



## Early intervention in 208 Swedish preschoolers with autism spectrum disorder. A prospective naturalistic study

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### ABSTRACT

Early intervention has been reported to improve outcome in children with autism spectrum disorders (ASDs). Several studies in the field have been randomized controlled trials (RCTs). The aim of this study was to assess ASD outcome in a large naturalistic study. Two hundred and eight children, aged 20–54 months, with a clinical diagnosis of ASD were given intervention and monitored prospectively in a naturalistic fashion over a period of 2 years. The toddlers were considered representative of all but the most severely multiple disabled preschool children with ASD in Stockholm county. They fell into three cognitive subgroups: one with learning disability, one with developmental delay, and one with normal intellectual functioning. Data on intervention type and intensity were gathered prospectively in a systematic fashion. Intervention was classified into intensive applied behaviour analysis (ABA) and non-intensive, targeted interventions, also based on ABA principles. Children were comprehensively assessed by a research team before the onset of intervention, and then, again, 2 years later. Change in Vineland adaptive behaviour scales composite scores from intake (T1) to leaving the study (T2) was set as the primary outcome variable. The research team remained blind to the type and intensity of interventions provided. One hundred and ninety-eight (95%) of the original samples stayed in the study throughout the whole 2-year period and 192 children had a complete Vineland composite score results both at T1 and T2. Vineland composite scores increased over the 2-year period. This increase was accounted for by the subgroup with normal cognitive functioning. There was no significant difference between the intensive and non-intensive groups. Individual variation was considerable, but no child in the study was “problem-free” at follow-up. Our data do not support that children with ASD generally benefit more from the most intensive ABA intervention programs than from less intensive interventions or targeted interventions based on ABA.

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## 1. Introduction

According to a systematic review of 11 controlled studies of autism spectrum disorder (ASD) (only two of which were randomized controlled trials (RCTs)), early intensive behavioural intervention (EIBI) led to improved IQ outcome relative to comparison groups (Howlin, Magiati, & Charman, 2009). There was, however, a very considerable individual variability in outcome, and low initial IQ tended to contribute to a less favourable prognosis. Since the publication of the systematic review, two further ASD intervention RCTs have been published. The largest RCT performed to date in the field included 152 preschool children with classic autism (Green et al., 2010). The primary outcome variable in that study was the level of autistic symptomatology, which did not change after parent directed communication training. However, parent synchronicity, i.e., parent–child interactions (one of the secondary outcome measures) improved. Another RCT including 48 preschool children (Dawson et al., 2010) demonstrated significant gains in IQ and reduction in autism severity after relatively intensive intervention delivered by trained therapists and parents using developmental and applied behavioural analytic (ABA) principles for 2 years.

In a meta-analysis of EIBI studies based on ABA (Eldevik et al., 2009), effect sizes for full-scale intelligence and adaptive behaviour were found to be larger in groups receiving EIBI than in groups getting no intervention or eclectic treatment. However, a naturalistic 2-year follow-up study of 44 toddlers revealed comparable outcomes in two groups of preschool children, one receiving early intensive behavioural intervention based on ABA and one group receiving autism specific nursery provision (Magiati, Charman, & Howlin, 2007).

Improvement of cognitive and adaptive functions in a child with autism gives a better quality of life and increased well-being for children and their parents (Dyer, Martino, & Parvenski, 2006). Consequently, even a minor improvement in outcome could generate substantial cost reductions for society over the lifetime (Järbrink & Knapp, 2001).

There is now clinical agreement that autism should be diagnosed early so that intervention can be implemented at the youngest possible age. However, the evidence that an early start makes a big difference is very limited, and the review just cited did not indicate an effect of age at onset of EIBI (Howlin et al., 2009). There are many other issues that need to be resolved in autism intervention research before general recommendations can be issued about exactly which type of method should be used and also the extent (for instance, in terms of number of hours per week, and number of months/years) to which it needs to be delivered. Some individuals with ASD are probably more likely than others to benefit from EIBI and it would be important to be able to make reasonable predictions about this at an early stage, in connection with the first diagnosis.

RCTs are usually considered the criterion standard in scientific intervention studies. However, this idea has recently been challenged in two important editorials (Graham, 2007; Rosenbaum, 2010). According to these, RCTs have serious disadvantages and limitations in complex multidisciplinary management of children with developmental disabilities. One of the editorials asks the question: “The randomized control trial: an excellent design, but can it address the big questions in neurodisability?” (Rosenbaum, 2010). In a seminal paper, Leichsenring (2004) discusses RCTs vs. naturalistic studies and shows that they refer to different domains of intended applications (laboratory vs. field), and that naturalistic studies are required to demonstrate that a form of therapy works in the field.

## 2. Aim

The present study is a longitudinal prospective naturalistic study over a period of 2 years of a population-based group of 208 1.5–4.5-year-old children with ASD referred for intervention to the only existing “intervention centres” for autism that exist in Stockholm county. The aims were to examine the outcome in terms of adaptive functioning in ASD over the 2-year period and relate this to type and intensity of intervention.

## 3. Patients and methods

There are two treatment centres for autism in Stockholm county, one organised by the county administration (the Autism Centre for Young Children (ACYC)), and the other a private centre supported by the county (PC). Children with a clinical diagnosis of ASD are all referred to the ACYC where the vast majority receive some kind of intervention. A minority are referred to a smaller treatment centre the PC, where EIBI is provided at a “very intensive” level (see Section 3.2) for all attending children. In addition, children with autism and severe, complex disabilities, including cerebral palsy, severe epilepsy and some syndromes with severe learning disability, are referred to ordinary habilitation centres where neuropediatric liaison services are better developed. This group accounted for fewer than 10% of the total cohort of children with ASD in Stockholm county at the time of the study.

### 3.1. Patients

Two hundred and eight children aged 20–54 months when referred to the ACYC participated in the study. They had all been clinically diagnosed with ASD (clinical autism spectrum diagnosis) and referred to the ACYC for intervention. On admission to the ACYC they were all comprehensively assessed by a multidisciplinary team comprising medical doctors ( $n=4$ ), psychologists ( $n=2$ ) and speech and language pathologists ( $n=2$ ) and re-diagnosed according to strict

operationalised criteria (research autism spectrum diagnosis); see Fernell et al. (2010) for a very detailed description of the procedure and results.

### 3.2. Methods

All 208 children were assessed at initial referral to the ACYC. The majority of them were then received intervention at the centre. However, 23 were referred on to the smaller treatment centre (PC) and received EIBI there. Approximately 2 years after the start of intervention, all 208 families were invited for follow-up and assessment by clinical research raters who had no prior information about the type and extent of intervention received. Of the 208 families, 198 participated in the follow-up assessment.

#### 3.2.1. Time 1 (T1)

**3.2.1.1. Interviews and questionnaires used with parents.** A clinical interview with at least one of the parents was performed by one of the four medical doctors in the team. A clinical observation and physical-developmental examination of the child was performed at one of the parental visits. The child's ASD symptoms were reassessed according to the DSM-IV (APA, 1994), see above. The Vineland adaptive behaviour scales (VABS) (Sparrow, Cicchetti, & Balla, 2005) was used in 204 cases and completed by one of the team members at personal parent interview. Several other scales and measures were used, one of which was the Autistic Behaviour Checklist (ABC) (Krug, Arick, & Almond, 1980), completed at the clinical interview with 203/208 parents.

**3.2.1.2. Cognitive assessment.** At T1 most children had had a formal developmental/cognitive test in conjunction with the initial clinical assessment at a child and adolescent mental health service (CAMHS) or at a neuropsychiatric clinic. The results from these tests were scrutinized by the psychologists in the research team at the ACYC. Thus, at Time 1, no testing was performed by the research team, but an assessment was made of each child's "cognitive level"; "learning disability" (LD), "developmental delay" and "normal" (Fernell et al., 2010).

#### 3.2.2. Time 2 (T2)

Of the original group of 208 children, 198 were assessed at the follow-up visit after approximately 2 years.

**3.2.2.1. Interview and questionnaires used with parents.** A clinical interview with at least one of the parents was done in all cases, focusing on the primary outcome measure (Vineland composite score) and other scales, the results of which are not reported here. A clinical observation and examination of the child was also performed in all cases. Of the 198 children a complete VABS interview at T1 and T2 was obtained in 192 children. An interview according to the ABC was performed in parents of 192 of the 198 children.

The Swedish version of the Diagnosis of Social and Communication disorder DISCO-10 (Nygren et al., 2009; Wing, Leekamm, Libby, Gould, & Larcombe, 2002) was also administered by a trained clinician (the members of the team are certified DISCO-interviewers). Final assessment of ASD was based on DISCO interview (172 children) and other compiled clinical data, and a classification according to DSM-IV (American Psychiatric Association (APA), 1994) was performed in 197 children. Parents of one child declined assessment of the child's ASD.

**3.2.2.2. Cognitive testing.** An "appropriate" IQ/DQ-test was used in all cases. A check was first made of which test had been used for cognitive testing before referral to the ACYC. If at all possible, the same test was used at T2. In addition, an attempt was made to administer the WPPSI-III (Wechsler, 2005) in all cases or the Griffiths (Alin-Åkerman & Nordberg, 1980) in those who could not take the WPPSI-III. Parents of 2 of the 198 children declined a new cognitive test for their child within the project.

After formal testing at T2, a similar cognitive classification of "cognitive level" as at T1 was performed, but at T2 a more detailed assessment was possible. The following categories were used: "learning disability" (LD) in cases with IQ/DQ < 70 and corresponding adaptive criteria, "developmental delay/borderline intellectual functioning" (BIF) in cases with IQ/DQ 70–84, and "normal" in cases with IQ/DQ 85 or above.

#### 3.2.3. Intervention subgroups

At least one, usually both, parents of all the 208 children were first given an autism education "start package" referred to as "The First Step". This comprised 3–5 half-days, during 3 or 5 consecutive weeks, when a group of parents met with expert staff from the ACYC who shared information about autism, ABA methods and practical exercises to perform at home; i.e., how to approach and cope with specific difficult and challenging behaviours of the child. The ACYC also provided regular education for the children's preschool staff in the county in each case delivered at full 1-day seminars.

For those children given EIBI (see below) a special preschool full-time resource assistant was assigned from the public nursery unit in each case. These assistants and the parents received training individually in relation to each assigned child from the staff at the ACYC.

After completion of “The First Step”, type of intervention was discussed and chosen for each child after discussion with the parents and also with consideration of the resources that the preschool could provide. In cases where parents opted for intensive ABA, the intensity, i.e., number of hours per week was chosen by parents in agreement with supervisors at the ACYC or PC and the preschool staff.

Intervention type, intensity and duration were monitored by a member of the staff at the ACYC or PC, who used a very explicit protocol measuring, for each of four 6-month periods, the number of hours per week each child had received of ABA and other interventions. The completed protocols were then submitted to a member of the research group at the end of the study (without further information about the child). On the basis of the protocol reports, the researcher subdivided the sample into two groups according to amount and type of intervention provided over the 2-year observation period:

(1) *Intensive intervention based on ABA*, i.e., early intensive behavioural intervention (EIBI), given at the preschool and by the parents at home with assistance from the ACYC or the PC, with the intention to treat (a) 15 h or (b) 25–30 h per week (ACYC) or 30–40 h per week (PC). The supervisor from the ACYC or PC centres met with the parents and the responsible preschool resource person (each child had his/her own full-time employed resource person) regularly during the intervention period. These meetings took place (a) once or twice a month (the group with treatment 15 h per week), or (b) once a week to (particularly during the last two 6-month-periods) once or twice a month (the two most intensive intervention subgroups). Children were referred to the intensive intervention (EIBI) group if they had received intensive intervention at least for two 6-months-periods.

The trainers of children receiving intensive ABA were all employed by the preschool and had different educational background. Approximately one third were preschool teachers or had similar educational background, approximately one third were trained preschool nurses and approximately one third had no formal education in the field. However, all trainers received regular supervision from highly skilled ABA specialists at the autism centres, as described above.

The intensive ABA programs included a variety of ABA methods tailored to the needs of the child, meaning that different ABA methods, such as discrete trial training and other methods were used and adapted according to treatment response.

(2) *Non-intensive targeted intervention based on ABA*, consisting of different targeted types of training (toilet training, speech and language training, training of compliance or other specific training that the child was deemed to need). These interventions, although not characterized as EIBI, used ABA techniques and were provided, when needed, over the total 2-year-period, or part of this period, with assistance from the ACYC.

### 3.3. Statistical analyses

Differences between the two treatment groups (intensive intervention and non-intensive intervention) and between cognitive levels (normal intellectual level, developmental delay, learning disability) in terms of change in Vineland composite scores, between T1 and T2 were analyzed with a mixed analysis of variances (ANOVA). In this analysis, eta-squared ( $\eta^2$ ) was used as a measure of effect size. The ANOVA was followed up by separate paired-samples *t*-test in order to study the degree of change in Vineland composite scores between T1 and T2 for each of the treatment subgroups and for each of the Cognitive levels subgroups separately. An alpha level of .05 was used for all statistical analyses.

#### 3.3.1. Ethics

The study was approved by the Regional Ethics Committee in Stockholm, Sweden.

## 4. Results

The mean amount of time that elapsed between the start of the educational program for parents, and the time 2 follow-up was 25.0 months (SD 2.8). The mean amount of time that elapsed between the two assessment visits was 20.9 months (SD 3.2).

### 4.1. Developmental characteristics of the treatment groups at T1

Cognitive levels and ASD conditions of children in the two intervention groups are presented in [Tables 1 and 2](#).

### 4.2. Duration of treatment

Of the 198 children at follow-up a total of 65 children had received high intensity intervention (25–30 or 30–40 h per week) of a mean duration of 3.5 6-month periods, 28 had had treatment 15 h per week of a mean duration of 2.3 6-month periods and 41 had had other types of varied targeted interventions, with ABA technique, of a moderate degree over the 2-year period. To this group 6 children who had received intensive treatment 15 h per week for one 6-months-period and one child who had received intensive intervention 25–30 h per week for one 6-months-period were referred. Sixty-four children had had fewer targeted interventions of a mean duration of 1.8 6-month periods.

**Table 1**  
Distribution of intellectual levels and ASDs at follow-up, T2.

Cognitive level	Autistic disorder	Atypical autism	Asperger syndrome	Not definitely ASD	Not assessed	Total
LD	80	10	0	4	1	95
BIF	20	22	4	4	0	50
Normal	4	26	8	13	0	51
Not assessed	1	0	1	0	0	2
Total	105	58	13	21	1	198

ASD, autism spectrum disorder; LD, learning disability; and BIF, borderline intellectual functioning

**Table 2**  
Intellectual levels at T1 related to treatment groups.

	Intensive ABA	Non-intensive ABA
Learning disability	36 (39%)	37 (35%)
Developmental delay	45 (48%)	34 (32%)
Normal	12 (13%)	34(32%)
Total	93	105

### 4.3. Cognitive data

At follow-up (T2) of the 198 children, 95 had learning disability (LD), 50 had borderline intellectual functioning (BIF), and 51 had normal IQ (and in two children data were missing) (Table 1). The corresponding data in this group at T1 were 73 (LD), 79 (developmental delay/borderline intellectual functioning) (BIF) and 46 (normal) (Table 2).

### 4.4. ASD subgroups

At follow-up (T2) of the 198 children 105 children met criteria for autistic disorder/autism, 58 had atypical autism/PDD-NOS/autistic like condition and 13 had Asperger syndrome. In 4 children LD was considered the main impairment, combined with autistic features and in 17 children (9%) with normal IQ the data and clinical picture were more compatible with autistic features as part of either of executive dysfunction/attention-deficit/hyperactivity disorder (ADHD and/or language impairment (Gillberg, 2010). Parents of one child with LD did not want a re-evaluation of the ASD diagnosis (Table 1). The corresponding numbers at T1 had been 120 (autistic disorder/autism), 52 (atypical autism/PDD-NOS/autistic like condition), 9 (Asperger syndrome), 3 (learning disability and autistic features) and 14 (full ASD criteria not met but autistic features with executive dysfunction/ADHD and/or language impairment) (Table 3).

### 4.5. Primary outcome variable

Vineland composite score change.

#### 4.5.1. Total group and intervention subgroups

A  $2 \times 2 \times 3$  ANOVA with time (1, 2) as a within-subject factor, treatment group (intensive and non-intensive) and cognitive level (normal IQ, developmental delay, learning disability) as between-subject factors and Vineland composite score as the dependent variable was performed. Means and standard deviations for each of the  $2 \times 2 \times 3$  cells are presented in Table 4.

There was a significant improvement between T1 and T2 with respect to Vineland composite score ( $F_{1, 186} = 3.90, p = .050, \eta^2 = .021$ ) for the total group. The time  $\times$  treatment interaction effect was however not significant ( $F_{1, 186} = .36, p = .549, \eta^2 = .002$ ), i.e. there was no difference with respect to the change in Vineland Behaviour Composite score between the two

**Table 3**  
ASD groups at T1 related to treatment groups.

	Intensive ABA, n (%)	Non-intensive ABA, n (%)
Autism	65 (70%)	55 (52%)
Atypical autism	23 (25%)	29 (28%)
Asperger	3 (3%)	6 (6%)
Not definitely ASD	2 (2%)	15 (14%)
Total	93	105

ASD, autism spectrum disorder

Table 4

Means and standard deviations for Vineland composite scores for the different combinations of cognitive level and treatment group.

Cognitive level	Treatment group	T1		T2		N
		Mean	SD	Mean	SD	
Normal	Intensive ABA	79.83	6.028	83.50	6.776	12
	Non-intensive ABA	79.16	10.054	83.45	11.445	31
	Total	79.35	9.045	83.47	10.276	43
Developmental delay	Intensive ABA	70.52	7.996	71.20	14.660	44
	Non-intensive ABA	70.97	8.480	74.56	10.500	34
	Total	70.72	8.159	72.67	13.041	78
Learning disability	Intensive ABA	60.51	7.114	59.20	13.121	35
	Non-intensive ABA	62.36	8.247	60.17	10.208	36
	Total	61.45	7.710	59.69	11.660	71
Total	Intensive ABA	67.90	9.883	68.21	15.507	91
	Non-intensive ABA	70.42	11.181	72.16	14.332	101
	Total	69.22	10.633	70.29	14.992	192

treatment groups. Fig. 1 shows that while both treatment groups had, in average, improved their Vineland composite scores, the improvement was only significant for the group who had received non-intensive ABA ( $t_{90} = .28$ ,  $p = .783$  for intensive ABA and  $t_{100} = 2.07$ ,  $p = .041$ , for non-intensive ABA).

#### 4.5.2. Cognitive subgroups

The time  $\times$  cognitive level interaction was highly significant ( $F_{2, 186} = 5.43$ ,  $p = .005$ ,  $\eta^2 = .055$ ). Fig. 2 shows that the group with normal intellectual level significantly improved their Vineland composite score between T1 and T2 ( $t_{42} = 3.00$ ,  $p = .005$ ). The group with developmental delay also improved their Vineland composite score whereas the group with learning disability lowered their Vineland composite score, these two latter changes however did not reach significance ( $t_{77} = 1.71$ ,  $p = .091$  and  $t_{70} = -1.73$ ,  $p = .088$ , respectively).

#### 4.5.3. Interventions vs. cognitive subgroups

There was no three way interaction time  $\times$  treatment group  $\times$  cognitive level ( $F_{2, 186} = .769$ ,  $p = .465$ ,  $\eta^2 = .008$ ), i.e., effects of the two interventions (intensive and non-intensive), measured as a change in Vineland composite score, did not differ in any of the three cognitive subgroups (Fig. 3).

#### 4.5.4. Age at referral

There was a positive correlation between age at referral to the ACYC and Vineland composite score increase over time ( $r = .21$ ,  $n = 192$ ,  $p = .003$ ). Children who had received intensive ABA had been referred to the ACYC at a significantly lower age than those who had received non-intensive ABA ( $M = 37.6$  months,  $SD = 8.5$  vs.  $M = 43.5$  months,  $SD = 8.1$ ;  $t_{196} = -4.93$ ,  $p < .001$ ). We therefore reran the “intervention group ANOVA” as an ANCOVA with the age at referral to the ACYC as a covariate. The results of this ANCOVA were very similar to the result of the ANOVA and will therefore not be presented here.

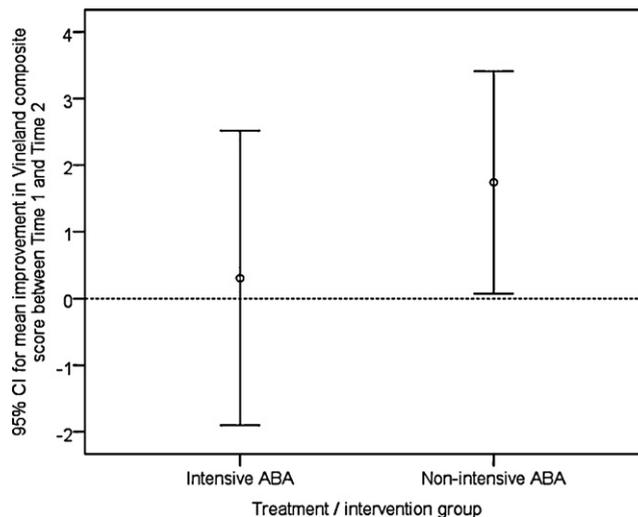


Fig. 1. The 95% confidence intervals for the mean change in Vineland composite scores between T1 and T2 for the two intervention groups (intensive ABA and non-intensive ABA;  $n = 93$  and  $105$ , respectively).

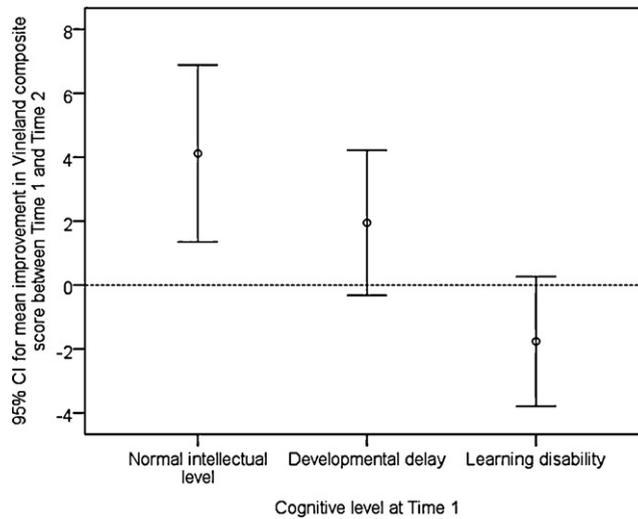


Fig. 2. The 95% confidence intervals for the mean change in Vineland composite scores between T1 and T2 for the three cognitive levels (normal intellectual level, developmental delay and learning disability;  $n = 46, 79$  and  $73$ , respectively).

4.5.5. Vineland composite scores in the treatment groups at T1

In order to examine potential differences between groups at T1, a  $2 \times 3$  ANOVA with treatment group (intensive and non-intensive) and cognitive level (normal IQ, developmental delay, learning disability) as between-subject factors and Vineland composite score as the dependent variable was performed, see Table 4 for descriptive statistics. There was no significant difference between treatment groups ( $F_{1, 189} = .162, p = .688, \eta^2 = .001$ ) and no treatment  $\times$  cognitive level interaction effect ( $F_{2, 189} = .397, p = .673, \eta^2 = .004$ ). The main effect of cognitive level was however, as expected, very strong and significant ( $F_{2, 189} = 60.992, p < .001, \eta^2 = .392$ ).

4.6. Autistic behaviour checklist change

There was a main effect of time with lower mean ABC score (i.e., improvement) at T2 compared to T1 ( $F_{1,186} = 41.95, p < .001, \eta^2 = .184$ ). No difference regarding degree of change in the ABC score was found between treatment groups ( $F_{1,186} < 1$ ).

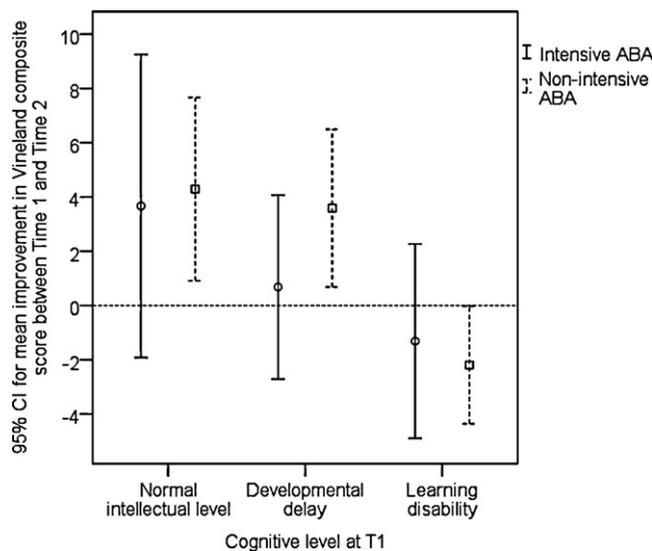


Fig. 3. The 95% confidence intervals for the mean change in Vineland composite scores between T1 and T2 for the two intervention groups as well as for the three cognitive levels (for intensive ABA and normal intellectual level, developmental delay, learning disability;  $n = 12, 44, 35$ , respectively. For non-intensive ABA and normal intellectual level, developmental delay, learning disability;  $n = 31, 34, 36$ , respectively).

## 5. Discussion

This prospective longitudinal naturalistic study of a relatively large population-based group of toddlers with ASD, referred for intervention to a specialized centre included children with a wide range of cognitive functioning and ASD severity. Our findings cannot be taken to support the view that more intensive is superior to less intensive ABA intervention for all young children with ASD. We found support for the notion that children with ASD and normal cognitive levels improve in terms of their levels of adaptive functioning over a 2-year period whereas those with ASD and clear LD do not.

Our intervention groups differed as to distribution of cognitive subgroups. There were fewer children with “normal IQ” in the intensive intervention group. However, the intensity/type of intervention was not associated with adaptive functioning outcome in any of the cognitive subgroups. We could not demonstrate that younger age at start of intervention was associated positively with outcome, rather the opposite was found.

Except for a recent French naturalistic study (also of 208 children, a few years older than our sample), this is the largest prospective intervention study to date in the field of ASD. It is of interest that the overall findings in the French study were very similar to ours (Darrou et al., 2010).

Both intervention groups in our study had been exposed to ABA methods. This held also in the group receiving “targeted” interventions, and in the instruction course given to parents, and in the courses to preschool staff essential principles of ABA were communicated.

Most outcome measures of autism intervention use the Vineland composite score and/or IQ (Dawson et al., 2010; Eikeseth, Smith, Jahr, & Eldevik, 2002, 2007; Hayward, Eikeseth, Gale, & Morgan, 2009; Magiati et al., 2007; Remington et al., 2007). Magiati et al. (2007) used VABS age equivalents and VABS composite scores and showed that age equivalents increased both in an EIBI group and in a specialist nursery group while adaptive composite scores showed little change over time. In that study, age equivalents were considered to “improve” even when there was only a 6–12-month-gain in development (minor improvement) or 13–19-month-gain (moderate improvement) during the 24-month intervention period. Since the VABS composite score is a standardized score, “no change” means that the child has followed his or her “expected” developmental trajectory.

We did not use IQ as an outcome measure. We believe that IQ is difficult to assess reliably at a very early age in this patient group who often have several cognitive domains affected. Our study group had initially been assessed at a CAMHS or a neuropsychiatric clinic, where they had already had a primary cognitive assessment (which was not repeated by the psychologists in the research group at T1 before study entry). Cognitive tests were performed by the research psychologists at follow up. These data revealed no major shifts in intellectual levels between T1 and T2 among children with LD and with normal IQ.

The ABC scale has no age norms but the results could be used to illustrate that both treatment groups improved as to behavioural symptoms. These behavioural problems are one of the main targets of ABA intervention. Behaviour problems have severe impact for the parents and family situation and have been found to predict maternal stress and parental mental health problems (Herring et al., 2006).

Most studies comparing ABA intervention and eclectic treatment/community intervention include between 10 and 30 subjects in each group, (for reviews, see Eldevik et al., 2009; Howlin et al., 2009) use randomized controlled trial (RCT) or quasi-experimental controlled trial design and have revealed superior gains in IQ and adaptive function among children receiving intensive ABA treatment (Dawson et al., 2010; Eikeseth, 2009; Eikeseth et al., 2007; Eldevik et al., 2009; Hayward et al., 2009; Matson & Smith, 2008; Remington et al., 2007).

Randomized controlled trials (RCTs) are often considered the gold standard in intervention and treatment studies. However, this view has been challenged (Graham, 2007; Leichsenring, 2004; Rosenbaum, 2010) and arguments have been raised that it is questionable whether the results of RCTs are representative of clinical reality. In a recent review by Mesibov and Shea (2011) the problem with RCT in heterogeneous groups, such as children in the autism spectrum – with numerous inter-related, pervasive deficits – was also highlighted. The same view was expressed by Worrall (2007) stating: “Indeed randomization has received such a favourable press that the educated layman could be forgiven for believing that its special scientific value is an entirely uncontroversial matter. However, this is far from true”, p. 452. In autism intervention research, using RCT, children with major disabilities are usually excluded which creates artificial conditions that are not representative of clinical practice. In many RCTs children with severe learning disability, those with medical disorders, including epilepsy and with sensory and motor impairments are excluded. Our study used a naturalistic design, which means that it belongs to the type of studies that provide evidence for the effectiveness of a therapy in practice (Leichsenring, 2004). We included all available children at a county-wide autism centre, and the children served as their own controls over the follow-up period. In our study group the only exclusion criteria was parents’ inability to communicate in either Swedish or English. Children with severe learning disability and concomitant medical disorders were included, except for those who never were referred to the autism centre due to very severe and complex “multihandicapping” disabilities.

The follow-up was performed by raters who were blind to type and intensity of intervention. This is an important aspect of our study design, and it is one that was taken into account in the comprehensive review of 25 outcome studies reported by Eikeseth (2009). In the classification of scientific merit they report whether the raters conducting the assessments had been blind or independent as regard to treatment. This was said to have been the case in about half of the quoted studies.

There is a preponderance of studies favouring high intensity intervention (for review, see Eikeseth, 2009). However, lower intensity treatment was studied by Vismara, Colombi, and Rogers (2009) evaluating results from a 1-h per week

parent–child education therapy including components from ABA. These authors concluded that a brief and economical 1-h per week intervention for only 12 weeks can lead to lasting change. Results from another study of a brief parent training based on ABA, pivotal response treatment, were reported by Coolican, Smith, and Bryson (2010). Their method included three 2-h training sessions over 2 consecutive weeks for a total of 6 h with a view to improving the child's motivation to communicate. The authors suggested that brief training based on this method provided an immediate cost-effective intervention.

We could not demonstrate more improvement among children receiving intensive intervention as compared to children receiving targeted non-intensive interventions. However, all our interventions were based upon ABA techniques which may be an important factor. A critical factor to take into account when interpreting our results is that all parents were offered an educational program when the child was registered at the autism centre with a view to increasing their knowledge about autism and to provide strategies for improved coping with the child. Another factor could be that the centre invited all preschool staff, caring for children with autism, in the county to receive information on autism including educational aspects based on ABA.

Our follow-up period between the parental interviews was 2 years, and could be taken as too short for conclusions as to intervention efficacy. However, Howlin et al. (2009) pointed out that if gains were made, they were likely to be greatest in the first 12 months of intervention.

There are certain limitations of our study. One is that we have no exact knowledge about how well the intensive intervention programs were implemented at home and preschool. The trainers at the preschools had different educational background and were not university students. Thus, this is a difference between our naturalistic study and some experimental design studies (see Reichow & Wolery, 2009).

However, protocols from the centres supervising the intervention demonstrated that regular follow-up meetings with parents and resource persons at the preschools had actually occurred. The amount of training in our three intensive ABA intervention groups was slightly less than the level often reported in the literature. Given the naturalistic nature of the study it was not possible to guarantee an exact number of hours of training each week. The aim was to attain 40 and 30 h per week, respectively, in the two most intensive programs. In reality, the amount was rather 30–40 and 25–30 h per week, respectively. We cannot completely exclude the possibility that this might have affected the lack of significance between the intensive ABA and non-intensive ABA treatment groups.

Another weakness is that there was no comparison group receiving exclusively “community intervention”, without any ABA methodology. We decided that such an approach would not be ethically appropriate due to the existing evidence of ABA effects. However, the amount of intervention needed and the way of communicating the ABA approach to parents and staff at preschools need to be studied further. Moreover, some children in the groups receiving targeted interventions may have had special training in their preschools, which might have contributed positively to their development.

The strengths of our study are the relatively large study group, the low attrition rate over the 2-year period, the naturalistic design with very few exclusion criteria, raters who were blind to type of intervention given and the population-based design.

## 6. Conclusion

In conclusion, our naturalistic follow-up study of outcome in very young children with ASD who have received early intervention of different types and intensity (ranging from very intensive ABA intervention to non-intensive targeted interventions based on ABA technique) differs from most other intervention studies in some key respects. The study design is naturalistic, meaning that children were not excluded due to severe learning disability, epilepsy or underlying medical disorders. All children below or at the age of 4.5 years whose parents gave their consent to participation and could communicate in Swedish or English were included. The follow-up rating was performed by researchers blind to type and intensity of intervention. Our results clearly indicate that better adaptive functioning outcome in young children with ASD is associated with normal cognitive level at diagnosis. The data cannot be taken to support that children with ASD generally benefit more from intensive than non-intensive ABA-based interventions.

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