

# A randomized controlled trial of preschool-based joint attention intervention for children with autism

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**Background:** Deficits in joint attention (JA) and joint engagement (JE) represent a core problem in young children with autism as these affect language and social development. Studies of parent-mediated and specialist-mediated JA-intervention suggest that such intervention may be effective. However, there is little knowledge about the success of the intervention when done in preschools. **Aim:** Assess the effects of a preschool-based JA-intervention. **Methods:** 61 children (48 males) with autistic disorder (29–60 months) were randomized to either 8 weeks of JA-intervention, in addition to their preschool programs ( $n = 34$ ), or to preschool programs only ( $n = 27$ ). The intervention was done by preschool teachers with weekly supervision by trained counselors from Child and Adolescent Mental Health Clinics (CAMHC). Changes in JA and JE were measured by blinded independent testers using Early Social Communication Scale (ESCS) and video taped preschool teacher–child and mother–child play at baseline and post-intervention. **Clinical trials registration:** Clinicaltrials.gov: NCT00378157. **Results:** Intention-to-treat analysis showed significant difference between the intervention and the control group, with the intervention group yielding more JA initiation during interaction with the preschool teachers. The effect generalized to significantly longer duration of JE with the mothers. **Conclusions:** This is the first randomized study to show positive and generalized effects of preschool-based JA-intervention. **Keywords:** Autism, joint attention, joint engagement, intervention, preschool, randomized controlled trial.

## Introduction

Autism is a neurodevelopmental disorder characterized by impairment in social interaction and verbal and non-verbal communication, along with a restricted repertoire of activities and interests (American Psychiatric Association, 1994). The deficit in social interaction is of major concern as it severely affects quality of life. Recent reviews suggest there is a substantial need for more interventions improving social interaction in young children (Kasari & Lawton, 2010; Reichow & Volkmar, 2010). Targeting core social-skill deficits at an early point may set off small improvements, altering long term prognosis. Therefore, intervention aiming to increase joint attention (JA) and joint engagement (JE) might be essential, as deficits in these areas are well documented in autism (Adamson, Bakeman, Deckner, & Romski, 2009; Chiang, Soong, Lin, & Rogers, 2008; Mundy, Sigman, & Kasari, 1994; Mundy, Sigman, Ungerer, & Sherman, 1986), and may influence later language abilities (Charman et al., 2003; Loveland & Landry, 1986; Thurm, Lord, Lee, & Newschaffer, 2007) and social interaction (Sigman & Ruskin, 1999).

JA refers to the child's capacity to coordinate attention with a social partner around an object or event (Mundy & Sigman, 2006; Scaife & Bruner, 1975) and is observed when the child is showing overt skills such as alternating gaze between an object and a person,

pointing, showing, or giving to share or to show. Similarly, JE is characterized by the child and the social partner being engaged in the same object or event (Bakeman & Adamson, 1984). However, while the child's JA is recognized by explicit acknowledgment of the social partner, JE does not require such overt recognition. The child's social partner might be the sole contributor maintaining the mutual focus.

Effects of both specialist-mediated and parent-mediated intervention aiming to increase JA and JE have been assessed in randomized trials and single case studies. Kasari, Freeman, and Paparella (2006) studied the effect of a specialist-mediated JA-intervention in an university based early intervention program. Fifty-eight 2–4 year old children with autism were randomized to one of three groups; JA, symbolic play, and control. Trained graduate educational psychology students delivered daily intervention sessions for 25–30 days. At post-intervention the children in the JA group demonstrated significantly more showing and responsiveness to JA on structured assessments, as well as more JA-skills and child initiated JE during mother–child play. Improvement in language was found at follow-up 1 year after the intervention (Kasari, Paparella, Freeman, & Jahromi, 2008).

Green et al. (2010) did a randomized multisite study of a parent-mediated social-communication intervention including 152 children with autism aged 24–59 months. In contrast to the results of their pilot study (Aldred, Green, & Adams, 2004), no effects were found

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on autistic symptoms or language. However, significant effects were reported on child communication initiations, parent synchronous responses, and shared attention. For child communication initiation, results for JA-skills, requesting, and verbalization were reported combined. The gains reported did not appear to generalize beyond the parent-child dyad in the time frame of the study assessment. Further, effects on JE and responsiveness to JA were found in younger children (21–36 months) following a waitlist-control randomized study (Kasari, Gulsrud, Wong, Kwon, & Locke, 2010). However, recent results reported from a parent-mediated intervention study, based on the manual developed by Drew et al. (2002) showed no effects (Oosterling et al., 2010). Positive effects on JA were found in small single case studies including 3–5 young children utilizing specialist-mediated (Taylor & Hoch, 2008; Whalen & Schreiber, 2003) and parent-mediated JA-intervention (Schertz & Odom, 2007; Vismara & Lyons, 2007).

Altogether the above-mentioned studies suggest that both parent-mediated and specialist-mediated JA-intervention can be effective. In contrast there is still a dearth of knowledge about the success of JA-intervention when implemented in preschool. Except for one small single case study, showing the effect of a preschool-based JA-intervention (Jones, Carr, & Feeley, 2006), little is known. Increased knowledge in this area is important because of (a) limited availability of specialist-mediated intervention, (b) restrictions in time available for parents to be involved in the intervention, and (c) improved benefit of available preschool time. Further, information about for whom the intervention works is needed. Age and IQ have previously been suggested to influence intervention outcome (Harris & Handleman, 2000). Different program philosophies (e.g., applied behavioral analysis (ABA) vs. eclectic approach) might also moderate the effect of more targeted social-skill interventions.

In order to expand the knowledge of effective interventions, we utilized a randomized controlled trial to see whether a preschool-based JA-intervention would increase JA-skills and JE in young children with autism. Two hypotheses were examined: (a) The children in the intervention group would show superior JA and JE compared to the children in the control group. (b) The effect would generalize to the interaction with the mothers. In addition, we explored possible moderating effects of cognitive level, language age, chronological age, and type of program philosophy (ABA or eclectic).

## Method

### Design

This study reports on baseline and post-intervention data collected in a randomized controlled trial with balanced allocation (1:1). Participants were randomized

either to the intervention group ( $n = 34$ ), receiving JA-intervention in addition to ordinary preschool program, or to the control group ( $n = 27$ ), receiving ordinary preschool program only. Figure 1 shows the participant flow through the trial.

### Participants

Children meeting the inclusion criteria of (a) a chronological age of 24–60 months, (b) a confirmed ICD-10 diagnosis of childhood autism, and (c) attendance in preschool, were identified from October 2006 to August 2008 by 10 Child and Adolescent Mental Health Clinics (CAMHC) in East and West Norway, and invited to participate in the study. Exclusion criteria were (a) central nervous system disorders (e.g., epilepsy, cerebral palsy), and (b) non-Norwegian speaking parents. Two parents and two preschools declined participation due to conflicting programs. The final sample included 61 children. All were diagnosed with childhood autism by a multi disciplinary CAMHC team based on a comprehensive clinical evaluation. Forty-nine children (80%) were tested with ADOS (Lord et al., 2000) and/or ADI-R (Lord, Rutter, & Le Couteur, 1994). Missing ADOS/ADI-R was due to site diagnostics practice, not child characteristics. No children withdrew from the study. Table 1 summarizes descriptive sample information.

### Power

A sample size of 60 was determined from a priori power analysis assuming a clinically significant group differences at measures of language at follow-up 1 year. The analysis was based on preliminary results from Kasari et al. (2008). Given the sample size of 61 in the present study, a group difference in JE of 15% ( $SD 20\%$ ) and JA of 1 ( $SD 1.4$ ) at post-intervention could be detected with a two-sided 5% significance level and a power of 80%.

### Randomization

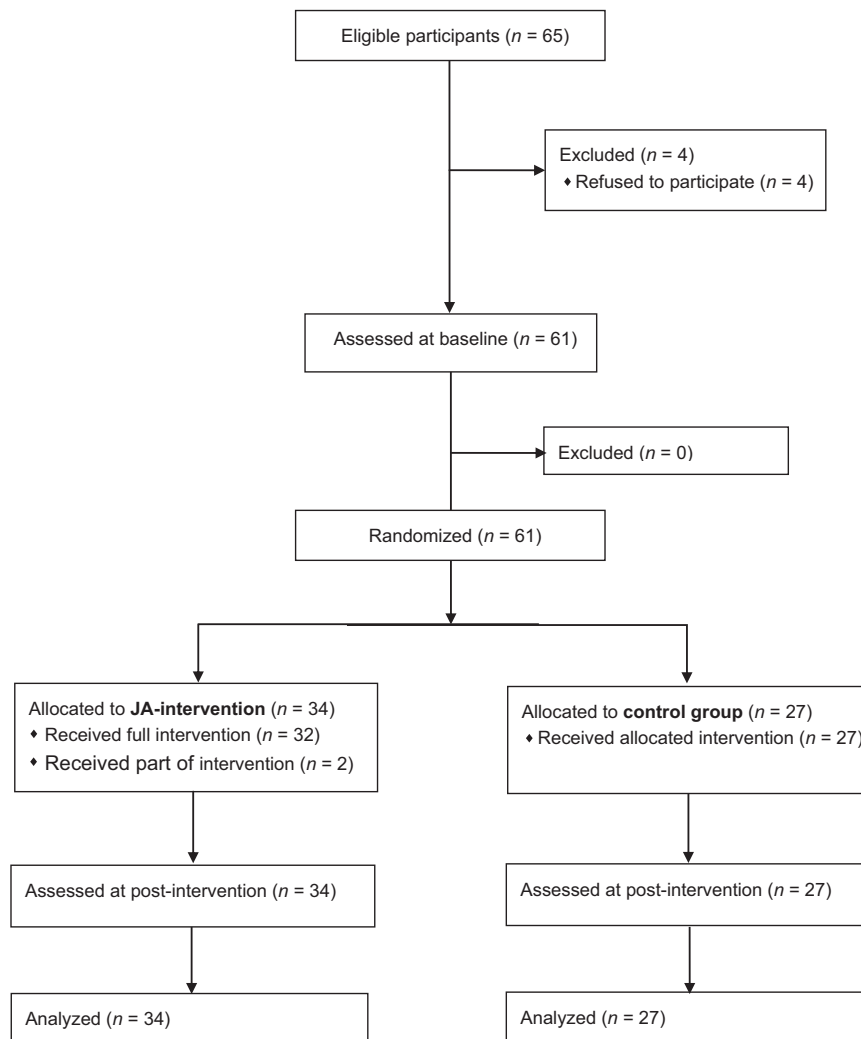
Randomization; not stratified for any child or preschool characteristics, was undertaken by the first author (AK) after the baseline assessment. It was based on a concealed randomization list generated prior to study start by an independent statistician. The list had one row with random blocks of four (e.g., AABB, BABA, ABBA, ...; A = intervention and B = control) for each CAMHC involved in the study. The block system was generated to ensure distribution to both intervention and control group at all CAMHC.

### Masking

Testers, parents, preschool staff, and counselors were blind to allocation status at baseline. The testers were independent of the research group. All video coding was done by research assistants blind to study purpose, group allocation and testing order.

### Assessment procedure

Baseline assessment was done during 1 day at the local CAMHC by one of two independent testers. Measures of



**Figure 1** Participant flow through the trial

JA were collected under three conditions; a semi-structured test, play with preschool teachers, and play with mothers. JE was measured during the same two play sessions. The children were also tested with measures of developmental abilities and language. Prior to baseline assessment, parents completed a demographic questionnaire while preschool staff completed a questionnaire about the preschool program. Identical assessments of JA and JE were repeated in the preschools by the same tester at post-intervention.

### Instruments

Developmental level at baseline was tested with Mullen Scale of Early Learning (MSEL; Mullen, 1997). Forty-three children (70%) scored below the norm-referenced T-scores on one or more of the MSEL scales. Therefore, a developmental quotient (DQ) was computed based on the mean of mental age on the four subscales divided by chronological age. The Norwegian standardization of Reynell Developmental Language Scale (Hagtvet & Liljestøen, 1985) was used to assess receptive and expressive language. For children scoring below basal level (< stanine 4 for 1.5 years) on the receptive or expressive scales (15/22 children respectively), scores on the MSEL language scales were used to calculate

language level. This was justified by high correlations between raw scores on the Reynell and the MSEL language scales for receptive language ( $r = .97$ ) and expressive language ( $r = .94$ ).

Early Social Communication Scale (ESCS; Mundy et al., 2003) was used to measure JA at baseline and post-intervention. The child was seated at the table. The experimenter presented a set of toys, one at the time. The interaction was videotaped and coded. For the present study, the variable used was frequency of *child initiated higher order JA* which included all pointing and showing to share. The intra-class coefficient (ICC; two way mixed model – absolute agreement, single measures) between two raters was .68 based on 22% (27/122) of the ESCS tapes.

Preschool teacher–child play (Bakeman & Adamson, 1984) was used to assess both JA and JE at baseline and post-intervention. Dyads were given a standard set of toys and instructed to play as they typically would do, and then video taped for 10 min. First, the duration of six mutually exclusive engagement states (unengaged, on-looking, person engagement, object engagement, supported JE, and coordinated JE) was coded. Supported and coordinated JE were characterized by the child and the preschool teacher being actively involved in the same object or event. During supported JE the

**Table 1** Baseline characteristics and preschool program for the joint attention-intervention group and the control group

	JA-intervention group n = 34	Control group n = 27	p-value <sup>5</sup>
<b>Child characteristics</b>			
Chronological age	47.6 (8.30)	50.3 (8.3)	.217
Gender (male/female)	26/8	22/5	.873
Mental age <sup>1</sup>	25.6 (10.8)	30.3 (12.0)	.116
Developmental quotient <sup>1</sup>	53.3 (19.2)	59.9 (19.7)	.196
Receptive language age <sup>2</sup>	21.0 (10.3)	25.8 (11.7)	.095
Expressive language age <sup>2</sup>	18.8 (10.5)	24.9 (12.8)	.047
Socioeconomic status <sup>3</sup>	3.2 (1.3)	3.5 (1.0)	.331
<b>Preschool program</b>			
Preschool placement			.905
Mainstream preschool	30 (88%)	24 (89%)	
ASD-unit in mainstream preschool	2 (6%)	2 (7%)	
ASD preschool	2 (6%)	1 (4%)	
Program philosophy			.390
ABA-based program	20 (59%)	12 (44%)	
Eclectic program	14 (41%)	15 (56%)	
Hrs/week in preschool	36.4 (5.7)	38.4 (3.6)	.105
1:1 training hrs/week	11.0 (5.2)	10.7 (6.9)	.872
1:1 support in group hrs/week	19.2 (7.6)	19.0 (7.3)	.928
Ordinary group hrs/week	6.1 (7.9)	10.0 (7.7)	.082
Teacher years of autism experience <sup>4</sup>	1.2 (1.2)	1.6 (2.9)	.968

JA: joint attention; ASD: autism spectrum disorders; ABA: applied behavioral analysis.

<sup>1</sup>Mullen Scale of Early Learning (MSEL). <sup>2</sup>Reynell; for scores <4 stanine for 1.5 years based on MSEL. <sup>3</sup>mean mother/father education level [1 (elementary school) to 5 (>4 years University)]. <sup>4</sup>including the time working with the study child. <sup>5</sup>based on  $\chi^2$ , Z or F statistics.

child did not overtly acknowledge the preschool teacher, while during coordinated JE both the child and the preschool teacher were actively coordinating their attention to the shared object or event and each other. Duration of *preschool teacher-child JE* was calculated from percentage of total time (subtracting time out of camera) in supported and coordinated JE combined. Second, frequency of *child initiated higher order JA* (show, point and give) was coded. Only spontaneous JA initiations, not initiations prompted by adult verbalizations (e.g., 'Give me') or gestures (e.g., holding out hand), were included. Further, initiation of requesting gestures (e.g., point to get) was not included. ICC was .91 for JE and .62 for *child initiated higher order JA* based on 17% (21/121) of preschool teacher-child play. To assess generalization of intervention effect, the same procedure was followed for mother-child play. This generated two new variables; duration of *mother-child JE* and frequency of *child initiated higher order JA*. ICC was .80 for JE, and .79 for child initiated higher order JA based on 16% (19/120) of mother-child play.

Last, to control for a potential difference in JE duration due to group differences in baseline to post-intervention change in preschool teacher or mother initiation, all the play tapes were coded for initiation of JE. For each JE episode the preceding three seconds

were evaluated to establish who initiated the JE episode by, for example, naming a toy, commenting on a toy, or introducing a toy. Frequency of child, mother and preschool teacher initiations were then calculated.

### Preschool program

Norwegian community preschools provide full day professional early childhood education and care for almost 90% of all children aged 1–5 years. The vast majority of children with autism are served in these mainstream preschools. They receive 1:1 support and systematic training in areas such as communication and social skills, based on either an ABA or an eclectic approach. The preschools are typically serving only one child with autism, and have little or no prior experience with autism but receive some guidance from a CAMHC autism expert. A minor fraction of children with autism are served in small autism spectrum disorders (ASD)-units within mainstream community preschools (for 2–3 children with autism) or in ASD-preschools. Services other than special education (e.g., speech therapy, occupational therapy, or physical therapy) are rare. If provided, these services are given within the preschool. The distribution of preschool placement, preschool hours per week, program philosophy, and preschool teacher experience with autism across the intervention and control group is presented in Table 1.

### Intervention procedure

A modification of the JA-intervention manual developed by Kasari (Kasari et al., 2006) was used in the study. The focus of the intervention was on increasing child initiation of higher order JA (show, point, give). Alternating gaze was not targeted directly in the intervention, only in combination with the other JA-skills. The starting point of the intervention was individualized, based on the child's baseline level of JA. The intervention strategies relied on a combined developmental and behavioral model. The JA-intervention lasted 8 weeks with two daily (5 days a week) intervention sessions, with an intention to provide a total of 80 sessions. Each session was 20 min; 5 min of table top training priming for the targeted JA-skill, and 15 min of floor play focusing on generalization of the skills within an optimized engagement setting.

During tabletop training the child was given 9–12 opportunities to initiate the targeted JA-skill within playful adult driven activities. Teaching opportunities to encourage JA initiation were created by using interesting toys (or objects), presenting the toys in, for example, a bag, or hidden to encourage JA initiation, prompting JA initiation when necessary by, for example, asking 'What do you have?', modeling JA, or physical prompting, and by preschool teacher exaggerating the interest in the shared toy. Brief moments of shared interest in the toys were established following each spontaneous or prompted child initiated JA as the preschool teacher joined the child's toy focus. Since the toys were appealing to the child, shared interest usually depended merely on the adult joining in. Example of a teaching trial: The preschool teacher holds a bag with



fun toys in front of the child. The child pulls out a car, and shows it to the preschool teacher; with prompt if necessary. The preschool teacher responds enthusiastically, 'Yeah, nice car!', and joins the child in play with the car for a few seconds. So, 'Bye, bye car'. Then the next trial starts. In contrast to table top training floor play was child driven. Strategies applied included, for example, facilitating JE, following the child's lead, creating play routines, talking about what the child was doing, prompting JA-skills, and responding to JA.

The intervention was delivered in a separate room in the preschool by 34 preschool teachers involved in the children's regular preschool program (23 with a bachelors degree in education or social science/6 with vocational education/5 with no formal training). The preschool teachers had no prior knowledge of JA-intervention. Eighteen counselors from the CAMHC, all with a degree in special education, psychology or social science, and an average of 11 years ( $SD = 6$ ) of experience with autism, provided weekly supervision to the preschool teachers. AK participated during supervision sessions two and five. Prior to study start, all the CAMHC counselors attended a 3-day training to learn the intervention method. Five rehearsal seminars were held during the study. As the children were randomized to intervention, the preschool teacher participated in a six hour didactic training provided by the counselor. The training was based on a script developed by AK covering the concepts of JA, JE, and the intervention procedures. Parents of children in the intervention group were invited to sit in during the didactic training. Mothers of 20 children (59%) participated. Parents were not involved in the implementation of the intervention. The parents' possible use of the intervention principles at home was not monitored.

The children completed an average of 75 ( $SD = 10$ ) of the intended 80 intervention sessions. Some sessions had to be canceled due to, for example, sickness. In some instances these sessions could not be compensated prior to the end of the preschool year. In two situations the intervention was terminated after 33/35 sessions because the preschool/parents withdrew the child from the intervention. However, these children participated in follow-up assessment. There were 59 preschools involved in the study, and one JA-intervention provider per child in the intervention group. None of the preschools provided programs for both intervention and control group children. Thus, treatment contamination was unlikely.

To evaluate the preschool teachers' adherence to the intervention manual, all counselors completed weekly fidelity checklist while observing an intervention session during the supervisions; 10 items for tabletop training and 14 items for floor-play. AK completed the same fidelity ratings of the preschool teachers while participating in the supervision in the preschool during intervention-week 2 and 5. Examples of fidelity items for table top training were behavior objective is clear, appropriate prompt is used when needed, JA is reinforced with natural interaction, variety of toys and activities are used, and for floor play adult follow child's lead, adult imitate child's play behavior, adult show positive affect, and adult response are contingent on the child's activities. Across the 34 preschool teachers,

mean fidelity for the 8 weeks was 85% (range 58%–100%) for tabletop training, and 83% (range 62%–100%) for floor-play. A gradual improvement in fidelity was seen from intervention-week 1 to 8 (table top: week 1 = 70%, week 5 = 85%, and week 8 = 91%, floor play: week 1 = 70%, week 5 = 88%, week 8 = 92%). Reliability of fidelity was assessed by comparing the fidelity ratings done by AK to the concurrent fidelity ratings done by the counselors. Results of this analysis revealed a fair reliability ( $ICC = .68$ ).

### Ethics and trial registration

The study was approved by The Norwegian National Committees for Research Ethics and Oslo University Hospital research ethics committee. Written consent was obtained from both parents and preschools. The study was registered with [clinicaltrials.gov](http://clinicaltrials.gov): NCT00378157.

### Statistical analyses

Statistical analyses were performed with SPSS 16.0 and R (R Development Core Team, 2010). To determine if the two groups differed on background variables, baseline level of the outcome variables, and preschool programs, *t*-tests, Mann-Whitney U tests, and chi-square tests were carried out. Effects of the intervention on three of the outcome variables; *frequency of child initiated higher order JA during ESCS, mother-child play, and preschool teacher-child play*, were evaluated with Poisson regression models to account for the positively skewed count variables. Quasi-Poisson models were used to make allowance for any over dispersion (Hoef & Boveng, 2007). Effects of the intervention on the two outcome variables; *duration of JE during mother-child and preschool teacher-child play*, were evaluated by analysis of covariance (ANCOVA). All the analyses used a strict intention-to-treat approach. The baseline scores of the outcome were added to the models as a covariate. The impact of the intervention was assessed by estimation of either percentage differences or event ratio (ER); both with 95% confidence interval (CI). Effect sizes for baseline and change scores (post-intervention scores minus baseline scores) were measured as Cohen's *d*. Possible moderator effects were explored with separate ANCOVA's and quasi-Poisson regression models including group\*moderator. The four moderators tested were chronological age, cognitive level, language age, and program philosophy.

## Results

### Preliminary analyses

As presented in Table 1, the groups did not differ significantly on the background variables chronological age, gender, socioeconomic status, mental age and DQ. However, the JA-intervention group performed significantly poorer on expressive language compared to the control group; the difference did not attain statistical significance for receptive language. There were no statistically significant group differences on type or content of preschool

program ( $p = .127$  to  $.614$ ); neither on any of the outcome variables at baseline ( $p = .393$  to  $.950$ ).

### Effect on JA and JE during preschool teacher–child play

As shown in Table 2, there was a statistically significant effect of JA-intervention on frequency of JA-skills during preschool teacher–child play at post-intervention (adjusted group difference = 1.506,  $t(1, 59) = 2.147$ ,  $p = .036$ ). Adjusted ER showed that children in the JA-intervention group were almost five times more likely to demonstrate initiation of JA-skills during the 10 min play with preschool teachers as compared to the children in the control group (ER = 4.51, 95% CI = 1.14, 17.84). Effect size was moderate ( $d = .44$ ). There was no statistically significant effect of intervention on duration of JE during preschool teacher–child play at post-intervention ( $F(1, 60) = .391$ ,  $p = .534$ ).

### Effect on JA and JE during mother–child play

There was a statistically significant effect on duration of JE during mother–child play at post-intervention ( $F(1, 59) = 6.271$ ,  $p = .015$ ). After adjusting for baseline JE the children in the JA-intervention group were on average 12.2% longer in JE with their mothers compared to the children in the control group (95% CI = 2.4, 22.0). Effect size was moderate ( $d = .67$ ). There was no conventional statistically significant effect of JA-intervention on frequency of JA-skills during mother–child play at post-intervention (adjusted group difference = .556,  $t(1, 58) = 1.727$ ,  $p = .090$ ). However, adjusted ER indicated that children in the JA-intervention group were almost two times more likely to demonstrate initiation of JA-skills during interaction with mothers compared to the children in the control group (ER = 1.74, 95% CI = 0.93, 3.27).

### Effect on frequency of JA during ESCS

There was no statistically significant effect of JA-intervention on frequency of initiation of JA-skills measured by ESCS at post-intervention (adjusted group difference =  $-.004$ ,  $t(1, 59) = -.011$ ,  $p = .992$ ). Adjusted ER indicated that children in the control group were equally likely to show JA-skills at post-intervention ESCS as the children in the JA-intervention group (ER = 1.00, 95% CI = .45, 2.20).

### Additional analyses

Because the JA-intervention group had significantly lower expressive language age at baseline, all the main analyses were repeated adding expressive language as a covariate. The inclusion of expressive language in the models did not change the results. Further, there was no significant difference between the control and intervention group in change from baseline to post-intervention in frequency of child initiation of JE during mother–child play;  $t(57) = .373$ ,  $p = .711$ ), child initiation of JE during preschool teacher–child play;  $t(57) = -1.007$ ,  $p = .318$ ), preschool teacher initiation of JE ( $t(57) = -.439$ ,  $p = .663$ ), or mother initiation of JE ( $t(56) = .282$ ,  $p = .779$ ). There were no significant effects on the five outcomes of mother participation in initial training ( $p = .25$  to  $.90$ ), number of intervention sessions completed ( $p = .17$  to  $.96$ ), preschool teachers years of experience with autism ( $p = .20$  to  $.68$ ), and fidelity of treatment ( $p = .39$  to  $.92$ ).

### Exploratory moderator analyses

Chronological age, language age (composite of expressive and receptive language age), DQ, and program philosophy (ABA or eclectic approach) did not moderate the effect of the JA-intervention.

**Table 2** Joint attention and joint engagement at baseline and post-intervention for the two groups

	n JA/C baseline post	JA-group		Control group		Diff. ES <sup>5</sup> pre	Diff. ES <sup>5</sup> change	Between groups*	
		Pre mean (SD)	Post mean (SD)	Pre mean (SD)	Post mean (SD)			p-value	Post-score diff. (95% CI)
JA during ESCS	34/27 33/27	1.3 (2.8)	1.6 (2.6)	1.3 (1.8)	1.6 (2.2)	.0	.04	.99 <sup>1</sup>	1.0 <sup>3</sup> (.5–2.2)
JA during teacher–child play	34/26 34/27	.7 (1.3)	1.8 (3.2)	.4 (1.1)	.4 (.7)	.25	<b>.44</b>	<b>.036<sup>1</sup></b>	4.5 <sup>3</sup> (1.1–17.8)
JE during teacher–child play (%)	34/26 34/27	53.1 (23.1)	56.0 (22.2)	58.0 (23.8)	62.7 (20.9)	–.21	–.04	.53 <sup>2</sup>	–2.8 <sup>4</sup> (–11.7–6.2)
JA during mother–child play	33/26 34/27	1.1 (1.6)	2.4 (3.6)	1.4 (2.0)	1.8 (3.2)	–.17	.37	.09 <sup>1</sup>	1.7 <sup>3</sup> (.9–3.3)
JE during mother–child play (%)	33/26 34/27	45.1 (23.4)	57.3 (22.8)	50.2 (21.7)	49.2 (19.9)	–.23	<b>.67</b>	<b>.015<sup>2</sup></b>	12.2 <sup>4</sup> (2.4–22.0)

JA: joint attention; JE: joint engagement; C: control group; ESCS: Early Social Communication Scale. \*Adjusted for baseline scores. <sup>1</sup>Quasi-Poisson model. <sup>2</sup>ANCOVA model. <sup>3</sup>event ratio (ER). <sup>4</sup>percentage. <sup>5</sup>Cohen's  $d$ .

## Discussion

This randomized controlled trial assessed whether a preschool-based JA-intervention would increase JA and JE in young children with autism using a modified version of a specialist-mediated intervention developed by Kasari et al. (2006, 2008). The children in the JA-intervention group evinced more JA-skills during play with the preschool teachers than the controls. The effect generalized to longer JE with the mothers. There was also a trend towards more JA-skills during play with the mothers. Interestingly, no significant effects were found for frequency of JA-skills on semi-structured tests, or for duration of JE during interaction with the preschool teachers. Altogether the findings suggest that preschool-based JA-intervention can be effective in altering some aspects of core social deficits in autism.

Compared to controls, children in the JA-intervention group were almost five times more likely to show initiation of JA-skills during preschool teacher-child play. This finding is central as few studies report positive effect on JA initiation when separated from responding to JA, and requesting. However, some single case studies of parent-mediated (Schertz & Odom, 2007) and specialist-mediated intervention (Taylor & Hoch, 2008; Whalen & Schreibman, 2003) have shown small effects on JA initiation with the intervention providers. Thus, it seems that targeting core social-skill deficits can lead to increased JA with the intervention provider no matter who it is; the preschool teacher, the mother or the specialist.

No effect was found on JE in preschool teacher-child play. This result led to the query why change was experienced in JA, whereas JE seemed to be unaffected. Maybe the preschool teachers had a stronger focus on finding opportunities to facilitate JA, compared to providing the responsive and reciprocal support required for JE. If true, this may be a dilemma when combining strategies from both behavioral and developmental theories; one more skill-oriented and one more relationship-oriented. This argument is supported by more developmentally oriented interventions showing positive effect on JE (Green et al., 2010; Kasari et al., 2010).

Even though the children did not clearly generalize learned JA-skills to the mother-child interaction, there was a significant increase in JE in the mother-child play. The children in the intervention group showed an increase of 10% in duration of JE from baseline, compared to a decrease of 2% in the control group. As there were no differences between the control and intervention group in frequency of mother initiation of JE, the increased duration of JE might be explained by the children's newly improved social orientation; a change that in turn may elicits more sustained engagement from mothers. Thus, there might be a bidirectional effect between the children and the mothers (Sameroff & Mackenzie,

2003). Further, this finding points to a generalization to familiar persons not involved in the intervention. This discovery is rare, as only Kasari et al. (2006) have been able to show generalization of JA or JE beyond the intervention provider.

It has been suggested that JE forms a rich interactive context contributing to JA development (Bakeman & Adamson, 1984). This is explained by the adult scaffolding a joint focus during JE, and hence stimulating the child's awareness of social attention coordination (Mundy & Sigman, 2006). However, the above findings suggest that the link from JE to JA is somewhat unclear, as the improvement in JA during preschool teacher-child play was not associated with concurrent changes in JE. This indicates that additional factors might be important for JA development. Interestingly, there was an improvement in JE but less clear progress in JA in the mother-child interaction. Maybe a different mindset causes preschool teachers and mothers to interact differently with the children. Possibly preschool teachers in their role as educators are more skill-oriented, while mothers are more relationship-oriented.

We did not find an effect of the intervention on structured assessment of JA. This finding is different from the results reported by Kasari et al. (2006) who found an increase in JA on ESCS. However, the current finding accords with results from studies of parent-mediated intervention (Green et al., 2010; Oosterling et al., 2010). Only the specialist-mediated intervention seemed to have the power to increase JA sufficiently to be captured by more formal testing. Perhaps the severity of the core social deficits requires highly trained professionals to induce changes outside familiar persons and situations. Nevertheless, it is possible that children receiving intervention from less skilled providers will need more intervention time. An alternative explanation is that the specialist-mediated intervention targeted JA directly (Kasari et al., 2006), whereas the parent-mediated interventions focused on social-communication more broadly (Green et al., 2010). However, this would not account for the negative result on ESCS in the present study, as we also targeted JA directly.

The analyses revealed no significant moderator effects which suggest that the JA-intervention might be effective for children with various language and developmental levels, across the 2-4 year age range, and in combination with both ABA-based and more eclectic programs. These are all important results when one seeks interventions to be used in a heterogenic preschool setting. However, due to power issues, these findings should be considered exploratory, to be reassessed in later studies. Future JA-intervention studies may also want to examine toy play and social approach behavior as these are found to moderate intervention outcome (Sherer & Schreibman, 2005).



The validity of the present results is strengthened by randomization, a large sample, independent assessors, blind raters, assessment of generalization, and no drop-out. Other assets are the use of an intervention manual, training of the intervention providers, and continued counseling; which are all elements facilitating good intervention adherence (Perepletchikova & Kazdin, 2005). There are also some limitations. The present study reports results on initiation of higher order JA-skills combined (show, point, and give), while, for example, Kasari et al. (2006) report separate results for alternating gaze, show, and point. When comparing the results it is important to recognize that although the JA concepts are strongly related, they are not identical. Further, lack of diagnostic confirmation by the research group might have diluted the sample. However, the diagnostic process in Norway includes multiple professionals, multiple observations (often in both clinic and preschools), and interviews with parents. In addition most participants were assessed by ADOS and/or ADI-R, confirming scores above the cut-off for childhood autism. Additionally, while including 59 mainstream preschools, the heterogeneity in, for example, teaching approach and staff is large. Thus, controlling for all moderating variables is impossible. On the other hand, the heterogeneity is an advantage to the external validity of the study.

In summary, this is the first randomized controlled study investigating the effect of a preschool-based JA-intervention. The results of the study are expanding the knowledge from earlier specialist-mediated and parent-mediated studies. The relatively short preschool-based intervention of 8 weeks by preschool teachers with no prior experience with

JA-intervention was improving some core behavioral signs of autism. However, further studies are needed to assess whether these initial changes will elicit positive long term changes in other areas. Additionally, larger studies are needed to fully investigate moderator and mediator effects. New studies might also want to put more emphasis on floor play strategies when training preschool teachers, to possibly encourage more growth in JE. A combined intervention paralleling both preschool-based and parent-mediated JA-intervention might solve some generalization problems. Parent-mediated JA-intervention should probably be seen as complementary to accessible and good preschool-based JA-intervention. Last, more research looking into JA and JE in different context are needed to better understand the link between them.

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### Key points

- Deficits in JA and JE are core problems in children with autism, and affect language and social development.
- Earlier studies suggest that parent-mediated and specialist-mediated JA-intervention may improve JA and JE.
- This is the first randomized controlled trial of a preschool-based JA-intervention.
- Results showed that the preschool-based JA-intervention was effective in increasing JA, and that the effect generalized to increased JE with mothers.
- JA-intervention might be a valuable addition in established preschool programs for children with autism.

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