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Masterproef

Relation between imitation ability and motor learning capacity in typically developing Flemish children: a pilot study

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Scriptie ingediend tot het behalen van de graad van master in de revalidatiewetenschappen en de kinesitherapie

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Acknowledgement

Firstly, we would like to express our sincerest gratitude to our promotor Prof. dr. Vanvuchelen Marleen for the continuous support of our master thesis. Not only by helping us with setting up the most appropriate research protocol, but also for teaching us the test administration of the Preschool Imitation and Praxis Scale and helping us with practical issues during data analysis.

Besides our promotor, we would also like to thank our copromotor, Prof. dr. Klingels Katrijn, for her insightful comments and encouragement while writing our thesis. Prof. dr. Bastiaenen Caroline has also been a great help, for providing us insight in a similar study, that was previously executed at the Maastricht University (Netherlands). Some parts of their protocol were retained, while others were changed or added.

We would also like to thank the different schools that participated in our study. 'De Step', 'De Sprankel' and 'PAleiS' gave us the opportunity to approach a large quantity of parents with children in the appropriate age group and provided us access to a testing room. All participating parents were of great assistance, by giving us their informed consent and filling in all three questionnaires. Without their precious support, it would not have been possible to conduct this research.

Koersel, Diepenbeek, 16 June 2016 C.N., G.O.

Research context

Young children learn by observing others and mimicking their behaviour. A key criterion in learning new skills through imitation is the accurate coupling of perception and action. Visual kinematic characteristics of the perceived action can then be transferred into motor kinematic characteristics of the child's movement (Lyon, Young & Keil, 2007).

It is well known that some children with a developmental disorder, such as Autism Spectrum Disorder (ASD), experience difficulties with imitation (Vivanti, Trembath, & Dissanayake, 2014). The inability to imitate behaviours of others may interfere with the ability to comprehend and learn new actions. The lack of imitation may subsequently play an important role in the development of cognitive, sensorimotor and social abilities of young children (Rogers & Williams, 2006).

Children with a developmental disorder also have difficulties with motor learning. Motor learning is the process where practice of a particular skill or movement can lead to a more fluent and automatic execution of the movement, possibly resulting in relatively permanent behavioural changes (Willingham, 1998). Children with DCD, for example, do not have learning deficits in the first stages of learning (Fitts & Posner, 1967), deficits in motor learning only seem to occur in the later stages of the learning process. As a result, these children may rely more on the cognitive processing of feedback (Smits-Engelsman, Jelsma, Ferguson, & Geuze, 2015). Evidence concerning motor learning in children with ASD remains unclear. Some research suggests that individuals with ASD tend to depend less on visual feedback when learning a new motor sequence than do normal developing individuals, which leads to little generalization to other conditions. The abnormal patterns of motor learning in children with ASD subsequently show an increased sensitivity to proprioceptive input, but a decreased sensitivity to visual error. Considering that visual-motor representations may underlie imitative learning and action understanding, abnormal implicit motor learning, relying on visual feedback, may partially explain the social communication deficits representing ASD (Sharer, Mostofsky, Pascual-Leone, & Oberman, 2016).

Both imitation and motor learning have been proven to be impaired in children with developmental disorders, but there is a lack of evidence investigating a possible relationship between imitation ability and motor learning. However, there is some evidence of a neurological link between motor control and action observation (Buccino et al., 2001).

Insight in the relation between imitative behaviour and motor learning might create opportunities in the current management and even diagnosis of children with developmental disorders. The aim of this pilot study therefore is to investigate the relation between imitative behaviour and motor learning capacity in typically developing children. If the results are interesting, this research can later be performed for children with developmental disorders.

This pilot study is executed by two master students in Rehabilitation Sciences and Physiotherapy of Hasselt University, Faculty of Medicine and Life Sciences. The study is conducted within the framework of the research on developmental and neural mechanisms underlying observational and motor learning in individuals with autism spectrum disorders, directed by Prof. Dr. Vanvuchelen Marleen.

The design and method of this study was based on a similar study executed at the Maastricht University (Netherlands). Some parts of their protocol were retained, while others were changed or added. In consultation with the promotor, the following adjustments were made; one questionnaire and a test for motor development were added and different tests were used for the evaluation of motor learning.

Recruitment of participants and data acquisition were independently executed by the master students.

The statistical analysis and the writing of the manuscript was performed independently by the master students as well. At times, preliminary versions of the manuscript were reviewed by the promotor and copromotor and their comments were taken into account in the final manuscript.

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1. Abstract

Background: Children with a developmental disorder, such as Autism Spectrum Disorder, often experience difficulties with imitation, as well as problems with motor learning. Currently, there is a lack of research investigating the possible relationship between imitation ability and motor learning capacity.

Objectives: (1) To investigate the direction and strength of the relation between imitative behaviour and motor learning in a group of typically developing (TD) Flemish children aged 3 to 4 years. (2) To explore which variables influence the motor learning capacity in this group.

Participants: Forty-five Flemish TD children were recruited of which 37 completed test administration (19 boys and 18 girls, mean age 42 months (SD = 2,81)).

Measurements: Test administration consisted of three parts: (1) assessment of motor learning, measured by two motor learning tasks on a tablet (Piano Tiles & Balloon Popping), (2) assessment of imitation ability, examined by the Preschool Imitation and Praxis Scale (PIPS), and (3) assessment of motor development, measured by the Peabody Developmental Motor Scales (PDMS-2). Three questionnaires were used to gather information about; (1) personal data, (2) developmental and socio-emotional status of the child (Ages & Stages questionnaire), and (3) social development of the child (Social Responsiveness Scale).

Results: Results showed little to no correlation between variables of motor learning and total imitation ability, as well as bodily and procedural imitation ability. A negative low correlation was found between progression in maximum number of tiles (Piano Tiles) and the father's age at child's birth ($\rho = -0.34$, $p = 0.04$). Progression in maximum number of tiles as well as average and maximum velocity was also low to moderately correlated with educational level of the parents ($\rho = 0.34\text{-}0.56$, $p = 0.0004\text{-}0.04$). Finally, progression in average and maximum velocity had a low correlation with the communicative and personal-social domain of the ASQ ($\rho = 0.30\text{-}0.40$, $p = 0.01\text{-}0.08$).

Conclusion: No correlation was found between imitation ability and motor learning, most likely because of the limitations in both motor learning tasks**.** Further research is needed to develop a reliable and valid motor learning task for children between 3 and 4 years of age.

2. Introduction

Imitation is a process where a new action is learned by observing another person performing that action (Tomasello, Carpenter, Call, Behne, & Moll, 2005). This imitation process can speed up the learning process of a novel action by providing a demonstration of a successful movement, which reduces the amount of trial-and-error (Schaal, 1999).

While imitation is a well-known skill already present at an early age in humans, it is noted that many nonhuman species are not capable of learning new actions by imitation (Byrne & Russon, 1998). Imitative behaviour is present in human newborns within hours after birth (Nagy, Pilling, Orvos, & Molnar, 2013). At the age of 6 months, infants can reach the same result of an observed movement in exactly the same manner as demonstrated (Csibra, 2008). This level of imitation is called the *action-level imitation*, in which there is a detailed copy of the model's action and result without understanding the underlying intention of the action (Byrne & Russon, 1998). Infants at 18 months however, will not copy the action at the same direct manner, but they do achieve the end-goal (Meltzoff, 1995). At this age, infants are capable of understanding the intention of a person's action and perform that action in a more effective way. This level of imitation is called *program-level imitation*, which includes a replication of the intentions and goals (Byrne & Russon, 1998). From this age on, children can still show an imitation in a direct manner, but only when they are asked to imitate a complex action (Wohlschläger, Gattis, & Bekkering, 2003). To be a good imitator, a large repertoire of movements is required, as well as adequate knowledge of different action effects, the possibility to anticipate these effects and an adequate motor imagery to perform a novel action with the combination of stored movements and goal-directed actions (Nadel, 2014). Therefore it takes two years for typically developing (TD) children to engage in deferred imitation, which is the delayed repetition of an action at a later time (Nadel, 2014). The capability to understand the underlying intention of an action continues to develop, to reach a high performance by the age of 6-7 years (Bello, Sparaci, Stefanini, Boria, Volterra & Rizzolatti, 2014).

When observing a person performing an action, the mirror neuron system is activated. These mirror neurons are not only active while observing an action, but also when performing those actions (Buccino et al., 2001). This system includes the supplementary motor area, premotor, primary motor and primary somatosensory cortices, superior parietal lobule and the middle temporal visual area (Caspers, Zilles, Laird & Eickhoff, 2010; Rizzolatti & Craighero, 2004). When the motor capabilities to perform the observed actions are present, the activation of these brain regions is stronger. These findings conclude that action observation evokes different responses of the mirror neuron system according to whether one has already experienced the actions or not (Calvo-Merino, Glaser, Grezes, Passingham, & Haggard, 2005). The neurological link between motor control and action observation makes it possible to map the observed actions in the motor system. The observer then acquires knowledge of these actions by "internally" executing them. This means that the link between observation and action could facilitate motor learning (Rizzolatti, Fogassi, & Gallese, 2001).

Motor learning is a process where practice leads to the execution of more rapid/smooth and accurate movements (Willingham, 1998). According to Fitts and Posner (1967), the process of learning new skills is characterized by three sequential stages. In the initial stage of learning, *the cognitive stage*, new strategies are used and the child should be encouraged to explore the environment via trail-and-error. The child will try different movements to solve the encountered problems, trying to determine the most applicable sequence of actions needed to achieve the desired goal. Learning at this stage generally involves the use of explicit knowledge. In the next learning phase, *the associative stage*, the child has determined the most appropriate sequence of movements and begins to demonstrate a more refined movement through practice, being able to focus the attention on specific details of the sequence (Fitts & Posner, 1967). The emphasis switches from "what to do" to "how to do", so there is less need for cognition to improve the efficiency and flexibility of the movement. In the final phase of learning, *the autonomous stage*, the intervention of cognitive functions is no longer required. The child has the ability to perform an action under various conditions in a smooth and coordinated manner. (Muratori, Lamberg, Quinn, & Duff, 2013). It should be noticed that the motor learning process is not linear, but improvements are larger during the early practice and smaller in the later phase. It is even possible that a large progression is followed by a plateau or a regression, but in these periods learning is still occurring (Muratori et al., 2013). Motor learning can be either explicit or implicit. Explicit

motor learning indicates the situation in which the individual is aware of the sequence and the goal of learning, while in implicit motor learning, learning occurs without conscious awareness of the individual (Wilson et al., 2003). Successful motor learning has three main goals; (1) improvement of performance in the trained task, (2) retention of the learned skill over a longer period of time, (3) transfer of the learned skill to other similar tasks or situation in which the particular action may occur (Smits-Engelsman et al., 2015). Practice after action observation facilitates motor learning, irrespective of whether the practice object is the same as the original (Nielsen, Mushin, Whiten, & Tomaselli, 2014).

It is possible that this action-observation network could improve motor learning, yet little research has investigated this hypothesis. McGregor and Gribble (2015) tried to assess the brain regions that are activated in motor learning during observation, measured by functional magnetic resonance imaging (fMRI). Through an observational learning task in adults they found changes in functional connectivity within the middle temporal visual area, the cerebellum and the primary motor and somatosensory cortices. These changes in functional connectivity were related to the amount of motor learning. Another study executed by Gonzalez-Rosa et al. (2014) also suggested that, through action observation, there will be a sensorimotor activation in the mirror neuron system which enhances motor learning in adults. Rotem-Kohavi et al. (2014) are the only authors who investigated the same action-observation network in infants. In comparison to adults, the network of infants shows an increased density and a decreased modularity during the observation of a task that is not yet fully controlled. This suggests that the action-observation network has a less structured organization, which becomes more efficient with experience.

From recent investigation, it can be concluded that the sensorimotor system is activated during action observation. Observation of actions also leads to changes of plasticity in the sensorimotor brain regions, which can improve motor learning. However, it remains ambiguous whether a good imitation *ability* will lead to an increased motor learning capacity *in children*.

There are also a few studies that report variables that influence the process of motor learning. The following variables were hypothesized to have a direct influence on motor learning; gender, age, success evaluations, affective state, social comparison and overnight sleep (Blischke & Erlacher, 2007; Desrochers, Kurdziel, & Spencer, 2016; Dorfberger, Adi-Japhab, & Karnia, 2009; Festini, Preston, Reuter-Lorenz, & Seidler, 2015; Noohi et al., 2016;

Sheth, Janvelyan, & Khan, 2008). Berger & Nuzzoa (2008) report that having older siblings offers a developmental advantage by influencing the onset of younger siblings' motor milestones. However, more research is needed to define the factors influencing the motor learning capacity in children.

In this pilot study, the following research questions will be addressed

a) What is the direction and strength of the relation between imitative behaviour and motor learning in a group of TD Flemish children aged 3 to 4 years?
b) Which variables influence the motor learning capacity in this group?

3. Methods

This study was approved by the Committee on Medical Ethics of the University of Hasselt on 02/12/2015 with following code; S58523.

3.1 Participants

For the recruitment process, local kindergartens were asked permission to contact parents of children who were in the age range of 3 to 4 years at the time of the study. Afterwards, during a parents' evening, parents were informed of the purpose, procedure, risks and requirements of the study. If parents were interested in participating in the study, they were asked to return an informed consent. Next, these parents were asked to fill in some questionnaires about the child's development before test administration. Inclusion criteria were: (1) a typical development, especially fine motor development (a score above the cut-off on the Ages & Stages questionnaire in combination with an average percentile score on the PDMS-2) (Bricker & Squires, 1999); (2) aged between 3 and 4 years; (3) a good knowledge of Dutch by the child and his parents, and (4) a normal or corrected normal vision. Children were excluded in case of a previous diagnosis of a hearing impairment.

3.2 Procedure

Participating parents were asked to fill in the following questionnaires: (1) a questionnaire with personal information, (2) the Ages & Stages questionnaire, (3) the Social Responsiveness Scale - Preschool (SRS-P).

The examination itself was conducted by two master students in Rehabilitation Sciences and Physiotherapy of the Hasselt University and consisted of two sessions which took place in the school in a time lapse of maximum seven days. The tests lasted maximum one hour distributed over two days and consisted of three parts: (1) assessment of motor learning, (2) assessment of imitation ability, (3) assessment of motor development. Only the assessment of motor learning was conducted on both testing days, while imitation ability and motor development were only assessed on respectively the first or second test day. One researcher conducted the PIPS on the first and the PDMS-2 on the second day, while the second researcher did the assessment in reversed order.

3.2.1 Assessment of motor learning

The ability of motor learning was examined by using two child friendly apps on a tablet or iPad. The first app was the game 'Guess The Movie Piano Tiles 4' (figure 1) that requires the repetitive tapping, with one or multiple fingers, of black fields appearing on the screen. A sound is presented when tapping on the upcoming black field and results in a song when all the black fields are tapped in the right order. Tapping a white field or skipping a black field stops the game. The goal is to tap as many black fields in the right order as possible in a time frame of 30 seconds. The song 'apple tree' is used for every child so that the difficulty and the repeatability were similar each game. By playing this game, the child learns to recognize different patterns, find an adequate tapping strategy and improve its tapping velocity. The child receives a score for both the amount of tapped black fields and the playing time, with a maximum of 30 seconds.

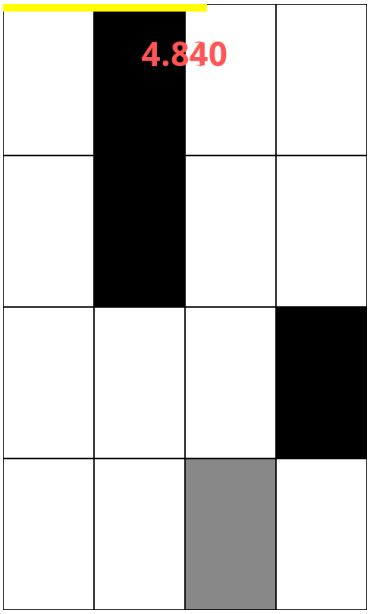

Fig 1: 'Guess The Movie Piano Tiles 4'

Fig 2: 'Balloon Popping For Kids Pop'

The second app was the game 'Balloon Popping For Kids Pop' (figure 2) that requires the repetitive tapping, with one or multiple fingers, of the balloons appearing at the bottom of the screen. The goal is to tap as much balloons as possible before three balloons have reached the top of the screen and the game stops. The more balloons are tapped, the faster the balloons will rise to the top of the screen. Playing this game, the child will develop a strategy to tap the balloons, improve its tapping velocity and learn to anticipate the movement of the

balloons. Again, the child receives a score for both the amount of tapped balloons and the playing time. Just as in the app, the child receives five points for each tapped balloon.
The scores represent the motor agility, the ability to recognize motor patterns and to adapt its own motor strategy to the changing environment. A higher final score can be reached if the child achieves a higher stage in the process of motor learning.

On the first day, the participants got one trial as rehearsal, followed by 3 other trials. Only the 3 last trials were taken into account. On the second day, participants again got 3 trials, which were all used in data-analysis.
For both games, the following variables were used to assess motor learning; (1) average score/number of tiles; (2) maximum score/number of tiles; (3) average velocity, and (4) maximum velocity. Scores of the first day were compared with those of the second day. In case there is a significant improvement, there is evidence of a process of motor learning.
So far, these two games have not been used in research, therefore no information is available on their reliability and validity.

3.2.2 Assessment of imitation ability

The ability of imitation was examined by using the Preschool Imitation and Praxis Scale (PIPS), which examined the procedural and bodily imitation (gestural and facial imitation) (Vanvuchelen, Roeyers, & De Weerdt, 2011a). The PIPS includes 10 task categories clustered according to the action features they examine. For gestural imitation the task categories are: (1) transitive meaningful gestures, (2) intransitive meaningful gestures, (3) single non-meaningful hand postures, (4) bimanual non-meaningful hand postures, (5) non-meaningful hand postures to the face or head and (6) sequences of non-meaningful hand postures. Task categories of procedural imitation are: (1) substituted action upon objects, (2) actions upon substituted objects and (3) sequences of non-meaningful actions upon objects. The last task category is facial expressions which examines the facial imitation. The PIPS consists of 30 items within these categories. All items are scored according to a three-to-five-point scale (Vanvuchelen et al., 2011a). The total score ranges between 0 and 81 and can also be compared by age equivalents (Vanvuchelen et al., 2011b). The total score can be split into

bodily and procedural imitation; bodily imitation consists of gestural and facial imitation items and procedural imitation of procedural imitation items.

The overall reliability of the PIPS is very good, with an ICC of 0.996 for inter-rater reliability and an ICC of 0.995 for test-retest reliability (Vanvuchelen et al., 2011b). Internal consistence of all 30 items is excellent, with a Cronbach's alpha of 0.97 (Vanvuchelen et al., 2011a). Criterium related and construct validity for the PIPS are also acceptable (Vanvuchelen et al., 2011a).

For this study the PIPS was administered by one researcher, but was videotaped, so both researchers could independently score the test. The ICC for inter-rater reliability was 0.99, which corresponds with an excellent inter-rater reliability.

3.2.3 Assessment of motor development

The Peabody Developmental Motor Scales (PDMS-2) was used to examine fine motor development (Folio & Fewell, 2000). In this pilot study only the visual motor integration subtest was used, with at most 21 items, depending on the age and motor capacity of the child. All items were scored according to a three-point scale; a score '2' was given when the skills could be performed according to the provided criteria and a score '0' when a child was not able to perform the skill. The raw scores were compared with normative data.

For the fine motor scale of the PDMS-2 excellent test-retest and inter-rater reliability were shown, with correlations that varied from 0.84 to 0.99. Validity with the fine motor scale of the Movement Assessment Battery for Children (M-ABC) was also acceptable (Van Hartingsveldt, Cup, & Oostendorp, 2005).

3.2.4 Questionnaires

Three questionnaires were administered to the parents before the tests were performed. The first questionnaire was used to gather personal information of the child such as age, gender, spoken language, comprehension of the Dutch language, age of the parents at the child's birth, educational level, the presence of a hearing and visual impairment, number of older siblings and tablet experience (amount of hours per week) (Appendix 1).

Secondly, parents were asked to fill in the Dutch version of the Ages & Stages questionnaire (second edition) (Bricker & Squires, 1999) (Appendix 2-3). This questionnaire examines the

developmental and socio-emotional status of the child, in six domains: communication, gross motor skills, fine motor skills, problem solving ability, personal-social behaviour and a general part. For each domain six questions should be answered with 'yes', 'sometimes' or 'not yet' depending on whether the activity is acquired or not. For each activity that has been acquired a score '10' is given, score '5' for an activity that the child performs occasionally and score '0' for an activity that has not yet been acquired. This leads to an ordinal score of maximum 60 on each domain, with a cut-off score depending on the age of the child. In the Dutch version of the Ages & Stages questionnaire, psychometric properties were only assessed for the 48 months questionnaire. This part of the questionnaire has an excellent reliability and validity, but data for 36 and 42 months are lacking (Kerstjens et al., 2009).

Finally, the Social Responsiveness Scale – Preschool (SRS-P) was administered to map the social development of the child (Constantino & Gruber, 2005) (Appendix 4). This questionnaire assesses the link between social development and imitation and motor learning. The Social Responsiveness Scale – Preschool consists of 65 items in five domains: social awareness (n = 8), social cognition (n = 12), social communication (n = 22), social motivation (n = 11) and autistic preoccupations (n = 12). All items were scored by means of a four-point scale; a score of 1 is given when the thesis is not true, a score of 2 when the thesis is sometimes true, a score of 3 when the thesis is often true and a score of 4 when the thesis is almost always true. For all domains together and each domain separately the total score (maximum 260 in total) could be converted in a T-score. A T-score below 40 corresponds with a high degree of social responsivity, between 40 and 60 with a normal degree of social responsivity, between 61 and 75 with mild to moderate shortcomings in social responsivity and a T-score of 76 or higher with serious shortcomings in social responsivity. Psychometric properties were not available at the time of the study for children younger than four years. From four years on, reliability and validity were determined for Flemish and Dutch children. A Cronbach's alpha of 0.92-0.95 was achieved, which is within the standard for acceptability. Concurrent validity was also acceptable, with a high and significant correlation with the Autism Diagnostic Interview-Revised (Roeyers, Thys, Druart, De Schryver, & Schittekatte, 2011).

3.3 Data-analysis

To analyse the characteristics of participants, descriptive statistics were used. Descriptive statistics were also performed for the results of the PIPS, PDMS-2, motor learnings tasks, the ASQ and SRS. Most variables showed a skewed distribution, for which a logarithmic transformation did not lead to a normal distribution in all variables. Therefore, non-parametric statistics were used. For descriptive statistics median and interquartile range were reported.
Subsequently, scores on the two trials of the motor learning games were considered to be paired samples, therefore significant differences in performance were evaluated by a Wilcoxon signed rank test. To calculate the ratio of change, the difference between scores of day 1 and 2 was divided by the score of day 1. This provides us with the relative amount of progression in addition to the achieved score on day 1 for the average and maximum number of tiles as well as for the average and maximum velocity.
Correlations between motor learning as calculated with the relative amount of progression and imitation ability were calculated by Spearmen's rho coefficient. A correlation of less than 0.30 was interpreted as little to no, between 0.30 and 0.50 as low, then moderate (0.50-0.70), high (0.70-0.90) and very high (0.90-1.00) (Tilburg University, 2016). For imitation ability, total percentile score as well as bodily and procedural percentile score were used. To investigate which other variables influence the motor learning capacity in TD Flemish children, a Spearmen's rho coefficient was calculated. The level of significance was set at $p<0.05$.

The statistical analyses were conducted with the JMP Pro 12 software package.

4. Results

4.1 Participants

For this pilot study, 155 parents of TD children in Flemish kindergartens were invited to participate. Fifty-five parents gave their consent. Ten children had to be excluded because the questionnaires were not filled in (n = 2) or the children had an age above four years (n = 8). Finally, 45 TD children were recruited based on inclusion and exclusion criteria.

Four children scored below the cut-off score on one subtest of the Ages and Stages questionnaire, but not across the board. One child had difficulties with gross motor, one with fine motor skills and two with personal and social behaviour. Because this study explicitly investigates fine motor skills, the child that fell below the cut-off score on fine motor skills might have been excluded. However, the PDMS-2 indicated a normal score on fine motor skills, with a percentile of 63, which led to the decision of including this child in our study.

During test administration another eight children could not be included for the following reasons; sickness (n=4), absence on the second day of test administration (n=2), incomplete test administration (n=1) and refusal to join the researcher for the assessments (n=1). Complete test administration could therefore be taken for 37 TD children.
Test administration of the PIPS was incomplete in two cases, in which one or more items were overlooked by the investigator. If possible, missing items were scored with the mean score of the remaining items in the task category. One test administration had to be excluded due to missing items from a full task category. Four participants required an additional break during test administration due to refusal, inattention and/or emotional status, in some cases leading to a score of zero on the current item.

From the 37 included children, 19 were boys and 18 were girls (mean age 42 months (SD = 2,81)). Nineteen children did not have any older sibling, but the remaining children did have one (n = 10), two (n = 6), three (n = 1) or four older siblings (n = 1). Most children had no tablet experience (n = 11), played less than 1 hour per week on a tablet (n = 11) or between 1 and 5 hours per week (n = 11). Three children played 5 to 10 hours per week and one child

played more than 10 hours per week. Parent's highest educational level in 49% was high school, in 19% college and in 32% university.

The recruitment and follow-up of participants is depicted in figure 3 and the demographic characteristics are depicted in table 1. Table 2 and 3 presents the descriptive statistics of the PIPS, PDMS-2, ASQ, SRS and motor learning tasks.

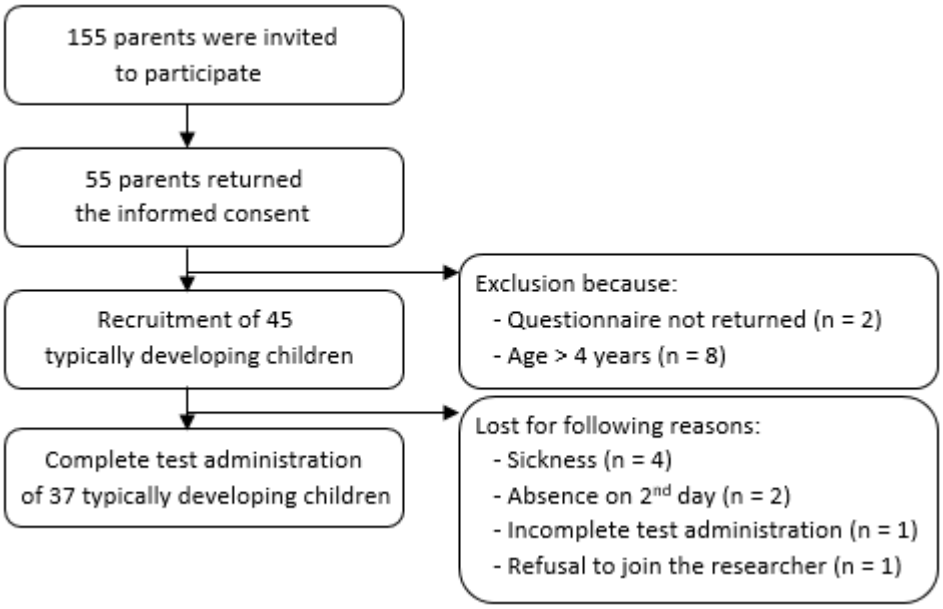

Figure 3: Flow chart of recruitment and follow-up

Table 1: Demographic characteristics

	Median	Interquartile range (p25-75)	Minimum	Maximum
Age entering crèche (years;months)	4m	3m - 5m	0m	3y 6m
Mother's age at child's birth	30y 6m	29y - 33y	23y	39y
Father's age at child's birth	33y	29y 3m - 35y 9m	23y	41y

	No … siblings	1 … sibling	2 … siblings	3 … siblings	4 … siblings
Older siblings	N = 19 (51%)	N = 10 (27%)	N = 6 (16%)	N = 1 (3%)	N = 1 (3%)

	No experience	< 1 hour	1-5 hours	5-10 hours	> 10 hours
iPad experience	N = 11 (30%)	N = 11 (30%)	N = 11 (30%)	N = 3 (8%)	N = 1 (3%)

	High school	College	University
Parent's highest education level	N = 18 (49%)	N = 7 (19%)	N = 12 (32%)

Table 2: Descriptive statistics of PIPS, PDMS-2, ASQ and SRS

	Median	P25-P75	Minimum	Maximum
PIPS (total imitation)				
Raw score	57	54.5-61	8	70
Age equivalent	42	40-47	16	>60
Percentile score	60	43.5-71.5	0	94
PIPS (bodily imitation)				
Raw score	38	36-42	0	51
Age equivalent	41	39-46	12	>60
Percentile score	54	42.5-59	0	80
PIPS (procedural imitation)				
Raw score	19	17-20	8	21
Age equivalent	53	37.5-60	21.5	>60
Percentile score	62	32-83	0	89
PDMS-2 (visual motor integration)				
Raw score	128	121.5-134	113	137
Standard score	12	10.5-13	8	15
Age equivalent	48	41-55	36	62
Percentile score	75	56.5-84	25	95
Ages and Stages Questionnaire				
Communication (0-60)	55	50-60	40	60
Gross motor (0-60)	60	50-60	35	60
Fine motor (0-60)	55	47.5-60	30	60
Problem solving (0-60)	60	55-60	40	60
Personal-social (0-60)	55	50-60	35	60
Social Responsiveness Scale				
SRS - Total	23	17.5-34	9	128
SRS - Awareness	7	5-8	0	14
SRS - Cognition	4	2.5-7	0	26
SRS - Communication	6	3.5-11.5	0	52
SRS - Motivation	4	2-6.5	0	14
SRS - Social preoccupations	2	1-5	0	22

Table 3: Descriptive statistics of motor learning

	Median	P25-P75	Minimum	Maximum
Piano Tiles day 1				
Average number of tiles	4.67	3.17-9	1.67	41.67
Maximum number of tiles	8	5-16.5	3	57
Average velocity	0.58	0.44-0.83	0.12	1.54
Maximum velocity	0.65	0.42-0.98	0.11	1.9
Piano Tiles day 2				
Average number of tiles	6.67	4.17-15.5	1.33	41
Maximum number of tiles	12	6.5-27.5	2	59
Average velocity	0.76	0.47-1.01	0.25	1.92
Maximum velocity	0.8	0.55-1.1	0.16	1.97
Progression 'Piano Tiles'				
Average number of tiles	0.39	-0.05-0.82	-0.61	5.67
Maximum number of tiles	0.21	-0.13-1.20	-0.63	8
Average velocity	0.25	-0.12-0.60	-0.55	1.99
Maximum velocity	0.24	-0.15-0.61	-0.56	2.27
Balloon Popping day 1				
Average score	292.5	167.5-515	60	712.5
Maximum score	420	232.5-565	75	720
Average velocity	2.96	2.71-3.09	2.12	3.45
Maximum velocity	3.03	2.80-3.14	2.21	3.43
Balloon Popping day 2				
Average score	240	142.92-399.59	70	760
Maximum score	340	200-512.5	95	770
Average velocity	2.82	2.49-3.08	1.79	3.21
Maximum velocity	2.93	2.65-3.12	2.3	3.21
Progression 'Balloon Popping'				
Average score	-0.09	-0.44-0.36	-0.73	0.89
Maximum score	0	-0.29-0.17	-0.73	1.43
Average velocity	-0.01	-0.10-0.04	-0.35	0.14
Maximum velocity	-0.01	-0.06-0.03	-0.32	0.15

4.2 Motor learning

For the game 'Piano Tiles', an overall improvement of median value was observed from day 1 to day 2, in average (IQR) number of tiles from 4.67 (3.17-9) to 6.67 (4.17-15.5) and in maximum (IQR) number of tiles from 8 (5-16.5) to 12 (6.5-27.5). An increase in average (IQR) and maximum (IQR) velocity was also found from day 1 to day 2 from 0.58 (0.44-0.83) to 0.76 (0.47-1.01) and 0.65 (0.42-0.98) to 0.8 (0.55-1.1), respectively. Statistical analyses showed that these improvements were all significant (p between <0.0001 and 0.0017).

Figure 4 shows the individual changes between day 1 and 2 for all the variables of the two games. For average number of tiles in 'Piano Tiles', 23 (62%) children showed a positive change between day 1 and day 2, 3 (8%) children remained stable and 11 (30%) showed a negative change. For maximum number of tiles, 23 (62%) children improved between day 1 and day 2, 1 (3%) child remained stable and 13 (35%) children achieved a lower maximum number of tiles. For average velocity, 26 (70%) children showed a positive change between day 1 and day 2 and 11 (30%) children played the game at a lower average velocity on the second test day. Finally for maximum velocity, 23 (62%) children showed a positive change, while 14 (38%) children showed a negative change between day 1 and day 2.

For the game 'Balloon Popping', an overall decrease of median value was observed between day 1 and day 2. Average (IQR) score decreased from 292.5 (167.5-515) to 240 (142.92-399.59), as does maximum (IQR) score from 420 (232.5-565) to 340 (200-512.5). A decrease was also noticeable in average (IQR) and maximum (IQR) velocity between day 1 and day 2 from 2.96 (2.71-3.09) to 2.82 (2.49-3.08) and 3.03 (2.80-3.14) to 2.93 (2.65-3.12), respectively. Statistical analysis only showed a significant decrease in average score ($p = 0.03$) and maximum velocity ($p = 0.05$).

Figure 4 shows that 15 (41%) children achieved a higher average score between day 1 and day 2 playing 'Balloon Popping', while 22 (59%) children showed a negative change. For the maximum score, 18 (49%) children showed a positive change between day 1 and day 2, 1 (3%) child remained stable and 18 (49%) children showed a negative change. For average velocity, 17 (46%) children played the game at a higher average velocity on the second test day, while 20 (54%) children played it at a lower average velocity. Finally for maximum velocity, 15 (41%) children showed a positive change, while 22 (59%) children showed a negative change between day 1 and day 2.

Because no motor learning process could be noticed, the game 'Balloon Popping' was left out of the remaining analyses.

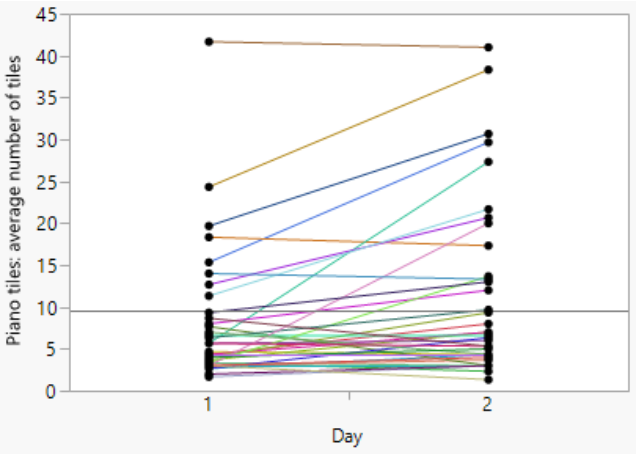

Fig 4a: Progression in average number of tiles

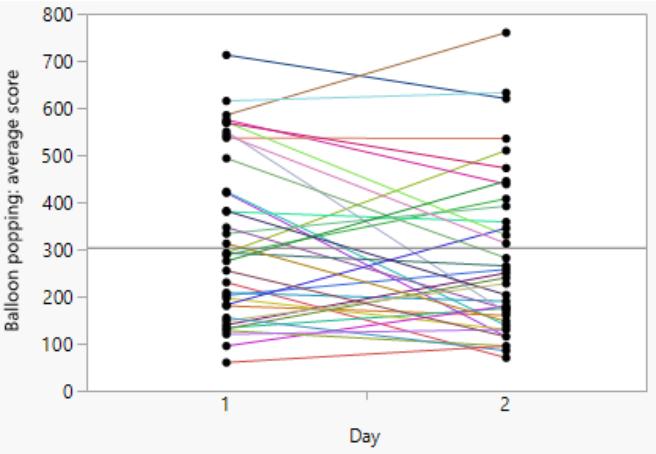

Fig 4b: Progression in average score

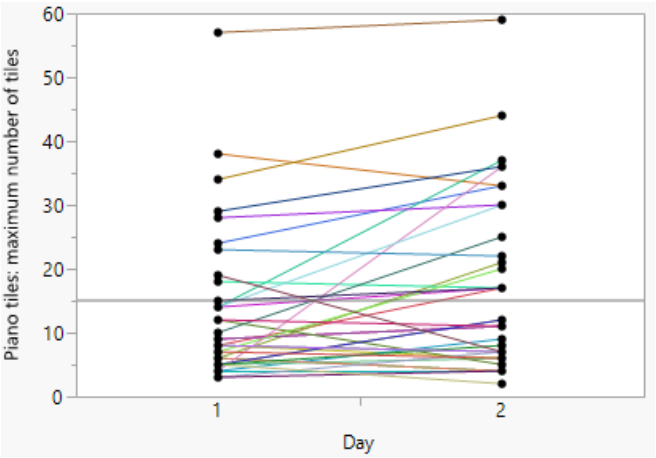

Fig 4c: Progression in maximum number of tiles

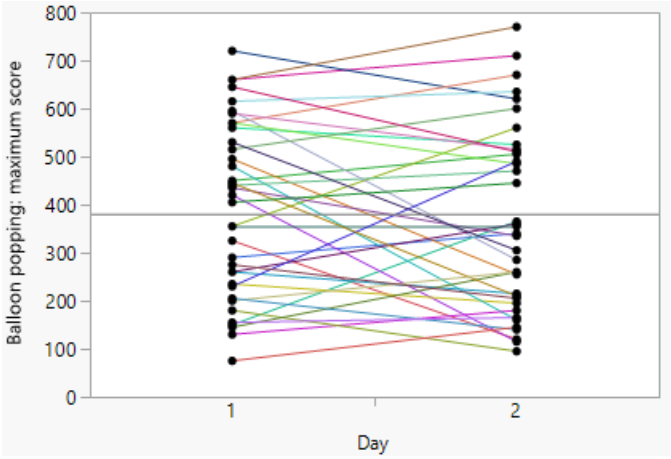

Fig 4d: Progression in maximum score

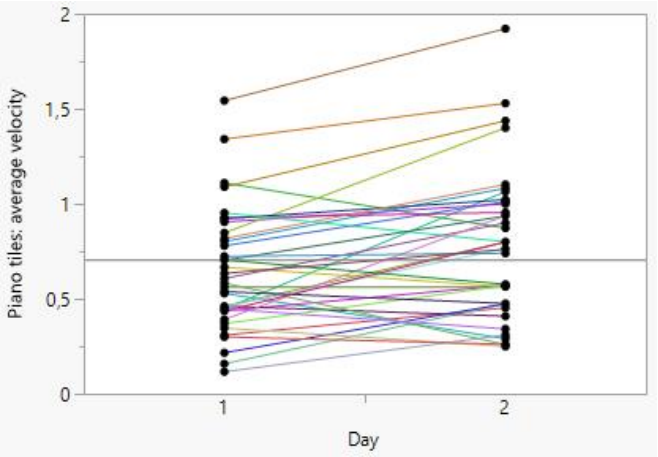

Fig 4e: Progression in average velocity

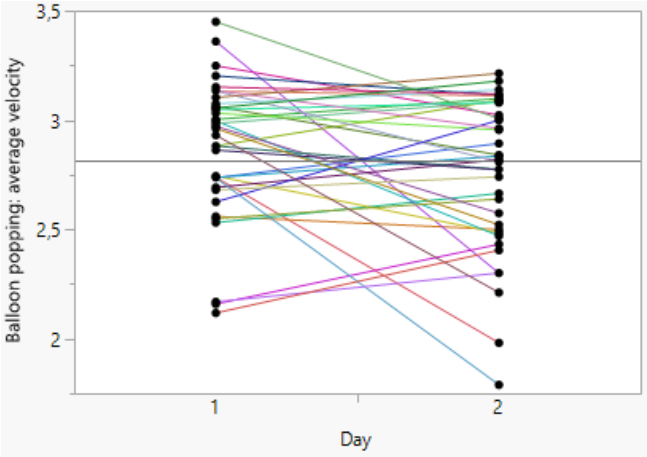

Fig 4f: Progression in average velocity

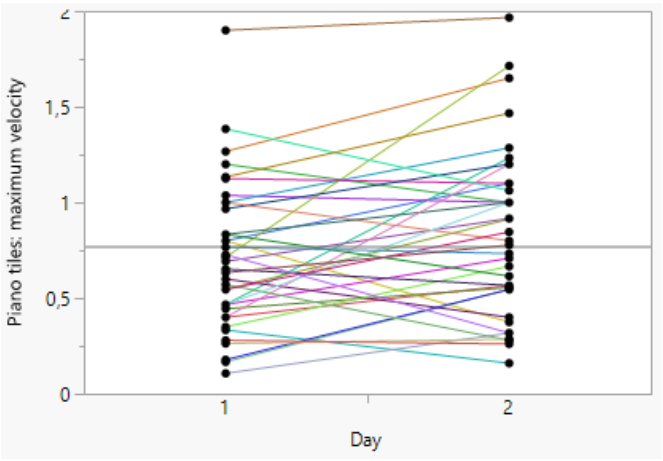

Fig 4g: Progression in maximum velocity

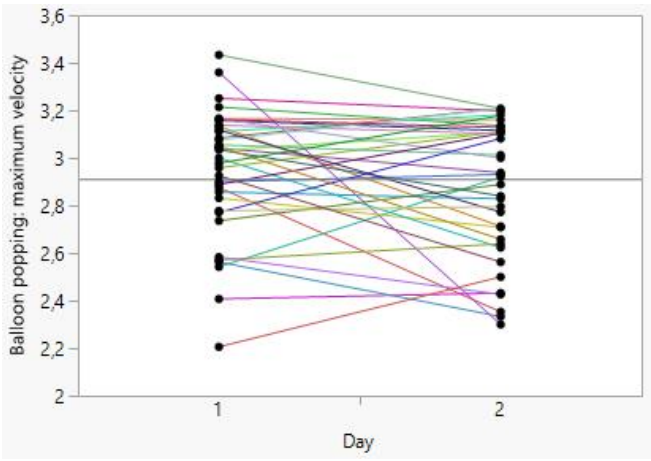

Fig 4h: Progression in maximum velocity

4.3 Correlation between motor learning capacity and imitation ability

Table 4 shows the correlations between motor learning capacity and percentile score of the PIPS. For progression in average and maximum number of tiles, no correlations were found. Little to no correlation was also found for progression in average and maximum velocity, with a Spearman rho of respectively 0.14 and 0.26 (p = 0.40; 0.12).

Table 4: Correlation between motor learning capacity and percentile score of the PIPS

	Spearman ρ	**p-value**
% PIPS		
Progression in average number of tiles	-0.00	0.99
Progression in maximum number of tiles	0.05	0.79
Progression in average velocity	0.14	0.40
Progression in maximum velocity	0.26	0.12
% bodily imitation		
Progression in average number of tiles	0.03	0.86
Progression in maximum number of tiles	0.03	0.87
Progression in average velocity	0.17	0.33
Progression in maximum velocity	0.20	0.25
% procedural imitation		
Progression in average number of tiles	-0.22	0.19
Progression in maximum number of tiles	-0.15	0.39
Progression in average velocity	-0.07	0.66
Progression in maximum velocity	0.06	0.71

It can be observed that for bodily imitation ability all variables of motor learning capacity had little to no correlation (ρ between 0.03 and 0.20). Likewise for procedural imitation capacity, all variables of motor learning capacity showed little to no correlation (ρ between -0.22 and 0.06).

4.4 Correlation between motor learning capacity and other variables

Finally, the relation between motor learning capacity and other variables such as age, tablet experience and fine motor function was analysed (table 5). Correlations between motor learning and other variables are all calculated by Spearmen's rho coefficient. Little to no correlation was found between age of children and motor learning variables (ρ between 0.01 and 0.19). Gender proved not to have an influence on the motor learning variables (ρ between -0.14 and 0.03). Moreover, tablet experience showed little to no correlation with motor learning variables (ρ between -0.10 and 0.07). No correlation was found between older siblings and motor learning variables (ρ between 0.11 and 0.21). The mother's age at child's birth showed little to no correlation for all motor learning variables (ρ between -0.24 and 0.06). For the father's age, a low correlation (ρ = -0.34) was found for progression in maximum number of tiles, with a corresponding p-value of 0.04. This indicates that having a younger father results in achieving a higher progression in maximum number of tiles. For the education level of one of the parents, all motor learning variables showed a low to moderate correlation (ρ = 0.34, 0.48 and 0.56, p = 0.04, 0.01 and 0.0004 respectively), except for progression in average number of tiles. This indicates that a higher education level of one the parents corresponds with a higher progression in maximum number of tiles and a higher progression in average and maximum velocity. Considering fine motor function of PDMS-2, little to no correlations were found (ρ between 0.09 and 0.20) (table 5).

Table 5 also shows correlations between variables of motor learning and all domains of the ASQ. For progression in average and maximum velocity, the domain communication showed a low correlation of respectively 0.40 and 0.35 (p = 0.014; 0.03). Achieving a higher communicative score corresponds with a higher progression in average and maximum velocity on the motor learning task. Low correlations were also found between progression in average and maximum velocity and the ASQ personal-social domain (ρ = 0.31; 0.30), however these

results were not significant. For other domains of the ASQ, little to no correlations were found with variables of motor learning.

Correlation between the SRS domains and motor learning variables are displayed in Table 6. Little to no correlations were found (ρ between -0,27 and 0,12) .

Table 5: Correlation between motor learning capacity and variables of the personal questionnaire, PDMS-2 & ASQ

		Age	Gender	Tablet exp[1]	Older sibs[2]	Age M[3]	Age F[3]	Educ[4]	PDMS[5]	ASQ[6]	ASQ[7]	ASQ[8]	ASQ[9]	ASQ[10]
Motor learning variables														
Progression in average	ρ (rho)	0.01	0.03	-0.01	0.12	-0.22	-0.29	0.21	0.12	0.26	0.01	0.25	0.03	0.20
number of tiles	p-value	0.97	0.87	0.98	0.48	0.21	0.08	0.21	0.48	0.12	0.97	0.14	0.84	0.24
Progression in maximum	ρ (rho)	0.05	-0.02	0.07	0.16	-0.24	**-0.34**	**0.34**	0.20	0.22	0.04	0.22	0.07	0.09
number of tiles	p-value	0.79	0.93	0.67	0.34	0.15	0.04	0.04	0.23	0.20	0.80	0.19	0.70	0.58
Progression in average	ρ (rho)	0.19	-0.14	-0.10	0.21	0.06	-0.22	**0.48**	0.09	**0.40**	0.07	0.06	0.21	**0.31**
velocity	p-value	0.26	0.42	0.57	0.20	0.74	0.20	0.003	0.62	0.01	0.66	0.73	0.22	0.06
Progression in maximum	ρ (rho)	0.07	-0.08	-0.05	0.11	-0.04	-0.29	**0.56**	0.10	**0.35**	0.07	0.08	0.29	**0.30**
velocity	p-value	0.66	0.66	0.78	0.51	0.81	0.08	0.0004	0.56	0.03	0.69	0.62	0.08	0.08

(1) tablet experience
(2) older siblings
(3) age mother/father
(4) educational level
(5) PDMS fine motor
(6) ASQ communication
(7) ASQ gross motor
(8) ASQ fine motor
(9) ASQ problem solving
(10) ASQ personal-social

Table 6: Correlation between motor learning capacity and SRS

		SRS Total	SRS Awareness	SRS Cognition	SRS Communication	SRS Motivation	SRS Preoccupations
Motor learning variables							
Progression in average	ρ (rho)	-0.12	0.02	-0.14	-0.12	-0.18	-0.09
number of tiles	p-value	0.48	0.91	0.41	0.47	0.30	0.60
Progression in maximum	ρ (rho)	-0.07	0.04	-0.05	-0.07	-0.11	-0.12
number of tiles	p-value	0.69	0.82	0.77	0.70	0.52	0.47
Progression in average	ρ (rho)	-0.23	0.01	-0.27	-0.23	-0.17	-0.21
velocity	p-value	0.18	0.95	0.11	0.17	0.32	0.21
Progression in maximum	ρ (rho)	-0.13	0.12	-0.21	-0.15	-0.16	-0.14
velocity	p-value	0.43	0.48	0.21	0.36	0.34	0.39

5. Discussion

The primary goal of this pilot study was to investigate the direction and strength of the relation between imitative behaviour and motor learning in a group of TD Flemish children between 3 to 4 years old. Previous research suggested an improvement of motor learning when observing an action due to changes of plasticity in the sensorimotor brain regions (McGregor & Gribble, 2015; Gonzalez-Rosa et al., 2014). Therefore, a higher imitative ability is also thought to correspond with a better motor learning capacity. However, no significant relation between both variables was found in this study. A possible explanation for this finding is that, in comparison to adults, the action-observation network in infants is still immature and has a less structured organization, which will become more efficient with experience (Rothem-Kohavi et al., 2014).

A secondary goal was to assess which variables had an influence on motor learning capacity in this group of children. Few correlations were found between motor learning capacity and other variables of interest. Three variables showed low to moderate correlations with the child's motor learning capacity; father's age at child's birth, educational level of one of the parents and the ASQ communication domain. The results of the influencing variables and motor learning are discussed below.

Prior to our research, it was unknown whether the father's age at child's birth was positively or negatively related with the motor learning capacity of the child. The results of this study however, showed a low negative correlation between both variables, indicating that a younger father corresponds with a higher level of motor learning (progression in maximum number of tiles). This finding might be explained by the hypothesis that children of younger fathers demonstrate a higher level of motor learning because these fathers might still actively participate in sports. Subsequently, these children might be more encouraged to play sports themselves, but will also observe their father while playing sports.
However, to the best of our knowledge no previous research exists that explicitly examines the relation between the father's age and the child's motor learning capacity. It would be interesting to investigate this potential correlation in future research.

Another hypothesis was that a higher education level of one of the parents resulted in a higher motor learning capacity of the child. A low to moderate correlation was found in this study, suggesting that a higher education level was associated with a higher motor learning capacity. This relation might be explained by an interaction between parental education and quality of parental investment in the child. A higher parental education is expected to lead to a higher quantity and quality of time spent with the children. Parents with a higher income might also be able to invest more financially in the development and education of their child (Edwards & Roff, 2010). Another study suggested a better gross and fine motor development when parents are higher educated (Lung, Shu, Chiang, & Lin, 2008), but so far no research was found that explicitly examines the relation of the parents' education level with motor learning capacity.

Assuming the developmental status of a child has an influence on motor learning (Newell, Liu, & Mayer-Kress, 2001), it was hypothesized that a higher score on the ASQ would correspond with a better motor learning capacity. This hypothesis was confirmed by our results and suggested a higher motor learning capacity (progression in average and maximum velocity) for children with a higher score on the ASQ communication domain. However, this correlation was only low. Bhat, Galloway and Landa (2012) reported that by observing peers or siblings performing motor actions, children are stimulated to explore new moving experiences. A child with social-communication difficulties might avoid social situations and making contact with peers, which causes a decreased exposure to respectively new motor learning situations and social learning situations. Therefore, a relation between motor learning difficulties and communication impairments might exist, but additional research concerning this relation is needed.

Furthermore, our study hypothesized that the presence of an older sibling would increase the motor learning capacity of a child. However, no correlation was found between older siblings and motor learning capacity. In contrast, Berger and Nuzzoa (2008) did find an earlier onset of motor milestones in younger siblings, when an older sibling was present. A possible explanation is that children are stimulated to initiate new movements when observing older siblings modelling these motor skills. In that way, children are challenged to learn new motor skills earlier in development. However, this could not be confirmed in our study.

Older children in this study (42 to 48 months) were hypothesized to exhibit a higher motor learning capacity compared to the younger part of the sample (36 to 42 months). Motor learning poses varying cognitive demands on children and younger children may have lower information processing abilities when learning motor skills (Chan, Luo, Yan, Cai, & Peng, 2015). However, in this study, no influence of age was found. It is possible that the age range in this study was not large enough to detect a difference in motor learning capacity.

The relation between gender and motor learning capacity in younger children has not yet been investigated. However, Dorfberger et al. (2008) explored the training-dependent motor sequence learning of both sexes in 9, 12 and 17 year old children. Their study reported an effect of male advantage, while no influence of gender was found in our pilot study. Differences in findings might be explained by puberty related central nervous system changes in older children, which might cause gender differences in motor learning at older ages.

In this pilot study, a few limitations were found that could possibly explain the lack of correlations between overall imitation ability and motor learning capacity. First, no reliable and valid tool was available for measuring motor learning capacity in 3 to 4 year olds. Therefore, two new experimental games were selected, namely 'Balloon Popping' and 'Piano Tiles'. The preconceived goal was to measure motor learning, using sequential, not cognitive demanding and repeatable motor tasks. During test administration, limitations of these games became apparent.

When playing the game 'Balloon Popping', no process of motor learning could be noticed, as scores of day 2 were even lower for most children compared to the scores of day 1. For this game, several limitations can be taken into account. Especially for older children, the autonomous phase of motor learning was already reached after a short period of time. While playing, the children were able to talk and look around, indicating the game was too simple and not challenging enough. A lack of motivation when playing multiple times resulted in refusal and premature cessation of the game on the second test day. These findings indicate that the game 'Balloon Popping' might not be valid and reliable for measuring motor capacity. The game 'Piano Tiles' however, also has some shortcomings. It proved to be difficult for younger participants, for whom additional instructions were needed. The starting point and

appearance of the black tiles varied from time to time, although the pattern was similar over several attempts. It is not clear whether this variation played a role in the total score between participants. Another limitation of this game was the limited amount of errors that could be made; one mistake was sufficient for the game to end. When one tile appeared just above another, this tile was often passed over by the child, causing the game to end.

The lack of correlation between imitation ability and motor learning capacity may be due to the limitations in the reliability and validity of these motor learning tasks. Therefore, in future studies, it might be beneficial to select or develop a more reliable and valid motor learning task. The pursuit rotor task is a widely used measurement tool in assessing motor skills and motor learning strategies and is thought to offer an accurate estimate of motor learning capacity (Hatakenaka, Miyai, Mihara, Yagura, & Hattori, 2012). The pursuit rotor task requires test subjects to track a target on a disk rotating at variable speeds (Baroun, 2007). For future research, this task could be made in the form of an application to use it on a tablet. The feasibility, reliability and validity of this test should still be investigated in young children.
Andrieux and Proteau (2016) also suggested that learning a new motor skill is enhanced if the participant is informed about the task beforehand. Therefore the motor learning game could be combined with standardized instructions before playing and a break between multiple attempts. A correction should also be incorporated when using games on a tablet to anticipate events where a child accidentally swipes or taps causing the game to stop by another function on the tablet.

When an appropriate tool can be used to measure motor learning, it will be beneficial to assess imitation ability and motor learning capacity in children with developmental disorders, who are known to have difficulties with imitation. Investigation of whether children with lower imitation ability will also exhibit less (if any) improvement in motor learning would be an additional element.
Another interesting possible correlation to examine is the imitation ability and motor learning capacity in TD children of other age groups. This assessment can be done in both younger and older age groups, to assess age-related changes. The motor learning game should then be adapted to the age group.

Also other variables that possibly influence motor learning should be further investigated. Sleep and affective state are some examples that have already proven to have an influence on motor learning capacity (Festini, Preson, Reuter Lorenz, & Seidler, 2015; Blischke & Erlacher, 2007; Desrochers, Kurdziel, & Spencer, 2016; Shet, Janvelyan, & Khan, 2008; Robertson, Pascual Leone, & Miall, 2004). Therefore, other questionnaires should be administered to gather information about these variables.

In conclusion, this pilot study showed no correlations between imitation ability and motor learning capacity, most likely because of the limitations of both motor learning tasks. However, this study showed that father's age at child's birth, educational level of one of the parents and communication (ASQ) were significantly correlated with motor learning capacity. Future study should implement a reliable and valid assessment of motor learning capacity as well as a larger sample with a wider age range.

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7. Appendices

Appendix 1: Personal information questionnaire

Gelieve alle vragen te beantwoorden

Algemene vragen

1. Achternaam van uw kind:
   …….
2. Voornaam en initialen van uw kind:
   …….
3. Geboortedatum van uw kind (dag/maand/jaar):
   …….
4. Leeftijd van uw kind in maanden:
   …….
5. ☐ Meisje
   ☐ Jongen

Ander

6. Is uw kind ooit gediagnosticeerd met een gehoorafwijking?
   ☐ Ja
   ☐ Nee
   Indien ja, maakt uw kind gebruik van een gehoorapparaat?
   ☐ Ja
   ☐ Nee
7. Is uw kind ooit gediagnosticeerd als minder of slechtziend?
   ☐ Ja
   ☐ Nee
   Indien ja, maakt uw kind gebruik van een bril, of een ander hulpmiddel dat het zicht corrigeert?
   ☐ Ja
   ☐ Nee
8. Welke taal wordt thuis hoofdzakelijk gesproken?
   ☐ Nederlands
   ☐ Dialect
   ☐ Andere taal
9. Als bij u thuis niet regelmatig Nederlands wordt gesproken, is uw kind dan voldoende in staat om te begrijpen en te reageren op wat er tegen hem/haar gezegd wordt in het Nederlands?
   ☐ Ja
   ☐ Nee
10. Hoeveel oudere broertjes en/of zusjes heeft uw kind binnen uw gezin?
    ……..
11. Hoeveel jongere broertjes en/of zusjes heeft uw kind binnen uw gezin?
    ……..

12. Wat was de leeftijd van uw kind (in maanden) toen uw kind voor het eerst de crèche of kinderopvang bezocht?

    ……..

13. Speelt uw kind spelletjes op een iPad, iPhone, of soortgelijk elektronisch apparaat?

    ☐ Ja

    ☐ Nee

    Indien ja, hoeveel uur per week speelt uw kind gemiddeld spelletjes met een dergelijk apparaat?

    ☐ < 1

    ☐ 1-5

    ☐ 5-10

    ☐ > 10

    Indien mogelijk, kunt u aangeven welke spelletjes uw kind speelt op een iPad, iPhone, of vergelijkbaar elektronisch apparaat:

    …….

14. Wat is de relatie tot uw kind?

    ☐ Moeder

    ☐ Vader

    ☐ Grootmoeder

    ☐ Grootvader

    ☐ Voogd

15. Hoe oud waren u en uw partner toen uw kind geboren werd? (Enkel indien van toepassing)

    Moeder: … jaar

    Vader: … jaar

16. Wat is uw hoogst bereikte opleidingsniveau?

    ☐ Lagere school

    ☐ Middelbare school

    ☐ Hogeschool

    ☐ Universiteit:

        ☐ Bachelor

        ☐ Master

        ☐ PhD

Appendix 2: Ages & Stages Questionnaire (36 months)

Ages & Stages Questionnaires

Tweede editie

door Diane Bricker en Jane Squires

met assistentie van Linda Mounts, LaWanda Potter, Flobert Nickel, Elizabeth Twombly, en Jane Furell.

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36 maanden 3 jaar

Vragenlijst

Naam van je kind: ……

Geboortedatum van je kind: ……

Duid aan: ☐ jongen ☐ meisje

Datum van vandaag: ……..

Deze vragenlijst wordt ingevuld door (naam): ……

Wat is jouw relatie tot het kind: ……...

Naam van de kinderopvang: ……

Gemeente: ……..

De gegevens in deze vragenlijst worden vertrouwelijk behandeld en uitsluitend in functie van het onderzoek gebruikt.

Bezorg de ingevulde vragenlijst terug voor _____
aan de verantwoordelijke van de kinderopvang.

Ages & Stages Questionnaires

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36 maanden 3 jaar

Vragenlijst

Op de volgende pagina's, vind je vragen over activiteiten van kinderen. Jouw kind heeft sommige van deze activiteiten misschien al gedaan. Er kunnen ook activiteiten beschreven worden die jouw kind nog niet doet.

Voor elke vraag duid je aan of je kind de activiteit:

- 'JA' regelmatig doet
- 'SOMS' af en toe doet
- helemaal 'NOG NIET' doet.

Hoe vul je deze vragenlijst in?

- ☑ Probeer met je kind eerst elke activiteit uit, alvorens je de vraag beantwoordt
- ☑ Maak het invullen van deze vragenlijst tot een prettig spel met je kind.
- ☑ Zorg dat je kind goed uitgerust is, geen honger heeft en zin heeft om te spelen.

Met dank voor uw tijd om deze vragenlijst over je kind in te vullen.

Taal en communicatie

Probeer elke activiteit met je kind:

		JA	SOMS	NOG NIET
1	Vraag je kind om haar/zijn neus, ogen, haar, voeten, oren ..... aan te wijzen. Kan je kind tenminste zeven lichaamsdelen juist aanwijzen. (Ze mag dit op zichzelf aanwijzen of op jou.)	☐	☐	☐
2	Zegt je kind zinnen van drie of vier woorden. Geef hieronder een voorbeeld: ……	☐	☐	☐
3	Vraag je kind: “Zet de schoen op de tafel” en “Leg het boek onder de stoel”. Geef geen hulp door te wijzen of gebaren te maken. Voert je kind deze beide opdrachten uit?	☐	☐	☐
4	Kijk met je kind in een plaatjesboek. Kan je kind je vertellen wat er gebeurt. Bijvoorbeeld: “blaffen, “lopen”, “eten”, “wenen”… Je mag vragen: “Wat doet de hond?”	☐	☐	☐
5	Toon je kind een rits (van een jas) en toon dat de rits op en neer gaat, zeg: “Kijk, dit gaat naar boven en naar beneden”. Zet de rits tot in het midden, vraag nu je kind om de rits naar “beneden” te doen. Zet de rits tot in het midden, vraag nu je kind om de rits naar “boven” te doen. Herhaal dit verschillende keren, vraag je kind de rits naar boven te doen, of naar beneden. Doet je kind dit onmiddellijk correct? Dus: naar boven als jij “boven” zegt, naar beneden als jij “beneden” zegt?	☐	☐	☐
6	Als je vraagt “Hoe heet jij?” , zegt je kind dan zijn/haar voornaam én achternaam?	☐	☐	☐

Grove motoriek

Probeer elke activiteit met je kind:

		JA	SOMS	NOG NIET
1	Kan je kind tegen een bal stampen, zonder steun of zich vast te houden, door een been naar voor te zwaaien?	☐	☐	☐
2	Kan je kind springen terwijl zijn/haar twee voetjes van de grond komen?	☐	☐	☐
3	Kan je kind, de trap opklimmen en zijn/haar voeten afwisselend gebruiken, een voet voor elke trap. (de linkervoet is op een trap, de rechtervoet op volgende …) Het kind mag de leuning vasthouden	☐	☐	☐
4	Kan je kind op een been staan, zonder zich vast te houden, tenminste gedurende 1 seconde.	☐	☐	☐

5	Kan je kind, rechtopstaande, een kleine bal overhands gooien naar een persoon die tegenover hem/haar staat op een afstand van minstens 2 meter? Om overhands te gooien moet uw kind zijn hand tot op schouderhoogte opheffen en naar voor gooien. (De bal laten vallen, de bal loslaten, de bal onderhands gooien: duid dan 'nog niet' aan.)	☐	☐	☐
6	Kan je kind tenminste 15 centimeter voorwaarts springen, met zijn twee voeten van de grond?	☐	☐	☐

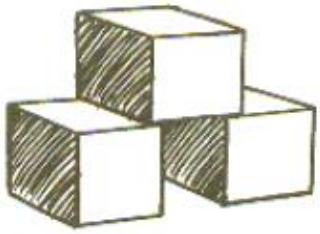
Fijne motoriek

Probeer elke activiteit met je kind:

		JA	SOMS	NOG NIET
1	Laat je kind toekijken terwijl je, met potlood, tekenpotlood of pen, een verticale lijn tekent van boven naar onder op een blad papier. Vraag je kind om net zo'n lijn te tekenen. Laat je kind jouw lijn niet overtrekken. Kan je kind een enkele verticale lijn natekenen. Scoor 'Ja': Scoor 'Nog niet':	☐	☐	☐
2	Kan je kind een schoenveter door een veteropening van de schoen, of een dikke kraal steken?	☐	☐	☐
3	Teken een cirkel voor. Vraag je kind om net zoiets te tekenen. Laat de cirkel niet overtrekken. Tekent je kind een cirkel? Scoor 'Ja': Scoor 'Nog niet':	☐	☐	☐
4	Laat je kind toekijken hoe jij een horizontale lijn trekt op een blad papier, van de ene kant naar de andere kant. Vraag je kind om net zo'n lijn te tekenen. Laat je kind jouw lijn niet overtrekken. Kan je kind je tekening van een horizontale lijn kopiëren? Scoor 'Ja': Scoor 'Nog niet':	☐	☐	☐
5	Probeert je kind met een kinderschaartje te knippen? Het kind moet nog niet echt knippen, maar de schaar moet al open en dicht gaan terwijl het kind het papier in de andere hand houdt. Je mag je kind voordoen hoe een schaar gebruikt moet worden) (Let op dat uw kind op een veilige manier te werk gaat!)	☐	☐	☐
6	Houdt je kind een potlood, tekenpotlood of pen op de juiste manier tussen de vingers en de duim?	☐	☐	☐

Probleemoplossend denken

Probeer elke activiteit eerst met je kind:

		JA	SOMS	NOG NIET
1	Laat je kind toekijken terwijl je een rijtje maakt van vier blokken (of auto's, speeltjes, doosjes …). Kan je kind dit namaken: vier dingen op een rij zetten?	☐	☐	☐
2	Als je kind iets wil, maar hij/zij kan er niet aan., zoekt je kind dan een stoel of een kist om op te staan?	☐	☐	☐
3	Je wijst op de onderstaande tekening en vraagt je kind: "Wat is dit?" Antwoordt je kind met een woord dat "mens" betekent? Antwoorden als: sneeuwman, jongen, man, meisje, papa … zijn correct.  Schrijf hieronder het antwoord van je kind: ……	☐	☐	☐
4	Je zegt: "zeg: zeven, drie". Kan je kind deze twee getallen in de juiste volgorde herhalen? *De cijfers niet herhalen*. Als het nodig is, maak dan een andere rij van twee cijfers, bijvoorbeeld: "zeg: acht, twee". Je kind moet maar één rij kunnen herhalen om 'Ja' te scoren.	☐	☐	☐
5	Toon je kind hoe je een brug maakt met blokken of doosjes, zoals in het voorbeeld. Kan je kind deze brug namaken? 	☐	☐	☐
6	Je zegt: "zeg: vijf, acht, drie". Kan je kind deze drie getallen in de juiste volgorde herhalen? *De cijfers niet herhalen*. Als het nodig is, maak dan een andere rij van drie cijfers, bijvoorbeeld: "zeg: zes, negen, twee". Je kind moet maar één rij kunnen herhalen om 'Ja' te scoren	☐	☐	☐

Persoonlijk en sociaal gedrag

Probeer elke activiteit met je kind:

		JA	SOMS	NOG NIET
1	Kan je kind zelf met een lepel eten, een beetje knoeien mag.	☐	☐	☐
2	Kan je kind een klein winkelwagentje, of karretje duwen, er andere objecten mee omzeilen, en achteruit uit een hoek rijden als hij zijn draai niet kan nemen?	☐	☐	☐
3	Laat je kind in de spiegel kijken en vraag: “Wie is dat?” Antwoordt je kind dan “Ik” of zegt hij/zij zijn/haar naam?	☐	☐	☐
4	Kan je kind haar/zijn eigen jas of blouse aandoen?	☐	☐	☐
5	Gebruik alleen deze woorden: “Ben jij een jongen of een meisje?” Kan je kind het juiste antwoord geven?	☐	☐	☐
6	Kan je kind zijn/haar beurt afwachten, als een ander kind of een volwassene aan de beurt is?	☐	☐	☐

Algemeen

		JA	NEEN
1	Denk je dat je kind goed hoort? Indien niet, leg uit ……	☐	☐
2	Denk je dat je kind even goed praat als andere kinderen van die leeftijd? Indien niet, leg uit ……..	☐	☐
3	Versta je het meeste van wat je kind zegt? Indien niet, leg uit ……..	☐	☐
4	Denk je dat je kind even goed stapt, loopt en klimt als andere kinderen van die leeftijd? Indien niet, leg uit ……..	☐	☐
5	Heeft één van beide ouders een voorgeschiedenis van doofheid of slechthorendheid in de kindertijd? Indien dit zo is, leg uit ……..	☐	☐
6	Ben je bezorgd over het zicht van je kind? Indien dit zo is, leg uit ……..	☐	☐
7	Heeft je kind tijdens de laatste maanden een medisch probleem gehad? Indien dit zo is, leg uit ……..	☐	☐
8	Maak je je zorgen over je kind? Indien dit zo is, leg uit ……..	☐	☐

Appendix 3: Ages & Stages Questionnaire (42 months)

Ages & Stages Questionnaires

Tweede editie

door Diane Bricker en Jane Squires

met assistentie van Linda Mounts, LaWanda Potter, Flobert Nickel, Elizabeth Twombly, en Jane Furell.

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42 maanden

Vragenlijst

Naam van je kind: ……

Geboortedatum van je kind: ……

Duid aan: ☐ jongen ☐ meisje

Datum van vandaag: ……..

Deze vragenlijst wordt ingevuld door (naam): ……

Wat is jouw relatie tot het kind: ……..

Naam van de kinderopvang: ……

Gemeente: ……..

De gegevens in deze vragenlijst worden vertrouwelijk behandeld en uitsluitend in functie van het onderzoek gebruikt.

Bezorg de ingevulde vragenlijst terug voor _____
aan de verantwoordelijke van de kinderopvang.

Ages & Stages Questionnaires

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42 maanden

Vragenlijst

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Voor elke vraag duid je aan of je kind de activiteit:

- 'JA' regelmatig doet
- 'SOMS' af en toe doet
- helemaal 'NOG NIET' doet.

Hoe vul je deze vragenlijst in?

- ☑ Probeer met je kind eerst elke activiteit uit, alvorens je de vraag beantwoordt
- ☑ Maak het invullen van deze vragenlijst tot een prettig spel met je kind.
- ☑ Zorg dat je kind goed uitgerust is, geen honger heeft en zin heeft om te spelen.

Met dank voor uw tijd om deze vragenlijst over je kind in te vullen.

Taal en communicatie

Probeer elke activiteit met je kind:

		JA	SOMS	NOG NIET
1	Vraag je kind: “Zet de schoen op de tafel” en “Leg het boek onder de stoel”. Geef geen hulp door te wijzen of gebaren te maken. Voert je kind deze beide opdrachten uit?	☐	☐	☐
2	Kijk met je kind in een plaatjesboek. Kan je kind je vertellen wat er gebeurt. Bijvoorbeeld: “blaffen, “lopen”, “eten”, “wenen” Je mag vragen: “Wat doet de hond?”	☐	☐	☐
3	Toon je kind een rits (van een jas) en toon dat de rits op en neer gaat, zeg: “Kijk, dit gaat naar boven en naar beneden”. Zet de rits tot in het midden, vraag nu je kind om de rits naar “beneden” te doen. Zet de rits tot in het midden, vraag nu je kind om de rits naar “boven” te doen. Herhaal dit verschillende keren, vraag je kind de rits naar boven te doen, of naar beneden. Doet je kind dit onmiddellijk correct? Dus: naar boven als jij “boven” zegt, naar beneden als jij “beneden” zegt?	☐	☐	☐
4	Als je vraagt “Hoe heet jij?” , zegt je kind dan zijn/haar voornaam én achternaam?	☐	☐	☐
5	Voert je kind drie, niet bij elkaar horende opdrachten uit, zonder dat je de aanwijzingen herhaalt of aanwijst? Bijvoorbeeld: vraag je kind: “Klap je handen, loop naar de deur en zit neer.”	☐	☐	☐
6	Gebruikt je kind alle woorden in een zin? Bijvoorbeeld: “een”, “het”, “ben”, “is”, “zijn”; zodat je kind een complete zin kan zeggen? Voorbeeld: zegt je kind zinnen als “Ik ga naar het park” “Is er iets om mee te spelen? ”of “Kom jij ook?”	☐	☐	☐

Grove motoriek

Probeer elke activiteit met je kind:

		JA	SOMS	NOG NIET
1	Kan je kind, de trap opklimmen en zijn/haar voeten afwisselend gebruiken, een voet voor elke trap. (de linkervoet is op een trap, de rechtervoet op volgende …) Het kind mag de leuning vasthouden.	☐	☐	☐
2	Kan je kind op een been staan, zonder zich vast te houden, tenminste gedurende 1 seconde.	☐	☐	☐
3	Kan je kind, rechtopstaande, een kleine bal overhands gooien naar een persoon die tegenover hem/haar staat op een afstand van minstens 2 meter? Om overhands te gooien moet uw kind zijn hand tot op schouderhoogte opheffen en naar voor gooien. (De bal laten vallen, de bal loslaten, de bal onderhands gooien: duid dan ‘nog niet’ aan	☐	☐	☐
4	Kan je kind tenminste 15 centimeter voorwaarts springen, met zijn twee voeten van de grond?	☐	☐	☐

5	Kan je kind een grote bal opvangen met beide handen. Je staat ongeveer op anderhalve meter afstand en je geeft je kind drie kansen.alvorens te scoren.	☐	☐	☐
6	Kan je kind op de glijbaan op de ladder klimmen en aan de andere kant naar beneden glijden?	☐	☐	☐

Fijne motoriek

Probeer elke activiteit met je kind:

		JA	SOMS	NOG NIET
1	Teken een cirkel voor. Vraag je kind om net zoiets te tekenen. Laat de cirkel niet overtrekken. Tekent je kind een cirkel?	☐	☐	☐

Scoor 'Ja': Scoor 'Nog niet':

2	Laat je kind toekijken hoe jij een horizontale lijn trekt op een blad papier, van de ene kant naar de andere kant. Vraag je kind om net zo'n lijn te tekenen. Laat je kind jouw lijn niet overtrekken. Kan je kind je tekening van een horizontale lijn kopiëren?	☐	☐	☐

Scoor 'Ja': Scoor 'Nog niet':

3	Probeert je kind met een kinderschaartje te knippen? Het kind moet nog niet echt knippen, maar de schaar moet al open en dicht gaan terwijl het kind het papier in de andere hand houdt. Je mag je kind voordoen hoe een schaar gebruikt moet worden. (Let op dat uw kind op een veilige manier te werk gaat!)	☐	☐	☐
4	Houdt je kind een potlood, tekenpotlood of pen op de juiste manier tussen de vingers en de duim?	☐	☐	☐
5	Kan je kind een puzzel van zes stukken leggen? (als je dit niet hebt, knip dan een pagina uit een tijdschrift in zes stukken, Kan je kind dit juist terug samenleggen?)	☐	☐	☐
6	Gebruik deze vorm. Kan je kind deze vorm overtekenen op een groot papier, zonder met het potlood over de oorspronkelijke vorm te gaan? De tekening van het kind moeten ongeveer dezelfde vorm hebben als de voorbeelden, maar ze mogen groter of kleiner zijn.	☐	☐	☐

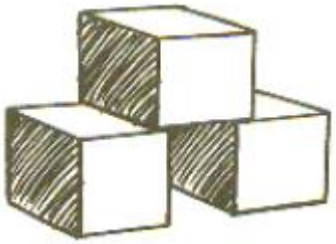
Probleemoplossend denken

Probeer elke activiteit met je kind:

		JA	SOMS	NOG NIET
1	Je wijst op de onderstaande tekening en vraagt je kind: "Wat is dit?" Antwoordt je kind met een woord dat "mens" betekent? Antwoorden als: sneeuwman, jongen, man, meisje, papa … zijn correct.	☐	☐	☐

Schrijf hieronder het antwoord van je kind:
……

2	Je zegt: "zeg: zeven, drie". Kan je kind deze twee getallen in de juiste volgorde herhalen? *De cijfers niet herhalen*. Als het nodig is, maak dan een andere rij van twee cijfers, bijvoorbeeld: "zeg: acht, twee". Je kind moet maar één rij kunnen herhalen om 'Ja' te scoren.	☐	☐	☐
3	Toon je kind hoe je een brug maakt met blokken of doosjes, zoals in het voorbeeld. Kan je kind deze brug namaken?	☐	☐	☐



4	Je zegt: "zeg: vijf, acht, drie". Kan je kind deze drie getallen in de juiste volgorde herhalen? *De cijfers niet herhalen*. Als het nodig is, maak dan een andere rij van drie cijfers, bijvoorbeeld: "zeg: zes, negen, twee". Je kind moet maar één rij kunnen herhalen om 'Ja' te scoren.	☐	☐	☐
5	Vraag aan je kind: "welke cirkel is de kleinste". Stel deze vraag zonder hulp te geven door te wijzen, te gebaren, of naar de kleinste cirkel te kijken. Kan je kind de kleinste cirkel aanduiden?	☐	☐	☐

6	Gaat je kind zich verkleden en "doen alsof" het iemand anders is? Bijvoorbeeld: je kind verkleedt zich en doet alsof hij/zij mama is, of papa, of grote broer, of zus, of een ingebeeld dier of een ingebeelde figuur.	☐	☐	☐

Persoonlijk en sociaal gedrag

Probeer elke activiteit met je kind:

		JA	SOMS	NOG NIET
1	Laat je kind in de spiegel kijken en vraag: “Wie is dat?” Antwoordt je kind dan “Ik” of zegt hij/zij zijn/haar naam?	☐	☐	☐
2	Kan je kind haar/zijn eigen jas of blouse aandoen?	☐	☐	☐
3	Gebruik alleen deze woorden: “Ben jij een jongen of een meisje?” Kan je kind het juiste antwoord geven?	☐	☐	☐
4	Kan je kind zijn/haar beurt afwachten, als een ander kind of een volwassene aan de beurt is?	☐	☐	☐
5	Kan je kind zichzelf bedienen door een grote lepel of vork te gebruiken. Bijvoorbeeld: met een grote lepel appelmoes in een schaaltje doen.	☐	☐	☐
6	Wast het kind handen en gezicht met zeep en water en droogt het zichzelf af met een handdoek, zonder enige hulp?	☐	☐	☐

Algemeen

		JA	NEEN
1	Denk je dat je kind goed hoort? Indien niet, leg uit …….	☐	☐
2	Denk je dat je kind even goed praat als andere kinderen van die leeftijd? Indien niet, leg uit …….	☐	☐
3	Versta je het meeste van wat je kind zegt? Indien niet, leg uit …….	☐	☐
4	Denk je dat je kind even goed stapt, loopt en klimt als andere kinderen van die leeftijd? Indien niet, leg uit …….	☐	☐
5	Heeft één van beide ouders een voorgeschiedenis van doofheid of slechthorendheid in de kindertijd? Indien dit zo is, leg uit …….	☐	☐
6	Ben je bezorgd over het zicht van je kind? Indien dit zo is, leg uit …….	☐	☐
7	Heeft je kind tijdens de laatste maanden een medisch probleem gehad? Indien dit zo is, leg uit ……..	☐	☐
8	Maak je je zorgen over je kind? Indien dit zo is, leg uit ……	☐	☐

Appendix 4: Social Responsiveness Scale – Preschool (SRS-P)

Sociale ontwikkeling van uw kind (30-48 maanden)

Voornaam (kind): Achternaam (kind):

…… …….

Geslacht (kind): Geboortedatum (kind):

☐ Jongen ☐ Meisje ☐☐ / ☐☐ / ☐☐☐☐

Uw geslacht: Datum van vandaag:

☐ Man ☐ Vrouw ☐☐ / ☐☐ / ☐☐☐☐

Uw relatie tot dit kind:

☐ Biologische ouder ☐ Adoptieouder ☐ Stiefouder

☐ Pleegouder ☐ Grootouder ☐ Anders, namelijk: …….

Instructie

Klik bij iedere vraag het vierkantje aan dat het gedrag van het kind in de laatste 6 maanden het best beschrijft:

1 = niet waar 2 = soms waar 3 = dikwijls waar 4 = bijna altijd waar

1.	Lijkt veel onrustiger in sociale situaties dan wanneer hij/zij alleen is.	☐ 1	☐ 2	☐ 3	☐ 4
2.	Zijn/haar gezichtsuitdrukkingen stemmen niet overeen met wat hij/zij zegt.	☐ 1	☐ 2	☐ 3	☐ 4
3.	Lijkt zelfverzekerd in de omgang met anderen.	☐ 1	☐ 2	☐ 3	☐ 4
4.	In stresssituaties lijkt het kind op de 'automatische piloot' te gaan (bijv. vertoont rigide of starre gedragspatronen die vreemd lijken).	☐ 1	☐ 2	☐ 3	☐ 4
5.	Merkt het niet als anderen van hem/haar proberen te profiteren.	☐ 1	☐ 2	☐ 3	☐ 4
6.	Is liever alleen dan samen met anderen.	☐ 1	☐ 2	☐ 3	☐ 4
7.	Is zich bewust van wat anderen denken of voelen.	☐ 1	☐ 2	☐ 3	☐ 4
8.	Gedraagt zich op een manier die vreemd of bizar overkomt.	☐ 1	☐ 2	☐ 3	☐ 4
9.	Klampt zich vast aan volwassenen, lijkt te afhankelijk van hen.	☐ 1	☐ 2	☐ 3	☐ 4
10.	Kan gesprekken van oudere kinderen of volwassenen inhoudelijk niet volgen.	☐ 1	☐ 2	☐ 3	☐ 4
11.	Heeft een gezonde dosis zelfvertrouwen.	☐ 1	☐ 2	☐ 3	☐ 4

12. Is in staat zijn/haar gevoelens in woorden en gebaren naar anderen te communiceren.	☐ 1	☐ 2	☐ 3	☐ 4
13. Is tijdens interacties met leeftijdsgenoten traag of onbeholpen in de beurt nemen.	☐ 1	☐ 2	☐ 3	☐ 4
14. Heeft geen goede coördinatie tijdens fysieke activiteiten.	☐ 1	☐ 2	☐ 3	☐ 4
15. Is in staat de betekenis van intonatie en gezichtsuitdrukkingen van anderen te begrijpen.	☐ 1	☐ 2	☐ 3	☐ 4
16. Vermijdt oogcontact of heeft ongewoon oogcontact.	☐ 1	☐ 2	☐ 3	☐ 4
17. Ziet in wanneer iets onrechtvaardig is.	☐ 1	☐ 2	☐ 3	☐ 4
18. Op de speelplaats of in een groep met andere jonge kinderen, probeert het kind geen interactie aan te gaan met andere kinderen.	☐ 1	☐ 2	☐ 3	☐ 4
19. Raakt gefrustreerd bij pogingen om ideeën over te brengen in gesprekken.	☐ 1	☐ 2	☐ 3	☐ 4
20. Speelt op een vreemde manier met speelgoed.	☐ 1	☐ 2	☐ 3	☐ 4
21. Is in staat om handelingen van anderen te imiteren.	☐ 1	☐ 2	☐ 3	☐ 4
22. Speelt op passende wijze met leeftijdsgenoten.	☐ 1	☐ 2	☐ 3	☐ 4
23. Doet alleen mee aan groepsactiviteiten wanneer hem/haar dat gezegd wordt.	☐ 1	☐ 2	☐ 3	☐ 4
24. Heeft het moeilijker dan andere kinderen met veranderingen in zijn/haar routine.	☐ 1	☐ 2	☐ 3	☐ 4
25. Lijkt het niet erg te vinden om ‘uit de toon te vallen’ of ‘niet op dezelfde golflengte’ als anderen te zitten.	☐ 1	☐ 2	☐ 3	☐ 4
26. Biedt troost aan anderen wanneer zij verdrietig zijn.	☐ 1	☐ 2	☐ 3	☐ 4
27. Vermijdt het starten van sociale interactie met leeftijdgenoten of volwassenen.	☐ 1	☐ 2	☐ 3	☐ 4
28. Denkt of praat telkens weer over hetzelfde.	☐ 1	☐ 2	☐ 3	☐ 4
29. Wordt door andere kinderen als eigenaardig of raar beschouwd.	☐ 1	☐ 2	☐ 3	☐ 4
30. Raakt overstuur in situaties waar veel dingen gaande zijn.	☐ 1	☐ 2	☐ 3	☐ 4

31. Kan zijn/haar gedachten niet van iets afbrengen als hij/zij er eenmaal over begint te denken.	☐ 1	☐ 2	☐ 3	☐ 4
32. Wil graag verschoond worden wanneer luier of ondergoed vies of nat is.	☐ 1	☐ 2	☐ 3	☐ 4
33. Is sociaal onhandig.	☐ 1	☐ 2	☐ 3	☐ 4
34. Vermijdt mensen die een emotionele band met hem/haar willen.	☐ 1	☐ 2	☐ 3	☐ 4
35. Heeft moeite om mee te komen in het normale verloop van een interactie met andere kinderen.	☐ 1	☐ 2	☐ 3	☐ 4
36. Heeft moeite om in de sociale omgang af te stemmen op volwassenen.	☐ 1	☐ 2	☐ 3	☐ 4
37. Heeft moeite om in de sociale omgang af te stemmen op leeftijdsgenoten.	☐ 1	☐ 2	☐ 3	☐ 4
38. Reageert passend op stemmingsveranderingen van anderen (bijv. wanneer de stemming van een vriend of speelkameraad omslaat van blij naar verdrietig).	☐ 1	☐ 2	☐ 3	☐ 4
39. Heeft een ongewoon beperkt interessegebied.	☐ 1	☐ 2	☐ 3	☐ 4
40. Is fantasierijk, kan goed doen alsof (zonder contact met de realiteit te verliezen).	☐ 1	☐ 2	☐ 3	☐ 4
41. Dwaalt doelloos van de ene activiteit naar de andere.	☐ 1	☐ 2	☐ 3	☐ 4
42. Lijkt overgevoelig voor geluiden, texturen of geuren.	☐ 1	☐ 2	☐ 3	☐ 4
43. Maakt zich makkelijk los van verzorgers.	☐ 1	☐ 2	☐ 3	☐ 4
44. Begrijpt minder goed dan leeftijdsgenoten hoe gebeurtenissen met elkaar verband houden.	☐ 1	☐ 2	☐ 3	☐ 4
45. Richt zijn/haar aandacht waar anderen naar kijken of luisteren.	☐ 1	☐ 2	☐ 3	☐ 4
46. Heeft overdreven ernstige gezichtsuitdrukkingen.	☐ 1	☐ 2	☐ 3	☐ 4
47. Doet te kinderachtig of lacht ongepast.	☐ 1	☐ 2	☐ 3	☐ 4
48. Heeft gevoel voor humor, begrijpt grappen.	☐ 1	☐ 2	☐ 3	☐ 4
49. Doet het bijzonder goed op enkele taken, maar doet het niet zo goed op de meeste andere taken.	☐ 1	☐ 2	☐ 3	☐ 4

50. Vertoont repetitieve, vreemde gedragingen zoals fladderen met de handen of wiegen.	☐ 1	☐ 2	☐ 3	☐ 4
51. Op rechtstreekse vragen geeft hij/zij antwoorden die onzinnig lijken.	☐ 1	☐ 2	☐ 3	☐ 4
52. Weet wanneer hij/zij te luid praat of te veel lawaai maakt.	☐ 1	☐ 2	☐ 3	☐ 4
53. Praat tegen mensen op een ongewone toon (bijv. spreekt als een robot of op een overdreven formele manier).	☐ 1	☐ 2	☐ 3	☐ 4
54. Lijkt op mensen te reageren alsof ze voorwerpen zijn.	☐ 1	☐ 2	☐ 3	☐ 4
55. Beseft wanneer hij/zij te dicht in de buurt is bij iemand of in in iemands persoonlijke ruimte binnendringt.	☐ 1	☐ 2	☐ 3	☐ 4
56. Komt er tussen wanneer twee mensen in gesprek zijn.	☐ 1	☐ 2	☐ 3	☐ 4
57. Andere kinderen vinden het niet leuk om met hem/haar te spelen.	☐ 1	☐ 2	☐ 3	☐ 4
58. Concentreert zich te veel op deelaspecten van dingen, eerder dan 'het hele plaatje te zien' (bijv. draait aan de wielen van een speelgoedauto, maar speelt er niet mee alsof het een auto is of speelt met het haar van een pop maar niet met de hele pop).	☐ 1	☐ 2	☐ 3	☐ 4
59. Is overdreven achterdochtig.	☐ 1	☐ 2	☐ 3	☐ 4
60. Is emotioneel afstandelijk, toont zijn/haar gevoelens niet.	☐ 1	☐ 2	☐ 3	☐ 4
61. Is niet flexibel, heeft moeite om van mening te veranderen.	☐ 1	☐ 2	☐ 3	☐ 4
62. Geeft een ongewone of onlogische reden voor wat hij/zij doet.	☐ 1	☐ 2	☐ 3	☐ 4
63. Raakt anderen op een ongebruikelijke manier aan (bijv. hij/zij raakt iemand aan om contact te maken en loopt vervolgens weg zonder iets te zeggen).	☐ 1	☐ 2	☐ 3	☐ 4
64. Is te gespannen in sociale situaties.	☐ 1	☐ 2	☐ 3	☐ 4
65. Staart of blik dwaalt af in het niets.	☐ 1	☐ 2	☐ 3	☐ 4

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Richting: **master in de revalidatiewetenschappen en de kinesitherapie-revalidatiewetenschappen en kinesitherapie bij kinderen**
Jaar: **2016**

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Datum: **16/06/2016**