Evaluation of a Conductive Education intervention for children with profound multiple disabilities in a residential children's home in South Africa

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Abstract

Conductive Education (CE) is a holistic educational system developed by András Petö, which aims on teaching and motivating the child with cerebral palsy (CP) to participate and function in society. The current research attempts to map out the effect of CE on motor abilities of the children in a residential children's home in South Africa, and the variables that possibly moderate the effectiveness of the program. Different from previous studies, in which progression is mostly measured by means of general functional motor skills, small individual goals, adjusted to the specific developmental level of the participants, are used and evaluated by observations during daily activities to determine the motor progression of the child. This contributes to more purposeful practicing and it makes it possible to also observe small progressions. The results show a significant progression with respect to the goals. This effect is moderated by the integrity of the intervention and the initial fine motor level of the child. In a subsample of children who participated in simultaneously executed programs aimed to increase social responsiveness and cognitive play next to CE, the level of social responsiveness as well as the level of cognitive play have no influence on the effectiveness of CE. Although a particular degree of fine motor functioning appears to be an important predictor for progression and the degree of progression, it is shown that CE is an effective intervention to positively stimulate the motor development of children with severe multiple disabilities.

Introduction

The most prevalent cause of physical disability in childhood is cerebral palsy (CP) (Beckung, Carlsson, Carlsdotter & Uvebrant, 2007). CP describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, perception, cognition, communication, and behavior, by epilepsy, and by secondary musculoskeletal problems (Rosenbaum, Paneth, Leviton, Goldstein & Bax, 2006). Children with neurodevelopmental disorders often show impairments over a wide range of functions. Therefore, there should not be an exclusive focus on motor deficits, and a multidimensional approach is required for the treatment of children and adults with CP. For this reason, CP is conceptualized as one group of neurodevelopmental disorders which involve numerous developing functions (Rosenbaum et al., 2006).

Worldwide, there are numerous methods developed to treat children with CP. One of these methods is Conductive Education (CE), a holistic educational system developed by András Petö, which aims on teaching and motivating the child with CP to participate and function in society (Hari & Tillemans, 1984; Sutton, 1988; Cotton, 1994). It focuses on developing physical, social, intellectual and psychological aspects of individuals with neuromotor disorders to allow them to become more functional participants in daily activities (Wright, Boschen & Jutai, 2005). The multimodality of CE perfectly suits the multidimensional approach of CP, that was advocated by Rosenbaum et al. (2006). One of the places where CE is implemented is the Sizanani Children's Home in Bronkhorstspruit, South Africa. The home gives care and accommodation to children and young adults with severe and profound neurological disorders.

The current research attempts to map out the effect of CE on motor abilities of the children in Sizanani, and the variables that possibly moderate the effectiveness of the intervention. Firstly, the quality of the intervention is assumed to be an important factor. CE in Sizanani is executed by childcare workers, instead of classified CE conductors. Therefore, a close watch must be kept on guaranteeing the quality of the intervention. This study contributes to this, by evaluating the intensity and integrity of the intervention and determining the influence of these variables on the effectiveness. Secondly, the children's initial motor abilities, as well as their social and cognitive abilities, may influence the efficacy of the intervention. Therefore, the initial level of these abilities is determined to examine for children with which level of motor, social or cognitive functioning CE is most effective. Finally, the participation in two simultaneously executed therapeutic intervention programs may moderate the children's performance in CE. These programs are Multi Sensory Story Telling (MSST), aimed to the increase of social responsiveness, and a Cognitive Play Intervention (CPI) that is focused on

increasing the cognitive play performance of the children. When these programs are positively related or complementary to CE, it may be worthwhile to offer these programs together in the future. Moreover, the outcomes of the study will help the managers of Sizanani to decide which children, i.e. with which level of motor performance, social responsiveness and cognitive play, will benefit the most from which program, or a combination of programs.

Conductive Education

Petö stated that, despite the fact that the brain damage in CP is non-progressive and the primary problem of the child with CP is physical, its effect upon all areas of development may be constantly changing and can result in a generalized dysfunction. This dysfunction is not seen as a feature, but the product of the interaction between the child and his environment (Hari & Tillemans, 1984). According to Petö, it is the result of an interrupted learning process. When the child initially experiences difficulties in adapting to the requirements of an activity, this can result in a decrease in motivation to continue the process of mastering problem-solving skills. As a consequence, the child learns to be dependent. Therefore, Hari (1990, in Fellner, 2008) finds, there is a matter of dysfunction not because the child is incapable of doing something, but because the child does not know how to do it. This dysfunction should be replaced by orthofunction: the individual with CP maximizes self-reliance, initiative and the ability to solve problems in all areas of life in a variety of ways, depending on the abilities of the child and the environmental context (Todd 1990; Sutton 1992; Coles & Zsargo 1998, in Wright et al., 2005).

What is to be derived from this, is that CP can be seen as a learning disorder. As the consequences of CP interrupt the general learning ability of the individual, Petö suggests that by applying an appropriate educational approach, the individual can learn to overcome these consequences. His ultimate goal and major rehabilitative objective was to restore the interrupted learning process while integrating the individual into the educational setting or society where he or she belongs (Fellner, 2008). This can be attained by considering of the following key principles of CE, which are mostly founded on learning theories and extensively described by Fellner (2008).

Firstly, learning is seen as a holistic process in which the individual is perceived as a unified whole. Holistic means that everything in life, the total functioning of the individual, personal development and social organization, is seen as interdependent, interconnected, multileveled, interacting and cohesive (Tatlow, 1980). This corresponds with an experiential approach to learning, which defines learning as the major process of human adaptation involving the whole person, operating in all areas of life (Kolb & Kolb, 2009).

Secondly, the individual is seen as an active participant in the learning process. Petö (in Fellner, 2008) stated that restoring the interrupted learning process is not possible without the

active participation of the individual. Passive exercises or patterns cannot change nor improve the functional stage of the individual. The active role of the learner is distinctive for a constructivist approach to learning (Mayer, 1999).

Continuity is the third principle and is founded in general learning theories. It will reinforce a new skill and it is essential to offer opportunities to use the same skill for many different tasks. CE turns a child's day into a learning situation and this way, provide possibilities for children to practice emerging skills not only in specific learning situations but in the many interconnecting situations of which life consists (Fellner, 2008). By doing so, the new skill becomes meaningful.

Based on Vygotsky's (1986, in Berk, 2006) theory on the self-regulatory functions of private speech, Petö innovated the use of the semantic and rhythmic part of speech as a tool for children with brain damage to plan, intend and regulate their movements for carrying out motor functions (Fellner, 2008). Rhyme, songs, and spoken description based on task analysis is used to promote motor control during functional tasks, direct the child's intention and attention to the task and to promote speech (Bairstow, Cochrane & Hur, 1993, in Bourke-Taylor, O'Shea & Gaebler-Spira, 2007; Reddihough, 1991). It is intended to break down the components of a task and form a cue to assist in the planning, execution, and completion of the motor requirements of a task (Brown, 2004, in Bourke-Taylor et al., 2007).

Finally, the conductor, the group and the type of model are factors that characterize CE. In accordance with problem-based learning (Norman & Schmidt, 1992), the conductor is seen as a facilitator of the learning process, providing the appropriate problem and the environment conducive to solving it, without helping directly (Bourke-Taylor et al., 2007; Hari, 1988, in Fellner, 2008). The latter promotes the earlier stressed active participation. The activities during CE integrate the learning of motor, cognitive, language, social, and other skills. Therefore, CE can be seen as an interdisciplinary model. In Sizanani, it consists of a structured program that is executed in a group as a daily routine and meets the individual goals of each participant in the group. The group in CE refers to a psychological entity that not only provides the environment for learning, but also can be used to facilitate and motivate children (Hari & Akos, 1988, in Fellner, 2008). Moreover, it provides an environment where the social and cognitive skills can be developed and improved. The group principle is based on Vygotsky's (1978, in Berk, 2006) theory that social interaction plays a fundamental role in learning and development.

The Effectiveness of CE

Previous research evaluating the effectiveness of CE shows varying results. Some studies showed a significant improvement of motor functioning (Cottam, McCartney & Cullen, 1985; Bairstow, Cochrane & Rusk, 1991; Sigafoos, Elkins & Kerr, 1993; Catanese, Coleman, King & Reddihough, 1995; Liberty, 2007). Other studies showed no significant effect of CE on motor

functioning (Hur & Cochrane, 1995; Coleman, King & Reddihough, 1995; Hur, 1997; Bochner, Center, Chapparo & Donelly, 1999). Though the methods for measurement and the duration of the intervention period vary, the above mentioned studies are mostly characterized by small sample sizes and/or the lacking of random assignment to the groups. This may account for the diverging results. The results of previous studies on the effectiveness of CE in Sizanani show no significant or just a small effect (Lange & Post, 2008; Mathot & Van Velzen, 2009; Vos & Van Westhrenen, 2010).

A possible explanation for the disappointing results of CE in Sizanani may be found in the instruments that are used. Motor functioning was measured with the Functional Motor Assessment Scale (FMAS) (Vermeer, Kruithof & Van Zoggel, 1995) and the Pediatric Evaluation of Disability Inventory (PEDI) (Haley, Coster, Ludlow, Haltiwanger & Andrellos, 1992). These scales measure general functional motor skills, tested in a standard test situation or derived by means of questionnaires from the childcare workers.

The steps from mastering one skill to another appear to be too big and/or unrealistic for the period of time between the pre-measurement and the post-measurement for this population. Moreover, the mastering of a variety of motor milestones is evaluated, while these are not all practiced during the research period. It is questionable whether an expectation of progression in this case is realistic. Another point is that these scales cover the entire motor development. The children in the CE intervention in Sizanani have severe disabilities and are often deformed, with the consequence that they are mostly far behind in their motor development. A large part of the scale will in most cases not apply to these children, which results in a low variance in scores. This makes the instrument unsuitable for this sample. Furthermore, with the FMAS, the children were tested in a standard test situation. Palmer (1997) showed, however, that children with CP may function better in their daily environment than in standard test situations. When executed in the daily context, the specific action will be more functional and meaningful to the child, which is an important principle of Petö's CE. According to Darrah and Bartlett (1995), movement can never be isolated from the context of the functional task the child is performing. The functional task is believed to organize the motor behavior; therefore, intervention and the measurement of effect must be carried out in a functional context rather than through a series of isolated exercises. The PEDI meets this condition, but it is doubtful to what extent mostly unskilled childcare workers, sometimes obstructed by a language barrier, are capable to come to a reliable evaluation. Additionally, it evaluates the mastering of a variety of motor milestones, while these are not all practiced during CE in this short research period.

Every child in the CE intervention in Sizanani has a specific motor developmental goal. Even though CE is a holistic system and directed to several domains of the child's development, the goals during this research period are mainly focused on improvement in motor development

to become more functional participants in daily activities. The reason for this is to interfere as little as possible with two other programs, which are focused on the social and cognitive development. To determine the effectiveness of the CE intervention in Sizanani, it is studied to what extent the individual goals concerning motor development are achieved during a period of twelve weeks of CE. The Goal Attainment Scale (GAS; Kiresuk & Sherman, 1968) is used to evaluate this achievement by observation, in every individual child. The GAS is an individualized, criterion-referenced measure of change. It involves defining a unique set of goals for each client and describing for each goal, five pre-determined levels of outcomes (Turner-Stokes, 2009). The setting of goals follows the SMART principle, that says that goals should be specific, measurable, attainable, realistic and timely. The goals are formulated by the CE conductors of Sizanani, who have a good perception of the abilities of the children at the start of the research and their development in the past years.

The earlier mentioned problems with respect to previous studies will thus firstly be eliminated by the formulation of small specific goals for every individual child. This way, smaller progressions can be mapped out and the learning process can be more purposeful, since it is clear on what to work and what the child is expected to achieve during a particular period. Secondly, the children will be tested by means of observations in daily activities instead of a standard test situation, to make the task at hand more meaningful to the child. This means e.g. that when a child's goals is to independently move himself to the bathroom, the performance of the child is observed during bathing time. This way, there is a motivation for the child, since he or she actually will take a bath. With these adjustments with respect to the previous studies, it is expected that the individual goals concerning motor development are achieved during a period of twelve weeks between the pretest and posttest.

Quality of the Intervention

For CE to have the desired effect, the intervention should be executed as it is intended. That is to say, with the consideration of the earlier mentioned key principles of CE. It is of extra relevance to examine the quality of the intervention, because of the fact that CE in Sizanani is executed by childcare workers instead of classified conductors. A good quality of the education is assumed to be essential for the effectiveness of the intervention. The quality of the intervention is operationalized through the intensity and integrity of the intervention.

Intensity. Firstly, it is studied to what extent the achievement of motor developmental goals after six and twelve weeks of CE is related to the intensity of the CE intervention. Five days a week in the morning, the children receive one and a half hour of CE. They are divided over four different groups, based on their capabilities and goals, to receive CE from two or three childcare workers. Also during the day, the childcare workers can work with the children on their goals,

while eating, dressing, toileting or participating in work activities. Nevertheless, it is the choice of the childcare workers with whom, how long and how often is practiced. This, and illness of the child, are the most common reasons why the intensity education may differ per child. Learning theories state that continuity, i.e. repetition over several situations, is essential for mastering new skills (Fellner, 2008). Various studies show that the intensity can positively influence the effectiveness of programs aiming to acquire motor skills (Kwakkel et al., 2004; Van Peppen et al., 2004) and of CE in particular (Darrah, Watkins, Chen & Bonin, 2004).

The intensity of the intervention is measured by the frequency and the time in minutes that is spent on practicing the specific actions that are necessary for achieving the goal. It is expected that achieving motor developmental goals after six and twelve weeks of CE is related to the intensity of the intervention.

Integrity. The integrity of the intervention, i.e. executing like it was meant by the developer, in this case Petö, is also expected to be of interest for the effectiveness. Therefore, it is studied to what extent the achievement of motor developmental goals after six and twelve weeks of CE is related to the integrity of the therapy.

Petö's method is operationalized by (1) positive reinforcement, (2) providing optimal help, (3) appropriate positioning, and (4) establishing an active, energetic and motivating atmosphere, which are considered to be the most important criteria for enhancing the motor abilities of the children in Sizanani (Visser, Magyarszeky & Stoffer, 2008). According to the behaviorist operant conditioning, the first criterion, positive reinforcement, will help to strengthen behavior, provides an external motivation, and can therefore positively affect the learning process (Skinner, 1963). While a child is trying to accomplish tasks, the childcare worker is responsible for providing optimal help, the second criterion, of which the importance is endorsed by Vygotsky (1978) with his concept of the zone of proximal development. Too little help will result in the child not being able to accomplish the task and in turn, may reduce the child's motivation and self-esteem (Visser et al., 2010). Too much help, on the other side, will result in passivity, what directly opposes the principle of the child as an active participant in the learning process. The third criterion, appropriate positioning, is in the first place important to prevent further deformities (Visser et al., 2010). Secondly, a child should be put in a position that stimulates him or her to actively participate in the program, that forms a good starting point for executing the desired behavior and possibly expand the skills that are already mastered. The fourth criterion, establishing an active, energetic and motivating atmosphere, refers to a constructivist learning approach. It will support active participation and learns the child that they can have a positive impact on their environment and achieve function. It will also have a positive influence on the group, which may provide the child a source of motivation, a social

context, and challenge for each individual child (Bourke-Taylor et al., 2007). This fits with social learning theories and an environmentalist perspective on learning (Vygotsky, 1978). Where the first criterion, positive reinforcement, refers to the praise or reward as a reaction on the child's performance during practicing, this fourth criterion cover the overall atmosphere during practicing, irrespective of the performances of the children, e.g. by creating positive group dynamics.

The integrity of therapy will be determined by an observation scale that measures the degree of conformity to the above described criteria, while practicing goals. Although CE in Sizanani is executed by childcare workers, it is assumed that, since they are trained, they are acquainted with these norms. Nevertheless, individual differences in quality may exist. It is expected that achieving motor developmental goals after six and twelve weeks of CE is positively related to the integrity of the received CE intervention.

Developmental Level of the Child

Besides intervention characteristics, it is plausible that the achievement of goals through CE is moderated by child factors. The current research will scrutinize motor, social and cognitive aspects of children's development in relation to the achievement of motor developmental goals. From both a practical as well as a theoretical point of view, it is helpful to map out for which specific group of children CE is most effective. Therefore, it is firstly examined to what extent the achievement of motor developmental goals after twelve weeks of intervention is related to the initial level of motor functioning.

Motor Performance. Conductive Education encourages the individual development and operates in accordance with the GAS with individual goals. These goals are set with the consideration of the developmental level and capabilities of the child. This means that children with a higher level also have more challenging goals, with the consequence that the motor level should not be responsible for a difference in the achievement of goals between the participants. Nevertheless, it must be considered that CE already takes place for eight years in Sizanani, which makes it conceivable that particularly children with low potentials already reached their upper limit. In this case there may be more room for improvement for children with less severe motor disabilities. In spite of this, it is expected that the goals are defined in such a way that they fit the individual level of the child. As a consequence, the initial motor level is expected not to moderate the achievement of the motor developmental goals when measured by means of the GAS.

The initial motor level is measured by means of a newly developed Fine and Gross Motor Scale for children with severe multiple disabilities (FGMS). The FGMS is a scale particularly developed for the population of children with severe, multiple disabilities in Sizanani, and is

used to measure the motor functioning at the start of the research. The scale consists of two subscales: a fine and a gross motor subscale. The fine motor subscale is based on grasping patterns as described by Halverson (1931, in Netelenbos, 1998) and Touwen (1977, in Netelenbos, 1998).The gross motor scale is based on various studies on motor development in the first two years of life (Allen & Alexander, 1990, 1997; Frankenburg & Dodds, 1967; Husaini et al., n.d.; Shirly, in Netelenbos 1998; Netelenbos, 1998; Ornitz, Guthrie & Farley, 1977). This scale focuses on the early motor development instead of the entire motor development.

Social Performance. Social interaction plays an important role in CE (Blank, Von Kries, Hesse, & Von Voss, 2008; Ludwig, Leggett & Harstall, 2000). The social aspect is especially used to increase the level of active participation, which is, according to Petö, essential for restoring the interrupted learning process. Social interaction within the group provides a source for facilitation, stimulation, and motivation, which, from a learning theoretical point of view, positively affects the learning process. The same applies to the social interaction with the CE conductors, in this case the childcare workers. Moreover, the functions of the individual can be more easily mobilized in collaboration with others (Fellner, 2008). Considering the prominent role of social interaction in CE, it is conceivable that more sociable children benefit more from this manner of education. To examine the importance of the social performance for the effectiveness of CE, it is studied whether the initial level of social responsiveness at the start of the research period, moderates the achievement of motor goals after twelve weeks of CE. Social responsiveness can be defined as the initiation of behaviors that are shaped in response to the actions of another person and fulfill a social function (Brune & Woodward, 2007).

Various learning theories endorse the importance of social factors for the motor development. Vygotsky (1998) stated that if the child's central nervous system is damaged or not mature enough, the ability to provide interpretable signals to the social environment is limited. As a consequence, the child does not receive the positive reinforcement, which, according to social learning theories, would stimulate the further development. This assumption is confirmed in a study done by Lamb, Garn and Keating (1982) on the relation between young children's social and motor development, since studies on children with severe multiple disabilities like the children in Sizanani where not found. The developmental level of these children, however, is comparable to the early motor and social development of young children. Lamb and colleagues (1982) show that social responsiveness appears to be an important predictor for the score on a motor scale and conclude that infant sociability is a significant predictor of motor performance. It is suggested that sociability affects motor and mental competence, presumably by affecting the amount of formative stimulation and attention children

receive. According to Lamb and colleagues, sociable infants elicit more attention and stimulation from parents and other adults than less sociable infants, which subsequently positively affects the mastering of motor skills.

The social aspects in CE especially serve to attain active participation, one of the principles of Petö's CE, which is seen as essential for restoring the interrupted learning process. Positive reinforcement, stimulation and motivation, operationalisations of this principle, are used to achieve active participation and are important norms for CE in Sizanani. Corresponding Skinner (1963), Vygotsky (1998) and the results of the study from Lamb and colleagues (1982), positive reinforcement motivates the child and stimulates the motor development. Since, according to last named, more sociable infants will elicit more stimulation from their caregivers, it is expected that the achievement of motor developmental goals is moderated by the initial level of social responsiveness. Children with a higher initial level of social responsiveness will elicit more positive reinforcement and other forms of stimulation from the childcare workers during CE, which, as a result, will lead to active participation and positively affect the achievement of their motor developmental goals. Social responsiveness is measured by the social responsiveness scale (SRS; Halfens, 2012) during MSST sessions. It measures the behavioral responses, typical for this population, from the child towards the objects in the story or the storyteller. Twenty three children participated in MSST next to CE, during a period of six weeks.

The effect of MSST. Beside the role of the initial level of social responsiveness, it is studied if the achievement of motor developmental goals is moderated by the degree of progress in social responsiveness that is made during the six weeks of MSST. During MSST, children become aware of their possibilities and environment. They are encouraged to react, manipulate objects and interact with the story teller. This way, the social development and beside, the cognitive and motor development is stimulated (Multiplus, 2008). If a higher social level is achieved during the research period, this seems to indicate that a child still has the potential to learn. The child may take advantage from this progression in other domains of the development, for instance by receiving more positive reinforcement due to interaction or being able to benefit more from the facilitations the group provides. According to Smith and Thelen (2003), even small changes in one or more components of the dynamic system, in this case the social functioning, can lead to a reorganization and to large differences in overall behavior, including motor behavior. It is hypothesized that the achievement of motor developmental goals is moderated by the degree of progression in social responsiveness.

Cognitive Performance. In addition to the level of social development of the child, various theories and studies demonstrate the importance of cognition for the development of motor

behavior. The current research examines whether achievement of motor developmental goals is moderated by the child's initial cognitive level.

The cognitive skills required for motor behavior, are considered to be executive functions. Executive functioning is an umbrella term incorporating all cognitive processes required to perform novel or difficult goal-directed tasks (Hughes & Graham, 2002). With regard to motor functioning, it includes the abilities of goal formation, planning of action sequences, monitoring, inhibition of a particular response, holding a mental representation of the task through working memory, and the effective execution of goal-directed plans (Welsh & Pennington, 1988; Sergeant, 2000; Jurado & Rosselli 2007).

With an action perspective on motor development, Von Hofsten (2004) emphasizes that the planning and prediction of movements is of central importance. This can be illustrated by a study from Claxon, Keen and McCarty (2003), who found that 10-month-old infants picked up a ball differently, depending on whether the intention was to throw it, or to put it in a box. This indicates that understanding the aim of a specific motor task is essential for the planning and execution of a specific sequence of actions required to complete the task. Furthermore, Von Hofsten (2004) stresses the importance of motivational factors in motor development. This motivation can be provided by presenting the child with functional tasks, which involve real, concrete demands and requires the brain to find solutions in the many interconnecting situations of which life exists. In CE, these aspects are assembled into the continuity principle of CE: the repetition of actions over several situations leads to predictability and motivation to execute specific motor behavior. The use of speech in CE to support actions also assist in the planning, execution, and completion of motor tasks (Brown, 2004, in Bourke-Taylor et al., 2007).

Various studies confirm the importance of cognition for motor behavior. Thelen and Smith (1998) found that changes in cognition induce change in locomotor behavior, as more cognitive skilled infants explore and exploit more and different aspects of their spatial environment, change their motor planning, and are able to make rapid adjustments to unexpected events. More specifically, Hartman et al. (2010), Frey and Chow (2006) and Simons et al. (2008) show that children with mild intellectual disabilities score lower on locomotor and object control tests than their typically developing peers. This can be explained by the deficits in mental sequence preparation that are found in children with intellectual disabilities (Kowalski & Sherrill,1992), which corresponds with Von Hofsten's action approach (2004).

In the present study, the cognitive level of the child is operationalized by the cognitive play performance during CPI. The level of cognitive play is measured with the Play Observation Scale (POS; Vos & Van Westrhenen, 2009; Flesch, 2012). This scale is originally based on play behavior distinctive for Piaget's (1962) sensorimotor phase of cognitive development, the basis for further cognitive development, which consists of three successive stage of play: functional

play, constructive play, and dramatic play. The sensorimotor phase corresponds with the cognitive level of the research population. The POS forms an independent cognitive measure that allows cognitive play performance, for which executive functioning is probably also required, to be measured to make a pronouncement about the cognitive abilities of the child. The level of cognitive play is determined on a 7-point scale which assumes more complex play to make a greater appeal on executive functions.

A higher cognitive level will help the child to give meaning to the task at hand and facilitate the planning and sequencing of actions. As such, it is expected that the initial level of performance in CPI will moderate the achievement of motor developmental goals during CE.

The effect of CPI. Beside the initial level of cognitive play, it was studied whether the achievement of motor developmental goals was moderated by the degree of progress in cognitive play during CPI. CPI is a play therapy with toys to foster cognitive play development (Vos & Van Westrhenen, 2009). If a higher cognitive level is reached, the child may attain new insights with regard to the execution of particular motor actions, e.g. he or she now understands what the aim of the action is, and thus may progress also in the motor domain. Therefore, a child that shows progress in the cognitive domain is expected to progress in the motor domain as well.

Methods

Participants

The sample of this research consist of 36 children, of whom 20 boys and 16 girls, from the Sizanani Children's Home in Bronkhorstspruit, South Africa. Even though an actual diagnosis is lacking in many of the cases, it is assumed that most of the children suffer from a type of CP. On the basis of their physical and intellectual abilities and health, the children from Sizanani either go to school or receive CE. Within the CE-group, the children are divided in four groups on the basis of their motor and cognitive abilities and aims. From the 36 children, 31 have one motor developmental goal. Five children have a second goal, for the CE conductors to orientate on their developmental possibilities. Due to this, the number of goals in the statistical analyses is higher than the number of participants. An overview of the goals can be found in appendix 1. Since CE is implemented in Sizanani in 2003, all of the participants received CE before at the start of this research, whether on a continuous or less continuous basis. Next to CE, 16 of these children receive MSST in the first six weeks of the research period and 23 children participated in CPI in the second period of six weeks. At last, there are 11 children who receive both CPI and MSST next to CE.

Design

A pretest-posttest quasi-experimental design without control group is used to compare the children's motor performance at the moment of the pretest with the children's performance at the moment of the posttest, after twelve weeks of CE. After six weeks of CE, also an in-between measurement is carried out.

Instruments

Goal Attainment Scale (GAS). The GAS (Kiresuk & Sherman, 1968) is used to evaluate by observation to what extent the motor developmental goals are achieved by the individual child. The GAS is an individualized, criterion-referenced measure of change. It involves defining a unique set of goals for each client and describing for each goal, five pre-determined levels of outcomes (Turner-Stokes, 2009). A score of -2 represents the child's baseline level before intervention, -1 represents improvement that is less than the expected level of attainment after intervention, 0 represents the expected level of attainment after intervention, and +1 and +2 represent levels of attainment that exceed the expectations set for the child (King, McDougall, Palisano, Gritzan, & Tucker, 2000). By way of illustration, an example of a specified goal is shown in table 1. The setting of goals is done by the CE conductors from Sizanani and follows the SMART principle (appendix 1). For every possible score, -2 to +2, the degree of attainment is specified in advance. This contributes to an increase of the objectivity of the measures. This can be seen in the good inter-rater reliability of the GAS (Cohen's $\kappa = .93$). To obtain this

reliability value, all 36 children (41 goals) were evaluated by the researcher as well as the CE conductor from Sizanani during the in-between measurement. The GAS scores in the present sample were not normally distributed, but the residuals in the model were.

Table 1

Example of a goal set up in accordance to the GAS

Score	Specified degree of attainment
-2	Is not able to eat half his plate at lunch, with help to scoop
-1	Is able to eat half his plate at lunch, with help to scoop
0	Is able to eat half his plate at lunch, with verbal cues only
+1	Is able to eat his full plate at lunch, with verbal cues only
+2	Is able to eat his full plate at lunch, without verbal cues

Procedure for Scoring Motor Performance. Before the start of the research, specific motor developmental goals, with five levels of outcomes, are formulated for every individual child by the CE conductors from Sizanani. Since the setting of goals started a considerable time before the start of the research, a pre-measurement is carried out in the first week of the research period of twelve weeks. Also the FGMS is conducted at this moment, to determine the initial motor level of the children. Thereafter, the children received six weeks of CE, followed by an in-between measurement and another intervention period of six weeks. The research period is concluded with the post-measurement. The in-between and post-measurement assessed the achievement of the individual motor goals. Every child is observed during the CE sessions and daily activities, while performing the specific actions with regard to the goal. The child's performance is scored according to the previously defined scores on the GAS (i.e. performance as it was predicted in advance, and under and over performance).

Fine and Gross Motor Scale for children with severe multiple disabilities (FGMS). The FGMS intends to determine the motor level of the child at the start of the research and consists of a fine motor subscale and a gross motor subscale. A manual of the FGMS can be found in appendix 2.

The fine motor subscale comprises seven sequential ways of reaching and grasping, which can be established by the child by means of three objects with different sizes (appendix 2). On the basis of these ways of reaching and grasping, children are grouped in three sequential categories: no reaching or grasping (score = 0), reaching (score > 0 and ≤ 3) and grasping (score > 3).

The gross motor subscale is composed of 13 gross motor milestones. The number of mastered milestones results in the score for gross motor skills. The scoring of the mastered gross motor milestones mainly depends on several observations in the daily living situation. If, however, the milestone is not seen during observations, it was tried to make the child performing the motor action. A more comprehensive description can be found in appendix 2.

The inter-rater reliability for the gross motor subscale is determined using a intraclass correlation coefficient. For the fine motor subscale Cohen's Kappa is used. After evaluating 20 children simultaneously by the researcher as well as the CE conductor, it can be concluded that both the fine motor subscale (Cohen's $\kappa = .81$) as well as the gross motor subscale (ICC[1] = .99) have a good inter-rater reliability.

Program Intensity. To determine the intensity of the CE intervention, the frequency and duration of practicing with respect to the motor goals is measured. The number of times that the goal is practiced forms the frequency of practicing for that observed CE session. Every time the child practices during the CE session, the duration in minutes is noted down. The sum forms the duration of practicing for that session.

Program Integrity Scale (PIS). The PIS is used to determine the integrity of the CE intervention as executed in Sizanani. The scale is divided into four subscales, namely the four criteria derived from Petö, which are considered to be the most important for enhancing motor abilities in Sizanani: (1) positive reinforcement, (2) providing optimal help, (3) appropriate positioning, and (4) establishing an active, energetic and motivating atmosphere. The PIS is described in more details in appendix 3.

The norms are evaluated on a 5-point Likert scale by daily observations in the four CE groups in Sizanani, five days a week. Each of the four groups is observed once a week, which results in a number of twelve observations per child for the whole research period of twelve weeks. The practicing for the attainment of particular goals that cannot be done during CE, like eating and bathing, are observed during these specific daily activities, also twelve times. The scale ranges from 1: not at all conform the norms, 2: slightly, 3: moderately, 4: mostly, to 5: completely conform the norms. The average of the scores of the four norms from all of the observed practicing sessions constructs the score for integrity of therapy.

The reliability of the PIS is analyzed using Cronbach's Alpha for the internal consistency of the scale and Cohen's Kappa for the agreement among observers. The PIS has an acceptable internal consistency ($\alpha = .72$) and the data are normally distributed. The former indicates that it is allowed to use the scale as a whole, instead of using the distinct subscale in the analyses. The

[1] ICC stands for Intraclass Correlation Coefficient

inter-rater reliability values for the subscales positive reinforcement (Cohen's κ = .75), optimal help (Cohen's κ = .86), appropriate position (Cohen's κ = .85) and active, motivation atmosphere (Cohen's κ = .80) indicate a substantial agreement between the two observers in evaluating 20 CE practicing sessions.

Social Responsiveness Scale (SRS). The SRS (Halfens, 2012) is used to determine the level of social responsiveness during MSST. With 13 items, the behavioral responses, typical for this population, from the child towards the objects in the story or the storyteller are measured. The Cronbach's alpha of .80 shows a good internal consistency of the scale. Further details on the SRS can be found in Halfens (2012). The initial level of social responsiveness is determined at the start of the twelve weeks lasting research period. The progress in social responsiveness is measured by the SRS after the first six weeks of the research period, when MSST was executed next to CE.

Play Observation Scale (POS). The POS (Vos & Van Westrhenen, 2009; Flesch, 2012) measures the level of cognitive play performance during CPI. The scale is based on play behavior distinctive for Piaget's (1962) sensorimotor stage of cognitive development, in which three levels of play are distinguished: functional play, constructional play and dramatic play. The cognitive play performance is measured using a 7-point scale and gives an indication of the level of sensorimotor cognitive development and by doing so, it indicates the cognitive abilities of the child. The internal consistency of the scale appears to be good (α = .90), as well as the inter-rater reliability (Cohen's κ = .84). The POS is described in more details in Flesch (2012). The initial level of cognitive play is determined at the start of the entire research period of twelve weeks. The progression in cognitive play is determined by the difference between the level of cognitive play at the start of the CPI intervention period and the level of cognitive play after participation of six weeks in CPI.

Results

The Effectiveness of CE

The main aim of this study is to evaluate the effectiveness of the CE intervention in Sizanani. First and foremost, the achievement of individual motor goals with the help of the GAS was examined. To find out whether there is a significant progression in GAS scores after twelve weeks of CE, the GAS scores obtained in the post-measurement are compared with the initial GAS score of -2, using the Wilcoxon signed rank test. For the entire research period, a significant progression with respect to the motor developmental goals is seen (Wilcoxon Z = -4.45, p = .001). The most progression is made in the first half (51,2%), but there is also an appreciable progression seen in the second half of the research period (34,1%), as can be seen in table 2.

Table 2

Frequencies and percentages of children who showed progression in GAS scores and children who stayed at their initial level, for the first half (week 1-6), the second half (week 6-12) and the whole research period (week 1-12)

	Progression		Same level	
	N	%	N	%
Week 1-6	21	51.2	20	48.8
Week 6-12	14	34.1	25	61.0
Week 1-12	25	61.0	16	39.0

Note. In the second period (week 6-12), two children deteriorated as a consequence of illness.

In table 3 it can be seen that the majority of the children who showed progression (36,6%) are at the -1 level of their goal after six weeks of CE: they are not yet on the level of what is expected after twelve weeks of intervention. After these twelve weeks however, 61% of the children showed progression, of whom 36,6% meet or even exceed the expectations set for them (GAS score 0, 1 or 2).

Table 3

Degree of progression made after 6 and 12 weeks of CE; frequencies and percentages of -2, -1, 0, 1 and 2 scores on the GAS

	-2		-1		0		1		2	
	N	*%*	*N*	%	*N*	%	*N*	%	*N*	*%*
After 6 weeks	20	48.8	15	36.6	3	7.3	2	4.9	1	2.4
After 12 weeks	16	39.0	10	24.4	11	26.8	3	7.4	1	2.4

Note. -2: baseline level before CE, -1: less improvement than the expected level of attainment after CE, 0: the expected level of attainment after CE, 1: slightly more improvement than the expected level, 2: clearly more improvement than the expected level.

The role of various program and child variables on the effectiveness of CE, is analyzed in two ways. Firstly, a one-way ANOVA is carried out to see whether the group of children who show progression in CE significantly differ from the group of children who did not progress, on intensity and integrity of the intervention, fine and gross motor skills, social responsiveness and cognitive play performance. Secondly, by means of multiple regression analyses, it is examined whether these variables moderate the effectiveness of CE.

'Progression group' versus 'no progression group'

Considering that the amount of children who did not show any appreciable progression after twelve weeks of CE is relatively large (39%), it becomes apparent that there are actually two groups within the sample of 36 children, who may differ on intensity and integrity of the intervention, fine and gross motor skills, social responsiveness and cognitive play performance. Table 4 shows an overview of the mean scores and standard deviations on the different variables for these two groups of children. A one-way ANOVA is executed to see whether both groups significantly differ from each other on these variables.

Table 4

Means (M), standard deviations (SD), and sample size (N) of program quality and child characteristics for the group of children who show no progression in CE and the group who do

	M (SD)				N (%)			
	No progress		Progress		No progress		Progress	
Frequency	8.56	(4.08)	9.52	(3.72)	16	(39)	25	(61)
Duration (in min.)	51.60	(54.17)	38.17	(40.80)	16	(39)	25	(61)
Integrity	**3.52**	(0.59)	**3.98**	(0.38)	16	(39)	25	(61)
Fine motor skills	3.31	(2.06)	4.28	(1.95)	16	(39)	25	(61)
Gross motor skills	6.81	(4.18)	7.04	(4.02)	16	(39)	25	(61)
SRS[a] week 1	4.78	(2.09)	4.72	(1.62)	11	(41)	16	(59)
SRS week 6-1	1.60	(2.07)	2.00	(1.33)	11	(41)	16	(59)
POS[b] week 1	**1.26**	(1.00)	**2.26**	(0.90)	8	(42)	11	(58)
POS week 12-6	1.20	(1.50)	0.60	(1.59)	8	(42)	11	(58)

Note. The bold means differ significantly ($p < .05$) from each other.

[a]SRS stands for Social Responsiveness Scale.

[b]POS stands for Play Observation Scale.

The 25 children who show progression in their motor performance do not differ significantly from the 16 children who did not progress, on the frequency and duration of practicing, and their fine[2] and gross motor level. However, for those who show progression in CE, the program integrity was significantly higher than for the children who did not progress (Welch $F(1, 22, 83) = 7.43$, $p = .01$)[3].

Within the subpopulation of children who received MSST next to CE ($N = 23$), there is no difference between the group of children who progressed in CE and who did not in the initial level of social responsiveness, nor in the progression in social responsiveness that is made during the study. Finally, from the children who received CPI next to CE ($N = 16$), those who show progression in CE have a significantly higher initial level of cognitive play than those who did not progress in CE ($F(1, 17) = 5.28$, $p = .04$). No difference between these two groups is found on the progression in cognitive play.

Moderators for the effectiveness of CE

After examining the effectiveness of CE and the differences between children who show progression in CE and children who did not, it was examined which variables moderate the effectiveness of CE, using multiple regression. Firstly, the effect of program quality is tested. Thereafter, it is studied if child characteristics play a role in the degree of effectiveness of CE. Finally, it is tested if performances in the MSST intervention and CPI have an effect on performances in CE.

Quality of the intervention. Multiple regression analysis shows that 21% of the variance in the GAS scores after twelve weeks of intervention can be explained by the quality of the intervention, as measured by the frequency, duration and integrity of practicing. As seen in table 5, the integrity provides a significant contribution, contrary to the duration and frequency. Although this group of variables does not significantly predict the variance in GAS scores in the first half of the research period, the explanation of variance inclines towards significance ($p = .06$).

[2] Because of the small sample size, resulting in more than 20% of the expected counts is less than 5, Fisher's exact test is used instead of Pearson's chi-square test.

[3] Welch F is used as an alternative F-ratio, since the assumption for homogeneity of the variances is violated.

Table 5

Multiple regression coefficients for intervention quality and motor performance on the GAS scores at the in-between measurement (GAS week 6) and the post-measurement (GAS week 12)

	GAS week 6					GAS week 12				
Explaining variables	B	SE B	β	(Δ)R^2	(Δ)F	B	SE B	β	(Δ)R^2	(Δ)F
Step 1				.18	2.68				.21	3.27*
Frequency	0.00	0.04	.01			0.05	0.04	.18		
Duration	0.00	0.00	.16			0.00	0.00	-.08		
Integrity	0.85	0.30	.45**			0.91	0.33	.43*		
Step 2				.17	3.02*				.23	4.60*
Frequency	0.00	0.05	.03			0.06	0.05	.20		
Duration	0.00	0.00	.12			0.00	0.00	-.17		
Integrity	0.71	0.30	.38*			0.74	0.30	.35*		
Reaching (0/1)	1.35	0.48	.50**			1.66	0.48	.54**		
Grasping (0/1)	0.57	0.39	.29			1.00	0.39	.45*		
Gross motor level	-0.01	0.04	-.04			-0.04	0.04	-.14		

Note. The underlined F value inclines to significance: $.05 < p < .10$

* $p < .05$, ** $p < .01$

Motor performance

To examine the contribution of the fine and gross motor level of the child before the CE intervention in explaining the variances in GAS scores after six and twelve weeks of CE, these variables are added in a second step in the former multiple regression analysis (table 5). Since the fine motor level is a categorical variable with three categories, it is recoded into two dummy variables, namely ‘reaching’ and ‘grasping’, before addition to the regression model.

Adding the initial level of fine and gross motor functioning to the program variables, accounts for explaining an additional 23% of the variation in GAS scores after twelve weeks of CE. The significant and positive beta value for the first dummy variable (β = .54, p = .001), being able to reach, indicates that the GAS score increases significantly more in children who show reaching behavior, compared to those who show no reaching behavior (see table 5). The same applies for the second dummy variable (being able to grasp beside reaching): the GAS score increases when a child shows grasping behavior compared to children who do not show reaching or grasping behavior. The latter is not found for the first half of the research period. The change in GAS scores after twelve weeks of CE can thus be predicted by whether a child shows reaching or grasping behavior compared to if the child does not.

Possible interaction effects between the integrity and the gross motor level and the integrity and the fine motor level were tested in a third step in the regression analyses, but proved to be non-significant.

Predictors for Success in CE. In the sections above, it is discussed which variables possibly influence the children's performance with respect to their goals. As mentioned earlier, 25 children showed progression with respect to their individual motor goals, while 16 children stayed at the same level. A multiple regression analysis is executed to find out which variables may contribute to predicting a GAS score higher than -2, thus making progression on the motor goals after participating in CE. Although former analyses show that the integrity of the CE intervention can explain the variance in GAS scores, in table 6 it can be seen that the variance in GAS score higher than -2 cannot be predicted by the integrity of the CE intervention. The integrity appears to be an important predictor for showing progression or not. The degree of progression, however, cannot be predicted by the integrity of the intervention.

After adding the fine and gross motor functioning to the model, 35% of the variance in the GAS scores can be explained. Being able to reach appears to be a significant predictor for the degree of progression.

Table 6

Multiple regression coefficients for intervention quality and motor performance on showing progression in CE (N = 25)

	GAS progression				
	B	SE B	β	(Δ)R^2	(Δ)F
Step 1				.04	.98
Integrity	0.44	0.44	.20		
Step 2				.31	3.24*
Integrity	0.31	0.46	.14		
Reaching (0/1)	1.41	0.57	.71*		
Grasping (0/1)	0.67	0.47	.39		
Gross motor level	-0.04	0.04	-.17		

* $p < .05$

Social responsiveness. The effect of social responsiveness during MSST on the performance in the CE intervention is tested in a subsample of 27 children who participated in both interventions. The average score for social responsiveness at the start of the current research is *M* = 4.74 (*SD* = 1.79), whereas the average score after six weeks of MSST is *M* = 6.58 (*SD* = 2.58). This comes to an average progression in the SRS score of *M* = 1.84 (*SD* = 1.65). More details on MSST can be found in Halfens (2012). Out of 27 children who received both MSST and CE, 16 children show progression in CE, which correspond to 59% of this subsample. This percentage is comparable with the total research population.

A multiple regression analyses is executed to see if and to what degree the score on the GAS after six and twelve weeks can be predicted by the initial level of social responsiveness. In addition, it is examined whether the degree of progression in social responsiveness due to MSST

predicts the score on the GAS in the same period (week 1-6) and after twelve weeks. In the second half of the research period there was no MSST next to CE, but it is possible that the elevated levels of social responsiveness after MSST (SRS score at week 6) contribute to the variances in GAS scores after twelve weeks. Given the small sample size of this subpopulation, the integrity of the intervention and the gross motor level, which appear to be no significant predictors, are excluded from this analyses to increase the reliability. The results, as can be seen in table 7, show that the initial level as well as the progression in social responsiveness do not contribute to the variance in GAS scores after six weeks and twelve weeks of CE.

Interactions between social responsiveness and fine and gross motor functioning do not contribute significantly to explaining variation in GAS scores.

Table 7

Multiple regression coefficients for motor performance and social responsiveness (SRS) on the GAS scores at the in-between measurement (GAS week 6) and post-measurement (GAS week 12) (N = 27)

	GAS week 6					GAS week 12				
	B	SE B	β	$(\Delta)R^2$	$(\Delta)F$	B	SE B	β	$(\Delta)R^2$	$(\Delta)F$
Step 1				.34	6.15**				.40	7.84**
Reaching (0/1)	1.80	0.51	.71**			2.23	0.57	.77**		
Grasping (0/1)	0.81	0.41	.41			0.90	0.45	.39		
Step 2				.06	1.07				.09	1.89
Reaching (0/1)	2.15	0.59	.85**			2.83	0.63	.97***		
Grasping (0/1)	1.33	0.54	.67*			1.42	0.57	.61*		
SRS week 1	-0.13	0.11	-.23			-0.23	0.12	-.33		
SRS week 6-1	-0.12	0.12	-.19			-0.02	0.13	-.03		

Note. The underlined value inclines to significance: $p \geq .05$ and $< .10$

* $p < .05$, ** $p < .01$, *** $p < .001$

Like previous analyses on predictors for success in CE, also the predictive value of performance in MSST is examined. Results of a multiple regression analysis, as can be seen in table 8, show again that also for the group of children who made progression in CE and received MSST ($N = 16$), children who show reaching behavior scored higher on the GAS compared to children who do not show reaching behavior. The initial level of social responsiveness of the child as well as the progression in social responsiveness appears not to significantly account for the variance in GAS scores.

Table 8

Multiple regression coefficients for intervention quality, motor performance and social responsiveness on showing progression in CE (N = 16)

	GAS progression				
	B	SE B	β	(Δ)R^2	(Δ)F
Step 1				.00	.04
Integrity	0.16	0.77	.06		
Step 2				.60	5.61*
Reaching	1.88	0.77	.95*		
Grasping	0.53	0.70	.29		
Step 3				.05	.67
Reaching	2.22	0.85	1.12*		
Grasping	0.50	0.80	.27		
SRS week 1	-0.11	0.15	-.20		
SRS week 6-1	0.17	0.19	.26		

* $p < .05$

Cognitive play performance. Finally, it was examined whether the cognitive play performance during CPI is a predictor for the score on the GAS. The initial level of cognitive play performance in CPI has an average score of *M* = 1.84 (*SD* = 1.05). After six weeks of intervention, an average increase of *M* = .85 (*SD* = 1.54) in de score on the POS is reported (Flesch, 2012). From the subsample of 19 children who received both CE and CPI, 11 children (58%) showed progression in CE against 8 who did not (42%). These percentages are comparable to those in the total research population.

Firstly, as reported earlier in table 4, the 11 children who showed progression appear to have a significantly higher level of cognitive play before the start of the research period, than the 8 children who did not progress. Thereafter, a multiple regression analysis is executed to examine the predictive value of the initial level of cognitive play before the start of the research period of twelve weeks (POS week 1), for the score on the GAS after six weeks of CE. The results in table 9 show that this initial level of cognitive play does not significantly contribute to explaining the variance in GAS scores in the first period. Different from previous analyses, the fine motor level of the child appears to be a significant negative predictor for the score on the GAS. Since all children in this subsample are at least able to reach, the fine motor level has two categories and is thus recoded into one dummy variable. The results therefore mean that being able to grasp predicts a lower GAS score, compared to only being able to reach.

Table 9

Multiple regression coefficients for intervention quality, motor performance and cognitive play performance on the GAS scores after 6 weeks of CE (N = 19)

	GAS week 6				
	B	SE B	β	(Δ)R^2	(Δ)F
Step 1				.20	4.23
Integrity	0.72	0.35	.45		
Step 2				.36	13.13**
Integrity	0.91	0.27	.56**		
Grasping (0/1)	-0.53	0.15	-.61**		
Step 3				.05	2.10
Integrity	0.81	0.28	.50*		
Grasping (0/1)	-0.62	0.15	-.72**		
POS week 1	-0.26	0.18	.27		

Note. The underlined values incline to significance: p ≥ .05 and < .10
* *p* < .05, ** *p* < .01

For the second period, in which the children participated in CPI next to CE, a multiple regression analysis is executed to examine whether the initial level of cognitive play before CPI, thus at the start of the second period (POS week 7), and the progression in cognitive play during CPI are predictors for the score on the GAS after twelve weeks of CE. The results, as seen in table 10, correspond with previous findings: the integrity as well as being able to grasp, although negative, are significant predictors of the score on the GAS after twelve weeks. The level of cognitive play before the start of CPI and the progression in cognitive play made during CPI do not account for the variances in GAS scores after twelve weeks of CE. The effect of interactions between cognition and fine motor functioning, and cognition and program integrity is tested, but appears not to be significant.

The group of children who made progress in CE and received CPI (*N* = 11) was too small to make a pronouncement about the predictable value of cognitive play performance for success in CE.

Table 10

Multiple regression coefficients for intervention quality, motor performance and cognitive play performance on the GAS scores after 12 weeks of CE (N = 19)

	GAS week 12				
	B	SE B	β	$(\Delta)R^2$	$(\Delta)F$
Step 1				.29	6.76*
Integrity	0.94	0.36	.53*		
Step 2				.25	8.35*
Integrity	1.11	0.31	.63**		
Grasping (0/1)	-0.47	0.16	-.51*		
Step 3				.00	0.00
Integrity	1.13	0.40	.64*		
Grasping (0/1)	-0.48	0.17	-.51*		
POS week 7	-0.02	0.26	-.02		
POS week 12-7	-0.01	0.15	-.01		

* $p < .05$, ** $p < .01$

Discussion

The Effectiveness of CE

In this research the main aim was to evaluate the effectiveness of CE by examining to what extent specific, individual goals concerning motor development were achieved after a period of twelve weeks of CE. It was hypothesized that the individual goals concerning motor development will be achieved during twelve weeks of CE. The attainment of goals was evaluated by means of observations in daily situations, including CE sessions, instead of a standard test situation, to make the task at hand more meaningful to the child. Since a significant part of the goals was not related to a specific situation or activity, the practicing and execution of these motor actions took mostly place during CE sessions and not much during daily activities. As a consequence, the attainment had to be observed during these sessions. The results show that during the whole research period, as well as in the first and second half distinctively, a significant progression is made with respect to the goals. The most progression is made in the first period. After twelve weeks of CE, 61% of the children showed progression on their motor goals, of which 36,6% meet or even exceed the expectations set for them. These results thus confirm the hypothesis and earlier positive evaluations of CE (Cottam et al., 1985; Bairstow et al., 1991; Sigafoos et al., 1993; Catanese et al., 1995; Liberty, 2007).

However, the results also indicate that the amount of children who did not show any appreciable progression in CE is relatively large (39%). Therefore, it was examined whether there are substantial differences on program variables and child characteristics between the group of children who showed progression in CE and the group of children who did not. Next to this, it was studied whether the effectiveness of CE is moderated by other factors, namely characteristics of the intervention and the developmental level of the child. In other words, which variables are predictors for success in CE. Finally, it was scrutinized whether these variables predict the degree of progression. The results of the evaluation of these research questions will be discussed per variable below.

Quality of the Intervention

Concerning whether the effectiveness of CE is moderated by other factors, it was firstly hypothesized that the effect of CE on the achievement of the motor developmental goals can be moderated by the intensity and integrity of the intervention.

Intensity. Firstly, there appears to be no difference on the intensity of the intervention between the group of children who showed progression and the group of children did not. Even though various studies show that the intensity can positively influence the effectiveness of a program (Darrah et al., 2003; Kwakkel et al., 2004; Van Peppen et al., 2004), the current research found no relation between the intensity and effectiveness of CE. This actually means

that it makes no difference for the achievement of goals whether a child had a few or a lot of practice, which is not plausible. Since there is a sufficient variance in frequency and duration this cannot explain this result. A possible explanation may be that a part of the goals does not perfectly fit the competences of the child: goals that are too easy may be reached with few or without practicing, while goals that are too challenging need more time and practicing to be reached or may never be reached. This can be found out in the future by following the performance by means of a daily logbook. This way, it can be seen whether there is progression but not enough to reach a higher level of attainment or whether there is no progression at all, which most likely indicates an unsuitable goal. Lastly, the results show that the frequency and duration of the intervention are no predictors for the degree of progression in CE. A critical comment can be found in the fact that these variables are measured during therapy sessions. Though individual differences in frequency and duration during the intervention exist, most important for mastering new motor skills is the frequency and duration of practicing outside the CE sessions. This way, the new skills become more meaningful to the child and the motivation to actually use the skills in daily activities will increase.

Integrity. Conversely, for the integrity of the intervention there is a difference between the group of children who made progression in CE and the group of children who did not. For the children who made progression, the integrity of the intervention was significantly higher. In addition, the integrity also appears to moderate the effect of CE on the achievement of the motor goals. Executing the intervention in accordance with the ideas of Petö (in Fellner, 2008), which are mostly endorsed by a variety of learning theories (Norman & Schmidt, 1992; Mayer, 1999; Vygotsky, 1978, in Berk, 2006), is positively related to the effectiveness of CE. However, the integrity does not significantly predict the degree of progression. It can be concluded that the integrity of the CE intervention is a significant predictor for either showing progression with respect to the goals or not, but not for explaining the degree of progression. Moreover, for children who showed progression in CE, the integrity of the intervention was significantly higher than for those who did not progress.

The latter may be explained by the attainability of the individual goals, as judged by the childcare workers who have to work with the children on the goals or as becomes clear during practicing. When, in their opinion, the goal is too ambitious, it is conceivable that they will not put as much effort and energy in practicing as when they have confidence in the fact that the child is able to achieve the goal. As a consequence, the integrity is related to progression in CE. The goal setting, and more specifically the differences between the levels, may also explain why the integrity does not predict the degree of progression. While for some goals a higher level of progression means that they have to sit or keep their head up two seconds longer, with other goals the child has to take the step from doing something with support to doing it independently.

Although the goals are set with consideration of the capabilities of the individual child, the steps from one level of progression to the other seem to be too diverse, which cannot be overcome by a good integrity of the intervention, i.e. a good integrity is of less influence.

The results above indicate that the setting of realistic, attainable goals and sub-goals, while taking the capabilities of the individual child into account, is important for making progression in CE, whether positively influenced by a good program integrity or not. The steps between the levels of attainment should relatively be as equal as possible for all of the children. The setting of realistic goals can firstly be obtained by doing this in consultation with the childcare workers. In fact, they have to practice with the children and considering the importance of the integrity of the intervention for the effectiveness, it seems to be important for the childcare workers to have confidence in the attainability of the goals. A trial period can be helpful for this, while at the same time it leads to a better insight in the attainability of the goals. Moreover, it offers the possibility to adjust the goals when necessary.

Developmental Level of the Child

Motor Level. Since the individual motor goals are set with the consideration of the developmental level and capabilities of the child, it was hypothesized that the motor level at the start of the research is not responsible for the differences in the achievement of goals between the participants. This is not completely confirmed by the results of this research. Though the gross motor level of the child appears to have no effect, the fine motor level does. Both reaching, as well as being able to grasp are significant predictors for progression in motor performance after participating in CE. Reaching behavior, however, appears to be the most important predictor for success in CE. The same applies to explaining the degree of success in CE: being able to reach is the only variable in this study that significantly predicts the degree of progression with respect to the motor developmental goals after twelve weeks of CE. This result indicates that for being successful in CE, it is desirable to have a certain motor potential, which may be determined by whether a child is able to reach. On the other side, there are no differences found on fine and gross motor skills between the group of children who showed progression in CE and the group of children who did not. This means that there were also children who cannot reach but did show progression and children who are able to reach and did not progress. It can be derived from this that being able to reach is not an absolute precondition for being successful in CE.

As suggested earlier, the fact that CE already takes place for eight years in Sizanani makes it conceivable that particularly children with low potentials already reached their limit. This, however, does not explain the specific importance of the fine motor functioning of the child. Neither the fact that only thirteen goals mainly make an appeal on fine motor skills, as opposed to 23 goals mainly directed to the gross motor functioning, as can be seen in appendix 1,

explains the specific importance of fine motor skills. A possible explanation may be that the distinction between not being able to reach and being able to reach or grasp, is a good way to distinguish the group with the lowest developmental potentials from the rest. Some children are not able to reach due to physical restrictions. Others do not show this behavior because of a low cognitive level or visual impairments, which both contribute to a lack of motivation to reach for an object. It is therefore questionable whether the score on the fine motor subscale is an absolute indication of the fine motor skills of the child. Nevertheless, not showing reaching or grasping behavior, for whatever reason, may result in less exploration of the environment and objects, which, as a consequence, has a negative effect on the development of executive functions and the acquiring of skills in daily life that require motor functions (Von Hofsten, 2004; Gibson, in Heft, 2001; Thelen & Smith, 1998). However, the fact that there is no difference in motor skills between the children who made progression and the children who did not, implies that there were also children with a lower level of motor functioning who did show progression in CE. Possibly, the suitability of the goals is also relevant in this case.

At last, the negative effect of being able to grasp compared to not being able to grasp (which means in this subsample that the child is only able to reach) on the motor performance in CE in the group of children who received both CPI and CE is a remarkable result. Since this result is difficult to explain from any theoretical point of view, a methodological explanation is obvious. The presence of extreme values that influence the results can be ruled out, but the small sample size could be a plausible explanation.

Social responsiveness. With respect to the relation between the social responsiveness of the child and the achievement of motor developmental goals, it was hypothesized that the initial level of social responsiveness as well as the progression in social responsiveness, made during MSST, moderate the effectiveness of CE. Firstly it was found that there is no difference on social responsiveness between the group of children who showed progression in CE and the group of children who did not. Secondly, the initial level as well as the progression in social responsiveness do not appear to moderate the effectiveness of CE, neither do they predict the degree of progression in CE. In line with Vygotsky's (1978, 1983, in Berk, 2006) theories on social development, dynamic systems theories (Thelen & Smith, 1998) and the important role of social interaction in CE, a positive, two way relation between social responsiveness and motor functioning was expected. As described in the introduction of this thesis, CE assumes a holistic approach of the child and is directed to various aspects of the development. Despite the important role of social interaction, CE also appears to be effective for less sociable children, because every child is approached on their own level and via different developmental aspects. This will overcome the possible disadvantage of being less sociable, since CE uses also other ways of learning than by means of social interaction.

Cognitive Play Performance. Among the children who received both CE and CPI, it is examined whether the effectiveness of CE is moderated by the child's initial level and progression in cognitive play. Because of the important role of cognition, and specifically executive functions, for the motor development, both are expected to moderate the effectiveness of CE. Firstly, the results show that the initial level of cognitive play is significantly higher in the group of children who showed progression in CE, than in the group of children who did not. A high level of cognitive play as measured by the POS, among other things, indicates that the child understands what he or she can do with objects, e.g. for what it is intended. In CE, this will help the child to understand what is asked from him, what the purpose of the specific motor action is, and it contributes to a more complete understanding of the environment in which the individual is embedded. The importance of motivational factors and exploration of objects for the motor development is stressed by Von Hofsten (2004), Gibson (in Heft, 2001) and Thelen & Smith (1998). However, this initial level, as well as the progression in CPI, not significantly accounts for the variances in GAS scores after twelve weeks of CE, which contradicts the hypotheses.

An explanation can be found in the type of motor goals. Due to the severity of handicaps by which this sample is characterized, the majority of the goals do not appeal to the ability of planning and sequencing of actions, while this is exactly the role of executive functions, to which CPI is aimed. From this point of view, it is not surprising that the cognitive level as measured by the POS, does not have an effect on the motor performance of the child during CE, since these aspects of cognition are not involved in most of the specific motor goals. This also explains the fact that despite the children who make progression in CE have a higher level of cognitive play than children who did not progress, this higher level of cognitive play leads not by definition to a better motor performance. Since the majority of goals make no appeal on the planning and sequencing of actions, children with a higher cognitive level cannot turn this to good account.

Another explanation may lie in the relationship between cognitive play and motor performance. Possibly this relation is non-linear. It can be suggested that in the consecutive stages of play, the appeal on motor functions is not equivalent and ascending. That is to say, it is possible that in dramatic play motor functions are in a lesser degree involved compared to the lower stages of functional and constructive play. Although in this sample with these motor goals executive functions appear to be of less influence, it is recommended for future research to find out more precisely the role of executive functioning in the different stages of cognitive play. It is for example conceivable that the executive functions involved in basic motor actions are increasingly involved in functional and constructive play, but in an equal or may be even lesser degree in dramatic play, a higher level of cognitive play. This way a higher level of cognitive

play does not make a greater appeal on executive functions. As a consequence a linear relationship between cognitive play and motor performance in which executive functions are involved should not be expected.

Conclusion

Seeing that 61% of the children showed progression on their motor goals after twelve weeks of CE, it can be concluded that CE, as executed in Sizanani, appears to be a successful intervention aimed at achieving motor developmental goals in order to replace the dysfunction by orthofunction in children with CP. With the use of small, specific goals, it is demonstrated that also this group of children, with severe multiple disabilities, is capable to learn by means of CE and that their progression can specifically be established.

The results firstly indicate that it is of central importance to execute the intervention with consideration of the four evaluated criteria, conceived by Petö, concerning reinforcement, assistance, positioning, and the atmosphere. It is therefore recommended to the management of Sizanani to keep a close watch on guaranteeing the quality of the intervention. However, in addition, the goals should be attainable, with realistic, equal steps for achieving a higher level of attainment. For this, it is important to take the capabilities of the children, with consideration of the recent evaluations, into account to possibly increase the number of children that benefit from CE and formulate more suitable goals. This can be obtained by means of consultation with the childcare workers and the introduction of trial periods for the goals.

Secondly, the ability to reach in particular appears to be an important predictor for the effectiveness of CE. It may give a general indication for which children the intervention is probably most effective. However, the fact that there were also children with a low level of motor functioning who did show progression, emphasizes that it should not be an absolute criterion for the individual to benefit from CE. More important, this suggests that it might be worthwhile to take a closer look at the goals of this group of children and make adjustments or try out different goals.

Finally, the child's level of social responsiveness as well as the level of cognitive play do not moderate the effectiveness of CE. This demonstrates that CE is an effective intervention regardless of the social and cognitive level of the child. It can be found, however, that the level of cognitive play may have a positive effect on the performances in CE when the goals call upon executive functions. Therefore, as emphasized by Petö and affirmed by Palmer (1997) and Darrah and Bartlett (1995), it is of great importance to provide highly functional goals, which make the task at hand more meaningful to the child.

As set out in the introduction, CE is a comprehensive intervention with a variety of principles, which are mostly founded on learning theories. The consideration of these principles, which can be partially determined by the PIS, is important for the effectiveness of the

intervention. This scale, however, measures the consideration of only four criteria while CE includes more than these four criteria. One of the most important principles of Petö's method is the continuity of practicing in daily activities, i.e. outside CE sessions, which cannot explicitly be measured with the PIS. Observations of the execution of CE in Sizanani learns that there is much to be desired at this point, which can be partly addressed to the appropriateness of the goals due to frequently lacking the aspect of functionality. As mentioned above, CE as developed by Petö requires the presence of the functional aspect in the goals. Observations of CE sessions and a review of the goals show that there is considerable potential on this aspect. For both the criteria of continuity and functionality, the goals form a good and important starting point for improvement. Moreover, the use of the semantic and rhythmic part of speech as a tool to plan, intend and regulate movements for carrying out motor functions is characteristic for Petö's CE, but cannot be measured with the PIS. The group aspect is also an important characteristic, by supplying a source of motivation and modeling. The fourth criterion of the PIS involves this aspect, but covers too much different aspects. Seeing the importance of the group aspect, it is desirable to make it a separate criterion. It is recommended to expand the PIS with these three important aspects of continuity, speech and the group to better operationalize CE as it is developed by Petö and get a more complete indication of the integrity of the intervention in Sizanani.

The results of the current research are useful for the management of Sizanani to improve the CE intervention and make it more efficient, by focusing on the children for whom it is beneficial. The formulation of highly functional, suitable and attainable goals is of great importance and should form the starting point for this aim. Since there is considerable potential on this point and the integrity of the intervention, which means that it should better reflect the intentions of Petö, it seems to be too early to start selecting children for CE. Beside the fact that theoretically seen the most progression can just be expected when CE includes all the key principles of the Petö method, a couple of reasons other than child factors came forward to possibly explain why a considerable part of the sample did not show progression. In this phase, it is therefore not legitimate to select the children on the base of personal factors, without examining the degree in which other factors are determinative for the child's performance.

To be concluded, this research provides a solid empirical base from which the interventions in Sizanani can be set forth. By using small, specific goals, which lead to more purposeful practicing and the observation of smaller progressions, it is proved that CE is an effective intervention to positively affect the development of children with severe multiple disabilities.

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Appendix 1

Goals and specified levels of outcomes

1. *-2* Not able to maintain crossed legs position for 2 minutes independently
   -1 To sit with crossed legs independently, encouraged by verbal cues, for 2 minutes
   0 To sit with crossed legs independently, encouraged by verbal cues, for 3 minutes
   1 To sit with crossed legs independently, encouraged by verbal cues, for 5 minutes
   2 To sit with crossed legs independently for 2 minutes, without verbal cues

2. *-2* Not able to stay on the chair independently for 5 minutes
   -1 To sit on chair independently, encouraged by verbal cues, for 5 minutes
   0 To sit on chair independently, encouraged by verbal cues, for 10 minutes
   1 To sit on chair independently, encouraged by verbal cues, for more than 10 minutes
   2 To sit on chair independently, without verbal cues, for 3 minutes

3. *-2* Not able to sit up independently from supine position and maintain sitting position for 3 sec.
   -1 To sit up independently from supine position and maintain sitting position for 3 sec.
   0 To sit up independently from supine position and maintain sitting position for 10 sec
   1 To sit up independently from supine position and maintain sitting position for 15 sec.
   2 To sit up independently from supine position and maintain sitting position for 30 sec.

4. *-2* Not able to put on shoes independently
   -1 To walk to shoes and put 1 shoe on independently, with verbal cues only
   0 To walk to shoes and put both shoes on independently, with verbal cues only
   1 To walk to shoes and put both shoes on independently, when they are standing not in the right way, with verbal cues only
   2 To walk to shoes and put both shoes on independently, when they are not necessarily standing in the right way, without verbal cues

5. *-2* Not able to get up on the red cushion independently
   -1 To get up on the red cushion independently
   0 To get into her wheelchair with help of the red cushion, independently
   1 To get in and out of her wheelchair with help of the red cushion, independently
   2 To get into her wheelchair without the help of the red cushion, independently

6. *-2* Not able to bring 3 blocks from the table to a box in 8 minutes
   -1 To help tidying up by bringing 3 blocks from the table and putting them into a box in 8 min.
   0 To help tidying up by bringing 5 blocks from the table and putting them into a box in 8 min.
   1 To help tidying up by bringing 5 blocks from the table and putting them into a box in 7 min.
   2 To help tidying up by bringing 5 blocks from the table and putting them into a box in 6 min.

7. *-2* Not able to get into wooden swing independently
   -1 To get into wooden swing independently
   0 To get in and out of the wooden swing independently
   1 To get into the tire swing independently
   2 To get in and out of the tire swing independently

8. *-2* Not able to maintain high-kneeling position independently for 5 sec., holding onto chair
   -1 Maintain high-kneeling position independently for 5 sec., holding onto chair with both hands
   0 Maintain high-kneeling position independently for 10 sec., holding onto chair with both hands
   1 Maintain high-kneeling position independently for 15 sec., holding onto chair with both hands
   2 Maintain high-kneeling position independently for 5 sec., without holding onto chair

9. *-2* Not able to maintain four-point kneeling with straight arms for 5 seconds
   -1 To maintain four-point kneeling with straight arms for 5 seconds
   0 To maintain four-point kneeling with straight arms for 8 seconds
   1 To maintain four-point kneeling with straight arms for 10 seconds
   2 Crawling two 'steps' on hands and knees

10. *-2* Not able to keep her head in the midline independently while sitting on a chair with support for 5 seconds
    -1 To keep her head in the midline independently while sitting on a chair with support for 5 sec.
    0 To keep her head in the midline independently while sitting on a chair with support for 8 sec.
    1 To keep head in the midline independently while sitting on a chair with support for 10 sec.
    2 To keep head in the midline independently while sitting on a chair with support for 15 sec.

11. *-2* Not able to tolerate sitting on a chair without crying for 1 min. with support at shoulders
    -1 To tolerate sitting on a chair without crying for 1 min. with manual support at shoulders
    0 To tolerate sitting on a chair without crying for 1 min. with manual support at knees

1 To tolerate sitting on a chair without crying for 1 min. without support

2 To tolerate sitting on a chair without crying for 2 min. without support

12. *-2* Not able to tolerate and maintain prone position independently for 10 seconds

-1 To tolerate and maintain prone position independently for 10 seconds

0 To tolerate and maintain prone position independently for 20 seconds

1 To tolerate and maintain prone position independently for 1 minute

2 To tolerate and maintain prone position for 1,5 minute

13. *-2* Not able to sit cross-legged independently with triangle cushion with head in the midline for 30 seconds.

-1 To sit cross-legged independently with triangle cushion with head in the midline, for 30 sec.

0 To sit cross-legged independently with triangle cushion with head in midline, for 1 minute

1 To sit cross-legged independently with triangle cushion with head in midline for 2 minutes

2 To sit cross-legged independently with triangle cushion with head in midline for 3 minutes

14. *-2* Not able to sit cross-legged independently with blankets under arms for 15 seconds

-1 To sit cross-legged independently with blankets under arms for 15 seconds

0 To sit cross-legged independently with blankets under arms for 5 sec. with head in the midline

1 To sit cross-legged independently with blankets under arms for 10 sec. with head in midline

2 To sit cross-legged independently with blankets under arms for 15 sec. with head in midline

15. *-2* Not able to grasp and hold a small ball with his right hand for 5 seconds

-1 To grasp and hold a small ball with his right hand for 5 seconds

0 To grasp and hold a small ball with his right hand for 8 seconds

1 To grasp and hold a small ball with his right hand for 10 seconds

2 To grasp and hold a small ball with his right hand for 15 seconds

16. *-2* Not able to maintain kneel sitting for 3 sec. with help provided only to keep his legs apart

-1 To maintain kneel sitting for 3 seconds with help provided only to keep his legs apart

0 To maintain kneel sitting for 5 seconds with help provided only to keep his legs apart

1 To maintain kneel sitting for 10 seconds with help provided only to keep his legs apart

2 To maintain kneel sitting for 15 seconds with help provided only to keep his legs apart

17. *-2* Not able to maintain prone position independently for 3 seconds
-1 To maintain prone position independently for 3 seconds
0 To maintain prone position independently for 5 seconds
1 To maintain prone position independently for 10 seconds
2 To maintain prone position independently for 15 seconds

18. *-2* Not able to grasp a facecloth with his right hand and move cloth to mouth
-1 To grasp a facecloth with his right hand
0 To grasp a facecloth with his right hand and move cloth to mouth
1 To grasp a facecloth with his right hand, move cloth to mouth and make wiping motion
2 To grasp a facecloth with his right hand, move cloth to mouth and make a more firmly wiping motion

19. *-2* Not able to play with toy piano with his right hand; pressing buttons once in 1 minute
-1 To play with toy piano with his right hand; pressing buttons once in 1 minute
0 To play with toy piano with his right hand; pressing buttons three times in 1 minute
1 To play with toy piano with his right hand; pressing buttons 5 times in 1 minute
2 To actively play with the toy piano with his right hand for 1 minute

20. *-2* Not able to play with toy piano actively for 5 min. without putting hands in mouth, verbal cues only.
-1 To play with toy piano actively for 5 min. without putting hands in mouth, verbal cues only
0 To play with toy piano actively for 8 min. without putting hands in mouth, verbal cues only
1 To play with toy piano actively for 10 min. without putting hands in mouth, verbal cues only
2 To play with toy piano actively for 12 min. without putting hands in mouth, verbal cues only

21. *-2* Not able to sit on bench independently, holding standing frame, for 3 sec with head in midline
-1 To sit on bench independently, holding standing frame, for 3 seconds with head in midline
0 To sit on bench independently, holding standing frame, for 5 seconds with head in midline
1 To sit on bench independently, holding standing frame, for 10 seconds with head in midline
2 To sit on bench independently, holding standing frame, for 15 seconds with head in midline

22. *-2* Not able to grasp toy with light or sound in front of her, while sitting independently on a chair
-1 To grasp a toy with light or sound in front of her, while sitting independently on a chair

0 To grasp a toy without light or sound in front of her, while sitting independently on a chair

1 To grasp a toy without light or sound from the table, while sitting independently on a chair

2 To grasp a smaller object < 5cm without light/sound from the table, while sitting on a chair

23. *-2* Not able to sit for 3 sec. with crossed legs, supported at the hips, and keep trunk and head in midline

-1 To sit for 3 sec. with crossed legs, supported at the hips, and keep trunk and head in midline

0 To sit for 5 sec. with crossed legs, supported at the hips, and keep trunk and head in midline

1 To sit for 10 sec. with crossed legs, supported at the hips, and keep trunk and head in midline

2 To sit for 15 sec. with crossed legs, supported at the hips, and keep trunk and head in midline

24. *-2* Not able to sit with crossed legs for 1 minute without complaining, manual support on back

-1 Sit with crossed legs for 1 minute without complaining, manual support on back

0 Sit with crossed legs for 1,5 minute without complaining, manual support on back

1 Sit with crossed legs for 10 seconds without complaining independently

2 Sit with crossed legs for 20 seconds without complaining independently

25. *-2* Not able to lift head up in supine position for 3 seconds

-1 Lift head up in supine position for 3 seconds

0 Lift head up in supine position for 5 seconds

1 Lift head up in supine position for 10 seconds

2 Lift head up in supine position for 15 seconds

26. *-2* Not able to shuffle on her back independently for 1 meter

-1 To shuffle on her back independently for 1 meter

0 To shuffle on her back independently for 2 meters

1 To shuffle on her back independently for 2,5 meters

2 To shuffle on her back independently for 3 meter

27. *-2* Not able to lift her right arm up above her head when instructed

-1 Lift her right arm up above her head when instructed

0 Lift both her arms up above her head when instructed

1 Lift right arm above head and hold it there for 3 sec

2 Lift both arms above head and hold them there for 3 sec

28. *-2* Not able to eat her lunch from a bowl with help to scoop
-1 To eat her lunch from a bowl with help to scoop
0 To eat her lunch from a bowl independently; half bowl
1 To eat her lunch from a bowl independently; full bowl
2 To eat her lunch from a plate independently, half her plate

29. *-2* Not able to walk from Tsakane to Thembalethu at the end of CE independently with verbal cues only; half-way.
-1 To walk from Tsakane to Thembalethu at the end of CE independently with verbal cues only; half-way.
0 To walk from Tsakane to Thembalethu at the end of CE independently with verbal cues only
1 To walk from Tsakane to Thembalethu at the end of CE independently, without verbal cues halfway.
2 To walk from Tsakane to Thembalethu at the end of CE independently without verb cues

30. *-2* Not able to eat half his plate at lunch with help to scoop
-1 To eat half his plate at lunch with help to scoop
0 To eat half his plate at lunch independently, with verbal cues only
1 To eat half his plate at lunch independently, without verbal cues.
2 To eat half his full plate at lunch independently, without verbal cues.

31. *-2* Not able to eat his lunch independently in 20 minutes, with verbal cues only
-1 To eat his lunch independently in 20 minutes, with verbal cues only
0 To eat his lunch independently in 15 minutes, with verbal cues only
1 To eat his lunch independently in 15 minutes, without verb cues.
2 To eat his lunch independently in 10 minutes, without verbal cues.

32. *-2* Not able to sit on a regular chair at a table independently during first half of her lunch
-1 To sit on a regular chair at a table independently during first half of her lunch
0 To sit on a regular chair at a table independently during entire lunch
1 To sit 30 seconds independently and alone after lunch
2 To sit 1 minute independently and alone after lunch

33. *-2* Not able to brush bottom teeth with verbal cues.
-1 To brush bottom teeth with verbal cues
0 To brush bottom and top teeth with verbal cues
1 To brush bottom teeth independently
2 To brush bottom and top teeth independently

34. *-2* Not able to creep on his stomach independently for 1 meter.
-1 To creep on his stomach independently for 1 meter
0 To creep on his stomach independently for 2 meters
1 To creep on his stomach independently for 2,5 meters
2 To creep on his stomach independently for 3 meters.

35. *-2* Not able to shuffle on his back for 1 meter, with manual support at right sole
-1 To shuffle on his back for 1 meter, with manual support at right sole
0 To shuffle on his back for 1 meter, independently
1 To shuffle on his back for 2 meters, independently
2 To shuffle on his back for 3 meters, independently

36. *-2* Not able to shuffle from the playroom to the bathroom independently within 5 min, with verbal cues.
-1 To shuffle from the playroom to the bathroom independently within 5 min., with verbal cues.
0 To shuffle from the playroom to the bathroom independently within 3 min., with verbal cues.
1 To shuffle from the playroom to the bathroom independently within 5 min., without verbal cues.
2 To shuffle from the playroom to the bathroom independently within 3 minutes, without verbal cues

37. *-2* Not able to grasp a facecloth with her right hand
-1 To grasp a facecloth with her right hand
0 To grasp a facecloth with her right hand and move cloth to mouth
1 To grasp a facecloth with her right hand, move cloth to mouth and make wiping motion
2 To grasp a facecloth with her right hand, move cloth to mouth and make a more firmly wiping motion

38. *-2* Not able to take his plate to the kitchen by himself after lunch, with verbal cues
-1 To take his plate to the kitchen by himself after lunch, with verbal cues
0 To take his plate to the kitchen by himself after lunch; independently
1 To take his plate and cup to the kitchen by himself after lunch; with verbal cues
2 To take his plate and cup to the kitchen by himself after lunch; independently

39. *-2* Not able to wheel himself from Tsakane to therapy building independently in 6 minutes
-1 To wheel himself from Tsakane to therapy building independently in 6 minutes
0 To wheel himself from Tsakane to Ekhayalethu independently in 10 minutes
1 To wheel himself from Tsakane to Ekhayalethu independently in 8 minutes
2 To wheel himself from Tsakane to Ekhayalethu independently in 6 minutes

40. *-2* Not able to push herself forward with her feet for 2 meters while sitting in a wheelchair
-1 To push herself forward with her feet for 2 meters while sitting in a wheelchair
0 To push herself forward with her feet for 4 meters while sitting in a wheelchair
1 To push herself forward with her feet for 5 meters while sitting in a wheelchair
2 To push herself forward with her feet for 6 meters while sitting in a wheelchair

41. *-2* Not able to walk 2 meters straight with walker with support provided to keep walker steady
-1 To walk 2 meters straight with walker with support provided to keep walker steady
0 To walk 4 meters straight with walker with support provided to keep walker steady
1 To walk 5 meters straight with walker with support provided to keep walker steady
2 To walk 6 meters straight with walker with support provided to keep walker steady

Appendix 2

FGMS; Fine and Gross Motor Scale for children with severe, multiple disabilities

Theoretical background

The Fine and Gross Motor Scale for children with severe, multiple disabilities is particularly developed for the research population in the Sizanani Children's Home in South Africa. Other, frequently used motor scales have various disadvantages when applied on this population. For instance, the steps from mastering one skill to another appear to be too big and unrealistic for shorter research periods (e.g. 4 months). Another disadvantage is that these scales cover the entire motor development. The children in the CE intervention in Sizanani have severe disabilities and are often deformed, with the consequence that they are mostly far behind in their motor development and simply not able to highly develop their motor skills. As a consequence, the majority of the children will be at the bottom of the scale, and therefore a normal distribution is lacking. The FGMS enlarges the early motor developmental stages, and by doing so allows for the mapping of smaller progressions in areas that would remain insufficiently specified when using general instruments.

The scale exist out of two subscales: a gross and a fine motor subscale. The gross motor scale is based on various studies on motor development (Allen & Alexander, 1990, 1997; Frankenburg & Dodds, 1967; Husaini et al., n.d.; Shirly, in Netelenbos 1998; Netelenbos, 1998; Ornitz, Guthrie & Farley, 1977). The fine motor subscale is based on grasping patterns as described by Halverson (1931, in Netelenbos, 1998) and Touwen (1977, in Netelenbos, 1998).

Although it is widely accepted that children in general develop their motor skills in a particular sequence (Netelenbos, 1998), it is doubtful whether the motor development of children in this research population follows this pattern. They may also show adjusted forms of locomotion, which emerges as a result of their disabilities (Netelenbos, 1998). Furthermore, the children in this population are often deformed by such an extent that they simply cannot reach some early milestones, while they may be able to master more complex ones. Therefore, the score on this scale is formed by the total of mastered milestones, instead of following the sequence and scoring the most complex milestone that is mastered.

Procedure

Fine motor subscale. If possible, the child should sit upright at a table or in a wheelchair with a table. If not, the objects can be offered from a flat surface, for example a plate or tray. The smallest of the four objects (the pin, see picture 1) is offered to the children and their way of grasping is observed. When the child scored below 6, and thus used an unsuitable way of

grasping with respect to the size of the object, a bigger object (the crayon, see picture 2) is offered to establish the preferred way of grasping. When the child is not able to grasp this object, again a bigger object is offered (the block, see picture 3). The most successful way of grasping with the smallest object is scored. This means that when a child is able to grasp the small pin, this way of grasping is scored and it is not necessary to offer the other, bigger objects. When a child, for example, only touches the chalk, but is not able to grasp it, you can offer the block. If the child is able to grasp the block, the way of grasping that is used with respect to the block forms the score on the fine motor subscale. For children with visual impairments, you can tap with the object on the surface in order for the child to localize the object.

The used objects

Picture 1. Pin; smallest object

Picture 2. Crayon; middle-sized object

Picture 3. Block; biggest object

7 milestones in reaching and grasping behavior

Reaching, but no contact (1)

Contact only, no grasping (2)

Primitive squeeze (3)

Hand grasp (4)

Inferior pincer grasp (5)

Superior pincer grasp (6)

Gross motor subscale. The scoring of the mastered gross motor milestones, which can be found on the scoring form, mainly depends on observations in the daily living situation. If, however, the milestone is not seen during observations, you can try to make the child performing the motor action. For this purpose, a child is taken out of his/her wheelchair on the floor and is placed in the right starting position with regard to the particular action. Thereafter, the child is motivated by the environment to execute the motor behavior. For example, if you want to know whether a child is able to lift his head up in prone position, you can turn the child on his stomach and rattle with an object or make noises above him. It is important that the child is motivated to execute the specific motor behavior. If the environment does not provide a reason to, for example, crawl, why would the child crawl then? In this case, asking to execute the action is not seen as a motivational factor for the child. The number of mastered gross motor milestones forms the score for this subscale.

Reliability of the FGMS

The inter-rater reliability for the gross motor subscale is determined using a intraclass correlation coefficient. For the fine motor subscale Cohen's Kappa is used. After evaluating 20 children simultaneously by two observers, it can be concluded that both the fine motor subscale (Cohen's $\kappa = .81$) as well as the gross motor subscale (ICC = .99) have a good inter-rater reliability.

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Scoring form FGMS

Name child: ……

Mark the gross motor milestones with either a ✓or ✘, when the milestone is respectively mastered or not and add up the number of mastered milestones.

Gross motor milestones	**Mastered?**
1. Fetal position	
2. Lifting head up in prone position	
3. Sit with support	
4. Sit with support; head steady	
5. Roll over from prone to supine position	
6. Roll over from supine to prone position	
7. Sit without support; body is not upright	
8. Sit without support; body is upright	
9. Creep	
10. Crawl	
11. Standing with support	
12. Walking with support	
13. Walking without support	
Total of mastered milestones	

Mark the fine motor milestones that is shown after presenting the object with a ✓. The *italic* number in brackets forms the score for the fine motor subscale.

Fine motor milestones	**Showed way of reaching/grasping**
No reaching ***(0)***	
Reaching, but no contact ***(1)***	
Contact only (no grasping) ***(2)***	
Primitive squeeze: palm and fingers enclose the object ***(3)***	
Hand grasp: claw-like move from above, with fingers and thumb in a parallel position ***(4)***	
Inferior pincer grasp: grasping with a stretched thumb and several fingers ***(5)***	
Superior pincer grasp: grasping with a bended thumb and forefinger ***(6)***	
Number of the showed way of reaching or grasping	

Appendix 3

PIS; Program Integrity Scale

Theoretical background

The Program Integrity Scale (PIS) is developed to determine the integrity of the Conductive Education intervention in the Sizanani Children's Home. CE, as it is developed by Petö, has a couple of key principles:

1. Learning is seen as a holistic process
2. The individual is seen as an active participant in the learning process
3. Continuity
4. The use of the semantic and rhythmic part of speech as a tool for children with brain damage to plan, intend and regulate their movements for carrying out motor functions
5. The conductor is seen as a facilitator of the learning process
6. Interdisciplinary
7. The group is a psychological entity that not only provides the environment for learning, but also can be used to facilitate and motivate children

CE, including these key principles, is comprehensively described by, among others, Fellner (2008).

Description of the subscales

In the PIS, the above mentioned principles of CE are operationalized into four criteria, which are considered by the CE conductor to be the most important for enhancing motor abilities in the Sizanani Children's Home. These criteria form the four subscales of the PIS:

1. *Positive reinforcement:* there is positive reinforcement when a desired response is strengthened by the presentation of a positive or rewarding stimulus after the response occurs (Skinner, 1963).
2. *Providing optimal help:* the degree of help with which the child seems to be able to actively accomplish the task. The degree of help must not result in passivity.
3. *Appropriate positioning:* an appropriate position will prevent further deformities, aid good circulation and facilitate the functioning of inner organs. It is important to position the children in such a way that they experience what it feels like to lie, sit, stand or walk in a way that is most useful in daily life. Since there are great individual differences between the children in Sizanani in their disabilities, deformities and contractures, what is appropriate for one child, may not be appropriate for the other. For a comprehensive description of appropriate positioning for the children in Sizanani, with specific positions for a majority of individual children, is therefore referred to Visser et al. (2010).

4. *Establishing an active, energetic, and motivating atmosphere:* an environment that provides a source of motivation and supports active participation.

Procedure

The integrity of practicing is determined by means of daily observations of the CE sessions and other moments during the day when the goals can be practiced. The presence of the four criteria is evaluated for each practicing session on a 5-point Likert scale. The scale ranges from 1: not at all conform the norms, 2: slightly, 3: moderately, 4: mostly, to 5: completely conform the norms. After evaluating a particular number of practicing sessions, the average of the scores of the four norms constructs the score for integrity of the intervention.

Simultaneously with the integrity, the intensity of the intervention is also evaluated and can be filled in on the same scoring form. The number of times that the goal is practiced forms the frequency of practicing for that observed CE session. Every time the child practices, the duration in minutes is noted down. The sum forms the duration of practicing for that session.

Reliability

The reliability of the PIS is analyzed using Cronbach's Alpha for the internal consistency of the scale and Cohen's Kappa for the agreement among observers. The PIS has an acceptable internal consistency ($\alpha = .72$) and the data are normally distributed. The former indicates that it is allowed to use the scale as a whole, instead of using the distinct subscale in the analyses. The inter-rater reliability values for the subscales positive reinforcement (Cohen's $\kappa = .75$), optimal help (Cohen's $\kappa = .86$), appropriate position (Cohen's $\kappa = .85$) and active, motivation atmosphere (Cohen's $\kappa = .80$) indicate a substantial agreement between the two observers in evaluating 20 CE practicing sessions.

References

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Scoring form PIS

Name child: ………………………………………………………………………………………..

Date of observation:	..... /..... /......... *day month year*				
Intensity					
Frequency of practicing:					
Duration of practicing:					
Integrity	Not at all	Slightly	Moderately	Mostly	Complete
Positive reinforcement	○	○	○	○	○
Optimal help	○	○	○	○	○
Appropriate positioning	○	○	○	○	○
Active, motivating atmosphere	○	○	○	○	○

Date of observation:	..... /..... /......... *day month year*				
Intensity					
Frequency of practicing:					
Duration of practicing:					
Integrity	Not at all	Slightly	Moderately	Mostly	Complete
Positive reinforcement	○	○	○	○	○
Optimal help	○	○	○	○	○
Appropriate positioning	○	○	○	○	○
Active, motivating atmosphere	○	○	○	○	○

Date of observation:	..... /..... /......... *day month year*				
Intensity					
Frequency of practicing:					
Duration of practicing:					
Integrity	Not at all	Slightly	Moderately	Mostly	Complete
Positive reinforcement	○	○	○	○	○
Optimal help	○	○	○	○	○
Appropriate positioning	○	○	○	○	○
Active, motivating atmosphere	○	○	○	○	○