

*Feasibility of a measurement
for the development of play
in pre-school children
with Autistic Spectrum Disorder*

<i>Name</i>	<i>M. E. Schutte</i>
<i>Student number</i>	<i>3206505</i>
<i>Date</i>	<i>July 1, 2011</i>
	<i>Utrecht University</i>
	<i>Clinical Health Science</i>
	<i>Master Nursing Science</i>
<i>Course</i>	<i>6, Research Internship</i>
<i>Course teacher</i>	<i>Drs. G. van der Hooft-Leemans</i>
<i>Mentor</i>	<i>Drs. I.E. Uitewaal-Poslawsky,</i> <i>Child and Adolescent Psychiatry, Division Neuroscience,</i> <i>Faculty Clinical Health Sciences, Utrecht University Medical Centre</i>
<i>Co-mentor</i>	<i>Dr. F.B.A. Naber</i> <i>General Pedagogies, Faculty Social Science</i> <i>University Leiden</i>
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Abstract

Introduction: Play is very important during the development of a child. Next to motor skills, social interaction, communication and imagination are important contributors to the development of play. These areas correspond with deficits typically experienced by children with Autistic Spectrum Disorder (ASD). The development of play can be described by different stages of play. There is no golden standard to measure development of play.

Problem statement: In an Academic Hospital in the Netherlands, a nursing intervention to promote interaction between parents and pre-school children with ASD is being examined. One of the outcomes is development of play. Assessment of play is a part of the Autism Diagnostic Observation Schedule (ADOS). The ADOS seems to lack sensitivity to measure change. Researchers need a measurement, that is more sensitive to changes in play behavior and examines more specific different stages of play, in order to capture development of play. The Structured Play Assessment (SPA) is the only suitable measurement.

Research question: What is the feasibility of the SPA, in measuring the development of play, in pre-school children with ASD

Methods: A pilot was conducted, using a quantitative, cross-sectional design. The SPA, added with extra variables, was used to assess video's of free play (n=43). The videos were taken, before the nursing intervention was provided, at the child's home. The outcomes were compared to the ADOS-play score with non parametric tests.

Results & Discussion: The SPA and the ADOS are compatible and give equal results; however, the SPA is more sensitive for measuring changes in play behaviour.

Conclusion and recommendations: The SPA is feasible to measure development of play, because it can detect even small changes in play and play behavior. Further research for the use of the SPA in general is needed.

Keywords: Measurement - Development of play – Autism – Children - SPA

Samenvatting

Introductie: Spel is een belangrijk element tijdens de ontwikkeling van een kind. Naast motoriek zijn sociale interactie, communicatie en fantasie belangrijke elementen die bijdragen aan de ontwikkeling van spel. Deze gebieden vertonen bij kinderen met een Autisme Spectrum Stoornis (ASS) tekortkomingen. De ontwikkeling van spel verloopt in verschillende fases. Er is geen gouden standaard om de ontwikkeling van spel te meten.

Probleemstelling: in een Academisch ziekenhuis in Nederland wordt een verpleegkundige interventie uitgevoerd om de interactie tussen ouders en jonge kinderen met ASS te bevorderen. Een van de uitkomsten is de ontwikkeling van spel. Beoordeling van spel is een onderdeel van de Autisme Diagnostisch Observatie Schema (ADOS). De ADOS lijkt niet sensitief genoeg om verandering te meten. De onderzoekers willen een meetinstrument dat beter veranderingen in spelgedrag meet en de verschillende fases van spel meet, om de ontwikkeling van spel in kaart te brengen. De Structured Play Assessment (SPA) is het enige geschikte instrument.

Onderzoeksvraag: is de SPA bruikbaar om de ontwikkeling van spel te meten bij jonge kinderen met ASS.

Methode: een pilotstudie is uitgevoerd, met een kwantitatief, cross-sectioneel design. De SPA, uitgebreid met extra variabelen, is gebruikt om video's van vrij spel te beoordelen (n=43). De video is gemaakt voorafgaand aan de verpleegkundige interventie bij het kind thuis. De uitkomsten zijn vergeleken met de ADOS-spel, met behulp van non-parametrische toetsen.

Resultaten en discussie: de SPA en de ADOS zijn compatibel en geven gelijkwaardige resultaten, echter, de SPA is sensitiever voor het meten van verandering in spelgedrag.

Conclusie en aanbevelingen: de SPA is bruikbaar om de ontwikkeling van spel te meten, omdat het zelfs kleine veranderingen in spel zichtbaar maakt. Verder onderzoek naar het gebruik van de SPA in het algemeen is nodig.

Steekwoorden: Meetinstrument – Ontwikkeling van spel – Autisme – kinderen - SPA

Introduction

Play is very important during the development of a child. During play the child has the opportunity to develop motor- and social interaction skills (1) while having fun. The development of play can be elucidated by dividing it into four different stages (2). The first expression of play is simple object manipulation (or manipulative play). It starts when infants of three to four months old attend to distant objects, and grasp, manipulate or mouth them. The next stage, the development of relational play, starts in the second half of the first year. This consists of combining two or more objects in a non-functional manner, such as touching one object to another, banging two objects together or stacking them. Between twelve and eighteen months a child starts to use an object in accordance with its designated function, this is called functional play. Typically developing children begin to show the next stage, symbolic play, between twelve and twenty-four months (2-4). Symbolic play includes treating an object as if it was something else (substitution play, e.g. watching a cardboard box as if it was a TV), attributing properties to objects that they do not possess (agent play, e.g. giving a doll a cookie as if she could eat), and referring to an object that is not really there (imaginary play, e.g. pretending to drink a cup of tea) (1, 2, 4, 5).

Next to motor skills, social interaction, communication and imagination are important contributors to the development of play (6). These areas correspond with deficits, typically experienced by children with Autistic Spectrum Disorder (ASD) (6, 7). ASD is a pervasive development disorder and is defined in terms of qualitative impairments in reciprocal socialization, communication and restricted, repetitive and stereotyped patterns of behaviours, interests and activities. All these impairments are prior to the age of three years (8, 9).

There is no golden standard to measure the development of play. Interventions that promote the development of play, are described by a large variety of instruments, for example the Structured Play Assessment (SPA) (10,11), the Symbolic Play Test (SPT) (12), the Communication and Symbolic Behaviour Scales Developmental Profile (CSBS-DP) (13), the Structured Laboratory Observation (14) and the Developmental Behaviour Scales (15). Some of these instruments measure different stages of play (e.g. SPA), others assess only one stage (e.g. SPT; only symbolic play) or they measure play combined with other developmental areas, such as communication (e.g. CSBS-DP).

Problem statement

In an Academic Hospital in the centre of the Netherlands, a nursing intervention, to promote the interaction between parents and pre-school children with ASD, is being examined. The intervention consists of brief home support (five times), by a trained nurse. The control group receives care as usual; the intervention group receives care as usual, including standardized video-feedback training. The goal is to find the best method to support parents, in order to improve the interaction between the parent and the child with ASD. One of the outcomes to establish the effectiveness of the intervention is the development of play.

Preliminary to the nursing intervention, all children were diagnosed with the Dutch version of the Autism Diagnostic Observation Scale (ADOS, module 1 or 2) (16, 17), based on the ADOS-Generic (ADOS-G). The ADOS is a diagnostic tool for individuals, who are suspected of having autism or other pervasive developmental disorders. It is a semi-structured, standardized assessment of play, interaction and social communication skills (16). The part of the ADOS that measures a child's play skills, consists of two scores; a score on functional play and a score on symbolic play. The scores range from 0 to 3¹. The ADOS assesses play in terms of similarity with normal play behaviour. A rating of 0 indicates no abnormality compared to normal play behaviour (so the child shows a variety of spontaneous functional or symbolic play), increasing to a score of 3, indicating no functional or symbolic play.

The ADOS establishes cut-off points for diagnostic purposes (16). The play scores of the ADOS are focussed on two stages of play at the moment of diagnosing the child and are not sensitive to measure development over time. Therefore, they cannot indicate small changes in play behaviour or development of play (18). In order to capture the development of play and to establish the effect of treatment, the researchers of the intervention are in need of a measurement that is more sensitive to changes in play behaviour and examines the different stages of play. The only measurement that seems suitable is the SPA, which assesses all four categories of play, and is sensitive for changes in play behaviour (2). The SPA has shown excellent reliability and validity in a number of studies (11).

The purpose of this study was to examine the feasibility of the SPA, to assess the development of play in a nursing intervention, in an Academic Hospital in the Netherlands.

¹ The full range of ADOS-G items codes (0-3) was used, although it is common to recode 3 to 2 as in the standard diagnostic algorithm. In this study a score of 3 is retained, to make a stronger statement of (the absence of) play.

Research question

What is the feasibility of the SPA in measuring the development of play in pre-school children with Autistic Spectrum Disorder.

Methods

Study design and participants

A pilot study was conducted, using a quantitative, cross-sectional design. The accessible population consisted of pre-school children with a diagnosis of ASD (n=49), who participated in a nursing intervention in an Academic Hospital in the centre of the Netherlands. The children were referred by general practitioners, Child Welfare Agencies, and Paediatricians.

Demographic variables

Demographic variables were gender, age, level of cognitive functioning, and the degree of autism (table 2). Age is of influence on play, because children develop and mature over time, so they achieve (or should achieve) a higher level of play as they grow older (1). The age of the children is linked to the moment the video of free play is taken. The level of cognitive functioning is determined with the Mullen Scales of Early Learning (19). The influence of cognition on play is described in a study by Ben-Itzhak (15), a higher initial cognitive functioning showed better acquisition of play-skills.

The degree of autism is determined by dividing the ADOS scores (algorithm) into three groups; mild (algorithm <12), moderate (algorithm 13-19), and severe autism (algorithm >20). The degree is of importance, because the deficits, typically experienced by children with ASD, are important contributors to the development of play (6, 7).

Variables of the measurement

Preliminary to the nursing intervention, each child was videotaped for approximately 15 minutes of free play. The video was taken at the child's home, with a standardized set of toys. This video was used to examine the feasibility of the SPA (1 video of each child). The SPA measures four categories of play: manipulative play, relational play, functional play and symbolic play (table 1). The SPA was not suitable for all play measures, so, at an early stage, the SPA was extended with the variables 'non-play' and 'other play', in case the child was not playing or otherwise engaged in play (adapted SPA). Taking into account the purpose of the intervention (promoting interaction), and in consultation with the researchers, the variables 'interaction of the child' and 'stimulation of the environment' were also added. Accordingly, it was possible to establish if, and how much, a child was interacting with his

parents, and if the child had to be stimulated to engage in play. To explore the development of play even further, the preference of specific toys was notated. Some toys are basic, some toys are more sophisticated and require a higher level of play (table 1).

> *insert table 1*

Data analysis

The videos were divided among two observers. Each video was first seen in its entirety, and then assessed in 10-second intervals. For each interval, the subcategory of play was notated in an Excel score sheet, as well as the preference of toys and, if it occurred, interaction and/or stimulation. Subcategories were used, even though only main categories of play were compared. This choice was made in order to explore the feasibility more thoroughly. Using the amount of intervals that play behaviour was coded, different levels of play were calculated into percentages of total play time (ratio-level), since the duration of the play sessions varied in time (shortest video: 47 intervals, longest video: 114 intervals). Data was entered and edited in the Statistical Package of the Social Sciences 15 (SPSS 15).

Assessing the videos with the adapted SPA, produced a detailed picture of the total play behavior of each child. The play scores of the ADOS assess only functional play and symbolic play, therefore only these stages of play of the SPA were used to establish a correlation. The main categories 'percentage functional play' and 'percentage symbolic play' were compared to the play scores of the ADOS. Due to the ordinal level of the ADOS play-scores, a non-parametric test was used; Spearman's Rank Order Correlation Coefficient (Spearman's rho, r_s). To avoid influencing, the play scores of the ADOS were unknown to the observers, until after the coding of play behaviour of all the participating children.

The reliability of the observers and correlation between the observers were measured with an Intraclass Correlation Coefficient (ICC), internal consistency of the instrument was measured with a Cronbach's Alpha.

Additional tests were executed to examine the influence of the demographic variables on play. Correlations between percentage of play, age, and level of cognitive functioning were established with a Pearson's Product Moment Correlation Coefficient (Pearson's rho, r). Correlation between percentages of play and autism (ASD algorithm and degree of autism), was determined with a Spearman's rho, due to the ordinal level of the autism measurement.

Also correlations between interaction and autism, and interaction and play were established. Demographic variables were analyzed with descriptive statistics.

Ethics

The present study was part of a larger research study, and did not include contact with patients. The Medical Research Ethics Committee of the Academic Hospital in the Netherlands granted their permission to the larger research study. The parents of the children gave their written approval to use the videotapes for research purposes. The privacy of the children was respected according to Dutch guidelines. The videos of the children were numbered and divided (odds and even) among two trained observers. Demographics of the children were not connected to the data.

Results

This pilot study lasted from January until May 2011. At the start of the study the intervention group consisted of 49 children. Four children were excluded because there was no ADOS score available (diagnosed elsewhere). Two children were excluded due to technical video problems. In total 43 children were assessed (table 2). They were 27 to 61 months of age at the moment the video of free play was taken ($M=44.7$, $SD= 8.4$). Their level of cognitive functioning ranged from 49 to 124, ($M=72.52$, $SD= 19.25$, 1 missing value). Ten children showed a developmental level of 49, the lowest score possible (23.25%).

The degree of autism is measured by the ADOS overall score, expresses in an ASD algorithm ($M= 13.58$, $SD= 5.04$). There were 19 children with mild autism (algorithm < 12, 44.2%, $M= 9.58$, $SD= 2.67$), 18 children with moderate autism (algorithm 13-20, 41.9%, $M= 14.89$ $SD=2.06$) and 6 children with severe autism (algorithm > 20, 14%, $M=22.33$, $SD=3.83$).

> *insert table 2*

The internal consistency of the measurement was .93 (Cronbach's alpha). The ICC of observer A (author) was .93, the ICC of observer B was not available. The ICC between the two observers was .96 (8 videos, 19% of total). The ICC in sub-categories of play was for manipulative play .73, relational play .72, functional play .96, symbolic play 1.00, other play .80 en interaction .96. The non-play score could not be calculated.

Correlations between the SPA and the play scores of the ADOS were determined using Spearman's rho (r_s) (table 3). There is a negative correlation between functional play (SPA) and ADOS functional play ($r_s = -.398, p < .01$), and between symbolic play (SPA) and ADOS symbolic play ($r_s = -.431, p < .01$). The more atypical play behaviour on the ADOS corresponds with a lower quality of functional and symbolic play according to SPA outcome.

> insert table 3

Correlation between play, age and level of cognitive functioning was determined using a Pearson's rho (r) (table 4). There is a negative correlation between age and manipulative play ($r = -.354, p < .05$), and between age and non-play ($r = -.352, p < .05$); so, the older the child, the less manipulative play the child performed. A positive correlation exists between age and functional play ($r = .318, p < .05$), so the older the child, the more functional play was demonstrated. There is a negative correlation between level of cognitive functioning and relational play ($r = -.361, p < .05$), and between level of cognitive functioning and other play ($r = -.360, p < .05$). A positive correlation exists between level of cognitive functioning and functional play ($r = .535, p < .01$). When the level of cognitive functioning was higher, there was less relational play and other play performed, but more functional play demonstrated.

> insert table 4

Correlation between play and autism was established using Spearman's rho (table 5). There were negative correlations between ASD algorithm and functional play ($r_s = -.408, p < .01$), between ASD algorithm and symbolic play ($r_s = -.428, p < .01$), and between the degree of autism and symbolic play ($r_s = -.400, p < .01$). Thus, a higher degree of Autism corresponds with a lower level of play. There were negative correlations between ASD algorithm and interaction ($r_s = -.313, p < .05$) and between the degree of autism and interaction ($r_s = -.366, p < .05$) (table 6), so, when a child showed more features of autism, there was less interaction. There were negative correlations between interaction and relational play ($r_s = -.449, p < .01$), and between interaction and non play ($r_s = -.334, p < .05$) (table 7). There is a positive correlation between interaction and functional play ($r_s = .343, p < .05$). Hence, more interaction corresponds with less relational play and non play, and more functional play.

> insert table 5, 6 & 7

Discussion

Strength

The adapted SPA and the play scores of the ADOS are compatible with one another and give equal results. The more features of autism a child demonstrates, the lower the quality of play. The adapted SPA however is more sensitive: it produces a perfect picture of the play behaviour of a child, showing variety of play, time spent on each category, variety of toys and number of times of interactions. The internal consistency as well as the ICC was high, which indicates a reliable measurement.

To investigate the effectiveness of the nursing intervention, the children will be videotaped at two follow ups after the intervention. The feasibility of the adapted SPA, to measure development of play in future video's, is high, because the adapted SPA will detect even small changes in play, play behaviour, preferences of toys and interaction. The ADOS however, lacks sensitivity as a measurement of change. In a previous study, Green (18) advocated to develop sensitive but still valid objective tests for measurement of change. The ADOS is suitable for diagnostic purposes, the adapted SPA is more suitable for treatment purposes.

At an early stage extra variables were added, which accounted for those moments the SPA failed. The variables of play (non play, other play) were indispensable and valuable additions to explore play behaviour. The variables interaction, stimulation and preferences of toys contribute to refine play behaviour even further. The additions were well suited for children with ASD.

There is a negative relationship between the ADOS play scores and the adapted SPA. A higher score on the ADOS (e.g. score 3, no play) corresponds with a lower quality of play on the adapted SPA. The relationship is weak to moderate, which can be explained by the nature of the ADOS score. The ADOS establishes cut-off points for diagnostic purposes (16). It is an unrefined, overall score, which reveals if functional or symbolic play was present during the ADOS-test in terms of similarity with normal play. There is no objective assessment of the amount of functional or symbolic play and there is no attention for other stages of play. The adapted SPA is more refined, it measures specific the number of times each stage of play occurs. It produces a precise percentage of the amount of play in each category. Since the ADOS score is not that specific, it would be unlikely to find a strong relationship.

The correlation between age, level of cognitive functioning, autism and the percentages of play is examined. Age correlates negatively with manipulative play and non-play, and positively with functional play. Therefore, in this sample, the older the child, the less manipulative play the child performed, and the more functional play was demonstrated. The level of cognitive functioning correlates negatively with relational play and other play, but positively with functional play. When the level of cognitive functioning was higher, the child showed more functional play, and less relational play or other play. Overall it can be stated that level of play was linked to age and developmental level of the child, as seen in another study (15, 20).

The correlations are weak, due to the fact that we're dealing with children with ASD. Autism correlates negative with play. The higher the ASD algorithm (more severe autism), the lower the score on functional or symbolic play, so when a child showed more features of autism, the level of play was lower. Autism correlates also negatively with interaction. When a child shows more severe autism, there was less interaction. This is consistent with the fact that ASD is characterized by deficits in the area of social interaction, communication, imagination and motor skills, all important contributors to the development of play (6, 7). The correlations between interaction and play show that more interaction corresponds with more functional play, and a decrease of relational play and other play. The quality of interaction is related to the development of play behaviour (21).

Limitations

One of the limitations is that assessing the videos with the SPA is labour-intensive compared to the ADOS. Assessing a video takes a trained person about an hour and a half, compared to half an hour for an ADOS test. On the other hand, it takes intensive training to be qualified to perform an ADOS test and to score an ADOS test, while recording and assessing the video requires little training.

Using the adapted SPA in clinical practice seems more expensive, but the adapted SPA is valuable in monitoring the effect of intensive treatment. There is no clear answer regarding the most effective treatment regarding children with ASD (22). Therefore, it is vital to have a sensitive instrument that monitors the effects of treatment for each individual child, so treatment can be adjusted, when needed, at the right time (22). This saves costs and energy in the long term, and holds a promise for treatment that is better tailored to the child.

The sample of the children was not balanced. Ten children demonstrated the lowest score possible (49) on the Mullen Scales (23.25%). There was one missing value on level of cognition. In fact, there was a score of 86, but this was not established with the Mullen Scale, therefore it was marked missing value. The group of children with severe autism was underrepresented (6 children, 14%).

Unequal appraisal of particularly symbolic play may have occurred, because it wasn't always possible to hear clearly what was said. For example, a child could speak as if the doll was speaking herself (symbolic play). If it wasn't possible to hear what the child said (noise in the environment or poor sound of the video), the intention of play could be misunderstood or misinterpreted. Also some children spoke softly or spoke unclear.

To examine stimulation of the parents it was important to hear and understand what they said. In some cases this was impossible; two mothers spoke in a foreign language. Also, at the start of the intervention (2008), mothers were more present in the video, and were stimulating their child more. Later on, parents were instructed to interfere only when the child was asking for it.

Although the initial ICC was very high, it is possible that the rating of the lower stages of play (e.g. non play) is more difficult than the rating of relational, functional and symbolic play. In the initial ICC the 'non-play score' could not be determined. Further research and/or education are recommended in the future.

Conclusion and recommendations

The feasibility of the adapted SPA, in measuring the development of play in preschool children with ASD is high. The original SPA was not suitable for all play measures since it failed to code for non-play and other play. The SPA was therefore extended, at an early stage, with extra variables (non-play, other play, interaction, stimulation and choice of toys). That resulted in an extensive, detailed picture of the play behaviour of each child, as well as the interaction with the parents and the preference of toys.

Although the adapted SPA is more labour-intensive, the feasibility for this instrument is high, especially in the nursing intervention. Future videos of the children's free play, assessed with the adapted SPA, will reveal even small changes in play, play behaviour, interaction, or preference of toys. The ADOS seems to lack this sensitivity to detect small changes. In clinical practice, using the adapted SPA seems more expensive, but the adapted SPA is capable of monitoring the effects of intensive treatment, therefore treatment can be adjusted on time if necessary. In the end this will be cost effective.

This pilot needs further research to promote the adapted SPA as an instrument to assess play in general in the Netherlands. Regarding the videos, attention is needed concerning the length of the videos, the quality of the sound and the involvement of the parents. Further research and/or education might be necessary to assess the lower stages of play.

References

- (1) Williams E. A comparative review of early forms of object-directed play and parent-infant play in typical infants and young children with autism. *Autism* 2003 ;7(4):361-377.
- (2) Ungerer J, Sigman M. Symbolic Play and Language Comprehension in Autistic Children. *American Academy of Child Psychiatry* 1981;20:318-337.
- (3) Wulff SB. The symbolic and object play of children with autism: A review. *J Autism Dev Disord* 1985;15(2):139-148.
- (4) Mundy P, Sigman M, Ungerer J, Sherman T. Defining the social deficits fo autism: The contribution of non-verbal communication measures. *Journal of Child Psychology and Psychiatry* 1986;27(5):657-669.
- (5) Lockett T, Bundy A, Roberts J. Do behavioural approaches teach children with autism to play or are they pretending? *Autism* 2007 Jul;11(4):365-388.
- (6) Dominguez A, Ziviani J, Rodger S. Play behaviours and play object preferences of young children with autistic disorder in a clinical play environment. *Autism* 2006 /;10(1):53-69.
- (7) Beyer J, Gammeltoft L. *Autism and Play*. London: Kingsley; 2000.
- (8) American Psychiatric Association. *Diagnostic an Statistical Manual of Mental Disorders, 4th edn text rev. (DSM-IV-TR)*. Washington, DC: APA; 2000.
- (9) World Health Organization. *International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), version 2007*. Geneva, Switzerland: WHO press; 1993.
- (10) Whalen C, Schreibman L, Ingersoll B. The collateral effects of joint attention training on social initiations, positive affect, imitation, and spontaneous speech for young children with autism. *J Dev Disord* 2006 2006/07;36(5):655-664.
- (11) Kasari C, Freeman S, Paparella T. Joint attention and symbolic play in young children with autism: a randomized controlled intervention study. *Journal of Child Psychology and Psychiatry* 2006 Jun;47(6):611-620.
- (12) BernardOpitz V, Ing S, Kong TY. Comparison of behavioural and natural play interventions for young children with autism. *Autism* 2004 Sep;8(3):319-333.
- (13) Keen D, Rodger S, Doussin K, Braithwaite M. A pilot study of the effects of a social-pragmatic intervention on the communication and symbolic play of children with autism. *Autism* 2007 Jan;11(1):63-71.
- (14) Ingersoll B, Schreibman L. Teaching Reciprocal Imitation Skills to Young Children with Autism Using a Naturalistic Behavioral Approach: Effects on Language, Pretend Play, and Joint Attention. *J Autism Dev Disord* 2006 May;36(4):487-505.

- (15) Ben-Itzhak E, Zachor DA. The effects of intellectual functioning and autism severity on outcome of early behavioral intervention for children with autism. *Res Dev Disabil* 2007 /;28(3):287-303.
- (16) Lord C, Rutter M, Goode S, Heemsbergen J, Jordan H, Mawhood L, et al. Autism diagnostic observation schedule: A standardized observation of communicative and social behavior. *J Autism Dev Disord* 1989;19(2):185-212.
- (17) de Bildt A, de Jonge M, Lord C, Rutter M, Dilavore P, Risi S. ADOS Autisme Diagnostisch Observatie Schema. Amsterdam: Hogrefe; n.d.
- (18) Green J, Charman T, McConachie H, et al. Parent-mediated communication-focused treatment in children with autism (PACT): a randomised controlled trial. *Lancet* 2010;375:2152-60.
- (19) Mullen EM. Mullen scales of early learning. Circle Pines: American Guidance Services, Inc.; 1995.
- (20) Ben Itzhak E, Lahat E, Burgin R, Zachor AD. Cognitive, behavior and intervention outcome in young children with autism. *Res Dev Disabil* 2008 Sep-Oct;29(5):447-458.
- (21) Naber FBA, Bakermans-Kranenburg MJ, IJzendoorn MH, Swinkels SHN, Buitelaar JK, Dietz C, et al. Play Behavior and Attachment in Toddlers with Autism. *J Autism Dev Disord* 2008;38(5):857-866.
- (22) Ospina MB, Krebs Seida J, Clark B, Karkhaneh M, Hartling L, Tjosvold L, et al. Behavioural and Developmental Interventions for Autism Spectrum Disorder: A Clinical Systematic Review. *PLoS ONE* 3(11): e3755, 2008.

Table 1 Variables

	Main category of play	Subcategory of play
Variables of the SPA	Manipulative play	Each instance of mouthing, waving, banging, fingering, or throwing a toy
	Relational play	<ul style="list-style-type: none"> • Combinations, e.g. touching or banging two objects together in a non-functional manner • Stacking objects • Using one object as a container to hold another object • exploration of an object, but not using it functionally (such as repeatedly opening and closing the doors of a toy-car)
	Functional play	<ul style="list-style-type: none"> • Self-directed acts, e.g. brushings one's hair • Doll-directed acts, e.g. feeding a doll with a spoon • Other-directed acts, e.g. holding a telephone receiver to the mother's ear • Object-directed acts, e.g. placing the top on the teapot or pushing the truck into the garage
	Symbolic play	<ul style="list-style-type: none"> • Substitution play; the use of one object as if it were a different object, e.g. using a teacup as a telephone receiver • Agent play; using a doll as an independent agent of action, e.g. propping a bottle in a doll's arms as if it could feed itself • Imaginary play; the creation of objects or people who have no physical representation in the immediate environment, e.g. making pouring sounds as imaginary tea is poured from a teacup into a cup.
Added variables	Non play	A child is not occupied with play. For example: the child is doing nothing, just sitting in the middle of all the toys, staring, lying on the ground, crying, showing stereotype behaviour like rocking or walking away of the toys
	Other play	The child is engaged in play, but this play cannot be classified in the SPA play stages. For example he is busy searching his own toys, he is looking at how the parent is modelling, he is jumping or dancing or playing with his mirror image in a reflective surface.
	Other categories	
	Interaction child	The child seeks contact with the parent, e.g. seeking eye contact, smiling at them, asking something, answering a question, repeating what the parent said, or asking for a hug. Only scored when the interaction was an initiative of the child
	Stimulation environment	The child is triggered to play by stimulation from the parent or siblings, e.g. the parent points at a toy or verbally encourages a child to try it again, or to play with another toy. Only scored if stimulation had an effect on play.
	Toys	A standardized set of toys was used (and will be used in future videos), including a doll with attributes, toy cars and a garage, a puzzle, a pop-up toy, a spinning-top, children's books, and children's tableware. It was also possible to notate 'no toy' or 'other toys' (like his own toys or things from the environment).

Table 2 Demographic variables

	number	range	Mean	SD	%
Total	49	43 boys, 6 girls			
Excluded	6	6 boys			13.95%
Age at 1^e video	43	27 – 61 months	44.7	8.4	
Cogn. Funct. total	42	49 – 124	72.52	19.25	
Cogn. Funct. lowest score	10	49			23.25%
Cogn. Funct.	19	<70	55.37	7.819	44.19%
	23	>70	86.70	13.29	53.49%
ASD algorithm	43	2 - 30	13.58	5.04	
ASD algorithm	19	< 12 (mild autism)	9.58	2.67	44,2 %
	18	13 – 20 (moderate autism)	14.89	2.06	41.9 %
	6	>20	22.33	3.83	14 %

Cogn. Funct. = Level of Cognitive Functioning

ASD= Autism Spectrum Disorder

Table 3 Correlation SPA and ADOS play scores

Spearman's rho

	Perc. Man play	Perc. Rel play	Perc. Funct play	Perc. Symb play	Perc. Non-play	Perc. Other play
ADOS funct .play score	.207	.156	-.398**	-.284	.314*	.205
ADOS symb .play score	.345*	.245	-.498**	-.431**	.369*	.251

* Correlation is significant at the .05 level

** Correlation is significant at the .01 level

Perc=percentage, Man=manipulative (simple object manipulation), Rel=relational , Funct=functional, Symb=symbolic

Table 4 Correlation between percentages of play and demographics age and IQ.

Pearson's rho

	Age in months	Cogn. Funct.	Perc Man play	Perc Rel play	Perc Funct play	Perc Symb play	Perc Non play	Perc Other play
Age in months	-	.422 **	-.354**	-.121	.318*	.267	-.352*	-.176
Cogn. Funct.		-	-.190	-.361*	.535**	.178	-.211	-.360*
Perc. Man play			-	.118	-.501**	-.167	.468**	-.047
Perc Rel play				-	-.743**	-.131	-.037	-.152
Perc Funct play					-	.027	-.394**	-.249
Perc Symb play						-	-.193	-.261
Perc Non play							-	.078

* Correlation is significant at the .05 level

** Correlation is significant at the .01 level

Cogn. Funct.= Level of cognitive functioning, Perc=percentage, Man=manipulative (simple object manipulation), Rel=relational , Funct=functional, Symb=symbolic

Table 5 Correlation between percentages of play and autism (ASD Algorithm and Degree of autism)

Spearman's rho

	Perc. Man play	Perc . Rel play	Perc. Funct play	Perc. Symb play	Perc. Non-play	Perc. Other play
ASD algorithm	.272	.193	-.408**	-.428**	.243	.249
Degree of autism	.152	.170	-.297	-.400**	.215	.159

* Correlation is significant at the .05 level

** Correlation is significant at the .01 level

Perc=percentage, Man=manipulative (simple object manipulation), Rel=relational , Funct=functional, Symb=symbolic

Table 6 Correlation autism (ASD algorithm and Degree of autism) and interaction

Spearman's rho

	Degree of autism	Interaction
ASD algorithm	.919**	-.313*
Degree of autism	-	-.366*

* Correlation is significant at the .05 level (2-tailed)

** Correlation is significant at the .01 level (2-tailed)

Table 7 Correlation between play and interaction

Spearman's rho

	Perc. Man play	Perc. Rel play	Perc. Funct play	Perc. Symb play	Perc non-play	Perc Other play
Interaction	-.182	-.449**	.343*	.252	-.334*	.145

* Correlation is significant at the .05 level (2-tailed)

** Correlation is significant at the .01 level (2-tailed)

Perc=percentage, Man=manipulative (simple object manipulation), Rel=relational , Funct=functional, Symb=symbolic