical component						x	x									2	13%
Close to surface						x	x			x		x				4	27%
Non-simultaneous take-off and landing												x	x		x	3	20%
Rhythmical / Controlled actions						x		x	x	x	x					5	33%
Hips:																	
Flexion / Extension	x	x		x			x	x	x	x	x	x	x	x	x	12	80%
Rotation	x	x	x		x	x	x	x	x	x			x	x		11	73%
Face to front						x										1	7%
Dead stop / feet together in landing /												x	x		x	3	20%
Feet lift simultaneously												x	x			2	13%
Touch line when landing															x	1	7%

Key: - General observations observable in 80% or more of items.

As can be seen in the table, there were far fewer general observations during the movement portion of the item than in the starting and finishing position. Instead, there were clusters of observations made in groups of items related to the type of movement being performed in the item. The following observations were classified as general observations and are highlighted in table 4.4: flexion and extension of the knees and hips. These observations can also be seen in the photographs below.

Figure 6 - Flexion and extension of the knees and hips

Children from the red group:





Children from the green group:




From table 4.4 the following clusters of observations were presented and are illustrated in the photographs below. Abduction and adduction of legs was visible in items 1-Kneel-walking forwards and backwards, 2-Heel-toe walking on line, 3-Hopping, 8-Ipsilateral stride jump, 9-Star jumps and 17-Trap and kick a ball. All these items have an element of locomotion which can be defined by movement patterns that permit exploring through space; in particular walking, running, jumping, hopping, etc., as well as an element of dynamic balance in them.

Figure 7 - Abduction and adduction of legs

Item 1 – Kneel-walking forwards and backwards

Child from red group

Abduction

Child from green group

Abduction

Item 2 – Heel-toe walking on line

Child from red group

Adduction

Child from green group

Adduction

Item 3 - Hopping

Child from red group

Abduction

Child from green group

Adduction

Item 8 – Ipsilateral stride jump

Child from red group

Abduction

Child from green group

Adduction

Figure 7 - Abduction and adduction of legs (Continue)

Item 9 – Star jumps

Child of red group

Abduction

Child of green group

Abduction

Item 17 – Trap and kick a ball

Child of red group

Adduction

Child of green group

Abduction

Items 3-Hopping, 5-Skipping, 8-Ipsilateral stride jump, 9-Star jumps and 11-Jumping sequence all presented with landing on the ball of the feet. Landing flat feet could be observed in items 3-Hopping, 4-Gallopping, 5-Skipping, 9-Star jumps and 11-Jumping sequence. Again all these items require the child to leave the ground momentarily and therefore landing is also part of this item.

Figure 8 - Land flat feet

Item 3 - Hopping

Child of red group

Child of green group

Item 4 - Galloping

Child of red group

Child of green group

Figure 8 - Land flat feet (Continue)

Item 5 - Skipping

Child from red group

Child from green group

Item 9 – Ipsilateral stride jump

Child from red group

Child from green group

Item 11 – Jumping sequence

Child of red group

Child of green group

Figure 9 – Landing on ball of feet

Item 9 – Star jumps

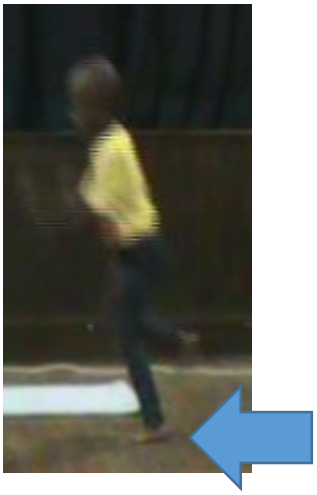
Child from red group

Item 11 – Jumping sequence

Child from green group

Item 3 - Hopping

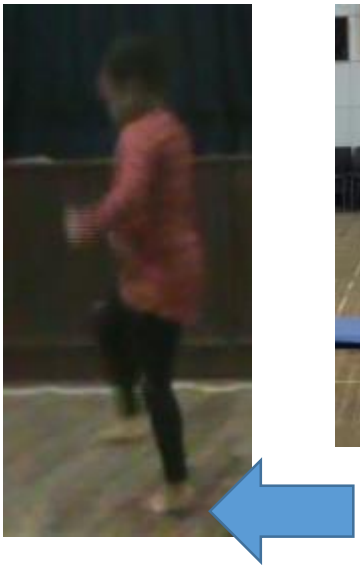
Child from red group



Child from green group

Item 5 - Skipping

Child from red group



Child from green group

Extra steps were needed in items 2-Heel-toe walking on line, 3-Hopping, 5-Gallopping, 10-Long jump and 17-Kick and trap a ball. All these items have an element of locomotion which can be defined by movement patterns that permit exploring through space, like walking, running, jumping, hopping, etc., as well as an element of balance in them. These observations are, however, difficult to capture in a photograph and consequently there are no photographs to illustrate these observations.

The movements in items 5-Skipping, 8-Ipsilateral stride jump, 9-Star jumps, 11-Jumping sequence and 17-Kick and trap a ball were not fluent or rhythmical but the movements in items 4-Galloping,6-Ipsilateral leg slap, 7-Contralateral leg slap, 8-Ipsilateral stride jump and 9-Star jumps were all rhythmical actions. These items all have an element of timing, rhythm and dynamic balance in them. These observations were also difficult to capture on photographs due to it being a movement and not a static position and therefore are not illustrated by photographs.

Flexion and extension of toes could be observed in items 1-Kneel-walking forward and backwards, 2-Heel-toe walking on line, 3-Hopping and 10-Long jump. This is a very subtle action and due to the poor quality of the screenshots taken from the movement videos it was not possible for the researcher to include photographs.

Plantar flexion or dorsiflexion was visible in items 3-Hopping, 4-Galloping, 6-Ipsilateral leg slap, 17-Trap and kick a ball and 18-Jumping into consecutive squares. All of these items have elements of dynamic balance in them.

Figure 10 - Plantar flexion / Dorsi-flexion

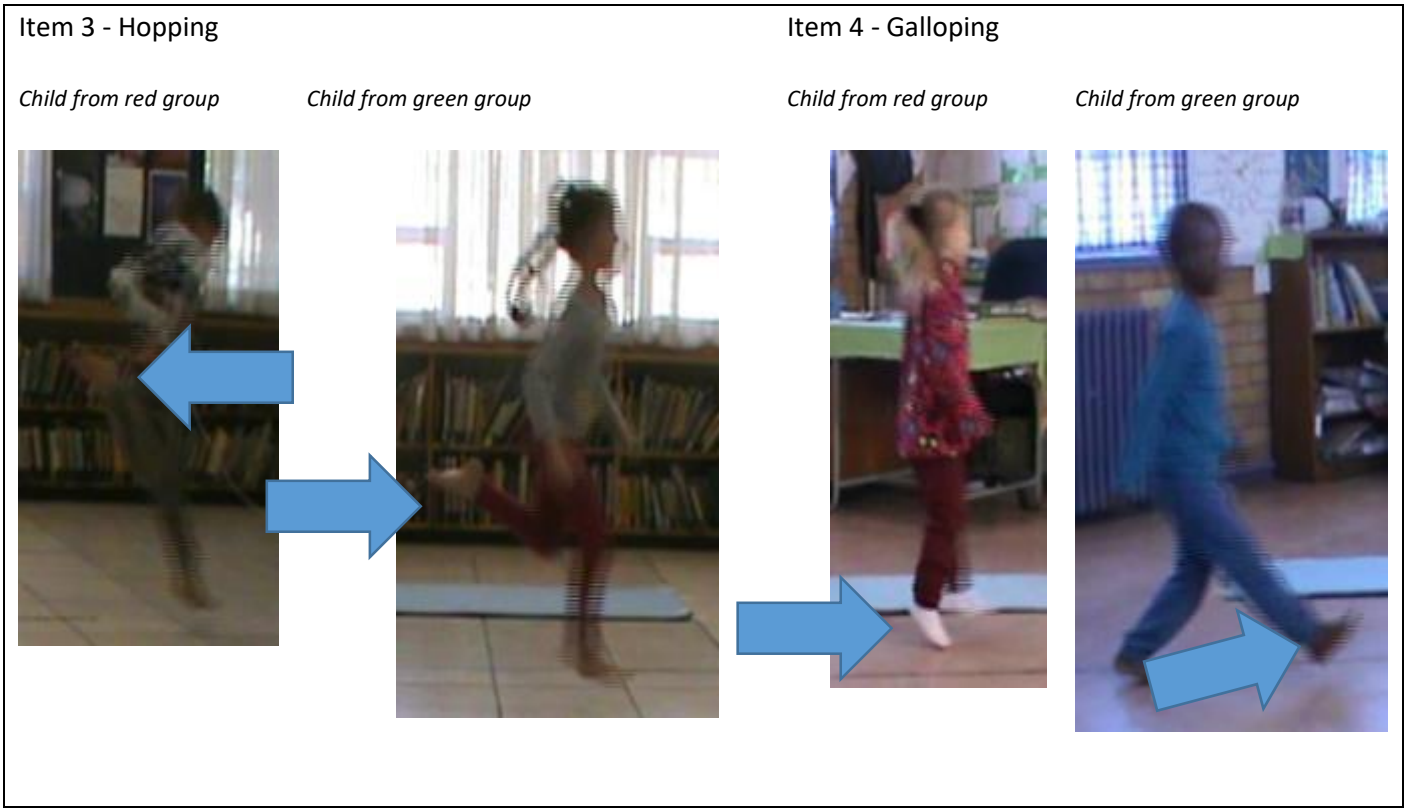


Figure 10 - Plantar flexion / Dorsi-flexion (continue)

Item 6 – Ipsilateral leg slap

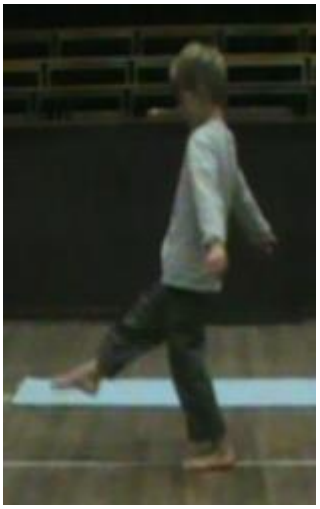
Child from red group

Child from green group

Item 17 – Trap and kick a ball

Child from red group

Child from green group



Rotation of the hips was observed in all the items except for items 9-Star jumps and 18-Jumping into consecutive squares.

Figure 11 - Hip rotation

Item 7 – Contra-lateral leg slap

Child from red group

Child from green group

Item 17 - Trap and kick a ball

Child from red group

Child from green group

From this it is clear that the observations of the lower limbs presented with much larger clusters than the other categories.

4.3.2.3. Observations of the head, neck and core.

Table 4.5 presents the observations of the head, neck and core during the movement part of the item. Again all the observations that occurred in 80% and more of the items were classified as general.

Table 4.5 – Observations of the head, neck and core during the movement part of the COGMI

Observation	Item1-Forward	Item1-Backwards	Item2	Item3-Right	Item3-Left	Item4	Item5	Item6	Item7	Item8	Item9	Item10	Item11	Item17	Item18	Total	%
Head:																	
Head in midline / Neutral position	x	x	x	x	x	x	x				x	x	x	x	x	12	80%
Head righting reactions	x	x	x	x	x	x	x			x			x	x		10	67%
Associated movements (chin-tuck)	x	x	x	x	x	x		x	x	x			x	x	x	12	80%
Eyes:																	
Eyes focus on floor	x	x	x	x	x	x	x	x	x	x		x	x	x	x	14	93%
Eyes focus on horizon	x	x	x	x	x	x	x	x	x	x	x	x	x			13	87%
Eyes shift between horizon and floor	x	x	x	x	x	x	x	x	x	x		x	x	x	x	14	93%
Neck:																	
Lateral flexion	x			x							x			x		4	27%
Flexion / Extension of neck	x	x	x	x	x	x	x	x	x	x		x	x		x	13	87%
Face turned to a side (rotation at the neck)	x	x	x				x	x	x	x	x	x		x	x	11	73%
Core:																	
Trunk flexion / extension	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	15	100%
Lordosis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	15	100%
Protruding belly	x	x	x			x	x	x	x	x	x				x	10	67%
Lateral flexion	x	x	x	x	x	x	x	x	x	x	x		x	x	x	14	93%
Anterior / posterior pelvic tilt	x	x	x							x					x	4	27%
Straight back	x	x	x	x	x	x	x	x	x	x	x		x			12	80%
Trunk rotation			x	x	x	x	x	x	x	x	x	x		x		11	73%

Key: -General observations observable in 80% or more of items.

As can be seen in table 4.5 the head, neck and core showed more generalizability of observations across items than the movement of the upper and lower limbs. Thus there were more general observations than clusters of observations in specific items. These observations are illustrated in the photographs below:

Figure 12 – General observations of head, neck and core

Children from red group:

Lordosis

Eyes focus on floor

Lordosis

Head in midline

Eyes focus on floor /

Chin tuck / Neck flexion

Associated movements

Lateral flexion at trunk

Straight back

Figure 12 – General observations of head, neck and core (Continue)

Children from green group:

Lordosis / Head in midline

Straight back

Neck rotation /

Lateral flexion at trunk

Eyes focus on floor

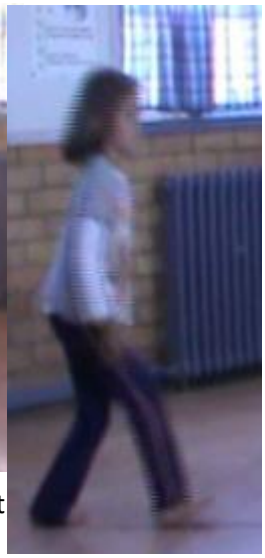
Lateral flexion at trunk

Eyes focus on floor

Lateral flexion at trunk

Eyes focus on horizon

Lateral flexion at trunk



Flexion at trunk

Clusters of observations at the head, neck as well as the core were observed during the movement section of the items performed. These observations are illustrated in the photographs below. Head righting reactions were observed in items 1-Kneel-walking forwards and backwards, 2-Heel-toe walking on line, 3-Hopping, 4-Galloping, 5-Skipping, 8-Ipsilateral stride jump, 11-Jumping sequence and Item 17-Trap and kick a ball. All these items have an

element of locomotion as well as balance in them. Most of them also expected the child to leave the floor momentarily.

Figure 13 - Head righting reactions & lateral flexion of neck

Item 2 – Heel-toe walking on line

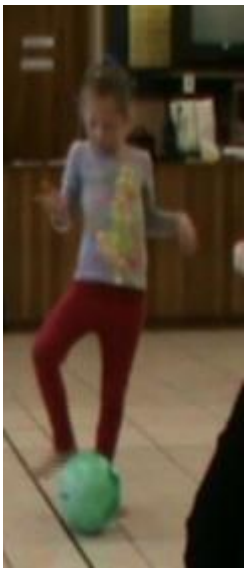
Child from red group

Child from green group

Item 17 – Trap and kick a ball

Child from red group

Child from green group



In items 1-Kneel-walking forwards and backwards, 3-Hopping, 9-Star jumps and 17-Trap and kick a ball lateral flexion of the neck is visible. These items all have an element of balance in them.

Neck rotation was visible in items 1-Kneel-walking, 2-Heel-toe walking on line, 5-Skipping, 6-Ipsilateral leg slap, 7-Contra-lateral leg slap, 8-Ipsilateral stride jump, 9-Star jump, 10-Long jump, 17-Trap and kick a ball as well as Item 18-Jumping into consecutive squares. These items all have an element of balance as well as bi-lateral coordination in them.

Figure 14 – Neck rotation

Item 1 – Kneel-walking forwards and backwards

Child from red group

Child from green group

Item 8 – Ipsilatral stride jump

Child from red group

Child from green group

Protruding belly could be seen in items 1-Kneel-walking forwards and backwards, 2-Heel-toe walking on line, 4-Galloping, 5-Skipping, 6-Ipsilateral leg slap, 7-Contra-lateral leg slap, 8-Ipsilateral stride jump, 9-Star jumps and 18-Jumping sequence. These items have an element of balance, as well as locomotion in them.

Figure 15 - Protruding belly

Item 2 – Heel-toe walking on line

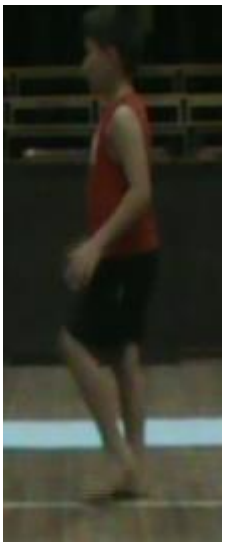
Child from red group

Child from green group

Item 7 – Contral-lateral leg slap

Child from red group

Child from green group



The last cluster of observations that could be seen was the observation of trunk rotation in items 2-Heel-toe walking on line, 3-Hopping, 4-Galloping, 5-Skipping, 6-Ipsilateral leg slap, 7-Contra-lateral leg slap, 8-Ipsilateral stride jump,

9-Star jumps, 10-Long jump and 17-Trap and kick a ball. Most of these items expected the child to leave the floor momentarily and also have an element of balance in them.

4.3.3. Conclusion – Objective 1:

From the analysis it was clear that many different observations can be made in the items of the COGMI, but that there are certain patterns of observations across the items. Firstly, the starting and finishing positions are not useful positions from which to make observations, but rather that the movement portion of the items should be observed and analysed. Secondly, the upper limbs and lower limbs present with clusters of observations related to specific items, while the head, neck and core presents with larger clusters and more general observations for the items.

4.4. OBJECTIVE 2 - COMPARE OBSERVATIONS FROM CHILDREN BETWEEN THE AGES OF 5 YEARS 0 MONTHS AND 5 YEARS 11 MONTHS WITH TYPICAL MOTOR COORDINATION AND THOSE WITH MOTOR COORDINATION DYSFUNCTION TO IDENTIFY THE SALIENT BEHAVIOURAL CHARACTERISTICS THAT WILL DETERMINE FUNCTION OR DYSFUNCTION.

One of the goals of the researcher was to develop a checklist with salient behaviour that can accompany the current score sheet of the COGMI. Having that goal in mind one needs to look at the current scoring sheet of the COGMI. This evaluation tool is currently scored by using a five point scoring system that focuses on the range of performance in each age group. The researcher looked at all the observations obtained from the various items and decided to divide the observations into the different scales (1 to 5) as follows:

Observations that could be seen in 33% of the red group were allocated to the 1-score of the scoring sheet of the COGMI. Observations that could be seen in 50% of the red group were allocated to the 2-score of the COGMI and observations that could be seen in 66% of the red group were allocated to the 3-score of the COGMI. Observations of the green group were also used and allocated as follows: Observations that could be seen in 75% - 100% of the green group were allocated to the 4-score of the COGMI and observations that could be seen in 50% of the green group were allocated to the 5-score of the COGMI.

Below in table 4.6 is an example of how the observations for each item were classified. The full set of Items with their observation classification can be found in appendix J

Table 4.6 Example of classification of observations

		1	2	3	4	5
Item 1 - Forwards	Movement	Support with hand (one or both) on mat or legs - going down	Support with hand (one or both) on mat or legs - standing up	Eyes focus on floor	Going down - Flexion at knees	Trunk flexion to horizontal level
		Only one arm swing reciprocal	Elbows in flexion	Eyes focus on horizon	Going down - Flexion at hips	Lordosis
		Flexion/Extension at wrist, fixate shoulders, supination/pronation, flexion/extension of fingers	Both arms swing reciprocal	Trunk flexion	Both arms swing reciprocal	Trunk upright while walking
		Abduction of arms > 45	Shoulders parallel with floor	Head in midline	Eyes focus on floor	Trunk forward flexion
		Walking: Abduction of arms < 45	Leg abduction		No half-kneeling	
		Neutral position of arms	Flexion at toes		Half-kneeling	
		Flexion at hips - Standing up			Head in midline	
		Flexion at knees - Standing up				
		Wide base of support				
		Slide legs over mat				
		Hip rotation				
		No half-kneeling				
		Half-kneeling				
		Going down to mat: Tilt trunk forward / Flexion to horisontal level				
		Anterior pelvic tilt				
		Lordosis				
		Lateral flexion				
		Trunk upright while walking				
		Eyes focus to a side				

From table 4.6 it is clear that some of the observations presented in more than one score. The reason for this is that there were two groups, the red and the green group. Some of the observations were observed in both groups. Therefore the researcher had to also split the observations into observations of dysfunction / movement mistakes and correct movement observations. The observations that were allocated to a 1-score, 2-score and 3-score were classified as observations of dysfunction / movement mistakes. The observations that were allocated to a 4-score were classified as correct movement observations. Observations that were allocated to a 5-score were classified as superior movement observations. It is however important to keep in mind that there will still be movement mistakes present under the 4-score, as these observations can be normal mistakes for children between 5 year 0 month and 5 year 11 months.

After dividing the observations in to the five point scoring system the researcher compared the observations statistically to determine whether there were significant differences in performance between the groups. Below is an example of the same item as above in table 4.6 but with the statistical information included. Only the observations which showed statistically significant differences were listed in table 4.7 below.

Table 4.7 Example of observations with statistical information included

		Observation	Percentage Green	Percentage Red	Chi-squares	df	p
Item 1 - Forward	Movement: Upper limbs	Support with hand (one or both) on mat or legs	14%	56%	36.95	1	<0.0001
		Abduction of arms >45°	43%	22%	9.12	1	0.0025
		One arms swing reciprocal	7%	22%	7.9	1	0.0049
		One / both arms in neutral position	7%	22%	7.9	1	0.0049
		Shoulders parallel to floor	21%	56%	24.41	1	<0.0001
		Both arms swing reciprocal	79%	56%	11.03	1	0.0009
	Movement: Lower limbs	Flexion at hips / knees	64%	22%	34.29	1	<0.0001
		Half kneeling - standing up	79%	33%	41.09	1	<0.0001
		No half-kneeling when going down	86%	22%	79.89	1	<0.0001
		Slide legs over mat	0%	33%	37.16	1	<0.0001
		Half kneeling - going down	0%	33%	37.16	1	<0.0001
	Movement: Head and neck	Neck rotation	0%	22%	22.52	1	<0.0001
		Eyes focus on floor	93%	78%	7.9	1	0.0049
	Movement: Core	Anterior pelvic tilt	14%	33%	9.01	1	0.0027
		Trunk flexion to horizontal level	57%	22%	24.19	1	<0.0001
		Lordosis	57%	22%	24.19	1	<0.0001
		Trunk flexion / extension	57%	78%	9.12	1	0.0025
		Straight back	50%	33%	5.27	1	0.0217

4.5. CONCLUSION

From the results it was clear that many different observations can be made in the items of the COGMI, and that there are certain patterns of observations across the items. These observations could be used to develop a checklist with more general observations for the items as well as to develop an item specific checklist with behavioural descriptors to identify function and dysfunction of motor coordination. Although the first step in developing the COGMI into a valid and reliable tool for the South African population, namely, standardising the scoring, has been taken by this study there is still a lot of research needed on these checklists.

CHAPTER 5: DISCUSSION

5.1 INTRODUCTION.

In this chapter the researcher will discuss the demographics of this study as well as the results of the study under each objective. The researcher will first discuss the observations which could be seen when using the COGMI, from these observations, clusters could be identified which will then also be discussed. The researcher will also discuss the comparisons which could be made from the two groups and look at the salient behavioural characteristics that will determine function and dysfunction in the age group of 5 year old children. Lastly, the process which was followed to develop the checklist from these observations will be discussed.

5.2 DEMOGRAPHICS.

The sample was reasonably small, consisting of 23 children between 5 years 0 months and 5 years 11 months of age. See table 4.1 in Chapter 4. All 23 participants were from mainstream schools in Orkney and Klerksdorp in North West Province. These participants were all from public as well as private schools. The schools were parallel medium, English medium and Afrikaans medium. This was largely because the researcher attempted to have some diversity in the sample, but was not able to represent the entirety of the South African population (which includes a large number of different races with different home languages) (Ngyende, 2012). However, as the researcher's aim was to try and clarify items of gross motor development, and further testing of the checklist on diverse populations will still have to take place, this sample was considered suitable for this research project. Males (48%) and females (52%) were equally represented in the study sample, which is also representative of the population of South Africa, when looking at the latest census which was done in 2011 by Statistics South Africa, where the population of South Africa was recorded as 48.7% males and 51,4% females (Ngyende, 2012).

The participants were divided into two groups; namely, the red group with motor coordination dysfunction, which was 39.1% of the total sample, and the green group with typical motor coordination which made up the other 60.9% of the total sample. Statistically the groups were comparable in terms of age, but showed a significant difference in motor coordination scores and thus the researcher found that the two groups were sampled appropriately in order to identify salient behavioural characteristics between children of the same age, that separate children with normal motor coordination development from children with mild to severe motor coordination dysfunction.

Results will now be discussed under each objective of the study.

5.3 Objective 1: DETERMINING THE OBSERVATIONS THAT CAN BE MADE WHEN USING THE COGMI WITH CHILDREN BETWEEN THE AGES OF 5 YEARS 0 MONTHS AND 5 YEARS 11 MONTHS.

With the aim of determining the observations that can be made when using the COGMI in mind and looking back at the observations, the researcher could identify when using the COGMI with two groups of children between the ages of 5 years 0 months and 5 years 11 months it was clear that many different observations can be made in the items of the COGMI, but that there are certain patterns of observations across the items. Firstly, the starting and finishing positions are not useful positions from which to make observations, but rather that the movement portion of the items should be observed and analysed. Secondly, the upper limbs and lower limbs present with clusters of observations related to specific items, while the head, neck and core presents with larger clusters and more general observations for the items. These conclusions will be discussed below.

5.3.1 Static Positions.

From the results it could be determined that the starting and finishing positions showed the same type of observations and therefore the researcher combined these positions. These two positions both presented with the same type of observations due to the fact that the child needs to be static before an action can be started, and the same for the finishing position, the child needs to stop and remain static, in order for the action to be completed. However, even when combining the two positions, observations showed so much variability that no obvious patterns of observation could be identified. From the results of this study it was also clear that children in this specific age range (5-year-old children), transition directly into performing the item demonstrated to them. The children do not always move to the starting point and then stop, before performing the item. Therefore the children do not always take in a starting and/or finishing position. This made it very difficult for the researcher to identify observations of static positions, as the children did not always take in static positions before performing the item and going into movement. Because of the difficulty in identifying the starting and finishing position, it became difficult to objectively determine observations in this position, thus there was a lot of variability in the data. There were also no clear patterns of function and dysfunction observed in these observations. If one looks at the observations listed in table 4.2 as a result of this study and one compares this to the observations that are stated in the literature, according to J. Ayres (SAISI, 2004), as observations of dysfunction, it appears that most of the observations listed as observations of dysfunction are not observations

that can be made during static positions or postures. Movement is needed to see these observations. For example, (to mention a few):

- Inadequate development of reciprocal flexion and extension of the trunk, with limited rotary movements, as seen in skipping or hopping.
- Undifferentiated movement synergies, like righting reactions and protective reactions predominate instead of more mature equilibrium reactions, as seen in heel-toe walking on a line or hopping.
- A lack of isolated movement patterns due to the presence of mass movement, as seen in ipsilateral stride jump or an inability to keep the wrist on the surface while writing.
- An inability of the two sides of the body to function independently, as seen in hopping or skipping.
- Excessive movement, as seen in kneel-walking (SAISI, 2005) (Bundy, et al., 2002) (Case-Smith & O'Brian, 2010).

This led to the conclusion that static positions are not useful when using the COGMI due to the fact that the COGMI focuses on the motor development and not on static positions. COGMI concentrates on coordination of movement rather than postures (SAISI, 2004). It is also stipulated in the manual of the COGMI that the emphasis is on the quality of movement (SAISI, 2004). Therefore the researcher concluded that the manual of the COGMI supports the fact that static positions are not useful when using the COGMI.

Taking all the reasons discussed above into consideration as well as the fact that observations could not be made objectively due to the difficulty identifying the starting and finishing position, the researcher made the decision to discard the observations made from the starting and finishing positions from this study. In order to determine and develop the criteria for the checklist the researcher needed to focus on the movement part of the items and not the static positions.

5.3.2 General Observations.

When analysing the movement the researcher looked specifically at the movement of the head and neck, the upper limbs, the lower limbs as well as the core of each child. During the video analysis process there were observations that could be made in 80% or more of all the items. These observations could be seen in 13 of the 15 items used in this study and were all classified as general observations that could be ascertained when using the COGMI with 5 year old children. This suggests that there are certain observations of postures and movements that are common to a variety of

different actions, for example: In the upper limbs as seen in table 4.3, elevated shoulders, elbow flexion and extension as well as arm abduction and supination and pronation of the forearm. In the lower limbs: flexion and extension of the knees as well as flexion and extension at the hips. These actions of the knees and hips are needed in all locomotion skills and fundamental motor skills such as hopping, galloping, skipping and jumping (Gallahue, et al., 2012). All of the items in the COGMI used in this study are fundamental motor skills. Therefore these observations of the lower limbs were expected to be present. The head, neck and core presented with the most observations of postures and movements that could be seen in 80% or more of all the items, for example; head in midline, associated movements like chin tuck and sticking out of tongue, eyes focusing on the floor or horizon, eyes shifting between the floor and horizon as well as flexion and extension at the neck and trunk, lordosis or straight back and lateral flexion of the trunk. The reason why the head, neck and core were the area which presented with more general observations than the upper limbs and lower limbs could be due to the fact that the head, neck and core are not used to initiate, propel or maintain movement. If one looks at the literature of motor development there is a lot of emphasis on what the upper and lower limbs are doing during movement (Getchell, 2006) (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012) (Kakebeeke, et al., 2013).

When one looks at the observation of posture and movement that is common to a variety of different actions, one might wonder if it perhaps relates to the balance required for actions like kneel walking forward and backwards – Item 1, heel-toe-walking on line – Item 2 or actions like hopping – Item 3 etc. Or to the difficulty of the actions like ipsilateral stride jump – Item 8, star jumps – Item 9 or actions like trap and kick a ball – Item 17 etc. which may cause an overflow of movements. Motor overflow observations which could be seen in this study and which could be classified as general observations were observations like: elevated shoulder, elbow extension, supination and pronation of the forearm, flexion and extension of the neck as well as chin-tuck or associated movements observed in the face. Although one needs to keep in mind that the children in this population are still in the emerging stage and might be transitioning into the proficient stage of fundamental motor skills development, it was interesting for the researcher to see these observations of motor overflow being classified as general observations. This means that it was seen in 80% or more of all the items. However, it was interesting that this population, although not yet proficient in their motor execution, presents with so much motor overflow especially in items like galloping and ipsilateral leg slap. These actions, galloping and ipsilateral leg slag, are actions that are normally included into sensori-motor programmes which children are introduced to in pre-primary schools (Motshekga, 2011). Therefore the practice opportunities should be more for this population, and the presence of motor overflow as a general observation in this population seems

unusual to the researcher. In the observations one should keep in mind when using this evaluation tool, which are listed in the manual of the COGMI, motor overflow is mentioned but it is clear from the manual that it should be less evident and is not mentioned under items like galloping and ipsilateral leg slap (SAISI, 2004). This supports the opinion of the researcher that motor overflow can still be present in this population but should not be seen as a general observation. This information made the researcher ask the question, whether the sample for this study was atypical and too small or not. This question of whether the sample was typical or atypical will be further discussed or explored under objective two.

If these general observations discussed above are to be compared to the list of observations of movement errors from J. Ayers mentioned previously it appears that there are similarities in the two lists (table 5.1):

Table 5.1 General observations compared to the list of observations of movement errors from J. Ayers

Observations of movement errors (J. Ayres)	**General observations of this study**
Inadequate development of reciprocal flexion and extension of the trunk, with limited rotary movements.	Lordosis.
Undifferentiated movement synergies – righting reactions and protective reactions predominate instead of more mature equilibrium reactions.	Arm abduction.
Prolonged stabilization by fixing	Chin tuck and elevated shoulders.

However one needs to look at observations of movement errors as well as what is acceptable for a 5-year old child before one can classify these general observations and observations of movement errors as observations of dysfunction. Due to the fact that literature form Gallahue et al.(2012) as well as Case-Smith(2010) states that a child in the pre-school years are still developing their fundamental motor skills, it make sense for the researcher to see observations of movement errors in the list of general observations for this population (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012). Also keep in mind that these general observations were classified as general because it was observed in 80% or more of the items and not necessarily in such a great percentage of children. On the other hand, movement mistakes or observations of movement errors can still be present in the green group of children, due to the fact that this population is developing their fundamental motor skills. They are not yet proficient in all these items.

5.3.3 Clusters of observations.

From analysing the movement the researcher also identified specific clusters of observations. These clusters related to specific movements required from certain items. These clusters can be divided into upper limb clusters, lower limb clusters, and head, neck and trunk clusters. Most of the clusters can also be related to either propulsion/locomotion or maintaining balance and will be discussed below.

5.3.3.1. Upper limb clusters.

Three main clusters could be identified; namely, reciprocal arm movement, flexion and extension of the fingers, and pumping of the arms. Reciprocal arm movement and pumping of the arms both appear to be related to propulsion or locomotion while flexion and extension of the fingers appears to be related to motor overflow associated with balance.

For example upper limbs cluster; Item 1: Kneel-walking forwards and backwards and Item 2: Heel-toe walking on line both portrayed reciprocal movements of the arms as well as flexion at the wrist and fingers.

Flexion at the wrist and fingers can be seen as overflow of movements or as discussed previously in the literature review of this study, involuntary movements that indicate a certain degree of difficulty regarding the actions that need to be performed. According to the manual of the COGMI and in the opinion of the researcher, children between 5 year 0 months and 5 year 11 months, when performing kneel-walking forwards and backwards as well as heel-toe-walking on a line, may present with excessive arms movements, poor backwards movement as well as extraneous movements in mouth, hands and feet to gain stability due to the fact that the actions in these items are not every day actions (SAISI, 2004). This study therefore supports these findings if the flexion at the wrist and fingers (extraneous movements in hands) are taken into consideration. Kneel-walking and heel-toe-walking on a line are not actions children perform every day. These actions expect more balance, coordination and planning from a person than normal walking and the opportunity for practicing these actions might differ from individual to individual. In that regard the researcher expected to see movement overflow in these items.

Reciprocal movements or alternating movements seen in items one and two like seen in the cluster mentioned above are related to locomotion, which can be defined as movement patterns that permits exploring through space, like walking, running, jumping, hopping etc. (Case-Smith & O'Brian,

2010) (Gallahue, et al., 2012) (Bardid, et al., 2016). Items one and two which are kneel-walking and heel-toe walking on a line therefore do have aspects of locomotion. If one looks at running, for instance, and the actions while performing the task of running is taken into consideration and one looks at the observations which can be made, such as arms lifted to waist in the 1st emerging stage and arms low guard in the 2nd emerging stage as well as arm-leg opposition in the proficient stage, and keeping in mind that the participants of this study are in the transition phase from 2nd emerging stage to proficient stage, it explains and supports the findings of this study regarding reciprocal movements observed in these items.

Pumping of arms, arms in winging action as well as semi-opposition patterns which could be observed in Item 3: Hopping, Item 4: Galloping, Item 5: Skipping, Item 11: Jumping sequence and Item 18: Jumping into consecutive squares, was another cluster that could be observed. If one looks at the literature of Gallahue et al (2012) specific to the upper limbs and how these items look like in the 5 year old child, keeping in mind that they are in the transition phase between the emerging stages and the proficient stage, you see the following actions: Emerging stage - arms move forward together at first and then break into semi-opposition. Arms provide body lift but hands are below shoulders. Proficient stage – arms swing loosely in opposition to the non-supporting leg and the use of arms as force producers are limited. These are specific to skipping. In hopping one will see bilateral arm actions in the emerging stages. Observations like arms swinging upwards and out to the side in a winging action or bilateral reactive motions and bilateral assist motions which can be described as arms pumping up and down together in front of body are all seen in the emerging stages of the development of hopping. In the proficient stage arms are pumping in opposition with swing leg's pendular motion. At first one will see semi-opposition in the proficient stage where the arm on the opposite side to the swing leg moves in opposition where the other arm may be variable in his actions, and as movements are refined one will see the arms swing in opposition to the swing leg – opposite assist. This last phase of the proficient stage is where the child is hopping for speed. In the literature there is no focus on the arm movements when galloping. Jumping sequence and jumping into consecutive squares once again requires similar actions from the child, like leaving the floor momentarily as well as landing on both feet simultaneously. A child also needs coordination as well as dynamic balance for all these items identified in this cluster. If we look at the literature of Gallahue (2012) specific to the upper limbs and the observations which can be made of the upper limbs when performing the jumping actions in the emerging stage and the proficient stage we can see the following: Emerging stage – arms start at the sides and swing forward or sideways at the shoulders so as to generate momentum; this is the 1st emerging stage. In the 2nd emerging stage the arms swing backwards together during knee flexion and then forward at take-off, again in an

attempt to generate momentum, but never reach above the head. In the proficient stage the arms swing backwards during knee flexion and then forward at take-off with full arm extension above the head (Gallahue, et al., 2012). The manual of the COGMI also stated that the arms may still be used to gain momentum at hopping and that some fixing may still be present. The manual also mentioned that when one look at skipping and the upper limbs the positions of the arms may varies and that jerky arm movement is evident (SAISI, 2004). The observations made in the study and the observations which can be made according to literature from Gallahue et al. (2012) as well the manual of the COGMI therefore, when compared, are similar observations. The finding of this study therefore is being supported by literature.

5.3.3.2. Lower limb clusters.

Once again clusters could be divided into those that are related to propulsion/locomotion and those related to balance. Propulsion/locomotion will be discussed first and then those related to balance.

Clusters observed in the lower limbs were identified as ***abduction and adduction of legs*** (sometimes related to balance and sometimes related to propulsion), in items 1 – Kneel-walking, 2 – Heel-toe walking on line, 3 - Hopping, 8 – Ipsilateral leg slap, 9 – Star jumps and 17 – Kick and trap a ball. These specific items included walking actions, hopping actions, jumping actions as well as kicking actions. Aspects of locomotion once again can be seen in some of these items, like items 1, 2 and 3 and as a result the development of locomotion also plays a role in these items. Kneel-walking and heel-toe-walking on a line are not actions children perform every day and like discussed above at the upper limb clusters, these actions expect more balance, coordination and planning from a person than normal walking. The opportunity for practicing these actions might also differ from individual to individual and the researcher also expected to see movement overflow specific to the lower limbs in these items. Practice opportunity improves motor development (Chow & Louie, 2013). According to the manual of the COGMI extraneous movements can be present in 5 year old children to gain stability and these movements can be seen in the mouth, hands and feet. The researcher concluded that the abduction of the legs observed while performing these items were present for exactly that reason, to gain stability. The manual also mentioned that at hopping which is item 3, the position of the knee may vary in the 5 year old child. Consequently the researcher believes that once again the manual supports the finding of abduction and adduction of the lower limbs during hopping. Due to the fact that the balance of a 5 year old child is still developing as mentioned in the literature of Gallahue et al (2012), as well as in the manual of the COGMI the fact that the child is presenting with lower limb abduction while performing item 8 – ipsilateral leg slap is supported. When performing item 8 the child is expected to lift the one leg and stand

momentarily on one leg. Balance is needed for this action. When performing star jumps the child is expected to jump and abduct his legs, land with open legs (abducted legs) and then jump and adduct his legs before landing with his feet next to each other. Abduction and adduction of the lower limbs is expected in this item and the researcher found that the expectations of this item support the observations that were made. At item 17 – Kick and trap a ball, it is also expected of the child to stand on one leg momentarily and therefore balance is once again also prerequisite in this item. It is also expected to stand on one leg while kicking the ball back to the researcher and thus dynamic balance is needed to perform this item. As discussed above a child of 5 year old does not present with proficient balance and when the expectations of an action are too difficult for a child motor overflow or associated movements will be present. Therefore it is likely that the abduction of the legs that can be seen in this item is due to the child trying to gain stability and balance.

Taking off and landing is another cluster which was observed in the lower limbs and will be discussed below. Items 3 – Hopping, 5 – Skipping, 8 – Ipsilateral stride jump, 9 – Star jumps and 11 – Jumping sequence all presented with landing on the ball of the feet, and landing flat feet could be observed in items 3 - Hopping, 4 - Galloping, 5 - Skipping, 9 – Star jumps and 11 – Jumping sequence. These items again all involved hopping and jumping actions which requires the child to leave the ground momentarily. Therefore landing is part of the action but how the landing takes place is important for this study, as the aim of this study is to improve the process-oriented aspect of the COGMI as well as to support the qualitative ability of the COGMI. If one look at the items identified in these clusters the development of balance and specifically dynamic balance immediately to comes to mind. Balance is the ability to maintain the equilibrium of one's body when it is placed in various positions, according to Gallahue et al (2012). Dynamic balance refers to the ability to maintain equilibrium when moving around in space. Static as well as dynamic balance, according to research mentioned in the book written by Gallahue et al (2012) states that the development of balance follows a linear trend towards improve performance from the age of 2 years old through to the age of 12 years (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012). Hence it can be seen that the population of this study falls right into the middle of this period in which balance develops. The researcher then made the assumptions that when looking at the population of this study and the items which they were expected to perform which required balance, there would be motor errors, like landing flat footed, visible. This assumption was supported by the literature found in the manual of the COGMI which stated that the balance of children of 5 years old has improved a lot from a child of 4 years of age; however a tendency to fix distally with the hands, feet and mouth are still present. The manual does not give a lot of information regarding landing specifically but stated that when performing the hopping action children of 5 years still tends to lands heavily. The manual

further mentioned that the movement of 5 year old children, in all the items grouped together in this cluster, were lacking fluidity and rhythm, or were not well developed or not well integrated. Well-developed dynamic balance is likely to be needed to perform an action with rhythm and fluidity. When you tend to land heavily or flat footed you usually tend to limit your rhythm and fluidity. For the researcher the importance of how the landing takes place, the observations which could be seen in these items, links the development of dynamic balance to the fluidity and rhythm of movement.

Another cluster of observations could be seen in Items 2 – Heel-toe walking on line, 3 - Hopping, 5 - Skipping, 10 – Long jump and 17 – Kick and trap a ball, where ***extra steps were needed***. All these items once again, also needs an aspect of balance, whether it is maintaining your balance while walking on a line or maintaining your balance after taking a long jump. Aspects of dynamic balance like discussed with the cluster above. ***Flexion and extension of toes or "clawing" action*** is another cluster that could be observed in items 1 – Kneel-walking, 2 – Heel-toe walking on line, 3 - Hopping and 10 – Long jump. Flexion and extension of the toes are observations which are usually also indicative of motor overflow. Motor overflow might indicate a certain degree of difficulty like discussed previously in this chapter. Kneel-walking and heel-toe-walking on a line are not actions children perform every day and like discussed above at the upper limb cluster of flexion at the wrist and fingers, these actions in item 1 and 2 expect more balance, coordination and planning from a person than normal walking. The opportunity for practicing these actions might also differ from individual to individual and in that case the researcher also expected to see movement overflow specific to the lower limbs in these items. According to the manual of the COGMI extraneous movements can be present in 5 year old children to gain stability and these movements can be seen in the mouth, hands and feet (SAISI, 2004). The researcher concluded that the flexion and extension of the toes observed while performing these items were present for exactly that reason, to gain stability. The development of balance and when you present with proficient balance development was also discussed above and is once again also important to keep in mind when looking at this observation cluster.

However, one can go further and ask what is needed to have good balance. According to literature by Gallahue et al (2012), the development of balance may be influenced by vision, as the eyes enable the child to focus on a specific point in order to maintain balance. Literature also states that vestibular apparatus in the ear does play a profound role in balance (Gallahue, et al., 2012). The vestibular apparatus coordinates visual, tactile and kinaesthetic systems in governing balance (Gallahue, et al., 2012) (Case-Smith & O'Brian, 2010). Therefore the researcher concluded that in

order to present with good balance one has to present with a vestibular system which is functioning at its full capacity in addition to a well-integrated sensory system. If one looks at the development of balance, discussed above, as well as with the previous clusters and one looks at the manual of the COGMI wherein they state which observations are normal for the 5 year old child; observations such as performance that is still hesitant although balance is improved (heel-toe walking), landing heavily (hopping), skipping action not well developed and at the long jump, inconsistencies with landing, balance and/or often over-step, flexion and extension of the toes, the observations from this study are supported by literature. These observations however do not indicate movement dysfunction or poor developed balance in this specific age group due to the fact that literature states that balance in a 5 year old child is still developing (Gallahue, et al., 2012) (SAISI, 2004).

The long jump action of item 10 also presented with flexion and extension of the toes, but this was not seen in item 10 due to motor overflow. If one looks at the development of the long jump action and the fact that there are four phases: first, a preparatory phase where the body positions itself for the jump; secondly, a force-producing phase where the body generates the forces necessary to take off. In this phase the proficient jumper presents with full extension of the body from the toes through the trunk, with the arms extended next to the head exactly at take-off. Finally, the third phase is the flight phase where the body is in the air and the fourth phase is the follow-through phase where the body lands and reduces the forces generated (Gallahue, et al., 2012). Keeping the developmental stages in mind as well as the fact that the population of this study is in the transition period from the emerging stage to the proficient stage of development, the observation of flexion and extension as part of the action and not due to motor overflow is supported by the literature (Gallahue, et al., 2012) (SAISI, 2004).

Plantar flexion or dorsiflexion was visible in items 3 - Hopping, 4 - Galloping, 6 – Ipsilateral leg slap, 17 – Trap and kick a ball and 18 – Jumping into consecutive squares. All these items entail the child to leave the floor with one or both feet simultaneously as well as landing on the floor again. If one looks at the action of taking off as well as landing as discussed above, and which observations can be made during landing and taking-off, plantar flexion and dorsiflexion are observations which are expected to be present (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012). For example, when taking off and kicking a ball the child presents with plantar flexion which could also be seen when the child lifted one leg; e.g., in item 6. Dorsiflexion could also be seen in item 3, item 6 and item 17, as an involuntary movement or motor overflow due to the child trying to gain stability.

The last cluster that could be identified was the cluster containing ***Reciprocal, timed and fluent movements as well as Controlled movement.*** The movements in items 5 - Skipping, 8 – Ipsilateral stride jump, 9 – Star jumps, 11 – Jumping sequence and 17 – Kick and trap a ball were not fluent or rhythmical. The researcher concluded when analysing these items that the movements were not fluent. The children tended to lose rhythm and stopped frequently while performing these items. When comparing the observations wherein the movements were not fluent or lacked rhythm made during this study to those listed in the manual of the COGMI as well as to literature from Gallahue et al (2012) and Getchell (2006) under this age group the researcher found that the literature supports the finding of this study; i.e., movement in this age group for these specific items are not always fluent. Children in this age group (5 years old) do not present with well-developed skipping patterns. Only at the age of 6 years old do children skip with good rhythm and their movements are smooth and well-controlled (SAISI, 2004) (Gallahue, et al., 2012) (Getchell, 2006). Therefore the movement mistakes that were observed in these items in this specific age group do not necessarily indicate dysfunction. The ipsilateral stride jump is a difficult item for the children in this specific age group. According to literature they often lose rhythm and the movements are not well-integrated up until the age of 9 years old (SAISI, 2004) (Getchell, 2006) (Gallahue, et al., 2012).

The movements in items 4 - Galloping, 6 – Ipsilateral leg slap, 7 – Contra-lateral leg slap, 8 – Ipsilateral stride jump and 9 – Star jumps were controlled actions. If the discussion in the paragraph above is considered it is clear that some items like item 8 - Ipsilateral stride jump and Item 9 – Star jumps present with both movement that is not fluent or lacks rhythm as well as controlled actions. What the researcher meant to convey with controlled actions at these two specific items is that although the arms and legs do not rhythmically work together the movements of the lower limbs are controlled. The children do show control when jumping and adducting or abducting their legs; they also show control in their movements when they jump with their legs one to the front and one to the back as expected from them in these two items. The movements, however, are not always fluent and rhythmical in execution. The children are slow in performing these items. For item 4 – Galloping, item 6 – Ipsilateral leg slap and item 7 – Contra-lateral leg slap the movements were all well-controlled when executed by the children in this age group. According to the manual as well as to literature from Gallahue et al (2012) children of 5 - 6 years old may present with controlled actions while performing these items (SAISI, 2004) (Gallahue, et al., 2012). Galloping is also, according to the researcher, a skill that the children are familiar with due to the fact that they get more practicing opportunities in school (Gallahue, et al., 2012). In the opinion of the researcher, galloping may become a practiced skill, and if the literature about motor development and how practice opportunities play a positive role in motor development and motor acquisition is taken into

consideration, the assumption can be made that the controlled movement of the 5 year old observed in this study is expected (Chow & Louie, 2013) (Colella & Morano, 2011). When performing ipsilateral leg slap and contra-lateral leg slap the children also presented with controlled actions or movements of the lower limbs. Whilst looking only at the lower limbs when the children performed these two items it was clear to the researcher that they executed the actions with control. The movements were not jerky.

5.3.3.3. Head, Neck, and trunk clusters.

Clusters identified under the head, neck and trunk were all clusters that might be related to differentiated movement.

Rotation of the hips was observed in all the items except for items 9 and 10. Item 9 – star jumps and item 10 – long jump, hip rotation was not present probably due to the fact that the child was expected to keep his / her legs next to each other with the long jump in item 10, and at item 9 abduction and adduction of the lower limbs were expected from the child. In all the other items hip rotation was observed by the researcher probably due to the fact that locomotion was needed as well as the fact that the children in the population of this study do still develop their balance. Hip rotation can, in the opinion of the researcher, be seen as associated movements or motor overflow in order to gain stability.

Head righting reactions were observed in items 1 – Kneel-walking, 2 – Heel-toe walking on a line, 3 - Hopping, 4 - Galloping, 5 - Skipping, 8 – Ipsilateral stride jump, 11 – Jumping sequence and 17 – Trap and kick a ball. Righting reactions helps to maintain head alignment with the body and upper-body alignment with the lower body when rotation is imposed on the body; these reactions realign the segments of the body. Righting reactions are used for adaptive postural adjustments during the carrying out of activities which are experienced as difficult by the children (Case-Smith & O'Brian, 2010). Like discussed previously in this chapter as well as in the literature review chapter of this study all these items in this cluster are not necessarily easy actions for the population of this study to perform. Righting reactions can also be seen as motor overflow or associated movements due to an expectation which is difficult to meet. If all the literature discussed previously throughout this study is taken into account the presence of head righting reactions in these items might be due to the population being in the transition phase between the emerging stage and the proficient stage of fundamental motor development and not yet proficient in these skills.

In items 1 – Kneel-walking, 3 - Hopping, 9 – Star jumps and 17 – Trap and kick a ball, ***lateral flexion of the neck*** was visible. Lateral flexion of the neck can be seen as an equilibrium reaction. Equilibrium reactions are responses to external disturbances and are reactive or compensatory. Equilibrium reactions oppose the imposed displacement and bring the centre of gravity back within the base of support (Case-Smith & O'Brian, 2010). As we know by now the population in this study is not yet competent in the execution of the items in this cluster. These items challenge the child's balance to a certain extent and when the child experiences difficulties maintaining their balance within these items they present with lateral flexion of the neck.

Neck rotation was visible in most of the items except in Items 3, 4 and 11. When detecting this cluster of neck rotation in most of the items the researcher went back to the videos and investigated this observation even more. The researcher concluded that the children presented with neck rotation in most of the items due to the fact that they kept the researcher in sight while performing the items and because of that the neck rotation was observed during most of the items. Therefore this was an important observation in terms of where the evaluator should be positioned when the child performs the items. The fact that the children kept the researcher in sight and presented with neck rotation one can ask whether their focus on the researcher, who was clearly not standing in front of the child, had an influence on their performance. If all the literature of Gallahue et al (2012) as well as the literature of Case-Smith (2010) is taken into consideration and one kept in mind at which stage of development of the fundamental motor skills this population is, it is apparent that vision as well as vestibular development does play a big role in the performance of these children. Nevertheless, the researcher is not convinced that the focus on the researcher standing on the side had a negative influence on the performance of these children. The reason why the researcher is stating this is that if the observations that were made, according to literature, during execution of the items of the COGMI are compared to the observations the researcher made during the video analysis there are similarities like discussed in each cluster above.

Protruding belly could be seen in items 1 – Kneel-walking, 2 – Heel-toe walking on line, 4 - Galloping, 5 - Skipping, 6 – Ipsilateral leg slap, 7 – contra-lateral leg slap, 8 – Ipsilateral stride jump, 9 – Star jumps and 18 – Jumping into consecutive squares. A protruding belly is normally seen in children presenting with hypotonia, low tone children or where the abdominal muscles are not sufficiently developed (SAISI, 2005). Protruding bellies are caused by non-active or under-active abdominal muscles. Think about a 2 year old child and a lady who has just given birth. Both these individuals will have protruding bellies because of the abdominal muscles. In the 2 year old child the muscles are not yet contracting good enough and in the lady who just given birth the abdominal muscles

were so stretched that they are no longer contracting like they used to. The presence of a protruding belly are mostly accompanied by the presence of lordosis and / or anterior pelvic tilt (Case-Smith & O'Brian, 2010). According to literature a child of 4 years old presents with a protruding belly but at the age of 5 years old, the abdominal muscles are becoming more active; however, it may still be present in the 5 year old age group (SAISI, 2004). This means that the abdominal muscles of a 5 year old child will not as yet contract in the same way as older children and adults and thus the pelvis is tilted forward and the organs of the abdominal area are held together loosely, resulting in the protruding belly. The researcher concluded after considering the literature that the presence of a protruding belly may indicate low muscle tone as well as the insufficient development of abdominal muscles, although in this specific population it may be considered as a normal observation.

Trunk rotation was visible in most of the items except for item 1 – Kneel-walking, item 11 – Jumping sequence and item 18 – Jumping into consecutive squares. If all the items in which this observation could be made is critically looked at and the expectations which each item requires from the child performing them are considered, the researcher found that trunk rotation could be observed due to the fact that this population is not yet proficient in their execution of these fundamental motor skills. Remember that this population is still in the emerging stage going into the transition stage to the proficient stage of the development of fundamental motor skills. For that reason the researcher concluded that trunk rotation could be observed as a compensatory movement due to balance still developing; e.g., in item 2 – Heel-toe walking, Item 3 – Hopping and Item 4 – Galloping. However, the researcher also concluded that trunk rotation could also be distinguished in items like item 7 – Contralateral leg slap and item 17 – Trap and kick a ball due to the child being required to cross his/her midline. Trunk rotation also indicates to us that the child does not need to fix his whole core in order to gain or maintain stability.

5.4 Objective 2: COMPARING OBSERVATIONS FROM CHILDREN BETWEEN THE AGES OF 5 YEARS 0 MONTHS AND 5 YEARS 11 MONTHS WITH TYPICAL MOTOR COORDINATION AND THOSE WITH MOTOR COORDINATION DYSFUNCTION TO IDENTIFY SALIENT BEHAVIOURAL CHARACTERISTICS THAT WILL DETERMINE FUNCTION OR DYSFUNCTION.

After identifying all the observations that could be made by using the COGMI with this population, the researcher had to compare the observations from the two groups: the red group with motor

coordination dysfunction and the green group with typical motor coordination, to be able to develop a checklist of salient behavioural observations that will improve the qualitative ability of the COGMI and make the scoring criteria of the COGMI more process-orientated.

The researcher divided the observations which could be made from this study into the 5 different scales of the current scoring system of the COGMI by using percentages. Observations that could be seen in 33% of the red group were allocated to the 1-score (Totally unable, even after practicing) of the scoring sheet of the COGMI. Observations that could be seen in 50% of the red group were allocated to the 2-score (Makes an attempt but achieves only part, even after practising) of the COGMI and observations that could be seen in 66% of the red group were allocated to the 3-score (Able, poor control, not well-integrated) of the COGMI. Observations of the green group were also used and allocated as follows: Observations that could be seen in 75% - 100% of the green group were allocated to the 4-score (Good, slight inconsistencies and lacks some integration) of the COGMI and observations that could be seen in 50% of the green group were allocated to the 5-score (Very good control, good integration, executes with ease) of the COGMI.

After dividing the observations into the 5 different scales the researcher found that some of them presented in more than one score. This was due to the fact that there were two groups and some of the observations were observed in both groups. The researcher had to look at the literature discussed above as well as in the literature review of this study and split the observations into observations of dysfunction / movement errors or mistakes and correct movement observations. Observations allocated to score 1, 2 and 3 were classified as observations of dysfunction / movement mistakes and the observations that were allocated to score 4 were classified as correct movement observations. However, due to the fact that the population of this study is busy transitioning between the emerging stage and the proficient stage of the developmental stages of fundamental motor skills, the presence of movement mistakes allocated to the 4-score is expected. Movement mistakes may be normal for children between 5 years 0 months and 5 years 11 months. The observations that were allocated to score 5 were classified as superior movement.

After dividing the observations into the five point scoring system and statistically compare them to determine significant differences the researcher found some interesting results. These findings such as variability, the presence of lordosis will be discussed below.

Like mentioned in the literature review of this study fundamental movement skills develop in the following sequential stages:

- Initial Stage – Which is typically the locomotor, manipulative, and stability movements of the 2-3-year-old,
- Emerging Elementary Stage – This stage involve gaining greater motor control and rhythmical coordination of fundamental movement skills. This can typically be seen in the 3-5-year old child and the
- Proficient Stage – This stage is characterized by mechanically efficient, coordinated, and controlled performances (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012).

When looking at these stages it is unmistakable that in the initial stages there is a lot of balancing present where the arms are still very high and gradually as the child moves through the development stages the arms move closer to the body. In stage 1 the initial stage the movement is also still very non-rhythmical and reciprocal movements are not yet present. The Emerging Elementary Stage – This stage involve gaining greater motor control and rhythmical coordination of fundamental motor skills. This can typically be seen in the 3-5-year old child. In the emerging stage we see that reciprocal movements are starting to develop although motor overflow may also still be present due to the fact that the skills are still developing and are not yet consolidated at this stage. Literature shows that variability in performance of fundamental motor skills (FMS) is typical for 5 year old children owing to the fact they are still developing their motor coordination and fundamental motor skills, and are still progressing through the developmental sequences while learning these important skills (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012) (Bardid, et al., 2016). This could also be seen in the results from this study that there was a lot of variability in this population observed.

Opportunity for practice of skills and the space to practice these skills are important factors in the development of fundamental motor skills. These factors may influence the results of this study, for example, if the numerous children, prior to this research project, were given different opportunities and stimulation in various locations in order to develop fundamental motor skills then different levels of development would be present. This may contribute to the variability which is present in the results of this study. It is also supported by literature and a study done in Hong Kong by Chow & Louie in 2013, where they found significant differences in motor skill development between preschools with a large playground versus a small playground (Chow & Louie, 2013). Another factor that can influence opportunity for practice is the emphasis placed on gross motor play by schools, parents and communities. If schools apply greater emphasis on academics, then possibly they won't encourage gross motor play as much and might not include opportunities for the children to be exposed to sensori-motor development programs.

Another aspect that can lead to variability in the observations that can be surveyed in this population of 5 year old children is the presence of motor overflow, which was also noted by the researcher. Motor overflow refers to the involuntary movements like sticking out of tongue or flexion and extension of fingers, which may accompany the production of voluntary movements and displays the effort the child is putting in to be able to do a certain action (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012). Motor overflow can also be defined as the increase in muscle tone on effort while performing an action (Finnie, 1997). The presence of motor overflow can be seen when a child has not yet became practised in a certain action and needs to put in a lot more effort and concentration in order to perform that action.

Observations like supination and pronation of the forearm, elevation of the shoulders, arm abduction as well as associated movements like chin tuck are all observations that the researcher observed during this study, and in the opinion of the researcher these observations were all involuntary movements which accompany the voluntary movements and therefore can be seen as motor overflow. These observations were not movements that were needed in order to perform the specific actions in which they were observed and therefore the researcher made the assumption that these movements were involuntary movements. Motor overflow can be seen due to the fact that this population is not yet proficient in their execution of the fundamental motor skills.

Another interesting finding for the researcher was to see that the presence of a lordosis as well as a protruding belly could also be classified as a general observation in the items and that it was common. If one looks at the manual of the COGMI they stated that a lordosis should be less evident in children 5 years 0 months to 5 years 11 months. The manual also mentioned a lordosis only in item 1, which is kneel-walking forwards and backwards (SAISI, 2004). But in the results of the current study the presence of a lordosis could be seen in all the items investigated, in static positions as well as during the movement phase.

These observations of motor overflow as well as the presence of a lordosis made the researcher ask: Could it just be due to the small sample used in this study? Could it be a sample error? Is the presence of a lordosis or motor overflow normal for this population? What are the causes of a lordosis? Or could this be indicative of a more sedentary modern lifestyle? And how will this influence a child's functioning later in life?

To answer the questions above, whether this is normal for the population of this study or not one has to comprehend the literature of normal development which can be seen in various sources like Gallahue et al (2012) as well as Case-Smith (2010) and the manual of the COGMI (2004), to mention a few. According to the literature, lordosis is still present but less evident. Literature also states that the tendency to revert back to mass patterns of flexion and extension as well as the tendency to fix distally with the hands, feet and mouth are also still present as the demands of the motor tasks increase (Case-Smith & O'Brian, 2010) (SAISI, 2004). Balance has also improved remarkably from 4 years of age and the abdominal muscles are becoming more apparent in children 5 years of age (SAISI, 2004). When a lordosis or motor overflow is present it may be an indication of low muscle tone which usually causes coordination problems (Bundy, et al., 2002) (Case-Smith & O'Brian, 2010) (SAISI, 2005). Therefore the researcher concluded that the presence of a lordosis and/or motor overflow in this population is normal and, in a less frequent manner, is not normal to see in all the items of the COGMI. It is also unusual to see in static postures or movement patterns of all the items. The researcher assumed that the presence of a lordosis and motor overflow would be much less in this population.

This made the researcher readdress the following questions: can this be indicative of a more modern sedentary lifestyle and how will this influence a child's functioning later in life? According to the literature review of this study it is clear that motor development and motor activity form an essential part of health promotion (Colella & Morano, 2011) (Gallahue, et al., 2012) (Bardid, et al., 2016). Multiple studies concluded that motor skill development plays an important role in cognitive development and that motor development delays can be associated with deficits in perceptual skills. These studies also concluded that motor skill development or the delay thereof is often linked to developmental problems in other areas, such as reading and writing difficulties. Children presenting with learning difficulties showed a history of early developmental delays regarding balance and motor skills (Portwood, 2004) (Rodger & Ziviani, 2006).

Delays in the development of motor coordination can hence have an effect on a child's development in all other aspects of their life, and can have long-term effects on a child's self-esteem and self-efficacy as they become aware of the difference in their own performance compared to their peers (Gallahue, et al., 2012) (Bardid, et al., 2016).

Motor coordination and fundamental motor skills development are critical for physical, cognitive and social development (Colella & Morano, 2011) (Portwood, 2004) (Bardid, et al., 2016). Therefore

it can be seen that delayed motor development does hold vast implications for the child's and adult's holistic functioning later in life (Sangster, et al., 2005) (Miller, et al., 2001) (Bardid, et al., 2016).

The presence of a lordosis as well as motor overflow in most of the items can, in the opinion of the researcher, also be an indication of a more sedentary lifestyle. This estimation is based on literature proving that practice opportunities, socio-economic status and the environments in which the child is reared does influence the development of fundamental skills positively (Chow & Louie, 2013) (Colella & Morano, 2011). When a child follows a more sedentary or inactive lifestyle the opportunities for gross motor activities are limited and so are the opportunities for gross motor development. Sedentary lifestyles are characterised by no or minimal physical activities and include activities like sleeping, sitting, lying down and watching television or other forms of screen-based entertainment. People following a sedentary lifestyle may also be known as couch potatoes. In both developing and developed countries this type of lifestyle is happening more often.

5.5. Limitations of the study.

During this study there were a few limitations identified. Firstly, the sample of this study was relatively small and this could affect generalizability of the results. Another limitation was the difficulty in filling the mild and severe motor coordination dysfunction group. The initial sample was planned for three groups but due to the difficulty in filling the severe motor coordination dysfunction group the researcher categorized the mild to severe motor coordination dysfunction children together in one group. If the sample size was bigger and more children in the severe motor coordination dysfunction group could be part of this study the results may have been broader. The third limitation to this study is the fact that the psychometric properties of this checklist have not yet been tested. Due to this limitation, it is not yet known whether the checklist will be effective and helpful in improving the qualitative process-oriented properties of the COGMI. The fourth limitation to this study is the fact that not all the items of the COGMI was included in this study. Due to this limitation, recommendations for standardization of the COGMI as a whole can't be done. Finally, the fact that this study was only done on 5 year 0 months to 5 years 11 months old children is also seen as a limitation. The COGMI is a process-oriented assessment tool which is commonly used by therapists, not only on the specific population of this study but it will also be in the best interest of the occupational therapy profession if this study can be performed on other age groups as well in order to improve the COGMI as a whole.

CHAPTER 6: COMPILATION OF THE CHECKLIST AND CONCLUSION

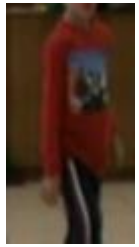
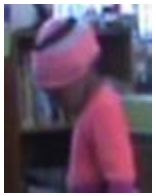
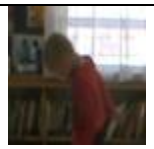
6.1. Develop a checklist of these observations to accompany scoring criteria.

Following the data analysis, the checklist was developed (see appendix K). The first step in developing the checklist was to augment a list of general observations that could be made throughout the COGMI. The researcher used the 5-point scale of the COGMI to categorize the observations that presented with statistically significant differences.

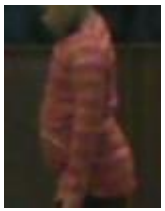
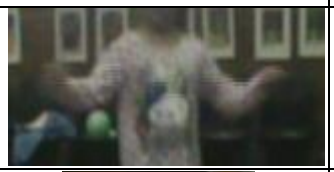
The results and discussion in Chapter 4 and 5 indicate how the descriptors for the items from gross motor coordination were defined and analysed. Only movements that showed differences between children in the green and red groups were included in the behavioural checklist. The checklist indicates movements to be observed for each item ordered from proximal to distal for ease of use. Descriptors are defined for each item and can be observed and scored on the checklist to determine function and dysfunction (Stufflebeam, 2000).

Below is the List of General observations (these are observations that can be seen in any of the items).

Figure 16 Checklist

List of General Observations															
Description	**Scale**	**Photo**	**Item 1**	**Item 2**	**Item 3**	**Item 4**	**Item 5**	**Item 6**	**Item 7**	**Item 8**	**Item 9**	**Item 10**	**Item 11**	**Item 17**	**Item 18**
Elevated shoulder	1														
Elbow extension	1														
Associated movements (chin-tuck)	1														
Flexion/Extension of neck	1	 													
Eyes shift between horizon and floor	2	No photo – This is a movement													

Trunk flexion/extension	3														
Lateral flexion at trunk	3														
Supination/Pronation of forearm	3														
Head in midline / Neutral position	4														
Eyes focus on floor	4														

Eyes focus on horizon	4														
Lordosis	4														
Straight back	4														
Elbow flexion	4														
Abduction of arms	4														
Flexion/Extension at knees	4														

Flexion/Extension at hips	4														

After compiling the general observations checklist, the researcher took the rest of the observations which presented with statistically significant difference to compile an item specific observations checklist. This checklist together with the general observations checklist needs to accompany the COGMI.

Table 6.1 Item Specific Observational Checklist

		1	2	3	4	5
Item 1 – Backwards	**Movement**	Support with hand (one or both) on mat or legs	Flexion / extension at wrist, fixate shoulders, flexion / extension of fingers	Standing up: Flexion at hips and knees	Leg abduction	No half-kneeling when going down
		Only one arm swing reciprocal	Going down to mat: Trunk flexion to horizontal level	Going down to mat: flexion at knees and hips	Both arms swing reciprocal	
		Shoulder retraction	Standing up; Trunk flexion	Wide base of support. Knees beyond shoulders		
		No trunk rotation				
		Hip rotation				
		Feet eversion				
		Posterior / Anterior pelvic tilt				
		1	**2**	**3**	**4**	**5**
Item 1 - Forward	**Movement**	Only one arm swing reciprocal	Support with hand (one or both) on mat or legs - Standing up	Trunk flexion standing up	No half-kneeling - going down	
		Neutral position of arms	Shoulders parallel with floor		Half-kneeling - standing up	
		Slide legs over mat			Both arms swing reciprocal	
		Anterior pelvic tilt			No half-kneeling	
		Eyes focus to a side			Half-kneeling	
					Going down to mat: Tilt trunk forward / Flexion to horizontal level	
		1	**2**	**3**	**4**	**5**
Item 2	**Movement**	Anterior pelvic tilt		Flexion / Extension at wrist		Heel-toe touching (more than 5 steps)
				Flexion / Extension at fingers		

		1	2	3	4	5
Hopping L Item 3 -	Movement	Flexion / extension at toes		Swing leg held in front of body	Swinging leg - pump back & forth	
		Dorsiflexion at ankle		Need to give support steps		
		1	**2**	**3**	**4**	**5**
Item 3 - Hopping R	Movement	Flexion/Extension at wrist, fixate shoulders, flexion/extension of fingers	Swing leg held in front of body		Swinging leg - pump back & forth	
		Shoulders parallel to floor			Arms swing up & out in winging action	
		Trunk rotation				
		1	**2**	**3**	**4**	**5**
Item 4	Movement	Semi-opposition - one arm pump back & forth			Back leg land besides front leg	Rhythmical movements
		Shoulders parallel to floor			Hips face front	
					Stay close to surface	
		1	**2**	**3**	**4**	**5**
Item 5	Movement	Protruding belly	Eye shift between floor and horizon			Land / take-off on ball of feet
		High vertical component at arms	Hip rotation			
		Not rhythmical movements				
		Head righting reactions				
		Trunk rotation				
		1	**2**	**3**	**4**	**5**
Item 6	Movement	Rotation of neck	Does not slap each lift with ipsi-lateral arm or as needed (does not touch legs)	Shoulders parallel to floor	Slap leg with open relaxed hands	
					Controlled actions (arms and legs work together)	
		1	**2**	**3**	**4**	**5**
Item 7	Movement	Slap legs with force	Slap leg while already down / going down		Slap leg with open relaxed hands	
		Eyes focus on legs	Shoulders parallel to floor		Controlled actions (arms and legs work together)	

		1	2	3	4	5
Item 8	Movement	Shoulders parallel to floor	Arms swing back and forth uncontrolled		Arms swing back and forth with legs (ipsilateral)	
		Unable to perform this item (does not jump, arms just swing back and forth, arms & legs does not work together)	Trunk rotation		Flexion/Extension at wrist, fixate shoulders, flexion/extension of fingers	
		Arms swing forward with leg > horizon				
		Neck rotation				
		Not fluent movement				
		Abduction of legs				
		Legs cross-over (adduction) when landing				
		Hip rotation				
		1	**2**	**3**	**4**	**5**
Item 9	Movement	Shoulders parallel to floor	Flexion / Extension at wrist	Arms and legs do not work together	Abduction - land - adduction - land - pattern	Abduction of arms with legs <horizon
			Flexion / extension of fingers			Adduction of arms with control
						Rhythmical movements / controlled actions
		1	**2**	**3**	**4**	**5**
Item 10	Movement	Give 1-3 steps after landing to retain balance	Arms swing forward before take-off		Tilt trunk forward before take-off (trunk flexion)	
		Feet not together in air / take-off / when landing	Trunk stay tilted forward from take-off to landing(not fully extend)		Landing - trunk tilts forward (flexion of trunk)	
		Tilt trunk forward (flexion) before take-off to horizontal level			Full extension of trunk when in air	
					Arms swing forward & up to shoulder height when jumping	

		1	**2**	**3**	**4**	**5**
Item 11	**Movement**	Walking action for 2+ hops	Arms pump up & down in front / next of body	One or both arms hanging relaxed next to body	Arms swing up & out in winging action	
		Lands on ball of feet				
		1	**2**	**3**	**4**	**5**
Item 17	**Movement**	Arms (one / both) swing up & out in winging action	One or both arms swing backwards to horizontal level	Flexion / Extension at wrist	Eyes follow the ball	
		Dorsi-flexi visible	Hip rotation	Trap ball with hands (less than 2 attempts)		
				Flexion / Extension at fingers		
		1	**2**	**3**	**4**	**5**
Item 18	**Movement**	Neutral position of arms	Knees does not fully extend in air	Arms pump up & down in front / next of body	Land 2 feet together	
		Arms pump back & forth			Arms swing up & out in winging action	
		Feet does not go together (take-off and land)				

6.2. Use of the checklists.

When making use of the COGMI, the checklists that was developed from this project must be used for a more process-oriented assessment of the child. When using the general observations checklist the person assessing the child needs to mark at what items the specific observations could be made. The observations of the general checklist have also been divided according to the 5-point scale of the COGMI, and therefore the person assessing the child needs to look at the scale next to the general observations as well, when scoring the child. The specific item checklist that was compiled from this project also needs to be used in conjunction with the current scoring sheet of the COGMI. The person assessing the child needs to look at the quality of the movement and if the observations recorded on the checklist are found this should be noted on the checklist. The observations on this checklist are also divided according to the 5-point scale of the COGMI, and if the child presents with those mostly from the column of the 1-score, the person assessing the child may consider scoring the child a 1(one) for that specific item. The checklist should be seen as a guide to clarify the current scoring system.

However, based on this discussion and the types of observations made during this research study, (particularly related to movement overflow and lordosis), further research on the use of this checklist is needed. In order for this checklist to be further refined and standardised the researcher suggests that this checklist be used by novices as well as experienced therapists together with the scoring sheet of the COGMI to determine whether it is helpful in scoring the children more accurately. The researcher also suggests that this checklist be used in different socio-economic status populations as well as different ethnic groups to determine whether it is suitable for all the children of South Africa due to the fact the population is so diverse.

6.3. CONCLUSION

6.3.1 Purpose of the study

With this study the researcher focused on the importance of assessing quality of movement when gauging children's motor development, and how the movement is performed rather than its outcome. That is to say, to be more process-oriented in assessing motor development rather than product-oriented.

Quality of movement, motor competence and motor co-ordination of fundamental motor skills are the building blocks for later activities in life or fundamental motor skills, where more advanced movements are required and are an important aspect to examine as early as possible. Literature has emphasised that motor development, the process through which a child gains movement skills, is a crucial factor that influences a person's quality of life as well as participation in daily occupational tasks and global functioning (Sangster, et al., 2005) (Case-Smith & O'Brian, 2010) (Colella & Morano, 2011) (Hsieh, et al., 2013). Furthermore, it was also stressed that early childhood and the pre-school years form a sensitive age period for motor development and the development of fundamental motor skills (Case-Smith & O'Brian, 2010) (Gallahue, et al., 2012) (Baghurst & Mwavita, 2014) (Bardid, et al., 2016) so researcher felt it necessary to use the COGMI assessment tool, which is a process-oriented tool commonly used in South Africa, on 5 years old children in this research study.

With this study the researcher aimed to identify salient behavioural chacharacteristics that separate children with normal motor coordination development, mild motor coordination dysfunction and severe motor coordination dysfunction from each other on the items of the COGMI in order to provide recommendations to improve the specificity and sensitivity of this observational evaluation tool, as well as to improve this commonly used assessment tool's qualitative ability. The researcher's intention for the COGMI is to be more process-oriented, especially to assist novice evaluators in making appropriate process-oriented judgements.

6.3.2 Main Findings of the Study

Throughout this study it was very clear to the researcher that this specific age group presents with a lot of variability due to the fact that they are still developing in their gross motor skills and are not yet proficient in fundamental skills. The inconsistency may also be due to different practicing opportunities that each child may have experienced as well as the fact that environmental factors such as size in play area also plays a role. The conclusions will be related to each objective below.

6.3.2.1. Determine the observations that can be made when using the COGMI with children between the ages of 5 years 0 months and 5 years 11 months.

From the movement analysis it could be concluded that the starting and finishing positions are not useful to make observations from when using the COGMI, but rather that the movement portion of the items should be observed and analysed. This conclusion is supported by the fact that the COGMI focuses on motor development and not on static positions, on coordination of movement rather than postures (SAISI, 2004). It is also stipulated in the manual of the COGMI that the emphasis is on the quality of movement (SAISI, 2004). Therefore the researcher concluded that the manual of the COGMI supports the fact that static positions are not useful when using the COGMI.

6.3.2.2. Compare observations from children between the ages of 5 years 0 months and 5 years 11 months with typical motor coordination and those with motor coordination dysfunction to identify salient behavioural characteristics that will determine function or dysfunction.

It could also be concluded that the development of balance is extremely important to keep in mind when assessing this population. As such, movement mistakes or observations of movement errors such as motor overflow can still be present in the green group of children, because this population is still busy developing their fundamental motor skills. They are not yet proficient in all of these items. One needs to look at observations of movement errors as well as what is acceptable for a 5-year old child before one can classify the general observations identified in this study and observations of movement errors as observations of dysfunction. Practice opportunity improves motor development (Chow & Louie, 2013) and as discussed in chapter 5, a child of 5 years old does not present with proficient balance and when the expectation of an action are too difficult for a child motor overflow or associated movements will be present. It is likely that the abduction of the legs as well as the flexion and extension of the toes observed while performing these items were due to the child trying to gain stability and balance. According to the manual of the COGMI extraneous movements or the movement overflow which was one of the general observations the researcher identified, can be present in 5 year old children to gain stability and these movements can be seen in the mouth, hands and feet. Therefore the movement mistakes that were observed in these items, in this specific age group, do not necessarily indicate dysfunction.

According to literature by Gallahue et al (2012), the development of balance may be influenced by vision, as the eyes enable the child to focus on a specific point in order to maintain balance. Literature also states that vestibular apparatus in the ear does play a profound role in balance (Gallahue, et al., 2012). The vestibular apparatus coordinates visual, tactile and kinaesthetic systems in governing balance (Gallahue, et al., 2012) (Case-Smith & O'Brian, 2010). Therefore the researcher further

concluded that in order to present with good balance one has to present with a vestibular system which is functioning at its full capacity in addition to a well-integrated sensory system.

Another very important conclusion in this study is the fact that neck rotation was visible in most of the items; except in Items 3, 4 and 11. The researcher found that the children presented with neck rotation in most of the items due to the fact that they kept the researcher in sight while performing the items. This was an important observation in terms of where the evaluator should be positioned when the child performs the items. The therapist when assessing the child should stand in front of him/her.

Furthermore the researcher also concluded that, after taking the literature into consideration, the presence of a protruding belly, which was visible in nine of the 13 items investigated in this study, may indicate low muscle tone as well as the insufficient development of abdominal muscles, however in this specific population it may be considered as a normal observation. According to literature a child of 4 years old presents with a protruding belly but at the age of 5 years old, the abdominal muscles are becoming more active however it may still be present in the 5 year old age group (SAISI, 2004). This means that the abdominal muscles of a 5 year old child will not as yet contract in the same way as older children and adults and thus the pelvis is tilted forward and the organs of the abdominal area are held together loosely, resulting in the protruding belly. The presence of a protruding belly is mostly accompanied by the presence of lordosis and / or anterior pelvic tilt (Case-Smith & O'Brian, 2010).

These observations of motor overflow as well as the presence of a lordosis made the researcher ask the questions: Is the presence of a lordosis or motor overflow normal for this population? What are the causes of a lordosis? Or could this be indicative of a more sedentary modern lifestyle? And how will this influence a child's functioning later in life?

According to the literature, lordosis are still present but less evident. Literature also states that the tendency to revert back to mass patterns of flexion and extension as well as the tendency to fix distally with the hands, feet and mouth are also still present as the demands of the motor tasks increase (Case-Smith & O'Brian, 2010) (SAISI, 2004). Balance has also improved remarkably from 4 years of age and the abdominal muscles are becoming more apparent in children 5 years of age (SAISI, 2004). When a lordosis or motor overflow is present it may be an indication of low muscle tone which usually causes coordination problems (Bundy, et al., 2002) (Case-Smith & O'Brian, 2010) (SAISI, 2005). Therefore the researcher concluded that the presence of a lordosis and/or motor overflow in this population is

normal to see, in a less frequently manner, and is not normal to see in all the items of the COGMI. It is also not normal to see in static postures or movement patterns of all the items. The researcher assumed that the presence of a lordosis and motor overflow would be much less in this population.

The presence of a lordosis as well as motor overflow in most of the items can, in the opinion of the researcher, also be an indication of a more sedentary lifestyle. This opinion of the researcher is based on literature proving that practice opportunities, socio-economic status and the environments in which the child is reared does influence the development of fundamental skills positively (Chow & Louie, 2013) (Colella & Morano, 2011). When a child follows a more sedentary or inactive lifestyle the opportunities for gross motor activities are limited and therefore the opportunities for gross motor development are also limited. Sedentary lifestyles are characterised by no or minimal physical activities and includes activities like sleeping, sitting, lying down, and watching television or other forms of screen-based entertainment. In developing countries as well as developed countries this type of lifestyle is happening more often.

6.4. RECOMMENDATIONS

The researcher recommends the following:

- Future research with a larger sample size in different age groups, and more participants in the severe motor coordination dysfunction group, needs to be done.
- The testing of the psychometric properties, specifically regarding the reliability and validity of this checklist was outside the scope of this research and therefore the researcher recommends that this be tested in future research projects.
- Further research can be done by repeating this study on diverse populations such as different social-economic status groups and cultures.
- In future research on all 18 items of the COGMI needs to be investigated.

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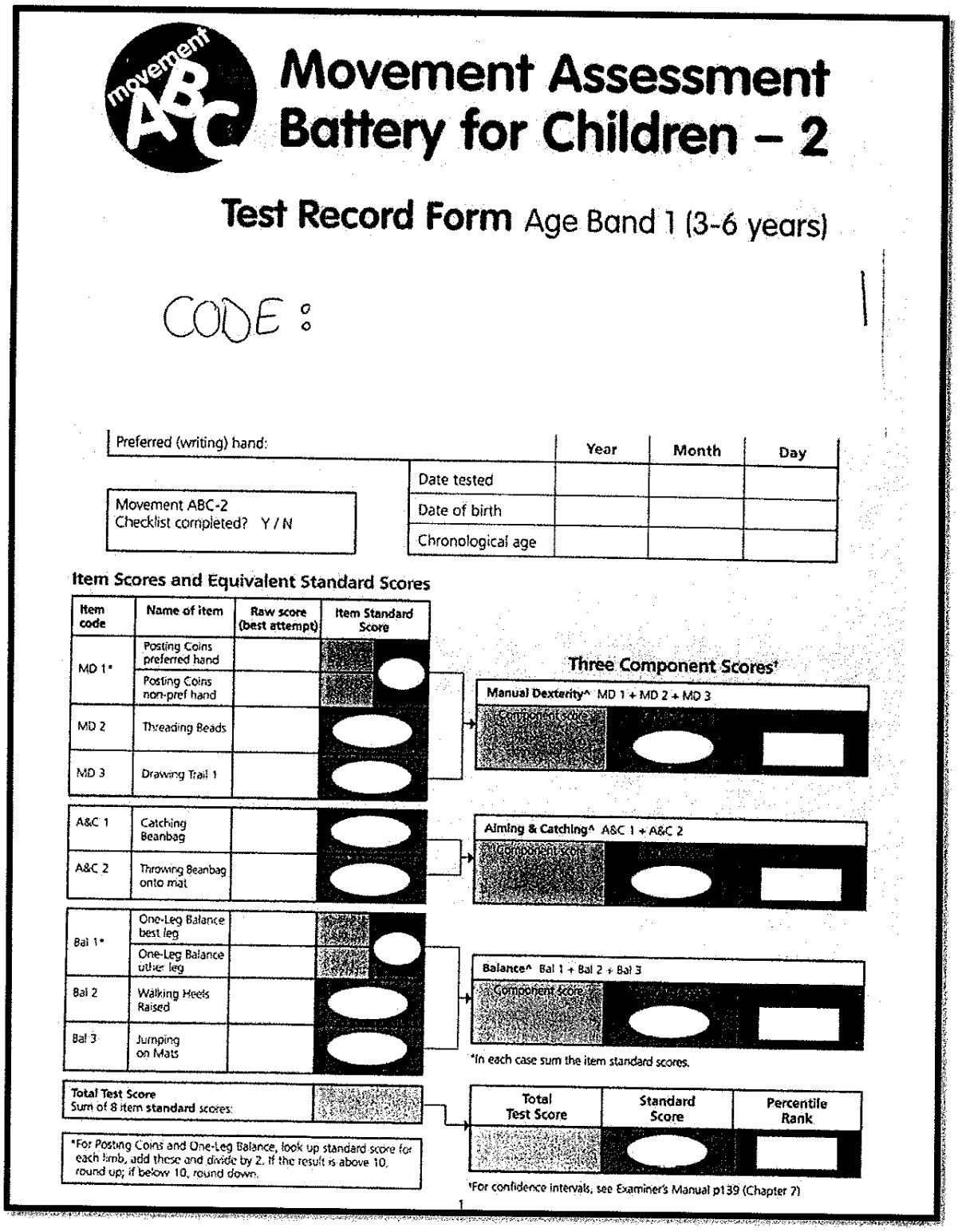
APPENDIX A – MOVEMENT ASSESSMENT BATTERY FOR CHILDREN – 2



Movement Assessment Battery for Children – 2

Test Record Form Age Band 1 (3-6 years)

CODE:

Preferred (writing) hand:		Year	Month	Day
Movement ABC-2 Checklist completed? Y / N	Date tested			
	Date of birth			
	Chronological age			

Item Scores and Equivalent Standard Scores

Item code	Name of item	Raw score (best attempt)	Item Standard Score
MD 1*	Posting Coins preferred hand		
	Posting Coins non-pref hand		
MD 2	Threading Beads		
MD 3	Drawing Trail 1		
A&C 1	Catching Beanbag		
A&C 2	Throwing Beanbag onto mat		
Bal 1*	One-Leg Balance best leg		
	One-Leg Balance other leg		
Bal 2	Walking Heels Raised		
Bal 3	Jumping on Mats		

Three Component Scores*

Manual Dexterity^ MD 1 + MD 2 + MD 3 — Component score

Aiming & Catching^ A&C 1 + A&C 2 — Component score

Balance^ Bal 1 + Bal 2 + Bal 3 — Component score

*In each case sum the item standard scores.

Total Test Score Sum of 8 item **standard** scores:

*For Posting Coins and One-Leg Balance, look up standard score for each limb, add these and divide by 2. If the result is above 10, round up; if below 10, round down.

Total Test Score	Standard Score	Percentile Rank

*For confidence intervals, see Examiner's Manual p139 (Chapter 7)

1

APPENDIX B – CLINICAL OBSERVATIONS OF GROSS MOTOR ITEMS

GROSS MOTOR RECORD FORM

NAME		DATE		DATE OF BIRTH		AGE	

		3 Able, poor control, not well integrated	4 Good, slight inconsistencies and lacks some integration	5 Very good control, good integration, executes with ease

	THERAPIST:						COMMENTS
1.	Kneel-walking forwards	1	2	3	4	5	
	Kneel-walking backwards	1	2	3	4	5	
2.	Heel-toe walk: on line	1	2	3	4	5	
	Heel-toe walk: off line	1	2	3	4	5	
3.	Hopping: • Right	1	2	3	4	5	
	• Left	1	2	3	4	5	
4.	Galloping	1	2	3	4	5	
5.	Skipping	1	2	3	4	5	
6.	Ipsilateral leg slap	1	2	3	4	5	
7.	Contra-lateral leg slap	1	2	3	4	5	
8.	Ipsilateral stride jump	1	2	3	4	5	
9.	Star jumps	1	2	3	4	5	
10.	Long jump	1	2	3	4	5	
11.	Jumping sequence	1	2	3	4	5	
12.	Throw and catch 20cm ball • Throw • Catch direct • Catch displaced	 1 1 1	 2 2 2	 3 3 3	 4 4 4	 5 5 5	
13.	Bounce and catch 20cm ball	1	2	3	4	5	
14.	Throw and catch tennis ball • Throw • Catch direct • Catch displaced	 1 1 1	 2 2 2	 3 3 3	 4 4 4	 5 5 5	
15.	Bounce and catch tennis ball • Both hands • One hand	 1 1	 2 2	 3 3	 4 4	 5 5	
16.	Bounce 43cm therapy ball • One hand • Alternate hands • Both hands	 1 1 1	 2 2 2	 3 3 3	 4 4 4	 5 5 5	
17.	Kick and trap a ball	1	2	3	4	5	
18.	Jump into consecutive squares	1	2	3	4	5	

APPENDIX C – AGE TRENDS OF DEVELOPMENT

Clinical Observations of Gross Motor Items

Galloping - Administration

e:
nths

Administer: 4 years 0 months - 6 years 11 months
Omit: 7 years 0 months - 10 years 11

scription:

To test the ability and quality of galloping, weightbearing and pushing off with alternate feet, keeping one leg in front of the other.

ipment:

4m distance

cedure:

Watch me gallop like a horse. E demonstrates gallop pattern (as demonstrated on video). **Now you do the same. Start there and stop here.** Indicate. If necessary: **Watch me first, then you do it.**

servations:

do difficulties in execution arise from underlying postural, vestibular proprioceptive, bilateral integration and sequencing; or from motor planning deficits?
skill and quality of co-ordination;
smoothness, rhythm, sequencing;
associated movements;
ability to learn a new task;
ability to gallop forwards and not sideways.

4. Galloping - Age Trends

Galloping is a precursor to skipping. The primitive form of the gallop can be observed as early as 3 years of age, as the child periodically introduces a slight leaping step into their run. By 5 years most children have developed a well co-ordinated gallop pattern wit controlled arm movements and a momentary suspension in the air. The true gallop pattern seems emerge around 4 years. (Williams)

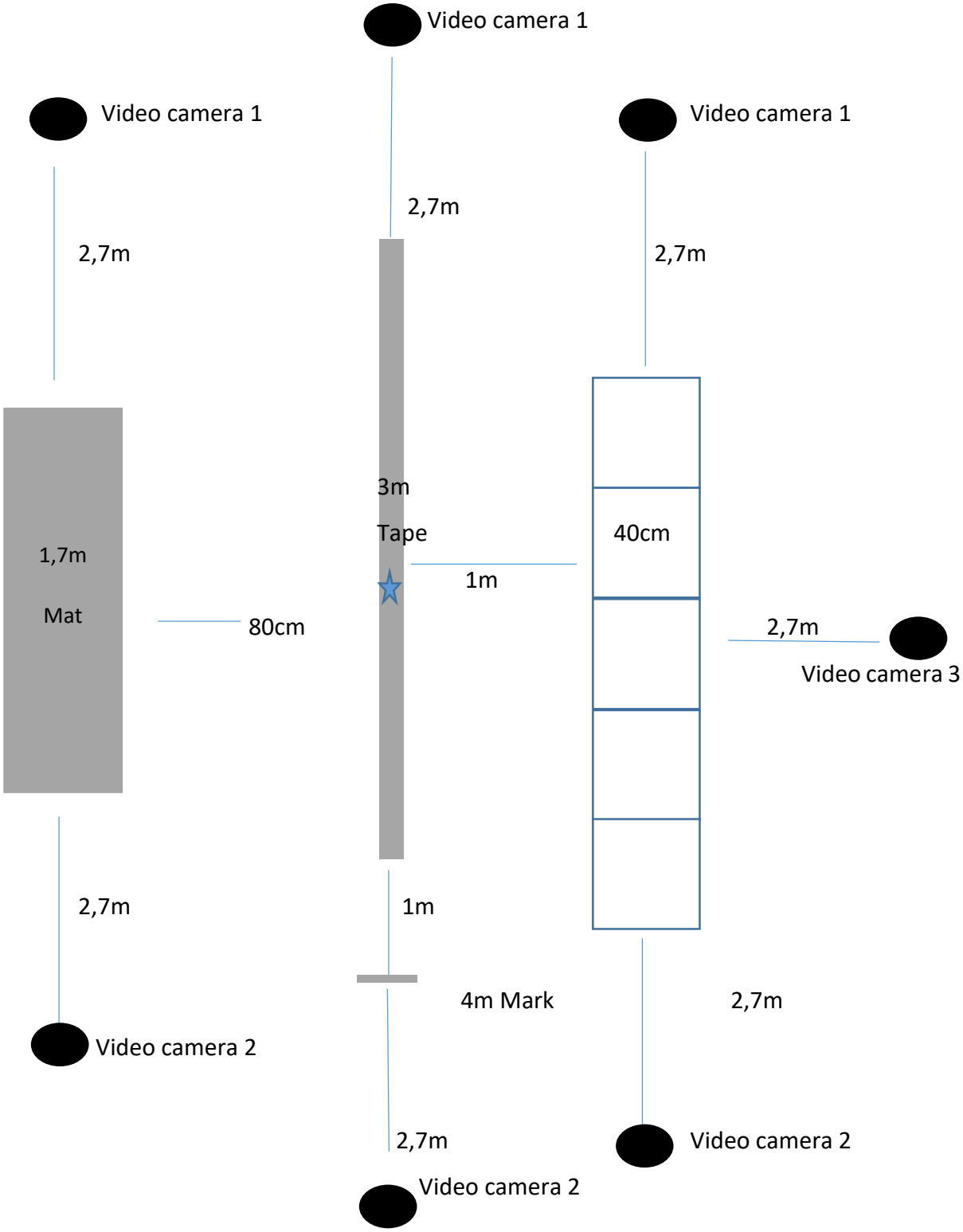
4 years 0 months - 4 years 5 months	Some gallop sideways, others change leading leg. Excessive arm action.
4 years 6 months - 4 years 11 months	Noticeably better than previous age band. Starting to integrate. Excessive arm action still evident. One leg consistently in front.
5 years 0 months - 5 years 5 months	Able to execute but movement lacks fluidity. Lower limb movement pattern varied, dependent on previous exposure. Arm movement apparent.
5 years 6 months - 5 years 11 months	Able to execute and body more upright.
6 years 0 months - 6 years 5 months	Well-controlled.
6 years 6 months - 6 years 11 months	Galloping not used in function, therefore, some become less proficient.
7 Years	Skill continues to decrease, as movement is not functional Child uses cognitive approach. After practise becomes automatic.
8 years - 9 years	Improved dissociation between upper and lower limbs.
10 years - 11 years	Movement performed fluidly
	Stilted movement because patterns foreign at this age, particularly in boys.

APPENDIX D – PROCEDURAL MANUAL

PROCEDURAL MANUAL FOR SETTING UP AND VIDEO RECORDING THE CLINICAL OBSERVATIONS FOR GROSS MOTOR SKILLS

SET-UP:

Diagram 1:



Equipment needed:

- 3m Tape
- Markers for tape
- 20cm ball
- Tennis ball
- 43cm ball
- One mat (approximately 1,75m)
- Marked squares 40cm x 40cm
- 3 Video cameras
- 3 Tripod stands for cameras
- Measuring tape
- Marker for mid position on 3m Tape

Set-up procedure:

- The room must be laid out prior to testing and recording.
- Use the diagram above for setting up the room.
- Put the side camera (camera 3) in place. It needs to be in the middle on the side.
- Mark the blocks 2,7m from the side camera. The middle point of the middle block needs to be in line with the camera.
- Measure 1m from the blocks and put the 3m tape in place. The middle of the tape must be in line with the middle point of the middle block.
- Put a star on the middle point of the 3m tape.
- Measure 1m from the end of the 3m tape and put a 4m marker in place.
- Measure 80cm from the tape and put the mat in place. The middle of the mat must be in line with the middle point of the 3m tape.

Setting up the front and back cameras (camera 1 and camera 2):

- Measure 2,7m from the mat, to the front, and place a marker on the floor for the camera (camera 2). Do the same for the back camera (camera 1).
- Measure 2,7m from the line, to the back, and place a marker on the floor for the camera (camera 2).

- Measure 2.7m from the 4m mark, to the front, and place a marker on the floor for the camera (camera 1).
- Measure 80cm to the left/right of the front camera marker in line with the 4m mark and 3m tape, place another marker for the front camera on the floor.
- Measure 2,7m from the blocks, to the front, and place a marker on the floor for the camera (camera 2). Do the same for the back camera (camera 1).
- The side camera stays in one position throughout the recordings.
- The front camera needs to move 3 times and the back camera needs to move twice throughout the recordings.
- All 3 cameras need to be zoomed out throughout the sessions
- Start the recordings on all 3 videos and then introduce yourself to the child and explain the goal of the session.

Procedure for recording the COGMI:

- When the child walks in to the room, the researcher will introduce herself to the child and explain the purpose of the day/session as follows:

Hello my name is Marlise. I am an Occupational Therapist and I am doing a special study on gross motor development.

Would you mind if I do some gross motor activities with you in order to see how good you are in playing ball and skipping for example? You can ask questions if you do not understand anything. The activities will help me to understand why some children might struggle with gross motor activities.

I will first show you exactly what I want you to do and then I will give you an opportunity to also perform the actions.

You do not have to be in the study if you do not want to be. If you decide that you don't want to be in the study after we begin, that's okay too. Nobody will be angry or upset. I have discussed the study with your parents and you should talk to them about it too.

Thank you for helping me. Let us start.

- Ask the child to take of his/her shoes and socks as well as any jackets or jerseys. The child must be suitably dressed to optimise the observations of the researcher. Bare feet are essential in order for the researcher to observe arches and weight-bearing.
- Explain to the child that the session will be recorded on video in order for the researcher to look at the child's performance again later.
- Explain to the child that it will be necessary to move some of the cameras during the session.
- Before moving a camera the researcher needs to inform the child that the camera will be moved, in order for the child to always know what is going on in the session. It is important that the child does not feel overwhelmed by not knowing what to expect next.
- Explain thoroughly to the child, as well as demonstrating to the child what he/she needs to do.

  Make use of the instructions stipulated in the manual of the COGMI. It is important that the child understands clearly what is expected of him/her.
- Cameras 1 and 2 are dead centre focused on the mat when administering item 1.
- Move camera 1 and 2 after administering item 1.
- Camera 1 and 2 are dead centre focused on the 3m tape when administrating items 2 – 11.
- The researcher must move off centre when demonstrating to the child during item 6 – 9, in order for camera 2 to record the front profile of the child when performing the items.
- The child needs to jumps over the mid-position of the 3m tape when administrating item 10.
- Move camera 2, 80cm off centre to record the front profile of the child when administrating items 12 – 17.
- When administrating item 18, cameras 1 and 2 are dead centre focused on the blocks/squares.

GROSS MOTOR RECORD FORM

NAME		DATE		DATE OF BIRTH		AGE	

1 Totally unable even after practising	2 Makes an attempt but achieves only part, even after practising	3 Able, poor control, not well integrated	4 Good, slight inconsistencies and lacks some integration	5 Very good control, good integration, executes with ease

THERAPIST:							COMMENTS
1.	Kneel-walking forwards	1	2	3	4	5	
	Kneel-walking backwards	1	2	3	4	5	
2.	Heel-toe walk: on line	1	2	3	4	5	
	~~Heel-toe walk: off line~~	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	
3.	Hopping: • Right • Left	 1 1	 2 2	 3 3	 4 4	 5 5	
4.	Galloping	1	2	3	4	5	
5.	Skipping	1	2	3	4	5	
6.	Ipsilateral leg slap	1	2	3	4	5	
7.	Contra-lateral leg slap	1	2	3	4	5	
8.	Ipsilateral stride jump	1	2	3	4	5	
9.	Star jumps	1	2	3	4	5	
10.	Long jump	1	2	3	4	5	
11.	Jumping ~~sequence~~ across room	1	2	3	4	5	
12.	Throw and catch 20cm ball • Throw • Catch direct • Catch displaced	 1 1 1	 2 2 2	 3 3 3	 4 4 4	 5 5 5	
13.	Bounce and catch 20cm ball	1	2	3	4	5	
14.	Throw and catch tennis ball • Throw • Catch direct • Catch displaced	 1 1 1	 2 2 2	 3 3 3	 4 4 4	 5 5 5	
15.	Bounce and catch tennis ball • Both hands • One hand	 1 1	 2 2	 3 3	 4 4	 5 5	
16.	Bounce 43cm therapy ball • One hand • Alternate hands • Both hands	 1 1 1	 2 2 2	 3 3 3	 4 4 4	 5 5 5	
17.	Kick and trap a ball	1	2	3	4	5	
18.	Jump into consecutive squares	1	2	3	4	5	

Move Camera

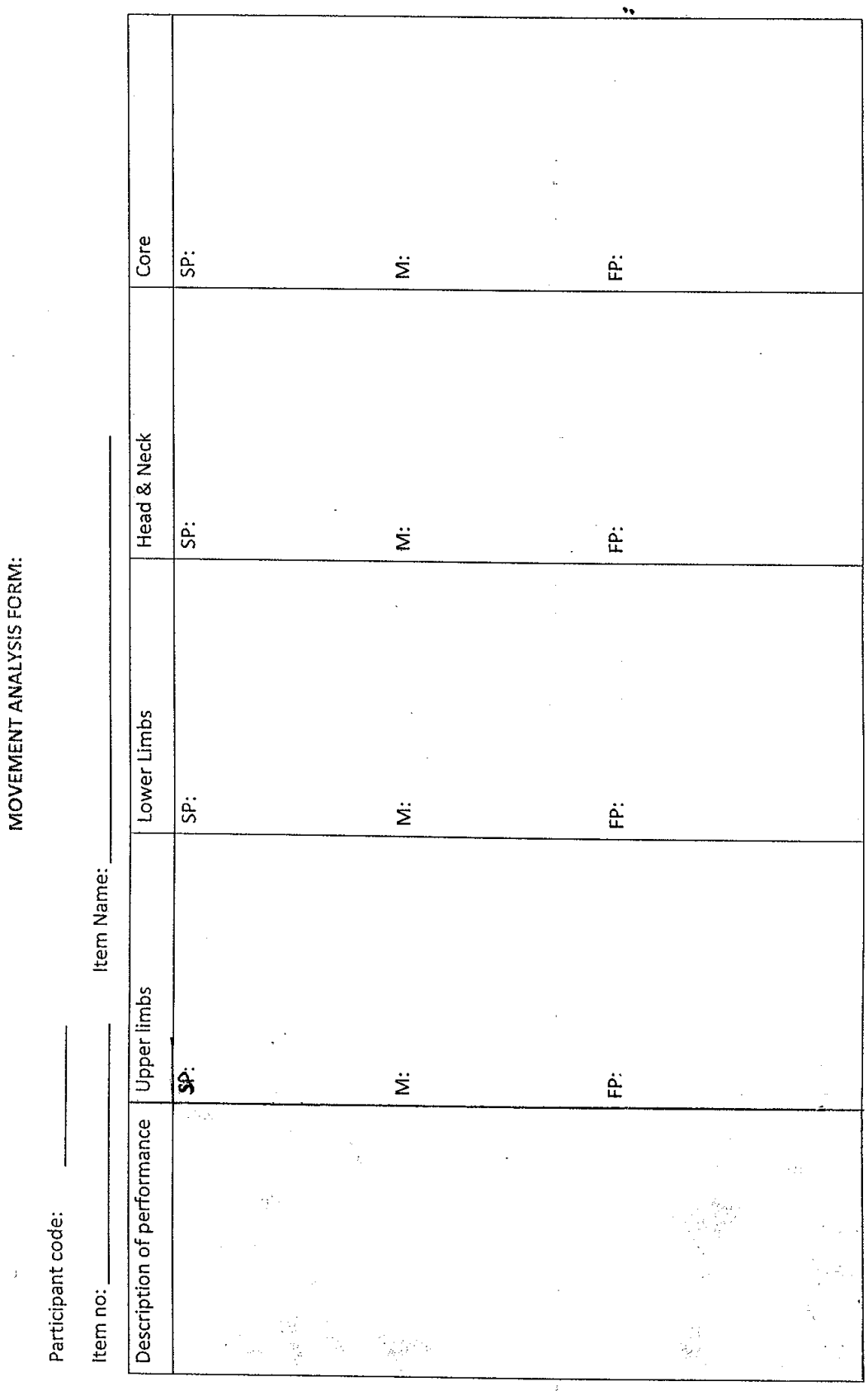
Evaluater off - centre

Front Camera off - centre

Front Camera off - centre

Move Camera

APPENDIX E – MOVEMENT ANALYSIS FORM



MOVEMENT ANALYSIS FORM:

Participant code: _____

Item no: _____ Item Name: _____

Description of performance	Upper limbs	Lower Limbs	Head & Neck	Core
	SP:	SP:	SP:	SP:
	M:	M:	M:	M:
	FP:	FP:	FP:	FP:

Key:

SP = Starting Position

M = Movement

FP = Finishing Position

Parameters to keep in mind:

Mobility

Stability

Strength

Endurance

Co-ordination

Posture

Sequence of joints

Control & stopping

Motion initiation

Speed

Direction

Balance

Equilibrium

Excessive movement

Voluntary & involuntary movement

Intentional & non-intentional movement

Patterned or isolated movement

APPENDIX F – PARENT INFORMATION SHEET

Dear Parent / Guardian

I am Marlise Jordaan, an Occupational Therapy Masters student at the University of the Witwatersrand. As part of my studies I need to conduct a research project. The title of the research project is: **Development of a checklist for use with the "Clinical Observations of Gross Motor Items" tool to refine observations of dysfunction".**

This study aims to identify posture and movement characteristics of children with no, mild and severe motor coordination dysfunction and to develop a checklist of these characteristics which will accompany the Clinical Observations of Gross Motor Items (SAISI 2002) that allows for standardised scoring.

The Clinical Observations of Gross Motor Items (SAISI 2002) is the evaluation tool used most often by South African occupational therapists to evaluate a child's gross motor functioning and is a set of highly structured formal observations of the child completing set of specific movement tasks. This tool indicates to the therapist whether a child struggles to perform gross motor skills consistent with his or her age.

The administration and scoring criteria of this tool has not been standardised and that implies that one therapist will administer and score these observations differently to other therapists. Newly graduated occupational therapists for example do not have the same clinical experience of that of a therapist practicing for a couple of years will have and they may score and interpret the child's actions differently than the more experienced therapists or vice versa. Thus I will aim to standardise the scoring method of this tool in order to improve the usefulness of this tool.

I am inviting children within the age group of 5 years 0 months and 5 years 11 months to participate in this study, and am asking for your permission to include your child in this research study.

Your child will be required to participate in two movement assessments that will happen on different days. The Movement ABC-2 is a standardised test to evaluate gross motor functioning. Your child's results from this test will be used to decide which group your child falls into, namely no, mild or severe motor coordination difficulties. Children with any diagnosed medical conditions such as genetic disorders, central nervous system lesions, muscular dystrophy or amputation, which can influence their motor coordination should not participate in the study. Children who have had

previous intervention such as Occupational Therapy or Physiotherapy regarding motor coordination problems should also not participate in the study. Please note that if the group your child falls into is already full, you will not need to do the second assessment. I will still provide feedback on your child's performance on the Movement ABC-2, and if necessary, I will provide you with a referral to an occupational therapist of physiotherapist.

The second assessment is the Clinical Observations of Gross Motor Items. Your child will be required to spend 45 minutes to one hour with the researcher during one school morning performing the items on the Clinical Observation of Gross Motor Items. This consists of movement activities such as hopping, skipping, jumping, catching and throwing a ball. The evaluation will happen at your child's school on a day and at a time that is convenient for you and the school. This evaluation will be video recorded for analysis by myself. The video recordings will be kept locked up and only I, my supervisor and one expert on the field of movement analysis will have access to these videos. After six years (the required time records from research procedures must be kept by law), the video recordings will be destroyed.

There are no risks when involved in this study. Your child's participation in this study is entirely voluntary and participants (both parents and children) will be given the opportunity to withdraw from the study at any time without any consequences. I will ask your child's permission before doing any of the assessments and if you child does not want to participate, I will not continue with the assessment. I will make an appointment to give you feedback on your child's specific performance. If necessary, I will provide you with a referral to an occupational therapist or physiotherapist. You are also welcome to request feedback on the overall outcomes of the study. If you do not wish to participate in this study you may do so with no harmful consequences.

Every effort will be made to keep your child's personal information confidential. No information will be disclosed to your child's teacher, school or anybody else without your written permission. However, absolute confidentiality cannot be guaranteed and personal information may be disclosed if required by law.

Should you allow your child to participate in this study, please complete the attached consent form. Please contact me on the details below should you have any questions.

Yours sincerely,

_____

Marlise Jordaan

Occupational Therapist 082 884 3894

APPENDIX G – LETTER OF INFORMED CONSENT

INFORMED CONSENT FORM

CONFIDENTIAL

Development of a checklist for use with the "Clinical Observations of Gross Motor Items" tool to refine observations of dysfunction

Dear Parent(s) / Guardian(s),

In order to obtain your written permission I request you to complete the following:

I, _____ (parent / guardian), of _____ (name of child and date of birth), hereby give my permission that my child may participate in this research project.

As parent / guardian I understand that neither my child nor myself will receive any remuneration for participating in this study. I also do understand that my child will be video recorded when participating in this study. I understand that the results of this study will be used for statistical calculations and that my child will not be identified in any way.

☐ I give my permission that my child's video recordings may be used for educational purposes as well (please only tick this box if you agree to this statement).

Parent / Legal guardian:

Signature: _____

Date & time: _____

CONTACT DETAILS

Researcher: Marlise Jordaan 082 884 3894

Supervisor: Lyndsay Koch 011 717 3701

APPENDIX H – VERBAL / WRITTEN ASSENT FORM

VERBAL ASSENT FORM

CONFIDENTIAL

Development of a checklist for use with the "Clinical Observations of Gross Motor Items" tool to refine observations of dysfunction

The purpose of the study has been explained fully to the participant and he/she understands what is required of them. He/she understands that participation is voluntary and that he/she is free to withdraw from the research at any time without being penalised in any way. The video recordings will remain confidential and the information gathered will be used for research purpose only.

Participant:

Printed name: _____

Signature/Mark: _____

Date & time: _____

Researcher:

Printed name: _____

Signature/Mark: _____

Date & time: _____

Witness:

Printed name: _____

Signature/Mark: _____

Date & time: _____

APPENDIX I – STANDARD INTRODUCTION

Hello my name is Marlise. I am an Occupational Therapist and I am doing a special study on gross motor development.

Would you mind if I do some gross motor activities with you in order to see how good you are in playing ball and skipping for example? You can ask questions if you do not understand anything. The activities will help me to understand why some children might find some movements difficult.

I will first show you exactly what I want you to do and then I will give you an opportunity to also perform the actions.

You do not have to be in the study if you do not want to be. If you decide that you don't want to be in the study after we begin, that's okay too. Nobody will be angry or upset. I have discussed the study with your parents and you should talk to them about it too.

If you decide you want to be in the study, please come and stand behind this line.

Thank you

APPENDIX J – FULL SET OF ITEMS WITH THEIR OBSERVATION CLASSIFICATION

		1	2	3	4	5
Item 1 - Backwards	**Movement**	Support with hand (one or both) on mat or legs going down	Support with hand (one or both) on mat or legs standing up	Elbow flexion	Leg abduction	Abduction of arms > 45˚
		Only one arm swing reciprocal	Flexion / extension at wrist, fixate shoulders, supination / pronation, flexion / extension of fingers	Going down to mat: Flexion at knees and hips	Both arms swing reciprocal	No half-kneeling when going down
		Shoulder retraction	Abduction of arms > 45˚	Standing up: Flexion at hips and knees		Trunk rotation
		Associated movements / chin tuck	Both arms swing reciprocal	Wide base of support / Knees beyond shoulders		Flexion at toes
		Lordosis	Leg abduction	Neck rotation		Neck rotation
		No trunk rotation	Flexion at toes	Lateral flexion of trunk		Head in midline/eyes focus on horizon
		Hip rotation	Going down to mat: Half-kneeling			Eyes focus on floor
		Feet eversion	Eyes focus on floor			Wide base of support / Knees beyond shoulders
		Posterior / Anterior pelvic tilt	Going down to mat: Trunk flexion to horizontal level			Lordosis
		Trunk flexion / extension	Standing up: Trunk flexion			Trunk flexion / extension
		Head in midline / eyes focus on horizon	Trunk rotation			

		1	2	3	4	5
Item 1 - Forwards	Movement	Support with hand (one or both) on mat or legs - going down	Support with hand (one or both) on mat or legs - standing up	Eyes focus on floor	Going down - Flexion at knees	Trunk flexion to horizontal level
		Only one arm swing reciprocal	Elbows in flexion	Eyes focus on horizon	Going down - Flexion at hips	Lordosis
		Flexion/Extension at wrist, fixate shoulders, supination/pronation, flexion/extension of fingers	Both arms swing reciprocal	Trunk flexion	Both arms swing reciprocal	Trunk upright while walking
		Abduction of arms > 45	Shoulders parallel with floor	Head in midline	Eyes focus on floor	Trunk forward flexion
		Walking: Abduction of arms < 45	Leg abduction		No half-kneeling	
		Neutral position of arms	Flexion at toes		Half-kneeling	
		Flexion at hips - Standing up			Head in midline	
		Flexion at knees - Standing up				
		Wide base of support				
		Slide legs over mat				
		Hip rotation				
		No half-kneeling				
		Half-kneeling				
		Going down to mat: Tilt trunk forward / Flexion to horizontal level				
		Anterior pelvic tilt				
		Lordosis				
		Lateral flexion				
		Trunk upright while walking				

		Eyes focus to a side				
		1	**2**	**3**	**4**	**5**
ITEM 2	**Movement**	Abduction of arms < 45˚	Abduction of arms > 45˚	Flexion / Extension at wrist	Lateral flexion of the trunk	Flexion / Extension at wrist
		Neutral position of arms	Elbows in flexion	Supination / pronation	Abduction of arms > 45˚	Supination / pronation
		Flexion at toes	Flexion at knees	Flexion / Extension at fingers	Elbows in flexion	Flexion / Extension at fingers
		Neck rotation	Eyes focus on floor	Shoulders elevated	Feet eversion / inversion	Shoulders elevated
		Head righting reactions	Associated movements / chin tuck	Heel-toe touching (more than 5 steps)		Heel-toe touching (more than 5 steps)
		Eye shift between floor and horizon	Trunk flexion / extension	Feet eversion / inversion		Flexion at knees
		Anterior pelvic tilt		Lateral flexion of the trunk		Trunk flexion / extension
		1	**2**	**3**	**4**	**5**
ITEM 3 - Hopping L	**Movement**	Elevation / Depression of one or both shoulders		Elbows in flexion	Elbows in flexion	Swing leg held in front of body
		Swinging leg - pump back & forth		Swing leg held in front of body	Flexion at knees (swinging leg)	Lateral flexion of trunk
		Dorsiflexion at ankle		Flexion at hips (swinging leg)	Flexion at knee of hopping leg when landing	
		Flexion / extension at toes		Need to give support steps	Swinging leg - pump back & forth	
		Eyes focus on floor		Flexion at knee of hopping leg when landing	Flexion at hips (swinging leg)	
				Head in midline	Flexion / Extension of trunk	
				Eye shift between floor and horizon		

		1	2	3	4	5
ITEM 3 - Hopping R	Movement	Flexion/Extension at wrist, fixate shoulders, supination/pronation, flexion/extension of fingers	Swing leg held in front of body	Flexion at hips (swinging leg)	Elbows in flexion	
		Shoulders parallel to floor		Lateral flexion of core	Arms swing up & out in winging action	
		Swinging leg - pump back & forth			Flexion at hips (swinging leg)	
		Trunk rotation			Flexion at knees (swinging leg)	
					Flexion at knee of hopping leg when landing	
Item 4		1	2	3	4	5
	Movement	Flexion / Extension at wrist	One or both arms hanging relaxed next to body	Flexion at knees	Flexion at knees	Back leg land just behind front leg
		Shoulders parallel to floor	Back leg land just behind front leg	Leading leg stay in front	Elbow flexion / extension	Rhythmical movements
		Elevation / Depression of one or both shoulders	Extended back leg	Flexion / Extension of trunk	Leading leg stay in front	Lordosis
		Arms swing up & out in winging action	Stay close to surface			
		Semi-opposition - one arm pump back & forth				
		Supination / pronation				
		Flexion / extension of fingers				
		Hips face front				
		Back leg land besides front leg				

		Land on heel of leading leg / land flat foot				
		Head in midline				
		Eyes focus on floor				
		Neck extension / flexion				
		Associated movements/chin tuck				
		Eye shift between floor and horizon				
		Lateral flexion of trunk				
		Trunk rotation				

		1	2	3	4	5
Item 5	Movement	Abduction of arms	Arms pump up & down in front / next of body (move in unison) (bilateral assist)	Head in midline	Elbow flexion one / both arms	Land / take-off on ball of feet
		Shoulders parallel to floor	Hip rotation	Flexion at trunk	Flexion at knees	Flexion at trunk
		High vertical component at arms	Land on flat foot		Head in midline	
		Semi-opposition - arms swing next to body	Eye shift between floor and horizon		Flexion at hips	
		Not rhythmical movements				
		Flexion at hips				
		Stay close to surface				
		Land / take-off on ball of feet				
		Head righting reactions				
		Eyes focus on horizon				
		Straight back				
		Lordosis				
		Lateral flexion of trunk				
		Trunk rotation				
		Protruding belly				

Item 6	**Movement**	**1**	**2**	**3**	**4**	**5**
		Slap legs with force	Does not slap each lift with ipsi-lateral arm or as needed (does not touch legs)	Shoulders parallel to floor	Slap leg with open relaxed hands	
		Slap leg while already down / going down	Eye shift between legs and horizon	Controlled actions (arms and legs work together)	Elbow flexion one / both arms	
		Eyes focus on horizon	Straight back		Controlled actions (arms and legs work together)	
		Rotation of head	Trunk flexion when leg is slapped		Flexion at knees (lifting leg)	
		Lordosis			Flexion at hips (lifting leg)	
		Protruding belly				
Item 7		**1**	**2**	**3**	**4**	**5**
	Movement	Slap legs with force	Does not slap each lift with contra-lateral arm or as needed (does not touch legs)	Slap leg with open relaxed hands	Slap leg with open relaxed hands	
		Supporting leg knee flexion	Shoulders parallel to floor	Trunk flexion / extension when leg is slapped	Elbow flexion one / both arms	
		Eyes focus on legs	Slap leg while already down / going down		Flexion at knees (lifting leg)	
		Neck extension / flexion	Controlled actions (arms and legs work together)		Flexion at hips (lifting leg)	
		Associated movements/chin tuck	Hip rotation (lifting leg)			
		Straight up trunk	Eyes focus on horizon			
		Lateral flexion	Eye shift between legs and horizon			

		Trunk rotation				
Item 8	**Movement**	**1**	**2**	**3**	**4**	**5**
		Shoulders parallel to floor	Arms swing back and forth uncontrolled	Elbow flexion one / both arms	Flexion at knees	
		Arms swing back and forth with legs (ipsilateral)	Flexion at hips	Trunk flexion / extension	Flexion/Extension at wrist, fixate shoulders, supination/pronation, flexion/extension of fingers	
		Elevation / Depression of one or both shoulders	Trunk rotation		Elbow flexion one / both arms	
		Arms swing forward with leg > horizon				
		Unable to perform this item (does not jump, arms just swing back and forth, arms & legs does not work together)				
		Not fluent movement				
		Abduction of legs				
		Kicking / running action				
		Knees extend fully when in air				
		Legs cross-over (adduction) when landing				
		Hip rotation				
		Eyes focus on horizon				
		Eyes focus on floor				
		Neck extension / flexion				
		Associated movements/chin tuck				

		Eye shift between floor and horizon				
		Neck rotation				
		Straight back				
		Lordosis				
		Lateral flexion of trunk				
		1	**2**	**3**	**4**	**5**
Item 9	**Movement**	Abduction of arms with legs <horizon	Flexion / Extension at wrist	Arms just fall back to body, uncontrolled (adduction)	Flexion at knees	Arms just fall back to body, uncontrolled (adduction)
		Shoulders parallel to floor	Elbow flexion one / both arms	Arms and legs do not work together	Trunk flexion / extension	Abduction of arms with legs <horizon
		Controlled actions arms and legs abduct and adduct together when needed	Abduction of arms with legs >horizon	Head in midline	Flexion at hips	Adduction of arms with control
		Extension at elbows	Shoulders elevated	Eyes focus on horizon		Head in midline
		Movement of arms not fluent / Not rhythmical	Supination / pronation	Trunk flexion / extension		Eyes focus on horizon
		Adduction of arms with control	Flexion / extension of fingers			
		Not rhythmical / slow movements of legs	Abduction - land - adduction - land - pattern			
		Flexion at hips				
		Rhythmical movements / controlled actions				
		Abduction - land - pattern NO adduction				
		Both legs extend when in air				
		Neck extension / flexion				

		Eye shift between floor and horizon				
		Straight back				
		1	**2**	**3**	**4**	**5**
Item 10	**Movement**	Arms swing forward & beyond shoulder height when jumping	Arms swing forward - before take-off	Arms swing forward & up to shoulder height when jumping	Flexion at knees - before take-off	Arms swing forward & up to shoulder height when jumping
		Landing - Arms swing to the front	Elbow flexion one / both arms	Landing - flexion at knees	Head in midline	Full extension of hips
		Extension at elbows	Arms swing backwards before take-off	Head in midline	Elbow flexion / extension	Full extension of knees
		Full extension of hips	Does not go into full extension - when in air		Landing - flexion at knees	
		Full extension of knees	Flexion at hips - before take-off		Flexion at hips - before take-off	
		Full extension of toes	Eye shift between floor and horizon		Tilt trunk forward before take-off (trunk flexion)	
		Landing - Flexion at hips	Tilt trunk forward before take-off (trunk flexion)			
		Feet not together in air / take-off / when landing	Full extension of trunk when in air			
		Give 1-3 steps after landing to retain balance	Trunk stay tilted forward from take-off to landing(not fully extend)			
		Eyes focus on horizon				
		Neck extension				
		Landing - trunk tilts forward (flexion of trunk)				
		Tilt trunk forward (flexion) before take-off to horizontal level				
		1	**2**	**3**	**4**	**5**

Item 11	**Movement**	Shoulders parallel to floor	Arms pump up & down in front / next of body	Abduction of arms	Elbow flexion one / both arms	Abduction of arms
		Flexion / extension at wrist	Arms swing up & out in winging action	Elbow flexion one / both arms	Flexion at knees	One or both arms hanging relaxed next to body
		Flexion / extension at fingers	Feet lift simultaneously	One or both arms hanging relaxed next to body	Flexion at hips	Feet lift simultaneously
		Shoulders elevated	Feet land simultaneously	Flexion at hips	Tilt trunk backwards (extension) and forwards (flexion)	Feet land simultaneously
		Supination / pronation	Neck extension / flexion			Lordosis
		Walking action for 2+ hops	Eye shift between floor and horizon			
		Lands on ball of feet				
		Extension at knees & hips in air				
		Head in midline				
		Eyes focus on floor				
		Eyes focus on horizon				
		Lateral flexion at trunk				
		1	**2**	**3**	**4**	**5**
Item 17	**Movement**	Arms swing forward (one / both)	One or both arms swing backwards to horizontal level	Flexion / Extension at wrist	Elbow flexion one / both arms	Does not trap each ball successfully
		One or both arms hanging relaxed next to body	Hip rotation	Abduction of arms	Flexion at knees	
		Elevation / Depression of one or both shoulders	Head in midline	Trap ball with hands (less than 2 attempts)	Flexion at hips	
		Arms (one / both) swing up & out in winging action	Associated movements/chin tuck	Shoulders elevated / depressed	Kicking = knee extend	

		Dorsiflexion visible	Eyes follow the ball	Supination / pronation	Head in midline	
		Kicking = knee extend		Flexion / Extension at fingers	Eyes follow the ball	
		Give extra steps to maintain balance		Flexion at hips	Lateral flexion at trunk	
		Trunk rotation		Does not trap each ball successfully	Abduction of arms	

		1	2	3	4	5
Item 18	Movement	Shoulders parallel to floor	Abduction of arms	Arms pump up & down in front / next of body	Elbow flexion one / both arms	Abduction of arms
		Flexion / extension at wrist	Arms swing up & out in winging action	Landing = flexion at knees	Flexion at knees	
		Flexion / extension at fingers	Legs extend quickly when in air		Flexion at hips	
		Shoulders elevated	Landing = flexion at hips		Landing = flexion at knees	
		Supination / pronation	Knees does not fully extend in air		Landing = flexion at hips	
		Neutral position of arms	Land 2 feet together		Head in midline	
		Arms pump back & forth			Eyes focus on floor	
		Ankles extend when in air (plantar flexion)			Tilt trunk forwards (flexion)	
		Touch lines of squares when landing			Arms swing up & out in winging action	
		Feet does not go together (take-off and land)				
		Associated movements/chin tuck				
		Lordosis				

STATISTICAL TABLES: CHI-SQUARES:

		Observation	Chi-squares	df	p
Item 1 - Backwards	Movement: Upper limbs	Support with hand (one or both) on mat or legs	19.53	1	<0.0001
		One arms swing reciprocal	19.53	1	<0.0001
		Shoulder retraction	7.9	1	0.0049
		Flexion / extension at wrist, fixate shoulders, supination / pronation, flexion / extension of fingers	20.42	1	<0.0001
		Both arms swing reciprocal	24.41	1	<0.0001
	Movement: Lower limbs	Hip rotation	18.02	1	<0.0001
		Feet eversion	22.52	1	<0.0001
		Posterior / Anterior pelvic tilt	22.25	1	<0.0001
		Leg abduction	11.03	1	0.0009
		Flexion at hips / knees	4.1	1	0.0429
		Wide base of support / knees beyond shoulder width	5.27	1	0.0217
		No half-kneeling when going down	34.06	1	<0.0001
	Movement: Head and neck	Head in midline / Eyes focus on horizon	5.27	1	0.0217

	Movement: Core	No trunk rotation	22.52	1	<0.0001
		Trunk flexion to horizontal level	7.27	1	0.007
		Lordosis	15.82	1	<0.0001
		Trunk flexion / extension	24.19	1	<0.0001

		Observation	**Chi-squares**	**df**	**P**
Item 1- Forward	**Movement: Upper limbs**	Support with hand (one or both) on mat or legs	36.95	1	<0.0001
		Abduction of arms >45˚	9.12	1	0.0025
		One arms swing reciprocal	7.9	1	0.0049
		One / both arms in neutral position	7.9	1	0.0049
		Shoulders parallel to floor	24.41	1	<0.0001
		Both arms swing reciprocal	11.03	1	0.0009
	Movement: Lower limbs	Flexion at hips / knees	34.29	1	<0.0001
		Half kneeling - standing up	41.09	1	<0.0001
		No half-kneeling when going down	79.89	1	<0.0001
		Slide legs over mat	37.16	1	<0.0001
		Half kneeling - going down	37.16	1	<0.0001
	Movement: Head and neck	Neck rotation	22.52	1	<0.0001
		Eyes focus on floor	7.9	1	0.0049

	Movement: Core	Anterior pelvic tilt	9.01	1	0.0027
		Trunk flexion to horizontal level	24.19	1	<0.0001
		Lordosis	24.19	1	<0.0001
		Trunk flexion / extension	9.12	1	0.0025
		Straight back	5.27	1	0.0217

		Observation	**Chi-squares**	**df**	**P**
Item 2	**Movement: Upper limbs**	Elbow flexion	17.12	1	<0.0001
		Abduction of arms >45˚	5.46	1	0.0195
		Flexion / extension at wrist and/or fingers; supination / pronation; Shoulders elevated	12.29	1	0.0005
	Movement: Lower limbs	Heel-toe touching more than 5 steps	6.44	1	0.0112
	Movement: Head and neck	Associated movements: chin tuck	7.25	1	0.0071
	Movement: Core	Anterior pelvic tilt	13.75	1	0.0002

		Observation	Chi-squares	df	P
Item 3 - Hopping L	Movement: Upper limbs	Elevation / Depression of shoulders	19.53	1	<0.0001
		Elbow flexion	19.53	1	<0.0001
	Movement: Lower limbs	Swing leg - pump back & forth	79.89	1	<0.0001
		Dorsiflexion at ankle	22.52	1	<0.0001
		Flexion / Extension at toes	22.52	1	<0.0001
		Swing leg held in front of body	5.27	1	0.0217
		Need to give support steps	62.73	1	<0.0001
		Flexion at knee of hopping leg when landing	7.9	1	0.0049
		Flexion at knee (swing leg)	Infinity	1	<0.0001
	Movement: Head and neck	Eyes shift between horizon and floor	18.02	1	<0.0001
	Movement: Core	Lateral flexion at trunk	24.38	1	<0.0001

		Observation	Chi-squares	df	P
Item 3 - Hopping R	Movement: Upper limbs	Shoulders parallel to floor	31.62	1	<0.0001
		Flexion / extension at fingers, flexion / extension at wrists, supination / pronation, shoulders elevated / depressed	31.62	1	<0.0001
		Elbow flexion	12.98	1	0.0003
		Arms swing up & out in winging action	31.62	1	<0.0001
	Movement: Lower limbs	Swing leg - pump back & forth	33.62	1	<0.0001
		Swing leg held in front of body	14.87	1	0.0001
		Flexion at hips (swing leg)	31.62	1	<0.0001
		Flexion at knee of hopping leg when landing	5.33	1	0.021
		Flexion at knee (swing leg)	Infinity	1	<0.0001
	Movement: Head and neck				
	Movement: Core	Trunk rotation	14.94	1	0.0001

		Observation	Chi-squares	df	p
Item 4	Movement: Upper limbs	Shoulders parallel to floor	7.9	1	0.0049
		Elevated / Depressed shoulders	19.53	1	<0.0001
		Semi-opposition = One arm pump back and forth	4.1	1	0.0429
	Movement: Lower limbs	Hips face front	34.29	1	<0.0001
		Back leg land besides front leg	4.1	1	0.0429
		Extended back leg	53.39	1	<0.0001
		Stay close to surface	7.27	1	0.007
		Flexion at knees	22.52	1	<0.0001
		Rhythmical movements	64.03		<0.0001
	Movement: Head and neck	Neck extension / flexion	7.9	1	0.0049
		Associated movements: chin tuck	22.52	1	<0.0001
	Movement: Core	Trunk lateral flexion	9.01	1	0.0027
		Trunk flexion / extension	24.19	1	<0.0001
		Lordosis	45.12	1	<0.0001

		Observation	Chi-squares	df	p
Item 5	**Movement: Upper limbs**	Abduction of arms	4.1	1	0.0429
		High vertical component at arms	22.52	1	<0.0001
		Elbow flexion	5.33	1	0.0429
	Movement: Lower limbs	Non-rhythmical movements	37.16	1	<0.0001
		Flexion at hips	41.09	1	<0.0001
		Land & take-off on ball of feet	15.82	1	<0.0001
		Hip rotation	7.27	1	0.007
		Flexion at knees	Infinity	1	<0.0001
	Movement: Head and neck	Head righting reactions	7.9	1	0.0049
		Eyes focus on horizon	9.01	1	0.0027
		Eyes shift between floor & horizon	13.83	1	0.0002
		Head in midline	7.9	1	0.0049
	Movement: Core	Straight back	9.12	1	0.0025
		Trunk rotation	22.52	1	<0.0001
		Protruding belly	22.52	1	<0.0001

		Observation	Chi-squares	df	p
Item 6	Movement: Upper limbs	Shoulders parallel to floor	46.31	1	<0.0001
		Doesn't slap each lift with ipsi-lateral arm / doesn't touch leg	20.42	1	<0.0001
		Slap leg with open / relaxed hand	9.62	1	0.0019
		Elbow flexion	Infinity	1	<0.0001
		Controlled actions (arms & legs go together)	19.53	1	<0.0001
	Movement: Lower limbs	Flexion at knees (lifting)	Infinity	1	<0.0001
		Controlled actions (arms & legs go together)	19.53	1	<0.0001
		Flexion at hips (lifting)	Infinity	1	<0.0001
	Movement: Head and neck	Neck rotation	22.52	1	<0.0001
		Eyes focus on horizon	9.01	1	0.0027
	Movement: Core				

		Observation	Chi-squares	df	p
Item 7	**Movement: Upper limbs**	Slap legs with force	7.9	1	0.0049
		Shoulders parallel to floor	11.03	1	0.0009
		Slap legs while already down / going down	13.83	1	0.0009
		Slap leg with open / relaxed hand	22.52	1	<0.0001
	Movement: Lower limbs	Controlled actions (arms & legs go together)	4.23	1	0.0397
		Flexion at hips (lifting)	Infinity	1	<0.0001
		Flexion at knees (lifting)	Infinity	1	<0.0001
	Movement: Head and neck	Eyes focus on legs	34.29	1	<0.0001
		Associated movements / Chin tuck	22.52	1	<0.0001
		Eyes focus on horizon	53.88	1	<0.0001
	Movement: Core	Trunk flexion and extension	24.19	1	<0.0001

		Observation	Chi-squares	df	p
Item 8	Movement: Upper limbs	Shoulders parallel to floor	17.67	1	<0.0001
		Arms swing back & forth with legs (Ipsilateral)	24.51	1	<0.0001
		Elevation / Depression of shoulders	22.52	1	<0.0001
		Arms swing forward with leg > horizon	17.67	1	<0.0001
		Unable to perform this action	17.67	1	<0.0001
		Flexion / extension at wrist; shoulder elevation / depression; supination / pronation of forearm; flexion / extension of fingers	4.29	1	0.0383
		Arms swing back & forth (uncontrolled)	8.98	1	0.0027
	Movement: Lower limbs	Not fluent movement	22.52	1	<0.0001
		Abduction of legs	6.63	1	0.01
		Knees extend fully when in air	5.36	1	0.0206
		Legs cross-over (adduction) when landing	6.63	1	0.01
		Hip rotation	6.63	1	0.01
		Flexion at knees	Infinity	1	<0.0001
	Movement: Head and neck	Associated movements / chin tuck	17.67	1	<0.0001
		Neck rotation	6.63	1	0.01
	Movement: Core	Straight back	22.52	1	<0.0001
		Lateral flexion at trunk	7.92	1	0.0049

		Trunk rotation	31.83	1	<0.0001
		Trunk flexion and extension	7.92	1	0.0049

		Observation	Chi-squares	df	p
Item 9	**Movement: Upper limbs**	Shoulders parallel to floor	7.9	1	0.0049
		Controlled actions / arms & legs abduct and adduct together when needed	9.12	1	0.0025
		Extension at elbows	9.12	1	0.0025
		Elbow flexion	7.27	1	0.007
		Flexion / Extension at wrist / fingers; Supination / pronation; Shoulders elevated	24.41	1	<0.0001
		Arms & legs do not work together	18.02	1	<0.0001
		Abduction of arms with legs (<horizon)	10.69	1	0.0011
		Adduction of arms with control	15.82	1	<0.0001
	Movement: Lower limbs	Flexion at hips	62.73	1	<0.0001
		Rhythmical movements / controlled actions	4.1	1	0.0429
		Abduction - land - adduction - land -pattern	4.23	1	0.0397
		Flexion at knees	9.62	1	0.0019
	Movement: Head and neck	Head in midline	15.82	1	<0.0001

	Movement: Core	Straight back	22.52	1	<0.0001
		Trunk flexion and extension	7.9	1	0.0049

		Observation	**Chi-squares**	**df**	**p**
Item 10	**Movement: Upper limbs**	Elbow flexion	20.42	1	<0.0001
		Arms swing backwards before take-off	4.23	1	0.0397
		Arms swing forward & up to shoulder height when jumping	5.27	1	0.0217
	Movement: Lower limbs	Full extension of hips	10.69	1	0.0011
		Full extension of knees	10.69	1	0.0011
		Landing - Flexion at hips	9.01	1	0.0027
		Feet not together when take-off, in air or landing	22.52	1	<0.0001
		Give 1-3 steps after landing to retain balance	19.53	1	<0.0001
		Flexion at hips before take-off	24.41	1	<0.0001
		Landing - Flexion at knees	9.01	1	0.0027
		Flexion at knees before take-off	5.33	1	0.021
	Movement: Head and neck	Neck extension	9.01	1	0.0027
		Head in midline	7.9	1	0.0049

	Movement: Core	Trunk flexion before take-off to horizontal level	37.16	1	<0.0001
		Landing - Trunk flexion	10.69	1	0.0011
		Trunk flexion before take-off	36.95	1	<0.0001
		Full extension of trunk when in air	7.27	1	0.007
		Trunk stay flexed from take-off to landing	20.42	1	<0.0001

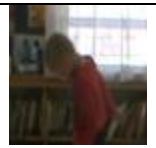
		Observation	**Chi-squares**	**df**	**p**
Item 11	**Movement: Upper limbs**	Arms pump up & down in front / next to body	11.03	1	0.0009
		Arms swing up & out (winging action)	13.83	1	0.0002
		Abduction of arms	5.27		0.0217
		Arms neutral position	5.27	1	0.0217
		Elbow flexion	7.9	1	0.0049
	Movement: Lower limbs	Walking action for 2 and more hops	37.16	1	<0.0001
		Lands on ball of feet	19.53	1	<0.0001
		Extension at hips / knees in air	34.29	1	<0.0001
		Hip flexion	19.53	1	<0.0001
		Flexion at knees	9.62	1	0.0019
	Movement: Head and neck	Eyes focus on horizon	18.02	1	<0.0001
		Head in midline	18.02	1	<0.0001
		Eyes focus on floor	22.52	1	<0.0001
		Neck flexion / extension	75.02	1	<0.0001
		Eyes shift between horizon and floor	4.23	1	0.0397
	Movement: Core	Extension / flexion at trunk	5.33	1	0.021
		Lordosis	34.06	1	<0.0001

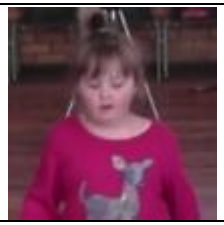
		Trunk flexion before take-off	36.95	1	<0.0001

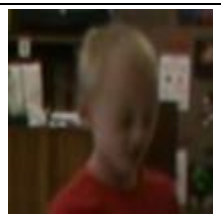
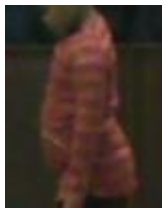
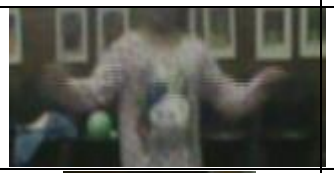
		Observation	Chi-squares	df	p
Item 17	Movement: Upper limbs	Arms swing up & out (winging action)	7.9	1	0.0049
		Arms swing backwards to horizontal level	11.03	1	0.0009
		Elevation / Depression of shoulders	19.53	1	<0.0001
		Abduction of arms	9.01	1	0.0027
		Trap ball with hands (< 2 attempts)	18.02	1	<0.0001
		Flexion / Extension at finger/wrist; supination/pronation	19.45	1	<0.0001
		Elbow flexion	7.9	1	0.0049
	Movement: Lower limbs	Dorsiflexion	22.52	1	<0.0001
		Kicking - knee extend	74.67	1	<0.0001
		Hip rotation	4.23	1	0.0397
		Hip flexion	22.52	1	<0.0001
		Flexion at knees	Infinity	1	<0.0001
	Movement: Head and neck	Head in midline	34.11	1	<0.0001
		Associated movements: chin tuck	11.03	1	0.0009
		Eyes follow the ball	19.53	1	<0.0001
	Movement: Core	Lateral flexion at trunk	9.62	1	0.0019

		Observation	Chi-squares	df	p
Item 18	**Movement: Upper limbs**	Arms pump back & forth	9.01	1	0.0027
		Neutral position of arms	22.52	1	<0.0001
		Arms swing up & out (winging)	36.95	1	<0.0001
		Arms pump up & down in front / behind body	41.09	1	<0.0001
	Movement: Lower limbs	Feet not together landing / take-off	22.52	1	<0.0001
		Land 2 feet together	13.83	1	0.0002
		Knees doesn't fully extend in air	4.23	1	0.0397
		Flexion at hips	9.62	1	0.0019
		Flexion at knees	Infinity	1	<0.0001
		Flexion at knees	Infinity	1	<0.0001
		Landing - flexion at knees	22.52	1	<0.0001
		Landing - Flexion at hips	53.88	1	<0.0001
	Movement: Head and neck	Associated movements - chin tuck	7.9	1	0.0049
		Eyes focus on floor	21.28	1	<0.0001
		Head in midline	9.62	1	0.0019
	Movement: Core	Flexion at trunk	Infinity	1	<0.0001

APPENDIX K – CHECKLIST

List of General Observations															
Description	**Scale**	**Photo**	**Item 1**	**Item 2**	**Item 3**	**Item 4**	**Item 5**	**Item 6**	**Item 7**	**Item 8**	**Item 9**	**Item 10**	**Item 11**	**Item 17**	**Item 18**
Elevated shoulder	1														
Elbow extension	1														
Associated movements (chin-tuck)	1														
Flexion/Extension of neck	1	 													
Eyes shift between horizon and floor	2	No photo – This is a movement													

Trunk flexion/extension	3														
Lateral flexion at trunk	3														
Supination/Pronation of forearm	3														
Head in midline / Neutral position	4														

Eyes focus on floor	4														
Eyes focus on horizon	4														
Lordosis	4														
Straight back	4														
Elbow flexion	4														
Abduction of arms	4														

Flexion/Extension at knees	4														
Flexion/Extension at hips	4														

Item Specific Checklist

		1	2	3	4	5
Item 1 – Backwards	**Movement**	Support with hand (one or both) on mat or legs	Flexion / extension at wrist, fixate shoulders, flexion / extension of fingers	Standing up: Flexion at hips and knees	Leg abduction	No half-kneeling when going down
		Only one arm swing reciprocal	Going down to mat: Trunk flexion to horizontal level	Going down to mat: flexion at knees and hips	Both arms swing reciprocal	
		Shoulder retraction	Standing up; Trunk flexion	Wide base of support. Knees beyond shoulders		
		No trunk rotation				
		Hip rotation				
		Feet eversion				
		Posterior / Anterior pelvic tilt				
		1	**2**	**3**	**4**	**5**
Item 1 - Forward	**Movement**	Only one arm swing reciprocal	Support with hand (one or both) on mat or legs - Standing up	Trunk flexion standing up	No half-kneeling - going down	
		Neutral position of arms	Shoulders parallel with floor		Half-kneeling - standing up	
		Slide legs over mat			Both arms swing reciprocal	
		Anterior pelvic tilt			No half-kneeling	
		Eyes focus to a side			Half-kneeling	
					Going down to mat: Tilt trunk forward / Flexion to horizontal level	

		1	2	3	4	5
Item 2	Movement	Anterior pelvic tilt		Flexion / Extension at wrist		Heel-toe touching (more than 5 steps)
				Flexion / Extension at fingers		
		1	2	3	4	5
Hopping L Item 3 -	Movement	Flexion / extension at toes		Swing leg held in front of body	Swinging leg - pump back & forth	
		Dorsiflexion at ankle		Need to give support steps		
		1	2	3	4	5
Item 3 - Hopping R	Movement	Flexion/Extension at wrist, fixate shoulders, flexion/extension of fingers	Swing leg held in front of body		Swinging leg - pump back & forth	
		Shoulders parallel to floor			Arms swing up & out in winging action	
		Trunk rotation				
		1	2	3	4	5
Item 4	Movement	Semi-opposition - one arm pump back & forth			Back leg land besides front leg	Rhythmical movements
		Shoulders parallel to floor			Hips face front	
					Stay close to surface	
		1	2	3	4	5
Item 5	Movement	Protruding belly	Eye shift between floor and horizon			Land / take-off on ball of feet
		High vertical component at arms	Hip rotation			
		Not rhythmical movements				
		Head righting reactions				
		Trunk rotation				

		1	2	3	4	5
Item 6	Movement	Rotation of neck	Does not slap each lift with ipsi-lateral arm or as needed (does not touch legs)	Shoulders parallel to floor	Slap leg with open relaxed hands	
					Controlled actions (arms and legs work together)	
		1	**2**	**3**	**4**	**5**
Item 7	Movement	Slap legs with force	Slap leg while already down / going down		Slap leg with open relaxed hands	
		Eyes focus on legs	Shoulders parallel to floor		Controlled actions (arms and legs work together)	
		1	**2**	**3**	**4**	**5**
Item 8	Movement	Shoulders parallel to floor	Arms swing back and forth uncontrolled		Arms swing back and forth with legs (ipsilateral)	
		Unable to perform this item (does not jump, arms just swing back and forth, arms & legs does not work together)	Trunk rotation		Flexion/Extension at wrist, fixate shoulders, flexion/extension of fingers	
		Arms swing forward with leg > horizon				
		Neck rotation				
		Not fluent movement				
		Abduction of legs				
		Legs cross-over (adduction) when landing				
		Hip rotation				
		1	**2**	**3**	**4**	**5**
Item 9	Movement	Shoulders parallel to floor	Flexion / Extension at wrist	Arms and legs do not work together	Abduction - land - adduction - land - pattern	Abduction of arms with legs <horizon
			Flexion / extension of fingers			Adduction of arms with control
						Rhythmical movements / controlled actions

		1	**2**	**3**	**4**	**5**
Item 10	**Movement**	Give 1-3 steps after landing to retain balance	Arms swing forward before take-off		Tilt trunk forward before take-off (trunk flexion)	
		Feet not together in air / take-off / when landing	Trunk stay tilted forward from take-off to landing(not fully extend)		Landing - trunk tilts forward (flexion of trunk)	
		Tilt trunk forward (flexion) before take-off to horizontal level			Full extension of trunk when in air	
					Arms swing forward & up to shoulder height when jumping	
		1	**2**	**3**	**4**	**5**
Item 11	**Movement**	Walking action for 2+ hops	Arms pump up & down in front / next of body	One or both arms hanging relaxed next to body	Arms swing up & out in winging action	
		Lands on ball of feet				
		1	**2**	**3**	**4**	**5**
Item 17	**Movement**	Arms (one / both) swing up & out in winging action	One or both arms swing backwards to horizontal level	Flexion / Extension at wrist	Eyes follow the ball	
		Dorsi-flexi visible	Hip rotation	Trap ball with hands (less than 2 attempts)		
				Flexion / Extension at fingers		
		1	**2**	**3**	**4**	**5**
Item 18	**Movement**	Neutral position of arms	Knees does not fully extend in air	Arms pump up & down in front / next of body	Land 2 feet together	
		Arms pump back & forth			Arms swing up & out in winging action	
		Feet does not go together (take-off and land)				

APPENDIX L – ETHICS CLEARANCE CERTIFICATE

R14/49 Ms LM Jordaan

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M130929

NAME: (Principal Investigator)	Ms LM Jordaan
DEPARTMENT:	Occupational Therapy Orkney and Klerksdorp Area, North-West Province
PROJECT TITLE:	Development of a Checklist for the use with the "Clinical Observations of Gross Motor Items" tool to Refine Observations of Dysfunction
DATE CONSIDERED:	27/09/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Lyndsay Koch
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	13/11/2013

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.**

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX M – INFORMATION LETTER TO DEPARTMENT OF EDUCATION NORTH WEST PROVINCE

University
of the Witwatersrand,
Johannesburg

Department of Occupational Therapy

7 York Road, Parktown, 2193 South Africa • Telegrams 'Witsmed' • Tel: +27-11-717-3701 • Fax: +27-11-717-3709
e-mail: Leilane.Mackay@wits.ac.za

Information letter to Department of Education North West Province

Dear Sir/Madam,

I am Marlise Jordaan, an Occupational Therapy Masters student at the University of the Witwatersrand, executing a research project. The title of the research project is: **A study to improve validity and reliability of the Clinical Observations of Gross Motor Items in Gr R children in the South African context.**

This study aims to identify salient behavioural characteristics of children with no, mild and severe motor coordination dysfunction and to develop a checklist of these characteristics which will accompany the Clinical Observations of Gross Motor Items (SAISI 2002) that allows for standardised scoring.

The Clinical Observations of Gross Motor Items are a set of highly structured formal observations which involves a set of specific tasks, reflexes and signs of nervous system integrity. One of the things that this tool indicates to the therapist is whether a child presents with low muscle tone and whether a child struggles to perform neurological and gross motor skills according to his or her age.

The Clinical Observations of Gross Motor Items (SAISI 2002) is the evaluation tool that is most commonly used by South African occupational therapists to evaluate a child gross motor functioning.

The administration and scoring criteria of this tool has not been standardised and that implies that one therapist will administer and score these observations different to the other therapist. Therefore it is clear that therapists have to rely on their expertise which also differs between therapists. Newly graduated occupational therapists for example do not have the same clinical experience of that of a therapist practicing for a couple of years will have and they may score and interpret the child's actions differently than the more experienced therapists or vice versa.

The researcher therefore feels that there is a need to standardise the observational tools. This study will improve the validity and reliability of the Clinical Observations of Gross Motor Items in order to create a more universal picture of each child that is evaluated. This will help and is extremely important for the planning of client specific treatment plans. This will be useful and will be a significant contribution to occupational therapy practice in South Africa.

The researcher will chose specific children within the age group of 5 years 0 months and 5 years 11 months to use in this study. The Movement ABC-2, a standardised test to evaluate gross motor functioning, will be used to prove what the child's level of functioning is in terms of

motor coordination so that they can be divided into 3 groups, consisting of children with no, mild or severe motor coordination dysfunction. Children with any diagnosable medical conditions such as genetic disorders, central nervous system lesions, muscular dystrophy or amputation, which can influence their motor coordination will be excluded from the study.

I would appreciate it if I could obtain permission to perform the video recordings on some of the grade R children in the North West Province. Schools which will be participating are Noordvaal Laerskool in Orkney, Laerskool Orkney in Orkney and St. Conrad's College in Klerksdorp.

Consent will be obtained from all principals of the above mentioned schools, parents of the students and the students themselves involved in this study, prior to the video recordings.

Ethical clearance has been given for this research project by the University of Witwatersrand HREC. Ethical number: M130929

Please contact me on the details below should you have any questions.
Yours sincerely,

Marlise Jordaan
Occupational Therapist

CONTACT DETAILS

Researcher:	Marlise Jordaan	082 884 3894
Supervisor:	Lyndsay Koch	011 717 3701
Ethical committee:		011 717 1252

APPENDIX N – PERMISSION TO CONDUCT RESEARCH LETTER FROM DEPARTMENT OF EDUCATION NORTH WEST PROVINCE

education
Lefapha la Thuto la Bokone Bophirima
Noord-Wes Departement van Onderwys
North West Department of Education
NORTH WEST PROVINCE

Temane Building
8 O.R. Tambo Street, Potchefstroom
Private Bag X1256,
Potchefstroom 2520
Tel.: (018) 299-8216
Fax: (018) 294-8234
Enquiries: Mr H. Motara
e-mail: hmotara@nwpg.gov.za

DR KENNETH KAUNDA DISTRICT

SENIOR PROFESSIONAL SUPPORT MANAGER

26 February 2014

Ms M Jordaan
Ethical Number: M130929
University of the Witwatersrand
JOHANNESBURG

PERMISSION TO CONDUCT RESEARCH ON "A STUDY TO IMPROVE VALIDITY AND RELIABILITY OF THE CLINICAL OBSERVATIONS OF GROSS MOTOR ITEMS IN GRADE R CHILDREN IN THE SOUTH AFRICAN CONTEXT" AT LAERSKOOL NOORDVAAL, LAERSKOOL ORKNEY AND ST CONRAD'S COLLEGE, KLERKSDORP AREA OFFICE - DR KENNETH KAUNDA DISTRICT

The above matter refers.

Permission is hereby granted to you to conduct your research at Laerskool Noordvaal, Laerskool Orkney and St Conrad's College, Matlosana Area Office - Dr Kenneth Kaunda District under the following provisions:

- **the activity you undertake at the schools should not tamper with the normal process of learning and teaching;**
- **you inform the principals of your identified school of your impending visit and activity;**
- **you provide my office with a report in respect of your findings from the research; and**
- **you obtain prior permission from this office before availing your findings for public or media consumption.**

Wishing you well in your endeavour.

Thanking you

MR H MOTARA
DISTRICT DIRECTOR
DR KENNETH KAUNDA DISTRICT

cc *Mr S S Mogotsi – Area Manager: Matlosana*

APPENDIX O – PRINCIPAL PERMISSION LETTERS

Principal Permission letter

Dear Sir

I am Marlise Jordaan, an Occupational Therapy Masters student at the University of the Witwatersrand. As part of my studies I need to conduct a research project. The title of the research project is: **Development of a checklist for use with the "Clinical Observations of Gross Motor Items" tool to refine observations of dysfunction".**

This study aims to identify salient behavioural characteristics of children with no, mild and severe motor coordination dysfunction and to develop a checklist of these characteristics which will accompany the Clinical Observations of Gross Motor Items (SAISI 2002) that allows for standardised scoring.

The Clinical Observations of Gross Motor Items (SAISI 2002) is the evaluation tool used most often by South African occupational therapists to evaluate a child's gross motor functioning.

The Clinical Observations of Gross Motor Items are a set of highly structured formal observations of the child completing set of specific movement tasks. This tool indicates to the therapist whether a child struggles to perform gross motor skills consistent with his or her age.

The administration and scoring criteria of this tool has not been standardised and that implies that one therapist will administer and score these observations differently to other therapists. Newly graduated occupational therapists for example do not have the same clinical experience of that of a therapist practicing for a couple of years will have and they may score and interpret the child's actions differently than the more experienced therapists or vice versa. Thus the researcher aims to standardize the scoring method of this tool in order to improve the usefulness of this tool.

The researcher will invite specific children within the age group of 5 years 0 months and 5 years 11 months to participate in this study. The Movement ABC-2, a standardised test to evaluate gross motor functioning, will be used to divide participants into 3 groups, consisting of children with no, mild or severe motor coordination difficulties. Children with any diagnosable medical conditions such as genetic disorders, central nervous system lesions, muscular dystrophy or amputation, which can influence their motor coordination will be excluded from the study. Children will be required to spend 45 minutes to one hour with the researcher during one school morning performing the items on the Clinical Observation of Gross Motor Items. This consists of movement activities such as hopping, skipping, jumping, catching and throwing a ball. If possible, the evaluation will happen at the school on a day

and at a time that is convenient for parents and the school. This evaluation will be video recorded for analysis by the researcher. The video recordings will be kept locked up and only the researcher will have access to these videos. After six years (the required time records from research procedures must be kept by law), the video recordings will be destroyed.

I would appreciate it if I could obtain permission to perform the video recordings on some of your grade R children.

Consent will be obtained from all parents of the students and the students themselves involved in this study, prior to the video recordings.

Please contact me on the details below should you have any questions.

Yours sincerely,

Marlise Jordaan
Occupational Therapist
Cell: 082 884 3894

BROTHERS OF CHARITY
TEL 018 462 9023
SAINT CONRAD'S COLLEGE
P.O. BOX 525
KLERKSDORP 2570
ELM STREET KLERKSDORP

Laerskool Goudkop

Floralaan, Adamayview, Klerksdorp
Posbus 1185, Klerksdorp 2570
Tel: 018 468 1038/9 • Faks: 018 468 4681 / 086 600 5806
e-pos: goudkop@global.co.za

16 Maart 2015

WIE DIT MAG AANGAAN

Insake: Marlise Jordaan

Hiermee gee ek, mnr. J.J.S. Zevenster, hoof van Laerskool Goudkop toestemming dat me. Marlise Jordaan, gr. R-leerlinge mag gebruik vir haar studies.

Ons wens haar sterkte toe met haar studies.

Goudkopgroete

Mnr. J.J.S. Zevenster
Hoof

Arnold & Wessels Drukkery, Klerksdorp Tel. 018 4624591

Laerskool Orkney

TELEFOONNOMMERS:
Tel: (018) 473-1234
Fax: (018) 473-4562

POSADRES:
Privaatsak X6
ORKNEY 2620

18 Maart 2014

VIR WIE DIT MAG AANGAAN

Hiermee bevestig ondergetekende hoof van Laerskool Orkney dat Me Marlise Jordaan (Arbeidsterapeut) die nodige toestemming het om haar navorsingsprojek by die skool te mag doen.

Groete

F. RUST
HOOF

LAERSKOOL ORKNEY
PRIVAATSAK X6
ORKNEY
2620
TEL: 018 473 1234
FAX: 018 473 4562
18 MAR 2014
ONDERWYSDEPARTEMENT

LAERSKOOL NOORDVAAL PRIMARY

Privaatsak X14
ORKNEY
2620

Byronlaan
ORKNEY
Tel: (018) 473-4144/5; 473-4033
Faks: (018) 473-4083

9 September 2013

Good Morning Marlize

Thank you for you letter on the research that you are planning.

Permission to conduct the requested research is granted on the following conditions:

1. You must obtain written permission from each parent whose child you want to involve.

2. The results must only be accessable to you.

3. You must be prepared to interview parents with questions afterwards, as the school is not involved in the actual research,

Please contact my office to finalize dates and times.

Yours sincerely

R.D.J. VAN WYK
PRINCIPAL
RDJVW\he