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Master thesis

“Sensory storytelling stimulates responsiveness”

The effectiveness of an adapted version of Multi-Sensory Story Telling on the responsiveness of moderate to profound multiple disabled individuals in South Africa.

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Abstract

The effectiveness of an adapted version of Multi-Sensory Story Telling (MSST) on the responsiveness of 50 moderate to profound multiple disabled individuals from a residential children's home and associated day-care centres in South Africa was evaluated. MSST aims to stimulate responsiveness through reading stories with multi-sensory stimuli. The development in responsiveness was observed during an MSST training of ten sessions. Generalisation effects were examined with a new untrained story. Short and long term maintenance effects and the moderating role of fine and gross motor functioning were examined, as well as if the characteristic elements of MSST matter for its effectiveness. Responsiveness increased during the MSST training. Social responsiveness developed gradually, while manipulative responsiveness started to increase after five sessions. Only increases in social responsiveness were generalised towards the untrained story and maintained after six weeks without MSST. Both social and manipulative responsiveness gains from last years' training period were not maintained after nine months of lower frequency MSST since then. Fine motor functioning moderated the development of social responsiveness positively, while gross motor functioning moderated the growth in manipulative responsiveness negatively. Quality of MSST positively influenced the effectiveness of MSST on the development of both social and manipulative responsiveness. The results indicate that MSST is a promising intervention to stimulate the development of responsiveness of multiple disabled individuals in South Africa, but that frequent sessions of high quality are essential to achieve and maintain these gains.

Keywords: Multi-Sensory Story Telling, development, social, manipulative, responsiveness, multiple disabilities, motor functioning, quality

Samenvatting

De effectiviteit van een aangepaste versie van Multi-Sensory Story Telling (MSST) op de responsiviteit van 50 matig tot ernstig meervoudig beperkte individuen uit een kindertehuis en bijhorende dagopvangcentra in Zuid-Afrika werd geëvalueerd. Het doel van MSST is de responsiviteit te vergroten door verhalen met multi-sensore stimuli voor te lezen. De ontwikkeling in responsiviteit werd geobserveerd gedurende een MSST training van tien sessies. Generalisatie-effecten werden onderzocht met een nieuw ongetraind verhaal. Korte en lange termijn effecten werden bestudeerd, net als de moderatie effecten van fijne en grove motoriek. Ook werd gekeken werd of de karakteristieke MSST elementen de effectiviteit beïnvloeden. Responsiviteit werd verhoogd gedurende de MSST training. Sociale responsiviteit ontwikkelde gelijkmatig gedurende de training, hoewel manipulatieve responsiviteit na vijf sessies begon te groeien. Alleen de toename in sociale responsiviteit werd gegeneraliseerd naar een ander verhaal en behouden na zes weken zonder MSST. Zowel de winst in sociale als manipulatieve responsiviteit werd niet behouden na negen maanden MSST van lagere intensiteit. De fijne motoriek modereerde de ontwikkeling van sociale responsiviteit positief, terwijl de grove motoriek de groei in manipulatieve responsiviteit negatief modereerde. De kwaliteit van MSST beïnvloedde het effect van MSST op de ontwikkeling van sociale en manipulatieve responsiviteit positief. De resultaten indiceren dat MSST een veelbelovende interventie is om de responsiviteit van meervoudig beperkte individuen in Zuid-Afrika te vergroten. Frequente sessies van hoge kwaliteit zijn essentieel om deze ontwikkeling te bewerkstelligen en te behouden.

Zoekwoorden: Multi-Sensory Story Telling, ontwikkeling, sociaal, manipulatief, responsiviteit, meervoudige beperkingen, motorisch functioneren, kwaliteit

Introduction

Storytelling and reading aloud are ancient and cross-cultural traditions that many children like (van den Berg, Middel, & Nouse, 1996; Dollerup, 2003). Moreover, they stimulate children's cognitive, communicative and socio-emotional development (Penne et al., 2012). Even multiple disabled individuals can learn from these activities (Park, 1998). However, because of their limitations and lack of fundamental skills, they need extra effort and support from their environment to develop and retain acquired abilities (Gibson, 1988; Petry & Meas, 2007). Although every child has the right to develop and learn, many facilities in developing countries like South Africa are only able to meet the basic needs of multiple disabled individuals due to financial constraints and limitations in the education of care workers (United Nations Children's Fund, 2013). Therefore, stimulating interventions need to be cost-effective and easy to implement. Multi-Sensory Story Telling suits these criteria, by offering multiple disabled individuals the opportunity to learn and understand the world in a special yet simple and inexpensive way (PAMIS, 2002). Present study evaluated the effectiveness of an adapted version of Multi-Sensory Story Telling on the responsiveness of moderate to profound multiple disabled individuals in a residential children's home and associated day-care centres in South Africa.

Multi-Sensory Story Telling (MSST)

MSST originates from Park's 'multisensory interactive drama' (1998) and Fuller's 'bag books' (1999) and was further developed by 'Promoting A More Inclusive Society' (PAMIS, 2002). In this structured stimulation programme, multi-sensory stories are read to children with profound multiple disabilities (PMD). These individuals are severely restricted in their cognitive, socio-emotional and motor functioning and often suffer from general health problems. Many also have communication, language and attention deficits (Zijlstra & Vlaskamp, 2005; Nakken & Vlaskamp, 2007; Bottcher, Flachs, & Uldall, 2010). Individuals with PMD generally have a mental age of around 24 months, corresponding with Piaget's sensorimotor stage of cognitive development (Ware, 1994; Piaget, 1952, 1954). They build a foundation of skills and knowledge by experiencing and exploring the world through their senses and physical movement (Gibson, 1988; Petry & Maes, 2007). MSST emphasizes on sensory experiences and social interaction, with the goal to stimulate children with PMD to explore and interact with their environment. This aims to promote their development of cognitive capacities, behavioural repertoire and socio-emotional, communication and language skills (PAMIS, 2002; Multiplus, 2008; Penne et al., 2012).

The stories of this study were as far as possible attuned to the participants' (dis)abilities, in order to be the most understandable and to optimally stimulate their development (PAMIS, 2002). A MSST session had a *fixed structure* (PAMIS, 2002). Structure is very important for children with PMD. Research showed that disabled children can acquire new (play) skills best with systematic (play) interventions and structured contexts and instructions (Jorup, 1979; Fall, Navelski, & Welch, 2002; Lifter, Ellis, Cannon, & Anderson, 2005; Lifter, Mason, & Barton, 2011; Frey & Kaiser, 2010; Barton & Wolery, 2008, 2010; Mesibov & Shea, 2010). Structure helps them to predict their environment and to understand their experiences (2005; Stahmer, Collings, & Palinkas, 2005; Petry & Maes, 2007). Moreover, *predictability* enables them to recognise what is expected from them, which seems to stimulate participation and anticipation on stimuli (Grove & Peacey, 1999; Monaghan & Rownson, 2008). It can also evoke a feeling of self-efficacy, which is suggested to increase their involvement and well-being (Young, Fenwick, Lambe, & Hogg, 2011; Petry & Maes, 2007). The story was regularly read in the same way, using the same words (PAMIS, 2002). Piaget emphasizes this *repetitive component*, because it stimulates learning of individuals in the sensorimotor stage (Piaget, 1951, 1952). As with structure, repetition increases the ability to predict the environment. Additionally, Vaughn and colleagues (2003) found that multiple disabled children need to be constantly reminded about how to use earlier acquired social skills.

Each page was illustrated by an *object of reference*. These objects contributed to the story's structure and were meant to enhance the participants' attention and to provoke exploration and meaningful responses. Visual, auditory, olfactory, tactile and gustatory stimuli were included, giving the participants a *multi-sensory experience* (PAMIS, 2002; Multiplus 2008; Penne et al., 2012). This aims to make MSST more suitable for individuals with language disabilities. As information enters the brain via several channels, individuals with PMD might easier apprehend their experiences. Sensory integration namely helps them to understand the story better without having a literal understanding (Mauer, 1999; Ayres & Robbins, 2005; Shams & Seitz, 2008). The objects thus seem to promote an effective way of learning for multiple disabled individuals.

The stories' *content* was based on daily experiences or frequently occurring activities, suiting the participants' experiential world. This aimed to familiarize them with these situations and to enable them to understand and cope better with these events in real life (Young et al., 2011; ten Brug, van der Putten, Penne, Maes, & Vlaskamp, 2012). As young children seem to learn more effectively of contextually relevant and developmentally appropriate instructions, the same is expected for individuals with PMD (Sandall, Hemmeter,

Smith, & McLean, 2005). The stories were short and the language was simple, adapted to the limited attention span and low cognitive level of individuals with PMD (PAMIS, 2002; Bottcher et al., 2010). The child's name was mentioned frequently to stimulate involvement and the maintenance of attention (Petry et al., 2005).

Social Learning

Individuals in the sensorimotor stage, and thus most individuals with PMD too, use social learning techniques to acquire and improve knowledge and skills. This includes imitation, observation, modelling and joint attention, whereby parents and other adults function as the child's example (Bandura, 1971; Gazzaniga, Heatherton, & Halpern, 2009). Since children with PMD strongly depend on their environment, care takers should optimally support them. They need to be *sensitive*; perceiving the child's behavioural signals, interpreting them accurately and responding adequately. This can be challenging, as individuals with PMD often communicate through basic, subtle and ambiguous bodily signals. However, by attuning their behavior to the child's needs, wishes and (dis)abilities, care takers can stimulate exploration, facilitate learning processes and promote optimal development (Petry & Meas, 2007). They should support and challenge the child just enough for him to perform a task, without helping too much or generating frustration (Goswami, 2008). Vygotsky (1978) described this as *the zone of proximal development*; the difference between what a child can do on his own and what he can achieve with guidance. *Intuitive parenting* is another aspect of being sensitive. This comprises simplifying and exaggerating emotional messages in facial expressions, gestures and touch (Papoušek & Papoušek, 1995). Speaking with a higher pitch, lower speed and exaggerated melody and rhythm is also important (Goswami, 2008). Due to the discrepancy between calendar and mental age of children with PMD, care takers might find it difficult to use this *infant directed speech* (Penne et al., 2012; Vallotton, 2012). However, this is very important because it highlights the important parts of the speech stream, facilitates the child's understanding of his experiences and sustains his attention (Papoušek & Papoušek, 1995; Goswami, 2008). Lastly, *positive reinforcement* is essential for social learning. This refers to immediately and systematically rewarding a child's desired response, which encourages children to show certain responses more, triggers mastery motivation and facilitates their development (Skinner, 1969; Wiegand & Geller, 2005). As these aspects described above are essential for the development of individuals with PMD, the storytellers were trained to apply them during MSST.

Effectiveness of MSST

Research on the effectiveness of MSST is limited and shows variable results. PAMIS (2002) found that children with PMD increased in behavioural responses, attention and interaction with the storyteller after a MSST training. They suggested that the stories can stimulate enjoyment, encourage recognition of and engagement in the story and promote the understanding of language. Young and colleagues (2011) also found that children with PMD engaged more with the stories and storytellers and were better able to cope with sensitive topics after they received MSST. In contrast to these positive findings, Jonckheere (2008) did not find significant effects of a MSST training on the wellbeing and involvement of children with PMD. These different outcomes might be due to methodological shortcomings, as discussed studies had a small sample size, lacked a control group and used different outcome measures. Additionally, they partly used questionnaires filled in by the participants' care takers, which are not objective instruments. Lastly, these studies did not examine maintenance and generalisation effects. All these elements, plus empirically validated theories, are necessary to be able to determine the effectiveness of MSST. More research that addresses these methodological issues is thus needed.

Present study did that. It evaluated the effectiveness of an adapted version of MSST on the responsiveness of moderate to profound multiple disabled individuals in a residential children's home and associated day-care centres in South Africa. The construct 'responsiveness' served as outcome measure, as Piaget (1952) viewed every social, cognitive and behavioural response as an attempt to explore the world. Individuals in the sensorimotor stage, and thus most children with PMD too, make sense of their experiences and environment through exploration (Thelen, 2000). Responses are also needed for reciprocal interactions, which in turn enables these individuals to make use of other people's knowledge, support and stimulation. Responsiveness thus contributes to their development, making it a suitable outcome measure (Goswami, 2008). Current research was conducted in 2015. To be able to draw conclusions about the effectiveness of MSST, several analyses were employed. Firstly, it was studied if the responsiveness of individuals with PMD could be improved after re-intensifying MSST. Their development was measured during ten sessions with the same story: the *trained story*. A matched control group design was used, enabling to determine the effectiveness of MSST with more certainty. As MSST of current study was as far as possible adapted to the (dis)abilities of children with PMD based on empirically validated theories (as described above), an increase in responsiveness was expected during the MSST training.

The second research question regards the capacity of 'learning by analogy'. This refers to finding correspondences between two events or domains of knowledge and transferring these to another situation (Goswami, 1991). Research regarding this generalisation ability among intellectually disabled children is limited, but findings suggest that a lack of generalization effects is quite common with these individuals (Ferretti & Butterfield, 1992; Lifshitz, Weiss, Tzuriel, & Tzemach, 2011). However, Bahrick (2002) found that 3.5-months-olds could already generalise intermodal knowledge across different tasks. As with any other therapy, the ultimate goal of MSST is that the knowledge and skills acquired during therapy are transferred to daily life situations (PAMIS, 2002). Finding a generalization effect would also support the effectiveness of MSST, as this is a prerequisite for an effective intervention. Current research therefore studied the first step of a generalisation effect by determining if the responsiveness level obtained during the MSST training could be generalized towards a similar type but different situation; the *untrained story*. The level of responsiveness obtained during the MSST training was expected to be generalised towards an untrained story.

A third way to draw conclusions about the effectiveness of an intervention is by examining its maintenance effects. In general, the positive results of an intervention should be maintained over time, before a programme can be considered as effective. Although research on maintenance effects among individuals with PMD is limited, they seem to have difficulties maintaining acquired skills (Frey & Kaiser, 2011; Case-Smith, 2013). Current study examined a short term maintenance effect by testing if the responsiveness level obtained during the training period was maintained after six weeks without MSST. A long term maintenance effect was studied by comparing the responsiveness level obtained at the end of last year's research period (Hogewind, 2015) to the responsiveness level towards the same story nine months later. Between these two measures, the participants received MSST of lower frequency, with a different story. By using this strict measure, current study examined the true long term maintenance compared to previous research done at current facility which were just speculations (Willems, 2014; Hogewind, 2015). It was expected that the responsiveness gains obtained after MSST training can be maintained on the short and long term.

When evaluating the effectiveness of an intervention, it is also important to determine who can benefit the most from it. With current study, it was examined if the effectiveness of MSST depends on the participants' level of fine and gross motor functioning. Motor abilities seem to influence children's development, by being a prerequisite for the acquisition and use of other developmental functions (Bushnell & Boudreau, 1993). Better motor abilities are also associated with higher levels of mastery motivation, which can stimulate involvement and

facilitate development (Majnemer et al., 2013; Wiegand & Geller, 2005). Moreover, a better motor functioning simply enables people to physically respond and manipulate objects more. Therefore, the responsiveness of participants with a higher motor functioning was expected to increase more during MSST training than that of those with a lower motor functioning.

At last, to be able to say something about the effectiveness of an intervention, the standards of fidelity must be met. Fidelity refers to the extent to which a treatment is implemented as it was intended, meaning conform its procedures and guidelines (Gearing et al., 2011). When MSST of current study was performed with fidelity, it is likely that the characteristic elements contributed to its effectiveness. In that case, responsiveness was expected to increase more for the participants who received MSST of higher quality. When MSST was performed inconsistent with its guidelines, no conclusions can be drawn about the importance of its active components. The participants then might just have benefited from the extra attention they received, or their responsiveness did not increase because of the poor quality of MSST (Carnaby & Cambridge, 2002; Petry & Maes, 2007).

Methods

Participants

Originally, 53 multiple disabled individuals participated in current MSST intervention. However, one passed away and two others were eliminated because they showed lots of protest and distress during the sessions. The remaining sample consisted of 29 girls and 21 boys from a residential children's home (n = 26), a group home (n = 6) and three associated day-care centres (n = 18) in South Africa. The residence accommodates orphaned and abandoned children of whom many receive 24-hour care. The group home offers assisted living to the abler young women who previously stayed at the residence. Because the inhabitants of these two facilities have the same social background, they are referred to as *residents*. The day-cares are for children who live at home with their families/caretakers, but who cannot go to a regular school due to their disabilities. These centres provide children with care, leisure activities and basic education during daytime on weekdays and are located in townships. Procedures of this study were performed in compliance with the relevant South-African laws and guidelines. Procedures on behalf of the residents were approved by the institutional committee of the residence, as they had legal guardianship over the children. For the day-care participants, a caretaker signed an informed consent.

At the start of this study, the participants were between 4 and 38 years old (M = 16.5; SD = 9.30). As Table 1 shows, the residents were on average older than the day-care participants.

All participants are referred to as children, according to their mental age. The development manager of the residence selected the participants, based on her professional judgement of the participants' intellectual (dis)abilities and suitability for MSST. Based on last year's responsiveness levels (Hogewind, 2015), children who exceeded the level of MSST were transferred to a therapy of higher cognitive level. Due to financial constraints and a lack of professional expertise, a number of participants is not diagnosed properly but to best efforts and insight. Besides an intellectual disability, all participants have at least one other disability. Most suffer from cerebral palsy (n = 42; 84%). Other concomitant disorders are epilepsy (n = 17; 34%), visual impairments including blindness (n = 12; 24%) and microcephaly (n = 6; 12%). Hearing deficits including deafness (n = 4; 8%), autism (n = 4; 8%), Down Syndrome (n = 2; 4%) and brittle bone disease, schizophrenia, hydrocephalus and scoliosis (n = 1, 2%) occur less frequently. Additionally to MSST, two other interventions were given at the facilities. Of all participants, 44 also received Conductive Education (CE; see Mulder, 2016), 17 received Cognitive Objects Play Intervention (COPI; see Schouw, 2016) and 11 received all three therapies. The residential staff was specialized in one therapy in order to alleviate their workload and to increase their motivation for and knowledge of this intervention. This was not possible at the day-cares and group home, due to a lack of childcare workers.

All analyses were checked for possible effects of several other characteristics of the study sample (e.g. location (residents versus daycares), additional interventions (CE and/or COPI), story), training period (first versus second), but no significant differences were found and deleting a small subgroup did not change the findings.

Table 1
Numbers, Sexes, Mean Ages, Standard Deviations and Ranges

Location	*n* total	*n* girls	*n* boys	*M* (years)	*SD*	Range
Residence	32	19	13	20.6	8.81	4.5 – 38.3
Day-cares	18	10	8	9.1	4.19	3.9 – 20.0
Total	50	29	21	16.5	9.30	3.9 – 38.3

Multi-Sensory Storytelling (MSST)

The MSST intervention carried out by current research facilities has an annually fixed pattern. MSST was introduced to the residents in 2009 by Nispel and Vermeer (2010) and from 2013 implemented at the day-cares. Since 2011, research have been conducted from February to June. During this period, MSST was implemented two to three times a week with close supervision of the researcher. Then, after some weeks of holiday, MSST was performed

weekly with little supervision until the next research period. From December until mid-January, the participants did not receive MSST due to the summer holiday.

In general, a storytelling session took about six minutes. It started with the presentation of a red box, containing the required material. Then the story was told, which was concluded with the "goodbye song". Every story consisted of seven pages, each with two to three sentences. Per page, the text was written on A3 sized cardboard, in English and Zulu (PAMIS, 2002). The story was read in the language best understood by the participant. Since 2009, the same stories circulated and new ones were developed (Halfens, 2012; van Eck, 2013; Willems, 2014; Hogewind, 2015). For this study too, new stories were written to optimise the participants' development of responsiveness. Three were improved versions of already existing stories and two were completely new. They regarded brushing teeth, washing hair, getting a haircut, having a picnic and a doctor's visit. Compared to the existing stories at the research facilities (Halfens, 2012; van Eck, 2013; Willems, 2014; Hogewind, 2015), these stories had a more cohesive and logically structured storyline and a more didactic content. Additionally, the objects were closer related to the story and covered all senses at least ones.

Procedure

MSST was performed by the staff of the research facility and one volunteer, who are referred to as storytellers. Prior to current research period, all storytellers received a refreshment training about the importance and essential elements of MSST to make sure that they performed it conform its guidelines. Moreover, last year's positive research findings were presented to stimulate them to continue with MSST (Hogewind, 2015). During some therapy sessions, the researcher gave them feedback on their performance.

Each participant received MSST from the same storyteller during the entire research period. The development manager of the residence made these matches, based on her professional judgement of the relationship between the participants and storytellers. This matching aimed to increase the storyteller's sensitivity towards the participant, to optimize their interaction during MSST and to ensure the continuity of MSST (Petry et al., 2005). MSST was always given at the same place. This place was familiar to the participant and storyteller, so that both felt comfortable and could focus on the therapy. Figure 1 shows the position of the participant, storyteller and videographer when the session was recorded. Appendix 1 gives a detailed description.

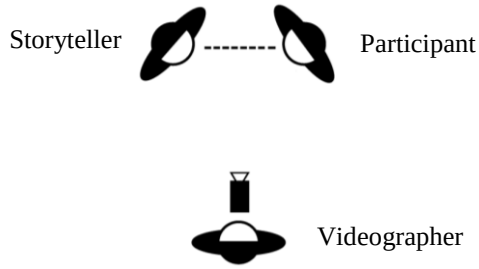

Figure 1. Positions of the storyteller, participant and videographer during MSST.

Instruments

Storytelling Responsiveness Scale (SRS). The SRS is an observational list to measure responsiveness, originally designed by Halfens (2012) and improved for this study. It consists of 17 items, describing meaningful behavioural responses (see Table 2). Responsiveness was scored using videotaped MSST sessions. Appendix 2 and 3 contain the SRS scorings form and an extensive explanation of the items. In the present version, most items were scored by counting the number of displayed behavioural responses per page and dividing the total sum of responses on all items by the duration of the MSST session in minutes. Hereby, one frequency per minute score was created. Although the items *claps hands*, *talks/sings* and *moves on sounds/singing* were included in this score, during the goodbye song these were scored dichotomously (absent = score 0, present = score 1). This was because participants either showed this behaviour during big parts of or the complete song, or they did not at all. The items *looks at object*, *looks at storyteller* and *smiles* were scored by partial-interval time sampling, with five second intervals. The percentage of intervals within which these responses were shown, were converted into Likert scale scores, to make them more comparable in range to the other items. For the items *looks at object* and *looks at storyteller,* the scale was: never (0%) = score 0, rarely (> 0-20%) = score 1, occasionally (20-40%) = score 2, regularly (40-60%) = score 3, often (60-80%) = score 4 and almost always to always (≥ 80%) = score 5. The item *smiles* has a 5-point Likert scale: never (0%) = score 0, rarely (> 0-10%) = score 1, occasionally (10-40%) = score 2, regularly (40-60%) = score 3 and often to always (≥ 60%) = score 4. The total frequency per minute score, the three dichotomous scores and the three Likert scale scores formed the subscale 'social responsiveness'. This subscale relates to all social responses of the participant and his interaction with the storyteller.

For the items *reaches/moves towards, touches* and *manipulates (functionally),* the frequencies were combined and divided by the times the objects were within the range of the participant's senses. Hereby, the amount of manipulations was expressed as the percentage of possibilities the participant was given. This score formed the subscale 'manipulative responsiveness', representing all behavioural responses directly related to the objects.

Table 2

Defined Items of the Storytelling Responsiveness Scale

Item	Definition
Social responsiveness	
Frequency social responses	
Claps hands	Brings two hands together in one movement, or taps with one/both hands on another body part, the storyteller's hand, or a part of the (wheel)chair/bed. Sound is not necessary
Nods yes/shakes no	*Nods yes:* lowers and raises head slightly and briefly *Shake no*: moves head sideways
Waves/points/gestures	*Waves*: moves hand(s) back and forth as in greeting. *Points*: stretches arm and uses index finger/hand to focus attention on a particular referent. *Gestures*: moves hand(s), arm(s) or other body part(s) to emphasize speech or express thoughts or emotions
Talks/sings	Produces words, by saying, repeating or singing them. Correct pronunciation is not necessary
Happy vocalizations	Laughs/produces sounds of joy/happiness
Vocal utterances	Produces sound(s) which have a communicative value but do not form words, in order to express an emotion or thought, answer a question or ask for attention
Child specific responses	Any physical response that characterizes the way a child reacts to the environment and expresses thoughts or emotions (e.g. a blind girl opens her eyes widely when hearing music)
Moves on sounds/singing	Moves part(s) of the body back and forth and/or up and down, as in swaying, rocking or dancing. Moving to the rhythm is not necessary
Makes physical contact with storyteller	Reaches for/touches the storyteller
Other responses	Residual category for physical responses that are rare, covering things like imitation of storyteller's behaviour, startle responses, all facial expressions other than smiling (e.g. frowning and making funny faces) and when the participant touches himself at the spot where an object/the storyteller's hand was placed
Goodbye song responses	
Claps hands	See description above
Talks/sings	See description above
Moves on sounds/singing	See description above
Looking behaviour	
Looks at object	Focuses eyes on and/or turns head towards the object
Looks at storyteller	Focuses eyes on and/or turns head towards the storyteller
Positive facial expression	
Smiles	Turns corners of the mouth upwards and alters facial features into a pleased or amused expression. Exposure of front teeth is not necessary
Manipulative responsiveness	
Reaches/moves towards	*Reaches:* stretches arm(s) out to touch/grasp an object. *Moves towards:* moves head and/or upper body and/or leg(s) towards the object
Touches	Strokes/hits the object for less than two seconds, without grasping it
Manipulates	Explores the object for at least two seconds
Manipulates functionally	Uses the object according to its intention/function. This includes pretend play and role taking

Due to time constraints, the SRS-scores were entered into SPSS as the sub-scores *frequency social responses*, *goodbye song responses*, *looking behaviour*, *positive facial expression* and

the sub-scale *manipulative responsiveness* (see Table 2). Cronbach's Alpha for the SQS was based on these sub-scores, probably decreasing its value. For the total responsiveness at all trained storytelling sessions (n = 149), Cronbach's Alpha was .61. This is good for an observational list examining a very heterogeneous group. Cronbach's Alpha for the subscale social responsiveness was .61, based on the sub-scores *frequency social responses*, *goodbye song responses*, *looking behaviour* and *positive facial expression*.

In order to determine the inter-observer reliability of the SRS, current researcher scored ten randomly selected videos from Hogewind's (2015) research. The scores of the two researchers were compared. The intra-class correlation coefficient was excellent, ranging from .89 to 1.00 ($p < .002$). Using a T-test, their scores did not differ significantly. As the SRS used by Hogewind (2015) was improved for current study, the researcher scored the new items for 10 randomly selected videos and compared them with those of a third researcher. The items, *looks at object*, *looks at storyteller* and *positive facial expression* had a good Cohen's Kappa ($.75 \leq K \leq .80$). For the other items, the intra-class correlation coefficient was excellent, ranging from .95 to 1.00. A T-test showed that the scores of the two researchers did not differ significantly.

Storytelling Quality Scale (SQS). The SQS measures the quality of the storyteller's MSST performance. This observational scale was developed by Hogewind (2015). The SQS consists of 12 items (see Table 3), based on the essential aspects of MSST (PAMIS, 2002; Multiplus, 2008; Penne et al., 2012). Five items concern the required therapy actions and six items regard the storyteller's desired social behaviour. The item *procedural mistakes* covers six types of mistake regarding fixed MSST elements (see Table 3). This item was scored by summing the number of mistakes. *Exploration time* was expressed as the percentage of the therapy session the objects of reference were within the range of the participant's senses. To make the range in outcomes comparable to the other items, it was converted into a Likert scale score: never to occasionally (< 60%) = score 0, regularly (60 - 70%) = score 1, often (70 - 80%) = score 2, very often (80 - 90%) = score 3 and almost always to always (> 90%) = score 4. All other items were scored by using a 5-point Likert scale: poor/never = score 0, moderate/occasionally = score 1, average/regularly = score 2, above average/often = score 3 and good/always = score 4. For the scorings form and an extensive explanation of the SQS-items, see Appendix 4 and 5. The total SQS-score is the sum of all Likert scale scores, excluding the items *exploration time* and *overall quality*. *Exploration time* was excluded, because it decreased the Cronbach's Alpha for the SQS considerably. The item *procedural*

mistakes was excluded, as this is a different measure and therefore not comparable with the Likert scale scores. These two items were analysed separately to determine the quality of MSST. The item *overall quality* was compared with the total SQS-score to check the validity of the SQS. A significant correlation of $r = .82$ ($p < .001$) was found, indicating a good validity.Without the items *procedural mistakes* and *exploration time*, Cronbach's Alpha for the SQS was .73, which is good. Cronbach's Alpha for the subscales 'required therapy actions' and 'storyteller's social behaviour' were good, respectively .60 and .61. For the inter-observer reliability of the SQS, current researcher randomly selected and scored ten videos from previous research (Hogewind, 2015). The scores of current and previous researcher were compared. The intra-class correlation coefficient is excellent, ranging from .81 to 1.00 ($p < .004$). A T-test showed that the scores of the two researchers did not differ significantly.

Table 3
Defined Items of the Storytelling Quality Scale

Items	Definition
Required therapy actions	
Procedural mistakes	Number of not performed fixed MSST elements, i.e., proper preparation, correct sequence of pages and objects, reading all pages, showing all objects and the red box, singing the end song
Exploration time	Total time the objects are within the range of the participant's senses
Verbal encouragement	Encourages the participant verbally to explore the object and repeats the participant's name
Encouragement through action	Encourages the participant to explore the objects by offering them in a way that is adapted to the participant's (dis)abilities and needs
Participant's positioning	Adjusts the participant's position to his (dis)abilities and needs, so that he is comfortable, can interact with the storyteller and can explore the objects
Storyteller's social behaviour	
Positive facial expression	Smiles: lifts corners of the mouth and alters facial features into a pleased, kind or amused expression. Exposure of the front teeth is not necessary
Eye contact	Tries to make eye contact with the participant. The participant does not have to look back
Positive physical contact	Touches the participant as in comforting, reassuring, coddling or getting attention.
Direct positive reinforcement	Reinforces a desired response directly after it occurred in a positive way, by presenting a positive or rewarding stimulus. This can be done (non)vocally, and physically
Exciting/dynamic reading	Tells the story with exaggerated voice intonation and enthusiasm and uses explicit facial expressions and gestures
Sensitivity	Attunes behaviour to the participant's needs and wishes: perceives his signals, interprets them accurately and responds adequately
Overall quality	Overall quality estimation based on the researcher's gut feeling

Fine and Gross Motor Scale (FGMS). The FMGS measures both fine and gross motor functioning and was developed by Twilhaar, van Beek and Magyarszeky (2014). Data about the participants' motor functioning were retrieved from Mulder's research (2016), conducted

simultaneously as current study. To measure fine motor functioning, the participants had to pick up three objects of different size. The way the participant did this was scored based on seven fine motor skill milestones (see Table 4). The average of the three scores formed the fine motor functioning score (FMS-score). The gross motor functioning score (GMS-score) was represented by the highest mastered gross motor milestone as listed in Table 5. For the FGMS scoring forms and the objects, see Mulder (2016). Cronbach's Alpha for the FMS and GMS were excellent, .91 and .97 respectively. The inter-observer reliability between two researchers was also excellent, with Cohen's Kappa's of 1.00 for FMS and GMS.

Table 4
Fine Motor Scale Milestones

Milestone
No reaching, no response at all
Reaching, but no contact
Contact only, but not grasping
Primitive squeeze; palm and fingers enclose the object
Hand grasp; claw-like move from above, fingers and thumb in parallel position
Inferior pincer grasp, with thumb and several fingers stretched
Superior pincer grasp, with thumb and forefinger bended

Table 5
Gross Motor Scale Milestones

	Milestone
1.	Foetal position
2.	Lifting head
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 not upright
8.	Sit without support, body upright
9.	Creep
10.	Crawl
11.	Standing with support
12.	Walking with support
13.	Walking without support

Design

The entire research period was divided into two MSST periods. During period 1, the MSST group was trained while the other served as control group. During period 2, the control group was trained and the MSST group was not. Within six consecutive weeks, each participant

received 10 MSST sessions with the trained story. The first, fifth and tenth session of this training period, also referred to as the pre-, halfway- and post-test, were videotaped. Shortly before and after this period, they were read the untrained story. These sessions are referred to as the pre- and post-test with the untrained story. Both sessions were videotaped. Table 6 shows all videotaped MSST sessions throughout the research period.

Table 6
Videotaped MSST Sessions per Group during Research Period

				Training period 1				Training period 2			
Group			Baseline	Pre-test	Halfway test	Post-test		Pre-test	Halfway test	Post-test	
MSST	Story nr[a]	LTMS	UTS 1	TS 1	TS 5	TS 10	UTS 2				TS 11
Control	Story nr[a]	LTMS	UTS 1				UTS 2	TS 1	TS 5	TS 10	UTS 3

Note. [a] Number of the session. LTMS is the trained story of last year's research. UTS and TS are respectively the untrained and trained story.

The participants were matched to each other based on their responsiveness at the first untrained storytelling session; the *baseline* session. Because the residential and day-care participants differ in social background, matches were formed within these groups. Participants were matched for comparable disabilities as much as possible. As the participants' baseline responsiveness varied strongly, some could not be matched. In total, 42 participants (26 residents and 16 day-care participants) were matched. After the matching procedure, the participants were randomly assigned to a group, with one member of each match per group. Due to time constraints, only the group receiving MSST in the first period received a follow-up session with the trained story after six weeks without MSST in order to measure the short term maintenance effect (TS 11 in Table 6).

The long term maintenance effect was analysed with the participants of last year's research (Hogewind, 2015), who were still present at the start of current study (LTMS in Table 6). This concerned 16 girls and 15 boys from the residence (n = 25) and day-cares (n = 6). Videos of the last session of the MSST training of Hogewind (2015) were scored by current researcher. For the post-test of this analysis, the participants were read the same story as last year. Between these measurements, the participants received weekly MSST with a different story for seven months. Although the storyteller of 16 participants differed between the pre- and post-test, this did not influence the results.

The quality of MSST was measured at the halfway-test of the training period. As the storytellers get more and more familiar with the story during this period, they are likely to improve their performance. The MSST performance at the fifth session is therefore assumed

to represent the average quality across all ten sessions given by a particular storyteller to a certain participant the best.

Preliminary Data Analyses

Normality checks of the total, social and manipulative responsiveness scores indicated rightly skewed distributions. These data were normalized with square root transformations. Data for the long term maintenance effect were normally distributed. For analysis with a sample size below 25, effects with $p < .1$ will also be reported.

In order to verify if the participants were matched correctly, the baseline responsiveness scores of the matched participants were compared with a T-test. The MSST group (first period) did not differ significantly from the control group in total, social nor manipulative responsiveness, indicating that the participants were matched correctly.

Normality checks of the SQS-scores showed a left skewed bimodal distribution. Attainable scores lie between 0 and 36. Current SQS-scores ranged from 12 to 34, with a mean of 24.0 (*SD* = 5.53). On average, 0.70 procedural mistakes were made per session, with a range of 0 to 4 mistakes across all 50 sessions. These outcomes suggest that the quality of MSST was at an acceptable level. However, the total quality of 22 sessions was below average. The distribution showed that the SQS-scores were divided into two groups, with a SQS-score of 19 as separation point. Scores below 20 were therefore considered as unacceptable and scores of 20 and higher as acceptable. Based on this distinction, ten sessions were of unacceptable quality. A dummy variable was created in order to be able to differentiate between an acceptable and unacceptable quality of MSST in further analyses; *unacceptable* (SQS-score < 20) versus *acceptable* (SQS-score ≥ 20) quality.

In terms of motor functioning, the participants mastered an average fine motor functioning of 2.57 (*SD* = 2.01, range = 0.00-5.67). For the gross motor functioning, all possible scores from 0 to 13 occurred (*M* = 7.06, *SD* = 4.06).

Results

As the outcomes for social and manipulative responsiveness differ a lot from each other, these results are showed separately. Following analyses were conducted with one-way repeated measures ANOVA's.

Development of Responsiveness within the Training Period

MSST versus control group, during period 1. To measure the effectiveness of MSST, the responsiveness of the MSST group at the pre- and post-test of training period 1 was

compared to the responsiveness of the matched control group at the untrained storytelling session shortly before and after this period. As Table 7 shows, the interaction effect for social responsiveness was not significant and borderline for a trend, $F(2, 38) = 2.85$, $p = .10$, $\eta_p^2 = .07$. The main within effect was significant, $F(1, 39) = 4.87$, $p = .033$, $\eta_p^2 = .11$. Social responsiveness increased significant for the MSST group, $F(1, 19) = 6.76$, $p = .018$, $\eta_p^2 = .26$. The control group increased slightly too in social responsiveness, but not significantly. The increase in social responsiveness seem to be mainly caused by MSST group, but this cannot be concluded with certainty. For manipulative responsiveness, a significant interaction effect was found, $F(2, 38) = 16.32$, $p < .001$, $\eta_p^2 = .26$. Manipulative responsiveness increased significantly for the MSST group, $F(1, 19) = 22.57$, $p < .001$, $\eta_p^2 = .54$, but not for the control group.

Table 7
Means and Standard Deviations for Social and Manipulative Responsiveness at the Pre- and Post-test Measurements per Group

	MSST group		Control group	
	Trained pre-test	Trained post-test	Untrained pre-test	Untrained post-test
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*
Social responsiveness	10.38 (8.35)	12.05 (8.06)	9.70 (6.69)	10.28 (7.41)
Manipulative responsiveness	0.70 (0.50)	1.26 (1.01)	0.68 (0.56)	0.63 (0.47)

Note. $n = 20$ per group.

Developmental pattern during training of the complete group. The effectiveness of MSST and its development during the training was also measured by comparing the responsiveness at the pre-, halfway- and post-test of both training periods combined, including all participants (matched or not). Table 8 shows a significantly increasing overall within effect for social and manipulative responsiveness, respectively $F(2, 96) = 5.59$, $p = .005$, $\eta_p^2 = .10$ and $F(2, 96) = 18.33$, $p < .001$, $\eta_p^2 = .28$. Social responsiveness increased gradually during the ten training sessions, $F(1, 48) = 9.21$, $p = .004$, $\eta_p^2 = .16$. For manipulative responsiveness, the linear and quadratic effect were significant, $F(1, 48) = 29.23$, $p < .001$, $\eta_p^2 = .38$ and $F(1, 48) = 5.18$, $p = .027$, $\eta_p^2 = .10$. Whereas manipulative responsiveness did not significantly increase between the pre- and halfway-test, it did between the halfway- and post-test, $F(1, 48) = 23.41$, $p < .001$, $\eta_p^2 = .33$.

Table 8
Means and Standard Deviations for Social and Manipulative Responsiveness at the Pre-, Halfway- and Post-test of the Training Period of both Groups Combined

	Pre-test	Halfway-test	Post-test
	M (SD)	*M (SD)*	*M (SD)*
Social responsiveness	10.20 (7.52)	11.09 (7.49)	11.37 (7.04)
Manipulative responsiveness	0.69 (0.48)	0.73 (0.45)	1.02 (0.74)

Note. $n = 49$.

Generalisation of Responsiveness towards the Untrained Story

MSST versus control group, during period 1. It was examined if the responsiveness obtained during the MSST training was generalised to the untrained story. Responsiveness at the untrained storytelling session shortly before and after training period 1 were compared for the MSST versus matched control group.

Table 9
Means and Standard Deviations for Social and Manipulative Responsiveness at Pre- and Post-test with the Untrained Story per Group

	MSST group		Control group	
	Pre-test	Post-test	Pre-test	Post-test
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*
Social responsiveness	9.93 (7.29)	12.25 (7.79)	9.70 (6.69)	10.28 (7.41)
Manipulative responsiveness	0.78 (0.61)	0.83 (0.53)	0.68 (0.56)	0.63 (0.47)

Note. $n = 20$.

Table 9 shows a significant interaction effect for social responsiveness, $F(2, 38) = 6.99$, $p = .012$, $\eta_p^2 = .16$. Social responsiveness during reading the untrained story increased significantly for the MSST group, $F(1, 19) = 18.78$, $p < .001$, $\eta_p^2 = .50$, but not for the control group. Two other analyses show the same. Combining both periods, social responsiveness of all participants increased significantly between the pre-test ($N = 50$, $M = 10.10$, $SD = 6.87$) and post-test with the untrained story ($M = 12.07$, $SD = 7.66$). Results even show that the social responsiveness level at the post-test of the training period ($N = 50$, $M = 11.63$, $SD = 7.20$) and the post-test with the untrained story ($M = 12.07$, $SD = 7.66$) were about the same. However, as Table 9 shows, no significant interaction nor main effect was found for manipulative responsiveness during the first period. Both MSST and control group did not increased in manipulative responsiveness during reading the untrained story. Manipulative responsiveness at the post-test with the untrained story ($N = 50$, $M = 0.79$, $SD = 0.53$) was even significantly lower than at the post-test with the trained story ($M = 1.03$, $SD = 0.74$).

Maintenance of Responsiveness

Short term maintenance effect. To measure this effect, the responsiveness at the pre- and post-test of the training period and a follow-up session six weeks later were compared, including all participants who received MSST during period 1. Table 10 shows that social responsiveness was maintained and even seem to have further developed after six weeks without MSST, $F(1, 27) = 8.16$, $p = .008$, $\eta_p^2 = .23$. Manipulative responsiveness was not maintained, $F(2, 26) = 16.84$, $p < .001$, $\eta_p^2 = .38$, but decreased significantly between the post-test and follow-up session, $F(1, 27) = 8.86$, $p = .006$, $\eta_p^2 = .25$.

Table 10
Means and Standard Deviations for Social and Manipulative Responsiveness at the Pre- and Post-test and Follow-up Session with the Trained Story

	Pre-test	Post-test	Follow-up
	M (SD)	*M (SD)*	*M (SD)*
Social responsiveness	11.93 (8.82)	13.09 (7.87)	13.72 (8.38)
Manipulative responsiveness	0.76 (0.46)	1.14 (0.84)	0.89 (0.54)

Note. $n = 28$.

Long term maintenance effect. To examine this effect, the responsiveness at the end of last year's training periods (Hogewind, 2015) and at the session with the same story nine months later, at the start of current research, were compared. Table 11 shows a significant decrease in social responsiveness between pre- and post-test, $F(1, 30) = 5.47$, $p = .026$, $\eta_p^2 = .15$. Although manipulative responsiveness just not decreased significantly, $F(1, 30) = 3.84$, $p = .059$, $\eta_p^2 = 11$, the post-test data had a positive outlier. Without this outlier, manipulative responsiveness decreased significantly, $F(1, 29) = 8.21$, $p = .008$, $\eta_p^2 = .22$.

Table 11
Means and Standard Deviations for Social and Manipulative Responsiveness at the Long Term Pre- and Post-test

	Pre-test	Post-test
	M (SD)	*M (SD)*
Social responsiveness[a]	12.50 (8.54)	10.73 (7.61)
Manipulative responsiveness[b]	0.84 (0.53)	0.64 (0.46)

Note. [a] $n = 31$, [b] $n = 30$.

Moderation effects

Hierarchical multiple regression analyses were employed to determine if the change in responsiveness during the MSST training is moderated by the participants' fine and gross motor functioning and the quality of MSST.

Fine and gross motor functioning. The dependent variable of this analysis was the difference in responsiveness of all participants between the pre- and post-test of their training period. The predictors were the responsiveness at the pre-test of both training periods, the FMS-score and mean centred GMS-score variable and the two interaction terms of the pre-test responsiveness scores and the FGMS-variables. Table 12 shows that participants with a higher fine motor functioning increased more in social responsiveness during MSST training than those with a lower fine motor functioning. The interaction term of social responsiveness and fine motor functioning was a trend (p = .09). When the variables regarding the gross motor functioning were eliminated from this analysis, a significant interaction effect was found for fine motor functioning and the development of social responsiveness. Compared to participants with a lower fine motor functioning, those with a higher fine motor functioning increased significantly more in social responsiveness during MSST training. But when the latter had a higher pre-test level of social responsiveness, they increased less, *Fchange* (3, 37) = 4.36, p = .04 for Model III. Gross motor functioning did not moderate the development of social responsiveness.

Table 12
Hierarchic Regression Analyses of Fine and Gross Motor Functioning on Growth in Responsiveness

	Δ Post-test – pre-test responsiveness					
	Social			Manipulative		
Predictor	t	β	R^2	t	β	R^2
Model I			.05			.06
Constant	2.67			3.68*		
Pre-test	-1.65	-0.23		-1.80	-0.25	
Model II			.12			.12
Constant	2.83			3.81**		
Pre-test	-2.46*	-0.40		-2.41*	-0.41	
FMS	1.90	0.31		0.90	0.17	
GMS	-	-		0.85	0.15	
Model III			.20*			.32*
Constant	0.41			1.22		
Pre-test	0.11	0.03		-0.49	-0.14	
FMS	2.70*	1.06		1.05	0.48	
GMS	-	-		-3.06*	-1.51	
Pre-test x FMS	-2.09*	-1.09		-0.73	-0.45	
Pre-test x GMS	-	-		3.48*	1.71	

Note. n = 50. * p < 0.05, ** p < 0.01.

The development of manipulative responsiveness was only moderated by gross motor functioning. Compared to participants with a higher gross motor functioning, participants with a lower gross motor functioning increased significantly more in manipulative responsiveness during MSST training. But when the latter had a higher pre-test level of manipulative responsiveness, they increased less, *Fchange* (5, 45) = 6.73, p = .003 for Model III.

Storytelling quality (SQ). The dependent variable of this analysis was the difference in responsiveness of all participants between the pre- and post-test of their training period. The first predictor is the responsiveness at the pre-test of the training period. The second predictor is the dummy SQS-score, distinguishing acceptable from unacceptable quality levels. The interaction term of pre-test responsiveness scores and dummy SQS-scores is the third predictor. Table 13 shows that social responsiveness increased significantly more during training for participants with a lower pre-test level. However, social responsiveness of the participants with a higher pre-test level increased more when MSST was of acceptable quality, *Fchange* (3, 47) = 4.53, p = .039 for Model III. MSST quality did not moderate the development of manipulative responsiveness.

Table 13
Hierarchic Regression Analyses of the Quality of MSST (Acceptable versus Unacceptable) on Growth in Responsiveness

	Δ Post-test – pre-test responsiveness					
	Social			Manipulative		
Predictor	t	β	R^2	t	β	R^2
Model I			.05			.06
Constant	2.67*			3.68*		
Pre-test	-1.65	-0.23		-1.80	-0.25	
Model II			.08			.10
Constant	1.28			2.07*		
Pre-test	-1.48	-0.21		-1.69	-0.24	
SQS	1.13	0.16		1.41	0.20	
Model III			.16*			.12
Constant	2.50*			-0.03		
Pre-test	-2.54*	-0.96		0.33	0.14	
SQS	-1.70	-0.80		1.24	0.67	
Pre-test x SQS	2.13*	1.16		-0.91	-0.60	

Note. *p < 0.05, **p < 0.01.

An one-way repeated measures ANOVA was employed to examine if the quality of the SQS-subscale ‘required therapy actions’ (RTA) influenced the development of manipulative

responsiveness during both training periods combined. The RTA-scores were divided into acceptable (≥ 9) and unacceptable (< 9) levels of quality. This distinction is made based on that the three items of the RTA-scale should be 3 or 4 on average, as these scores correspond with a good to excellent quality. Item scores lower than 3 are regarded as average to poor, associated with an unacceptable quality. A significant interaction effect was found, $F(2, 48) = 5.60$, $p = .022$, $\eta_p^2 = .10$. Manipulative responsiveness increased significantly between the pre- and post-test of the training periods with RTA of acceptable quality ($N = 50$, $M = 0.41$, $SD = 0.53$), $F(1, 40) = 36.79$, $p < .001$, $\eta_p^2 = .48$, but not when the RTA were of unacceptable quality ($M = 0.05$, $SD = 0.27$).

Discussion

Present study evaluated the effectiveness of an adapted version of a MSST intervention on the responsiveness of moderate to profound multiple disabled individuals in a residential children's home and associated day-care centres in South Africa. With this study, new insights have been gained. As the results for social and manipulative responsiveness differed considerably, these findings will be discussed separately.

Effectiveness on social responsiveness

Although social responsiveness of the trained group increased significantly during these ten sessions, it seem to have increased slightly for the control group too after just two sessions with the same story. This is in line with the finding that social responsiveness of all participants already increased after five sessions and gradually developed further. Additionally, although individuals with PMD seem to have difficulties maintaining acquired skills (Frey & Kaiser, 2011; Case-Smith, 2013), a positive short term maintenance effect was found for social responsiveness. The level of social responsiveness obtained during the training period was maintained and even seem to have further developed after six weeks without MSST. Furthermore, in contrast to other studies (Ferretti & Butterfield, 1992; Lifshitz et al., 2011), the social responsiveness level obtained during the MSST training was transferred towards a different type but similar situation: a session with a new and untrained story. Compared to the group that did not receive MSST, the trained group also increased significantly in social responsiveness towards the untrained story. The development of social responsiveness between the two untrained storytelling sessions was even as big as during the training period. Social skills mastered during the MSST training were thus transferred to a session with an unfamiliar story. This first step in generalizing skills suggest that individuals with PMD seem to be able to learn by analogy, at least when it comes to social

responsiveness. These results suggest that a development in social responsiveness can be achieved with only a few MSST sessions, and that the gains after a training can be maintained for at least a short period and can be generalized towards an unfamiliar story. A possible explanation for these findings is that most social responses require little physical effort, so the participants are not impaired much in their interaction with the storyteller (Hughes & Graham, 2002; Thelen & Smith, 1998). Moreover, social interaction skills like looking, smiling and laughing might be relatively easy to develop, as they can be acquired by observation and imitation and do not require high cognitive processes (Bandura, 1971; Sroufe & Waters, 1976; Johnson, Posner and Rothbarth, 1991). The development of a more trusting relationship between the participant and storyteller during the training period might also have contributed, as that seems to promote (social) development (PAMIS, 2002; Penne et al., 2012). An additional explanation for the generalization effect could be that the trained and untrained story had the same structure and were read by the same storyteller. The contextual and social aspects of the untrained storytelling session were thus familiar to the participant. As recognition and predictability are important for learning processes of individuals with PMD, the participants seem to have known what was expected from their interaction with the storyteller (Piaget, 1952, 1954; Grove & Peacey, 1999; Vaughn et al., 2003; Penne et al., 2012). This emphasizes the importance of structure and predictability in stimulation interventions for individuals with PMD. For the short term maintenance effect, it should be noted that the storytellers kept interacting with the participants during the control period, as they also were the participants' caregivers. This might have contributed to the maintenance of social responsiveness, if they interacted a similar way as during MSST. This is however doubtful, because the caregivers at the facilities are often not very involved with the children during daily life. Future research needs to determine this.

Although the participants were able to maintain their social skills acquired during MSST for six weeks, they did not show maintenance over a longer period. Social responsiveness obtained at the end of last year's MSST training period decreased significantly after nine months of weekly MSST with a different story. This suggests that MSST once a week might not have been frequent enough. Multiple disabled children need to be constantly reminded about how to use earlier acquired social skills and repetition is essential for this (Piaget, 1951, 1952; Vaughn et al., 2003). However, the development manager of the residence questioned the quality of MSST during this period. According to her, many storytellers were not very motivated for and not fully engaged in giving MSST and they skipped sessions. As current research findings show, the social responsiveness of the participants with a higher social

responsiveness level at the start of the training period increased more when MSST was of acceptable quality. This is in line with the finding that the quality of a programme is important for its effectiveness and that optimal support is essential for the development of individuals with PMD (Carnaby & Cambridge, 2002; Petry & Maes, 2007). It is thus not unlikely that at least a part of the participants decreased in social responsiveness due to MSST of low quality. For future research, the quality of MSST during these nine months should be evaluated to confirm this argument. For the children with a lower social responsiveness level at the start of the training period, the quality of MSST seem to matter less. Their social responsiveness can already develop when the quality is not very high. Higher functioning children presumably need more challenge and effort from their environment to develop further.

In terms of motor functioning, participants with a higher fine motor functioning increased significantly more in social responsiveness during MSST training than those with a lower fine motor functioning. This is in line with the literature suggesting that individuals with a higher motor functioning often have a higher level of mastery motivation, which in turn stimulates their interaction with others (Majnemer et al., 2013; Wiegand & Geller, 2005). However, the participants with a higher motor functioning and a higher social responsiveness level at the start of the training increased less. This might mean that the participants with a high motor functioning had already almost reached their maximum level of responsiveness at the pre-test of the training period and that they need more support from their environment to develop even further. Gross motor functioning did not influence the development of social responsiveness, possibly because most participants were positioned in a way that they could interact with the storyteller without having to make any physical effort.

Effectiveness on manipulative responsiveness

The results for the effectiveness of MSST on manipulative responsiveness differed considerable from those for social responsiveness. Compared to participants who did not receive MSST training, the group that was trained increased significantly in manipulative responsiveness. In contrast with social responsiveness, manipulative responsiveness only increased between the fifth and tenth session. This suggests that for the development of manipulative responsiveness of individuals with multiple disabilities, repetition is essential (Piaget, 1951, 1952). They needed repeated sessions to get familiar with the objects and their purposes, before they began to explore and manipulate them physically. Repetition enabled them to predict and anticipate on stimuli and events and have control over their environment (Petry & Maes, 2007). They could probably participate more after a few sessions, as they

recognized what was expected from them (Grove & Peacey, 1999). These findings might explain why no short term maintenance effect was found for manipulative responsiveness. The level of responsiveness obtained during the MSST training decreased significantly after six weeks without MSST. Since the participants only started to grow in manipulative responsiveness after five sessions, it is likely that they had not mastered these skills completely, making it difficult to maintain them. Frey & Kaiser (2011) suggest that a longer intervention facilitates maintenance, as disabled individuals often seem to have difficulties maintaining new skills. Perhaps the participants needed more MSST sessions to be able to maintain their level of manipulative responsiveness. Memory problems might have played a role in this too. An impaired memory is a feature of intellectual disability, which all participants have (Beail, 2002; van der Molen, van Luit, Jongmans, & van der Molen, 2009). Due to deficits in working memory, they have difficulties with the storage and retrieval of information in their long term memory (van der Molen et al., 2009; Schuchardt, Gebhardt, & Mäehler, 2010; Carlesimo, Marotta, & Vicari, 1997; Baddely, 2003). As the objects were completely out of sight during the six weeks without MSST, the participants possibly did not recognize the objects offered during the follow-up session and therefore did not know what to do with it (Grove & Peacey, 1999). The same reasons might explain why the participants had trouble maintaining the manipulative responsiveness acquired during MSST training for a longer period. The responsiveness level obtained at the end of last year's MSST training period decreased significantly after nine months of weekly MSST with a different story. As the quality of MSST during this nine month period was suspected to be low, this probably had a negative influence too. Current study namely found that manipulative responsiveness increased more, when the required therapy actions were met. Positioning the participant correctly and encouraging him verbally and by offering object adequately seem to be important aspects of MSST for the development of manipulative responsiveness. Thus when these actions were not performed as desired and the participants were not stimulated enough to explore and use manipulative skills, they were likely to decrease in manipulative responsiveness. A last possible explanation for the loss of acquired skills is that the story and objects used for the pre- and post-test of this analysis differed from those used during the nine months in between. As this study showed, the level of manipulative responsiveness obtained during MSST training was not generalised towards an unfamiliar story. The reason for this might be that the objects associated with the untrained story were unfamiliar to the participants. A lack of the generalization effect is quite common with intellectually disabled individuals (Ferretti & Butterfield, 1992; Lifshitz, Weiss, Tzuriel, & Tzemach, 2011).

Additionally, Frey and Kaiser (2011) showed that that play actions were associated with a specific toy, rather than to be used across different toys. Bahrick (2002) also found that 3.5-month-olds showed limitations in the generalisation of tasks that differed most from the trained tasks on key features. In line with the finding that manipulative responsiveness only started to develop after five sessions, it is likely that the participants needed repeated sessions with the untrained story to get familiar with the objects, before they started to explore them (Piaget, 1951, 1952; Brodin, 2005, Vaughn et al., 2003).

Lastly, it was examined if the development of manipulative responsiveness could be influenced by motor functioning. Compared to participants with a higher gross motor functioning, participants with a lower gross motor functioning increased significantly more in manipulative responsiveness during MSST training. But when the latter had a higher level of manipulative responsiveness at the start of the training, they increased less. Gross motor functioning is the most related to the item *reaches/moves towards*. The participants with a lower gross motor functioning and lower manipulative responsiveness level at the start of the training might have gained in manipulative responsiveness by reaching or moving towards the objects more. As the participants with a higher gross motor functioning probably already did this, they are more likely to increase in manipulative responsiveness by touching and (functionally) manipulating more. These behaviors are more related to fine motor functioning. Unexpectedly though, fine motor functioning did not predict the development of manipulative responsiveness.

Limitations, recommendations for future research and strengths

Current study has some limitations. Although a sample size of 50 is considered relatively big when investigating individuals with multiple disabilities, when this group is split up the statistical power drops. To be able to draw conclusions about the effectiveness of MSST on responsiveness with more certainty, a bigger sample size is needed. Although the SRS was improved considerably for current study, the way the items *reaches/moves towards, touches* and *manipulates (functionally)* were scored might have distorted the outcomes concerning manipulative responsiveness. These items were assigned one point per associated response, irrespective of the difficulty level of each response. One could argue that these responses increase in level of difficulty, as manipulating requires more physical effort and higher cognitive processes than reaching (Thelen & Smith, 1998). In order to obtain a more representative development of manipulative responsiveness, the manipulative responses should be scored as following in future research: reaches/moves towards = score 1, touches =

score 2, manipulates = score 3 and manipulates functionally = score 4. A third limitation regards the sub-scale 'required therapy actions' of the SQS, which only contained three items that were used in the moderation analyses. By adding items to this sub-scale, more can be said about the importance of the characteristic elements of MSST for its effectiveness. Moreover, the development of both social and manipulative responsiveness might have increased more when all MSST sessions had been of outstanding quality (Carnaby & Cambridge, 2002; Petry & Maes, 2007). For future research, the quality of MSST could be improved by further motivating and educating the storytellers in performing MSST according its guidelines. Another recommendation for future research is to examine if responsiveness can be further improved after more than ten MSST sessions. This seems likely for social responsiveness, as this increased slightly further after six weeks without training. For manipulative responsiveness, this is unknown. Interesting for future research is to study a possible ceiling effect for the development of responsiveness, in order to find out of how many sessions multiple disabled individuals benefit the most from. Lastly, current research studied the first step in the generalization capacity of multiple disabled children, by using a different type but similar situation. It is recommended to extend this by examining if the responsiveness level obtained during MSST can be generalized towards other activities and daily life situations. This should be done in similar situations as the MSST stories, in order to see if MSST can stimulate the children's understanding of these activities and their self-efficacy and independency. An even higher step would be that the caregivers apply the same techniques as with MSST during other situations to facilitate their development optimally. Hereby, it can be determined if MSST stimulates exploration, social interaction and self-reliance in real life, the ultimate goal of MSST (PAMIS, 2002).

From a developmental perspective, current study has a significant contributing value to the existing knowledge about the effectiveness of MSST. First of all, current study is one of the few that examined the link between MSST and responsiveness extensively. This study also had a control group, whereas other research regarding the effectiveness of MSST had not (Young et al., 2001; PAMIS, 2002; Jonckheere, 2008). In addition, current research measured responsiveness by videotaped observations, in contrast to other studies who partly used questionnaires filled in by the participants' caretakers (Young et al., 2001; PAMIS, 2002; Jonckheere, 2008). Hereby, the outcomes are objective and even subtle behavioural changes could be measured. Furthermore, current study was based on empirical validated theories, assessed treatment fidelity, examined maintenance effects and studied who could benefit the most from this intervention in terms of motor functioning. Moreover, three different analyses

were used to examine the generalisation effects of responsiveness, conclusions could be drawn with more certainty. Lastly, compared to the stories used in previous studies at the research facility, current ones had a more cohesive and logically structured storyline and a more didactic content (Halfens, 2012; van Eck, 2013; Willems, 2014; Hogewind, 2015). Additionally, the objects covered all the senses at least ones and were more closely related to the story, in order to optimize the development of responsiveness.

In conclusion, most findings support the hypothesized effectiveness of an adapted version of a MSST intervention on the development of responsiveness, especially for social responsiveness. Frequent repetition and high quality seem to be the key aspects of MSST for increasing responsiveness of individuals with moderate to profound multiple disabilities. Future research is recommended to examine if MSST can increase responsiveness in daily life situations. MSST is thus not only a pleasurable activity, it also seems to be a promising intervention to stimulate exploration and responsiveness of multiple disabled individuals, making a valuable contribution to their development.

References

Published work

Ayres, A. J., & Robbins, J. (2005). *Sensory integration and the child: Understanding hidden sensory challenges*. Los Angeles: Western Psychological Services.

Baddeley, A. (2003). Working memory: looking back and looking forward. *Nature Reviews Neuroscience*, *4*(10), 829-839.

Bahrick, L. E. (2002). Generalization of learning in three-and-a-half-month-old infants on the basis of amodal relations. *Child Development, 73*(3), 667-681.

Bandura, A. (1971). *Social learning theory*. New York: General Learning Press.

Barton, E. E., & Wolery, M. (2008). Teaching pretend play to children with disabilities: A review of the literature. *Topics in Early Childhood Special Education, 28,* 109-125.

Barton, E. E., & Wolery, M. (2010). Training teachers to promote pretend play in young children with disabilities. *Exceptional Children*, *77*(1), 85-106.

Beail, N. (2002). Interrogative suggestibility, memory and intellectual disability. *Journal of Applied Research in Intellectual Disabilities*, *15*(2), 129-137.

Berg, van der, I., Middel, A., & Nouse, R. (1996). *Voorlezen, gewoon omdat het leuk is! Basisboek boekenpret*. Amsterdam: Stichting Lezen.

Bottcher, L., Flachs, E. M., & Uldall, P. (2010). Attentional and executive impairments in children with spastic cerebral palsy. *Developmental Medicine & Child Neurology*, *52*(2), e42-e47.

Brug, A. ten, Putten, A. A. van der, Penne, A., Maes, B., & Vlaskamp, C. (2012). Multi-sensory Storytelling for Persons with Profound Intellectual and Multiple Disabilities: An Analysis of the Development, Content and Application in Practice. *Journal of Applied Research in Intellectual Disabilities*, *25*(4), 350-359.

Carlesimo, G. A., Marotta, L., & Vicari, S. (1997). Long-term memory in mental retardation: evidence for a specific impairment in subjects with Down's syndrome. *Neuropsychologia, 35*(1), 71-79.

Carnaby, S., & Cambridge, P. (2002). Getting personal: An exploratory study of intimate and personal care provision for people with profound and multiple intellectual disabilities. *Journal of Intellectual Disability Research, 46*(2), 120–132.

Case-Smith, J. (2013). Systematic review of interventions to promote social–emotional development in young children with or at risk for disability. *American Journal of Occupational Therapy*, *67*(4), 395-404.

Durkin, K. (1998). *Developmental social psychology.* Oxford: Blackwell publishers.

Dollerup, C. (2003). Translation for reading aloud. *Meta: Journal des traducteurs/ Meta: Translators' Journal*, *48*(1-2), 81-103.

Fall, M., Navelski, L. F., & Welch, K. K. (2002). Outcomes of a play intervention for children identified for special education services. *International Journal of Play Therapy*, *11*(2), 91-106.

Ferretti, R. P., & Butterfield, E. C. (1992). Intelligence-related differences in the learning, maintenance, and transfer of problem-solving strategies. *Intelligence, 16*(2), 207-223.

Frey, J. R., & Kaiser, A. P. (2011). The use of play expansions to increase the diversity and complexity of object play in young children with disabilities. *Topics in Early Childhood Special Education, 31*(2), 99-111.

Fuller, C. (1999). Bag books tactile stories. *The SLD Experience, 23*, 20-1.

Gazzaniga, M. S., Heatherton, T. F., & Halpern, D. (2009). *Psychological science (3rd ed).* New York: W. W. Norton & Company, Inc.

Gearing, R. E., El-Bassel, N., Ghesquiere, A., Baldwin, S., Gillies, J., & Ngeow, E. (2011). Major ingredients of fidelity: A review and scientific guide to improving quality of intervention research implementation. *Clinical Psychology Review, 31*(1), 79–88.

Gibson, E. J. (1988). Exploratory behaviour in the development of perceiving, acting and the acquiring of knowledge. *Annual Reviews of Psychology, 39*(1), 1-41.

Goswami, U. (1991). Analogical reasoning: What develops? A review of research and theory. *Child Development, 62*(1), 1-22.

Goswami, U. (2008). *Cognitive development: The learning brain.* New York: Psychology Press.

Grove, N., & Peacey, N. (1999) Teaching subjects to pupils with profound and multiple learning difficulties. *British Journal of Special Education, 26*(2), 83-86.

Hogg, J., Cavet, J., Lambe, L., & Smeddle, M. (2001). The use of 'Snoezelen' as multisensory stimulation with people with intellectual disabilities: A review of the research. *Research in Developmental Disabilities, 22*(5), 353-372.

Hughes, C., & Graham, A. (2002). Measuring executive functions in childhood: Problems and solutions? *Child and Adolescent Mental Health, 7*(3), 131-142.

Johnson, M. H., Posner, M. I., & Rothbart, M. K. (1991). Components of visual orienting in early infancy: Contingency learning, anticipatory looking, and disengaging. *Journal of Cognitive Neuroscience, 3*(4), 335-344.

Jorup, B. (1979). *Lekens pedagogiska möjligheter: En analys av barns lek på daghem utifrån Jean Piagets teori.* Stockholm: Pedagogiska Institutionen Stockholms Universitet.

Lifshitz, H., Weiss, I., Tzuriel, D., & Tzemach, M. (2011). New model of mapping difficulties in solving analogical problems among adolescents and adults with intellectual disability. *Research in Developmental Disabilities, 32*(1), 326-344.

Lifter, K., Ellis, J., Cannon, B., & Anderson, S. R. (2005). Developmental specificity in targeting and teaching play activities to children with pervasive developmental disorders. *Journal of Early Intervention, 27*(4), 247-267.

Lifter, K., Mason, E. J., & Barton, E. E. (2011). Children's play: Where we have been and where we could go. *Journal of Early Intervention, 33*, 281-297.

Majnemer, A., Shikako-Thomas, K., Lach, L., Shevell, M., Law, M., & Schmitz, N. (2013). Mastery motivation in adolescents with cerebral palsy. *Research in Developmental Disabilities, 34*(10), 3384-3392.

Mauer, D. M. (1999). Issues and applications of sensory integration theory and treatment with children with language disorders. *Language, Speech, and Hearing Services in Schools, 30*(4), 383-392.

Mesibov, G. B., & Shea, V. (2010). The TEACCH program in the era of evidence-based practice. *Journal of Autism and Developmental Disorders, 40*(5), 570-579.

Molen, M. J. van der, Luit, J. E. van, Jongmans, M. J., & Molen, M. W. van der. (2009). Memory profiles in children with mild intellectual disabilities: Strengths and weaknesses. *Research in Developmental Disabilities, 30*(6), 1237-1247.

Monaghan, P., & Rowson, C. (2008). The effect of repetition and similarity on sequence learning. *Memory & Cognition*, *36*(8), 1509-1514.

Multiplus. (2008). *Handleiding: Multi-sensory storytelling. Verhalen voor mensen met ernstige meervoudige beperkingen.* Leuven: Expertisecentrum Leuven.

Nakken, H., & Vlaskamp, C. (2007). A need for a taxonomy for profound intellectual and multiple disabilities. *Journal of Policy and Practice in Intellectual Disabilities, 4*(2), 83-87.

PAMIS. (2002). *Developing literacy skills through Multi-sensory Story-telling in children and young people with profound and multiple learning disabilities. Final Report.* Dundee: University of Dundee.

Papoušek, H., & Papoušek, M. (1995). Intuitive Parenting. In M. H. Bornstein (Ed.), *Handbook of parenting: Volume 2 biology and ecology of parenting* (pp. 183-203). New Jersey: Lawrence Erlbaum Associates Publishers.

Park, K. (1998). Focus on practice: dickens for all: inclusive approaches to literature and communication with people with severe and profound learning disabilities. *British Journal of Special Education, 25*(3), 114-118.

Penne, A., Brug, A. ten, Munde, V., Putten, A. van der, Vlaskamp, C., & Maes, B. (2012). Staff interactive style during multisensory storytelling with persons with profound intellectual and multiple disabilities. *Journal of Intellectual Disability Research, 56*(2), 167-178.

Petry, K., & Maes, B. (2007). Description of the support needs of people with profound multiple disabilities using the 2002 AAMR system: An overview of literature. *Education and Training in Developmental Disabilities, 42*(2), 130-143.

Petry, K., Maes, B., & Vlaskamp, C. (2005). Domains of quality of life of people with profound multiple disabilities: The perspective of parents and direct support staff. *Journal of Applied Research in Intellectual Disabilities, 18*(1), 35-46.

Piaget, J. (1951). *The psychology of intelligence.* London: Routledge & Kegan-Paul.

Piaget, J. (1952). *The origins of intelligence in the child.* London: Routledge & Kegan-Paul.

Piaget, J. (1954). *The construction of reality in the child.* London: Routledge & Kegan-Paul.

Sandall, S., Hemmeter, M. L., Smith, B. J., & McLean, M. E. (2005). *DEC recommended practices: A comprehensive guide.* Longmont, CO: Sopris West.

Schaffer, H. R. (2000). *Social development.* Oxford: Blackwell publishers.

Schuchardt, K., Gebhardt, M., & Mäehler, C. (2010). Working memory functions in children with different degrees of intellectual disability. *Journal of Intellectual Disability Research, 54*(4), 346-353.

Shams, L., & Seitz, A. R. (2008). Benefits of multisensory learning. *Trends in Cognitive Sciences, 12*(11), 411-417.

Skinner, B. F. (1969). *Contingencies of reinforcement: A theoretical analysis*. New York: Meredith Corporation.

Sroufe, A., & Waters E. (1976). The ontogenesis of smiling and laughter: A perspective on the organization of development in infancy. *Psychological Review, 83*(3), 173-189.

Stahmer, A. C., Collings, N. M., & Palinkas, L. A. (2005). Early intervention practices for children with autism: Descriptions from community providers. *Focus on Autism and Other Developmental Disabilities, 20*(2), 66-79.

Thelen, E. (2000). Motor development as foundation and future of developmental psychology. *International Journal of Behavioural Development, 24*(4), 385-397.

Thelen, E., & Smith, L. B. (1998). Dynamic systems theories. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology. Theoretical models of human development* (pp. 563-634). New York, NY: Wiley.

Twilhaar, S., Beek, Y. van, Magyarszeky, Z. (2014). Evaluation of a Conductive Education program for children with profound multiple disabilities in a residential children's home in South Africa. In: A. Vermeer en Z. Magyarszeky (Eds.) *Disability care in Africa. Community based rehabilitation in rural regions* (pp. 139-171). Amsterdam: VU University Press

United Nations Children's Fund. (2013). *The state of the world's children 2013. Children with disabilities.* New York: United Nations Children's Fund.

Vaughn, S., Kim, A. H., Sloan, C. V. M., Hughes, M. T., Elbaum, B., & Sridhar, D. (2003). Social skills interventions for young children with disabilities a synthesis of group design studies. *Remedial and Special Education, 24*(1), 2-15.

Vallotton, C. D. (2012). Infant signs as intervention? Promoting symbolic gestures for preverbal children in low-income families supports responsive parent–child relationships. *Early Childhood Research Quarterly, 27*(3), 401-415.

Vygotsky, L. (1978). *Mind in Society.* Cambridge, MA: Harvard University Press.

Ware, J. (Ed.). (1994). *Educating children with profound multiple learning difficulties.* London: Fulton.

Wiegand, D. M., & Geller, E. S. (2005). Connecting positive psychology and organizational behavior management: Achievement motivation and the power of positive reinforcement. *Journal of Organizational Behavior Management, 24*(1-2), 3-25.

Young, H., Fenwick, M., Lambe, L., & Hogg, J. (2011). Multi-sensory storytelling as an aid to assisting people with profound intellectual disabilities to cope with sensitive issues: a multiple research methods analysis of engagement and outcomes. *European Journal of Special Needs Education, 26*(2), 127-142.

Zijlstra, H. P., & Vlaskamp, C. (2005). The impact of medical conditions on the support of children with profound intellectual and multiple disabilities. *Journal of Applied Research in Intellectual Disabilities, 18*(2), 151-161.

Unpublished work

Eck, T. van. (2013). *Evaluation of Multi-Sensory Storytelling in children with profound multiple disabilities at Sizanani Children's Home.* Utrecht: Utrecht University.

Halfens, J. L. (2012). *Multisensory Storytelling: the effect on positive Social Responsiveness in Children with Profound Multiple Disabilities.* Utrecht: Utrecht University.

Hogewind, N. (2015). *Read to me. The effectiveness of Multi-Sensory Storytelling intervention on the responsiveness of youth with profound multiple disabilities in a Children's Home and associated day-care centres in South-Africa.* Utrecht: Utrecht University.

Jonckheere, L. (2008). *Multi-sensory storytelling aan personen met ernstige meervoudige beperkingen: Onderzoek naar de effecten en de methodiek.* Leuven: Catholic University Leuven.

Mulder, B. M. (2016). *Focus on functional skills. An evaluation of Conductive Education for people with multiple disabilities in South Africa.* Utrecht: Utrecht University.

Nispel, W., & Vermeer, A. in cooperation with Boer, N., & Wikkerman, C. (2010). *Implementation of Multi-Sensory Story Telling in Sizanani Children's Home.* Utrecht: Utrecht University.

Schouw, G. I. (2016). *Can structured play stimulate cognitive growth in disabled youth?* Utrecht: Utrecht University.

Willems, N. (2014). *Sense the story: The effectiveness of an adapted version of Multi-Sensory Storytelling on the responsiveness of children, adolescents and young adults with multiple disabilities at a Children's Home in South Africa.* Utrecht: Utrecht University.

Appendix 1: Positions during MSST session

For the residents, the therapy sessions took place in their bedroom. Here was enough space and the therapy sessions were not likely to be disturbed. The participants from the daycares received MSST inside at a quiet place away from the other children and noise or outside. The position of the participant was adjusted to his (dis)abilities and needs and varied from lying down horizontally to sitting upright, in either a bed or (wheel)chair. By positioning the participant comfortably, the possibilities for him to respond to the story, to interact with the storyteller and to explore the objects were optimized. The storyteller sat at approximately one meter distance from the participant. This facilitated the storyteller and participant to respectively present and reach for or manipulate objects. In addition, the participant and storyteller could easily make physical contact with each other. By facing each other diagonally, they could see each other clearly and their faces could be captured on video. During a number of sessions, a videographer sat in front of the participant and storyteller. The distance between them was not more than two meters to make sure that the both clearly presented behaviours and fine and more detailed behavioural responses (e.g., subtle eye movements and facial expressions) were visible on video. Most of the times, the researcher was the videographer, who controlled the camcorder manually so that the participant and storyteller were visible at all times. The objects and pages were spread out in the correct order on a table or bed close to the storyteller. Sometimes the storyteller held the pages.

Appendix 2: The Storytelling Responsiveness Scale (SRS)

Name participant: ..... **Story: .....**

Name storyteller: ..... **Date: .....**

Unit: ..... **Period and measurement: .....**

	Red box	Page 1	Page 2	Page 3	Page 4	Page 5	Page 6	Page 7	End song	Total
Time										
Intervals										

High symbolic cognitive responses	Red box	Page 1	Page 2	Page 3	Page 4	Page 5	Page 6	Page 7	Eng song	Freq
Claps hands**										
Nods yes/ shakes no										
Waves/points/ gestures										

** based on dichotomous score during end song (absent = score 0, present = score 1).

Verbal responses	Red box	Page 1	Page 2	Page 3	Page 4	Page 5	Page 6	Page 7	Eng song	Freq
Talks/sings**										

** based on dichotomous score during end song (absent = score 0, present = score 1).

Vocal responses	Red box	Page 1	Page 2	Page 3	Page 4	Page 5	Page 6	Page 7	Eng song	Freq
Happy vocalizations										
Vocal utterances										

Bodily responses	Red box	Page 1	Page 2	Page 3	Page 4	Page 5	Page 6	Page 7	Eng song	Freq
Child specific responses										
Moves on sound/ singing*										
Makes physical contact with storyteller										
Other responses										

** based on dichotomous score during end song (absent = score 0, present = score 1).

Intervals/ total intervals	Never (0%)	Rarely (> 0 - 20%)	Occasionally (20 - 40%)	Regularly (40 - 60%)	Often (60 - 80%)	Almost always - always (≥ 80%)
Score	0	1	2	3	4	5

Attention	**Red box**	**Page 1**	**Page 2**	**Page 3**	**Page 4**	**Page 5**	**Page 6**	**Page 7**	**Eng song**	**Intervals**	**Score**
Looks at object*											
Looks at storyteller*											

*based on partial-interval time sampling with five second intervals

Intervals/ total intervals	Never (0%)	Rarely (1-10%)	Occasionally (10-40%)	Regularly (40-60%)	Often - always (≥60%)
Score	0	1	2	3	4

Positive facial expression	**Red box**	**Page 1**	**Page 2**	**Page 3**	**Page 4**	**Page 5**	**Page 6**	**Page 7**	**End song**	**Intervals**	**Score**
Smiles*											

*based on partial-interval time sampling with five second intervals

Manipulations of objects	**Red box**	**Page 1**	**Page 2**	**Page 3**	**Page 4**	**Page 5**	**Page 6**	**Page 7**	**Eng song**	**Freq**
Reaches/ moves towards										
Touches										
Manipulates										
Manipulates functionally										
Possibilities										

Total Storytelling Responsiveness score (SRS-score): ……

Social Storytelling Responsiveness score (SSRS-score): ……

Manipulative Storytelling Responsiveness score (MSRS-score): ……

Appendix 3: Items and Definitions of the Storytelling Responsiveness Scale

In general, a certain behaviour was considered as a new response when it had been absent for two or more seconds. Only for the item *positive facial expression*, a new response is measured when the corners of the mouth have been in a neutral position for one second or more. *Reaching, touching* and *(functionally) manipulating* with one or both hands is considered as one response, also when the second hand follows shortly or a while after the first one. Tics and random movements are not included in the observation list, because they are not considered as conscious or meaningful responses to the story, object nor storyteller.

- *Social responsiveness*

Claps hands: the participant brings his two hand together in one movement, or taps with one or both hands on another body part, the hand of the storyteller or a part of the (wheel)chair or bed. The participant does not necessarily have to produce sounds.

Nods yes: the participant lowers and raises his head slightly and briefly, as in agreeing, understanding, acknowledging, approving or greeting. Shakes no: the participant moves his head from left to right and vice versa, as in disagreeing, not understanding, disapproving or disliking something.

Waves: the participant moves his hand(s) back and forth, as in greeting. Points: the participant stretches out his arm(s) and uses his index finger(s) or hand(s) to focus attention on a particular referent. Gestures: the participant moves his hand(s) or other body part(s) to emphasize speech or express thoughts or emotions. This includes shaking hands and giving a high five.

Talks/sings: the participant makes an attempt to or produces words, by saying, repeating or singing them. Words do not have to be pronounced correctly. Note: this item is different from 'happy vocalisations' and 'vocal utterances'.

Happy vocalizations: the participant laughs or produces other sounds of joy or happiness.

Vocal utterances: the participant produces sound(s) that have a communicative value but do not form words, in order to express an emotion or thought, to answer a question or ask for attention (e.g. 'hmm', 'ieh' and 'wow'). Note: this item is different from 'happy vocalisations' and '(attempts to) talk or sing'.

Child specific responses: the participant shows physical behaviour that characterizes the way he reacts to the environment and expresses thoughts or emotions (e.g. a blind girl opens her eyes widely every time she hears music or sounds from a voicepad).

Moves on sounds/singing: the participant moves part(s) of his body back and forth and/or up and down, as in swaying, rocking or dancing. Moving to the rhythm is not necessary.

Makes physical contact with the storyteller: the participant reaches for or touches the storyteller in order to be comforted or to get attention or reassurance.

Other responses: this is a residual category including all physical responses that are rare but meaningful, covering things like the imitation of storyteller's behaviour during pretend play, startle responses, all facial expressions other than smiling (e.g. frowning and making funny faces when looking in the mirror) and when the participant touches himself at the spot where an object or the hand of the storyteller was placed.

Looks at object: the participant focuses his eyes on the object and/or turns head in that direction

Looks at storyteller: the participant focuses his eyes on the face of the storyteller and/or turns his head in that direction. Moreover, this item is scored when the participant focuses his eyes on the storyteller's hands when she is clapping, gesturing or touching the participant.

Smiles: the participant turns the corners of his mouth upwards and alters his facial features into a positive facial expression (kind, pleased or amused). Exposure of the front teeth is not necessary. Even the slightest smile is considered as a positive facial expression. If the corners of the mouth have been in a neutral position for one second or more, a new positive facial expression can be measured.

- *Manipulative responsiveness*

Reaches: the participant stretches his arm(s) out (in an attempt) to touch or grasp the object.
Moves towards: the participant moves his head and/or upper body and/or leg(s) towards the object (in an attempt) to get a closer look, hear a sound better or touch the object

Touches: the participants touches, strokes or hits the object for less than two seconds, without grasping it. This can be done with the participant's hands and feet

Manipulates: the participant explores the object for at least two seconds, by grasping, holding, moving, rattling, stroking or hitting it. This must be a non-functional way of manipulating the object.

Manipulates functionally: the participants uses the object in a functional manner, according to its intention or how it operates (e.g., pushing the button of the voicepad, combing hair with a comb). This also includes pretend play or take a role of someone else.

Appendix 4: The Storytelling Quality Scale (SQS)

Name participant:..... **Story: .....**

Name storyteller: ..... **Date: .....**

Unit: ..... **Period and measurement: .....**

Required therapy actions

Procedural mistakes							
	Preparation of therapy session	Sequence of pages & objects	Forgot to read a page	Forgot to show red box/object	Used same page/object twice	Forgot to sing good bye song	**Total**
Mistakes							

	Red Box	Page 1	Page 2	Page 3	Page 4	Page 5	Page 6	Page 7	**Total**	**Score**
Exploration time										

Exploration time	Never - occasionally (< 60%)	Regularly (60 - 70%)	Often (70 - 80%)	Very often (80 - 90%)	Almost always - always (> 90%)
Score	0	1	2	3	4

Evoking a response	0 = Never	1 = Occasionally	2 = Regularly	3 = Often	4 = Always
Verbal encouragement					
	0 = Never	1 = Occasionally	2 = Regularly	3 = Often	4 = Always
Encouragement through action					

	0 = Poor	1 = Moderate	2 = Average	3 = Above average	4 = Good
Participant's positioning					

Storyteller's social behaviour

Communicative skills	0 = Poor	1 = Moderate	2 = Average	3 = Above average	4 = Good
Positive facial expression					
Eye contact					
Positive physical contact					
Direct positive reinforcement					
Exciting/dynamic reading					
Sensitivity					

	0 = Poor	1 = Moderate	2 = Average	3 = Above average	4 = Good
Overall quality					

Total Storytelling Quality score (SQ-score): ……

Required Therapy Actions score (RTA-score): ……

Storyteller's Social Behaviour score (SSB-score): ……

Appendix 5: Items and Definitions of the Storytelling Quality Scale

- *Required therapy actions*

Procedural mistakes: MSST has a structure with fixed and essential elements, which should be included in all sessions. When an element or action is not performed, this is scored as one mistake. The sum of the number of the mistakes made during the session represents the total score of this item.

- Preparation: this conveys all aspects concerning the preparation of the MSST session. One mistake is scored when the storyteller has to put the pages and objects in the right order after the participant has entered the room. Moreover, if the battery of a voicepad is running low, resulting in sounds of bad quality, this is scored as one mistake. A cup without water/juice is also scored as one mistake. Lastly, each disturbing sound is scored as one mistake (e.g. phone ringing, keys jingling).
- Sequence of pages and objects: one mistake is scored for every time the storyteller switches the sequence of two pages. Another mistake is scored for every time the storyteller switches the sequence of two objects. Note: when the storyteller switches the sequence of two pages and associated objects, this is scored as just one mistake.
- Forgot to read a page: one mistake is scored for every time the storyteller forgets to read a page.
- Forgot to show the red box/object: one mistake is scored for every time the storyteller forgets to show the red box or another object. Note: when the storyteller forgets to read a page and does not show the object corresponding to this page, this is scored as only one mistake.
- Used same page/object twice: every time the storyteller reads a page that has been read before again, one mistake is scored. Every time the storyteller shows an object that has been showed before, another mistake is scored. This also yields for when an object is still present during the reading of the next page. Note: when the storytellers reads a page that has been read before and shows the corresponding object again, this is scored as only one mistake.
- Forgot to sing the goodbye song: the storyteller forgets to sing the goodbye song at the end of the MSST session. This mistake is also scored when the storyteller needs a hint from the videographer to sing the goodbye song.

Exploration time: total time in seconds that the objects are offered intentionally within the range of the participants' senses, so that he can visually and physically explore them. This includes the time that the objects are within sight of the participant (visual exploring time) and the time the participant gets to explore and manipulate the objects (physical exploring time). Physical time can be active (the participant explores the objects himself) or passive (the participant is unable to explore the objects himself, so the storyteller makes sure that he can explore the objects with her help, or example by brushing the toothbrush on the participant's hand). Per page, the exploration time is timed with a stopwatch and then summed up to form the total exploration time.

Verbal encouragement: the storyteller encourages the participant to explore the objects by using words as 'touch', 'feel', 'smell', 'taste' and 'see' and repeating the participant's name.

Encouragement trough action: the storyteller encourages the participant to explore the objects by showing and offering them in a way that is adapted to the participant's (dis)abilities and needs and fits within the story. Hereby, the participant is optimally stimulated to explore the objects and he will understand the intention/function of the object.

Participant's positioning: the participant needs to be in a position in which he is comfortable, can interact and make eye-contact with the storyteller and can explore the offered objects. This can be in a (wheel)chair or lying down in bed. Sitting on the lap of the storyteller is not recommended, as making eye-contact and interacting is very difficult in this position.

- *Storytellers' social behaviour*

Positive facial expression: the storyteller smiles, by turning the corners of her mouth upwards and altering her facial features into a kind, pleased or amused expression. Exposure of the front teeth is not necessary.

Eye contact: the storyteller tries to make eye contact with the participant, by looking him in the eyes. The participants does not necessarily have to look back.

Positive physical contact: the storyteller touches the participants in a positive way, as in comforting, reassuring, coddling or getting attention. Shaking hands and giving a high-five is also included.

Direct positive reinforcement: the storyteller reinforces a desired responses directly after it occurred in a positive way. This reinforcement strengthen the desired response by presenting a positive and rewarding stimulus. The reinforcement can be done verbally, non-verbally (i.e. smiling, nodding, gesturing) of physically (touching the participant in a positive way, i.e. cuddling or stroking). A desired response of the participant can be any kind of response scored by the Storytelling Responsiveness Scale, e.g. looking at the storyteller, talking, manipulating an object (Skinner, 1969).

Exciting/dynamic reading: The storyteller tells the story with exaggerated voice intonation and enthusiasm and uses explicit facial expressions and gestures

Sensitivity: The storyteller attunes her behaviour to the needs, wishes and (dis)abilities of the participant. She perceives the participant's signals, interprets them accurately and responds adequately (e.g., stop showing an object or touching the participant when he reacts negatively to this) (Papoušek & Papoušek, 1995).

Overall quality: an estimation of the overall quality of the MSST session, based on the researcher's gut feeling