Journal of Child Psychology and Psychiatry 48:8 (2007), pp 803–812 doi:10.1111/j.1469-7610.2007.01756.x

A two-year prospective follow-up study of community-based early intensive behavioural intervention and specialist nursery provision for children with autism spectrum disorders

Iliana Magiati,[1] Tony Charman,[2] and Patricia Howlin[1]

[1]Institute of Psychiatry, King's College London, UK; [2]UCL Institute of Child Health, London, UK

Background: This prospective study compared outcome for pre-school children with autism spectrum disorders (ASD) receiving autism-specific nursery provision or home-based Early Intensive Behavioural Interventions (EIBI) in a community setting. **Methods:** Forty-four 23- to 53-month-old children with ASD participated (28 in EIBI home-based programmes; 16 in autism-specific nurseries). Cognitive, language, play, adaptive behaviour skills and severity of autism were assessed at intake and 2 years later. **Results:** Both groups showed improvements in age equivalent scores but standard scores changed little over time. At follow-up, there were no significant *group differences* in cognitive ability, language, play or severity of autism. The only difference approaching significance ($p = .06$), in favour of the EIBI group, was for Vineland Daily Living Skills standard scores. However, there were large *individual differences* in progress, with intake IQ and language level best predicting overall progress. **Conclusions:** Home-based EIBI, as implemented in the community, and autism-specific nursery provision produced comparable outcomes after two years of intervention. **Keywords:** Autism Spectrum Disorders (ASD), Early Intensive Behavioural Intervention (EIBI), autism-specific nursery provision, outcome.

Many studies report positive outcomes for young children with autism spectrum disorders (ASD) receiving early intervention (Howlin, 2002; Lord et al., 2005). Particularly impressive results were reported for Early Intensive Behavioral Intervention (EIBI), beginning around 2–3 years of age, with claims that up to 47% of participants attain 'normal intellectual and educational functioning' (Lovaas, 1987; McEachin, Smith, & Lovaas, 1993). Although findings from subsequent studies have been generally positive (Bibby, Eikeseth, Martin, Mudford, & Reeves, 2002; Birnbauer & Leach, 1993; Boyd & Corley, 2001; Cohen, Amerine-Dickens, & Smith, 2006; Eikeseth, Smith, Jahr, & Eldevik, 2002; Harris & Handleman, 2000; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Luiselli, Cannon, Ellis, & Sisson, 2000; Sallows & Graupner, 2005; Sheinkopf & Siegel, 1998; Smith, Buch, & Gamby, 2000a; Weiss, 1999), most of the children involved have continued to require specialized services (Shea, 2004).

There are also large individual differences in response to intervention, although identifying prognostic indicators presents considerable challenges (Yoder & Compton, 2004). Duration/intensity of intervention, age, IQ, language level and autism severity have been reported as predictive variables in some studies (Eikeseth et al., 2002; Gabriels, Hill, Pierce, & Rogers, 2001; Harris & Handleman, 2000; Ozonoff & Cathcart, 1998; Smith, Eikeseth, Klevstrand, & Lovaas, 1997), but others have failed to identify any specific factors relating to outcome (Birnbauer & Leach, 1993; Smith, Groen, & Wynn, 2000b). Family and socio-economic characteristics have received little attention. There have been only a few studies comparing home-based EIBI programmes with *autism-specific* school-based provision (Eikeseth et al., 2002; Howard et al., 2005, Sheinkopf & Siegel, 1998). Indeed, there is little outcome research on children attending autism-specific schools (Charman, Howlin, Berry, & Prince, 2004; Gabriels et al., 2001; Lord & Schopler, 1989; Ozonoff & Cathcart, 1998; Panerai, Ferrante, & Zingale, 2002).

The present study

This study provides independent outcome data on pre-school children with ASD after 2 years of either home-based EIBI in a community setting or autism-specific nursery provision. The study was a naturalistic opportunity to study a relatively large number of children with ASD whose families had already chosen the intervention they wished to pursue. Whilst this is weaker than a randomised control design, children in the 2 groups were closely matched at intake and pre-treatment IQ differences were accounted for statistically in the analysis.

The following questions were addressed:

- At follow-up, were EIBI children functioning at a significantly higher level than Nursery children

Conflict of interest statement: No conflicts declared.

Published by Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA

with respect to IQ/MA, language, play, adaptive behaviour and severity of autism?
- What specific child, family or treatment characteristics were related to outcome?

Method

Ethics approval

The study protocol was approved by Wandsworth Local Research Ethics Committee (Ref IAS/der/02.42.6).

Participants

Inclusion criteria. Potential participants were identified via Local Educational Authorities, specialist schools, diagnostic centres and the UK National Autistic Society (NAS). Inclusion criteria were:

- Chronological age (CA) 22–54 months.
- Independent professional diagnosis of autism/ASD; diagnosis was additionally confirmed in the majority of cases on the Autism Diagnostic Interview-Revised (ADI-R; Lord, Le Couteur, & Rutter, 1994).
- No additional major medical diagnoses.
- English the main language spoken at home.
- Living within 3 hours' travel of Central London.
- Enrolled in *either* EIBI home-based programmes *or* specialist autism-specific school-based nursery provision for a minimum of 15 hours per week (treatment beginning within 3 months prior to initial evaluation).
- Receiving no other intensive intervention.

Of 63 children who initially appeared to meet inclusion criteria, 19 were subsequently excluded (see Figure 1). The final sample comprised 44 children, 28 (27 boys; 1 girl) in the EIBI group and 16 (12 boys; 4 girls) in the Nursery group.

Child characteristics. All children had a recorded independent clinical diagnosis of autism or ASD. At Time 1 (T1), parents of 41 of the 44 children completed the ADI-R. All but two met criteria on all 3 domains. These 2 children met criteria on the Reciprocal Social Interaction and Communication domains but were one point below cut-off on the Repetitive and Stereotyped Behaviours domain. The ADI-R was completed for one child (who met full criteria) at T2 only. Table 1 summarises children's CA, independent diagnosis, and family demographics. EIBI children were on average 4 months younger than the Nursery children at T1, although this difference just failed to reach statistical significance. There were no differences in diagnosis or ethnicity. Other T1 characteristics (cognitive, language, play, adaptive behaviour, ADI-R scores) are presented in Table 2, Results section.

Family characteristics. There were no group differences in parental age or family status. EIBI families were more highly educated than nursery families. They also tended to belong to somewhat higher socio-economic categories (SEC; Office of National Statistics, 2000), but this difference failed to reach statistical significance.

Follow-up (Time 2 – T2). All children were traced and assessed 23 to 27 months after their initial assessment (mean months elapsed from T1–T2: EIBI = 25.5 (sd = 1.04); Nursery = 26.0 (sd = 1.5); $t(42) = 1.3$, $p = .20$); one Nursery child had left England and partial assessments (Vineland and ADI-R only) were completed by phone at T2.

Measures

As far as possible, the same tests were used at T1 and T2 to minimise difficulties resulting from comparing scores from different instruments (Magiati & Howlin, 2001). The *Merrill-Palmer Scale of Mental Tests* (MPS;

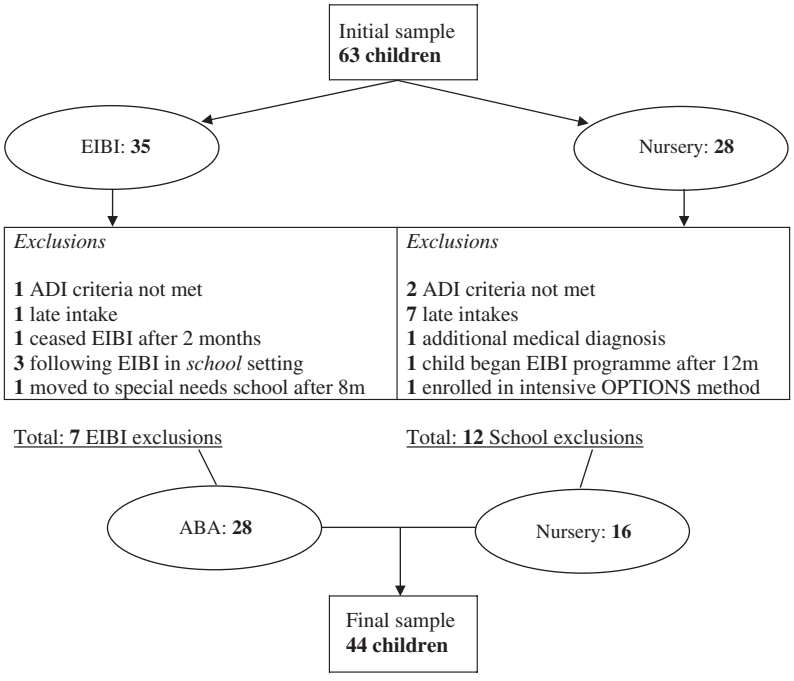

Figure 1 Participant exclusions

Table 1 Child and family characteristics at Time 1

	EIBI	Nursery	Statistics
Children's CA (months)			
Mean (sd)	38.0 (7.2)	42.5(7.8)	$t(42) = 1.9$, $p = .06$
Range	23–54	33–54	
Maternal age (mean, sd)	36.0 (5.7)	33.9 (3.4)	$t(41) = -1.3$, $p = .2$
Paternal age (mean, sd)	38.1 (6.1)	36.2 (4.6)	$t(36) = .98$, $p = .3$
Independent diagnosis			
Autism	19	13	$x^2(1) = .9$,
ASD	9	3	$p = .34$
Ethnic group			
White	21	11	$x^2(1) = .2$, $p = .65$
Mixed	4	0	
Asian/Asian British	2	2	
Black/Black British	1	3	
Family status			
Two-parent	25	11	$x^2(1) = 2.89$, $p = .09$
One-parent	3	5	
Family SEC			
Higher (categories 1–3)	23	9	$x^2(1) = 3.37$, $p = .07$
Lower (categories 4–9)	4	6	
No information	1	1	
Parental education			
Higher (degree or above)	18	7	$x^2(1) = 4.0$, $p = .04$
Lower (A-levels or below)	5	8	
No information	5	1	

Stutsman, 1948) was routinely administered; children scoring at basal on this were administered the *Bayley Scales of Infant Development* (BSID; Bayley, 1993); those at ceiling were administered the *Weschler Preschool and Primary School Intelligence scales-Revised* (WPPSI-R; Weschler, 1990; see Tables 2 and 3 for *N* of participants assessed on each test). To avoid repeated separate comparisons of T1 and T2 cognitive scores obtained from the different tests used and in order to utilise all available IQ data, a 'best test' MA and IQ variable was created using the most appropriate/best standardised test available for each child at each timepoint according to the following hierarchy: WPPSI > Merrill-Palmer > Bayley.

Adaptive behaviour was assessed using the survey form of the *Vineland Adaptive Behavior Scales* (VABS; Sparrow, Balla, & Cicchetti, 1984).

Receptive and expressive language was assessed on the *British Picture Vocabulary Scale-II* (Dunn, Dunn, Whetton, & Burley, 1997) and the *Expressive One-Word Picture Vocabulary Test-Revised* (Gardner, 1990). Twenty-eight children at T1 and nine children at T2 were at floor on one or both of these measures. As both language tests suffered from floor effects, particularly at T1, *raw* scores at T1 were compared to those obtained at T2.

Play was assessed using the *Symbolic Play Test-Second Edition* (SPT-II; Lowe & Costello, 1988). At T1, 6 children were unable to score; they were assigned a raw score of 0 and the lowest age equivalent score of 12 months. At T2, the structured section of the *Test of Pretend Play* (Lewis & Boucher, 1997) was additionally used with 12 children who scored near or at ceiling in the SPT-II.

The *Autism Diagnostic Interview-Revised* (Lord et al., 1994) was used to confirm diagnosis and assess autism severity. Total algorithm scores were calculated: Reciprocal Social Interaction + Non-verbal Communication + Restricted Stereotyped and Repetitive behaviours domain scores.

A non-standardised questionnaire was designed to obtain information on family characteristics, and type, intensity and duration of interventions from parents (26 EIBI and 15 Nursery parents completed these).

Not all children completed all measures. Tables 2–3 indicate numbers of children per measure at each timepoint.

Procedure

T1 assessments were completed between July 1998 and April 2000; T2 assessments 23–27 months later. Assessments were conducted at home or school by the first author and a Research Assistant. They were not blind to group status but were independent of treatment delivery and had extensive experience of assessing children with ASD.

Reliability

Video-recorded assessments for IQ, play and language (46 tests) were scored by the third author (PH), blind to group treatment and the first examiner's ratings. Raw scores for IQ, play and language tests were highly correlated (intraclass correlation coefficient = .99, $p < .001$). For the ADI-R, PH – blind to group status and the first interviewer's scores – used the interviewer's detailed notes to score the algorithm items of 10 randomly selected interviews. Agreement on individual ADI-R items ranged from 69% to 94% (mean 84.2%).

Interventions

The following information was provided by the children's parents, teachers and schools via questionnaires at T1 and T2.

EIBI programmes. All EIBI children received 1:1 home teaching. All families used discrete trial teaching techniques (Lovaas, 2002), although 2 later introduced 'Verbal Behaviour' (Sundberg & Michael, 2001). Most families ($N = 27$) attended an initial workshop of 1–3 days. Fourteen families employed a consultant *and* a supervisor, 7 had a supervisor, 3 a consultant and 2 a senior therapist. Consultants visited monthly (3 families), every 2–4 months (9 families) or every 5–6 months (5 families); 24 families had weekly or fortnightly supervision. Twenty families received supervision/consultancy from recognised ABA organisations in the UK, Norway or USA; the remaining EIBI families were supervised by independent supervisors. Eight families changed their ABA organisation or supervisor/

Table 2 Time 1 scores

	EIBI		Nursery		Statistics		
Dependent variable	*N*	Mean (sd) range	*N*	Mean (sd) range	*t* or *z*	*p*	ES[a]
Cognitive[b]							
MA	28	31.4 (11.1) 5 to 55	16	29.1 (13.1) 9 to 48	$t = -.62$	.54	.19
IQ	28	83.0 (27.9) 16 to 138	16	65.2 (26.9) 27 to 112	$t = -2.1$	**.04**	.62
Play							
AE	27	18.8 (8.0) 12 to 36	16	19.2 (8.6) 12 to 34	$z = -.08$	.94	.05
Receptive Vocabulary							
Raw	28	4.9 (9.1) 0 to 32	16	2.9 (7.7) 0 to 27	$z = -.78$	.44	.23
Expressive Vocabulary							
Raw	28	2.2 (7.8) 0 to 39	16	1.7 (3.7) 0 to 12	$z = -.31$	.78	.08
Vineland: Communication							
AE	26	14.4 (5.2) 8 to 28	14	13.1 (4.5) 8 to 26	$t = -.81$	.42	.26
SS	26	60.0 (7.4) 50 to 78	14	55.8 (6.8) 47 to 74	$t = -1.74$	.09	.57
Daily Living							
AE	26	19.0 (6.1) 11 to 39	14	20.0 (3.9) 15 to 27	$t = .53$	.59	.19
SS	26	63.0 (7.4) 55 to 89	14	61.4 (4.9) 52 to 69	$t = -.76$	.45	.24
Socialisation							
AE	26	13.0 (4.4) 6 to 24	14	11.1 (3.4) 6 to 20	$t = -1.34$	.19	.46
SS	26	60.3 (6.0) 51 to 76	14	56.6 (4.8) 52 to 67	$t = -2.01$	**.05**	.63
ABC							
AE	26	18.6 (5.4) 12 to 32	14	17.3 (3.9) 12 to 26	$t = -.78$	.44	.26
SS	26	59.6 (6.2) 50 to 72	14	55.4 (5.4) 47 to 64	$t = -2.15$	**.04**	.68
ADI-R total algorithm score							
Raw	26	36.4 (6.7) 18 to 46	15	40.0 (6.9) 18 to 46	$t = -1.40$	.16	.52

MA = mental age (months); AE = age equivalent (months); SS = standard score; ABC = Adaptive Behaviour Composite; a: ES = Effect size (Cohen's d); b: T1 cognitive scores based on MPS for 25 EIBI and 12 Nursery children, Bayley for 2 EIBI and 4 Nursery children, WPPSI for one EIBI child.

consultant at least once. Most therapists were psychology or special needs education students or graduates. The average number of therapists working with each family was 9 (range 3–18). In 23 families, at least one parent trained as a therapist.

School provisions. Nursery children were enrolled in 10 different schools at T1: 7 autism-specific nurseries in segregated settings; 3 autism-specific units (1 within mainstream school; 2 within generic special schools).

All schools described their teaching practices as 'eclectic', emphasising structure, visual cues, individualised teaching and close liaison with parents. The most common named practices were: TEACCH-based approaches (Schopler, 1997); PECS (Bondy & Frost, 1994); Makaton (Grove & Walker, 1990) and SPELL (NAS, 2001); other developmental and behavioural teaching methods were also used. Pupil:adult ratios ranged from 1:1 to 3.3:1. The average amount of 1:1 teaching was 6 hours per week (range 90 minutes to 20–25 hours per week).

Intensity of interventions. Over 2 years, EIBI children received significantly more hours of intervention (EIBI mean = 3,415 hours, sd = 444; Nursery mean = 2,266 hours, sd = 533; $t = -7.54$, $p < .001$). Average hours reported per week/per child were significantly higher for EIBI children at T1 and T2 (T1: EIBI = 32.4 hours, sd = 6.4, range = 18–40; Nursery hours = 25.6, sd = 6.4, range = 15–30, $t(1,42) = -3.4$, $p < .001$; T2: EIBI = 33.2 hours, sd = 3.5, range = 26–40; Nursery = 27.4 hours, sd = 4.2, range = 19–30; $t = -4.9$, $p < .001$).

Other treatments/interventions. Many families followed additional specific interventions at some point during the study. More EIBI than Nursery children followed special dietary (21 EIBI: 6 Nursery; $x^2 = 7.03$, $p = .01$) and other biological interventions (17 EIBI: 3 Nursery; $x^2 = 7.8$, $p = .01$). More Nursery than EIBI children (2 EIBI: 7 Nursery; $x^2 = 8.4$, $p < .01$) followed extra-curricular educational interventions. Eight EIBI and 2 Nursery families explored other alternative treatments ($x^2 = 1.65$, $p = .18$).

Table 3 Time 2 (T2) scores (unadjusted means)

	EIBI		Nursery		Statistics		
Dependent variable	*N*	Mean (sd) range	*N*	Mean (sd) range	F^a	*p*	ES[b]
Cognitive[c]							
MA	28	49.2 (9.8) 29 to 70	15	44.7 (14.1) 17 to 67	$F(1,40) = .08$	.78	.39
IQ	28	78.4 (17.6) 43 to 129	15	65.3 (18.0) 30 to 94	$F(1,40) = 1.87$	.18	.70
Play							
AE	28	29.2 (12.7) 12 to 65	15	28.8 (13.0) 12 to 61	$F(1,40) = 3.04$	.09	.03
Receptive Vocabulary							
Raw	27	20.8 (20.8) 0 to 68	15	13.2 (17.8) 0 to 52	$F(1,39) = .001$	.98	.38
Expressive Vocabulary							
Raw	27	13.0 (17.3) 0 to 59	15	10.2 (13.7) 0 to 38	$F(1,40) = .80$	.38	.18
Vineland: Communication							
AE	28	29.6 (17.2) 12 to 70	16	23.6 (16.8) 11 to 67	$F(1,41) = .04$	.84	.35
SS	28	61.2 (17.6) 41 to 106	16	51.6 (14.8) 37 to 87	$F(1,41) = .31$	.58	.83
Daily Living							
AE	28	32.4 (8.2) 20 to 55	16	29.4 (9.7) 17 to 49	$F(1,41) = .00$	.99	.34
SS	28	58.6 (8.4) 38 to 78	16	49.6 (12.4) 28 to 73	$F(1,41) = 3.81$	**.06***	.83
Socialisation							
AE	28	25.1 (11.8) 12 to 61	16	20.2 (14.0) 7 to 53	$F(1,41) = .001$	.98	.39
SS	28	61.8 (10.4) 41 to 90	16	56.7 (10.3) 47 to 82	$F(1,41) = .12$	.73	.49
ABC							
AE	28	32.6 (10.2) 19 to 58	16	26.1 (12.4) 11 to 48	$F(1,41) = .50$	.48	.57
SS	28	57.5 (10.1) 41 to 79	16	48.6 (10.7) 35 to 72	$F(1,41) = 2.94$	.09	.80
ADI-R Total algorithm							
Raw	26	30.7 (8.8) 13 to 40	16	34.9 (9.9) 11 to 48	$F(1,39) = .17$	.68	.45

MA = mental age (months); AE = age equivalent (months); SS = standard score; a: *F* values for ANCOVA of T2 scores with T1 IQ covaried; b: ES = Effect size (Cohen's d); c: T2 cognitive scores based on MPS for 22 EIBI and 12 Nursery children and on WPPSI-R for 6 EIBI and 3 Nursery children; *$p = .06$ (approached statistical significance).

Cost and funding

Twenty-one EIBI programmes and all Nursery placements were funded by Local Educational Authorities. Information from parents indicated that 5 EIBI programmes cost £15,000 per year or less, 15 cost £15,000–£20,000 per year, and 5 cost £20,000–30,000 per year (cost unknown for one child). Precise costings were difficult to obtain from schools but most Nursery placements cost £15,000–£20,000 per year; 2 cost £20,000–£25,000 and 3 cost £25,000–£30,000 (1 was residential).

Investigating individual differences in progress after 2 years

For cognitive, play and adaptive domains, change in age equivalent scores was categorised as follows:

- *Deterioration/minimal change:* decrease or <6 months gain in 2 years
- *Minor improvement:* 6–12 months gain
- *Moderate improvement:* 13–19 months gain
- *Major improvement:* 20–26 months gain
- *Marked change:* >26 months (i.e. gain in months > than length of intervention).

Receptive and expressive language change raw scores were divided into quartiles and classified as:

- *Deterioration/minimal change:* −5 to 0 points (receptive); 0 points (expressive)
- *Minor/little improvement:* +1 to 10 points (receptive); +1 to 4 points (expressive)
- *Moderate improvement:* +11 to 24 points (receptive); +5 to 18 points (expressive)
- *Major improvement:* 25+ points (receptive); 19+ points (expressive).

ADI-R change scores (T1–T2) were divided into quartiles:

- *Deterioration:* ADI-R increase (i.e. more severe symptoms) ≥3 points
- *Minor/little improvement:* −4 to +2 points
- *Moderate improvement:* −5 to −12 points
- *Major improvement*: *decrease* ≥13 points.

Statistical analysis

SPSS-Version 11 was used. *T-tests* or *Mann–Whitney* non-parametric tests for independent samples (for play and language data which were significantly negatively skewed at T1) were used to examine whether the two groups were comparable at T1. *ANCOVAs* were used to compare outcome for the 2 groups at T2 with T1 IQ as the covariate, since the groups were less closely matched on this variable at T1 (see below).

Results

Group differences at T1

There were no statistically significant differences in T1 MA, play and adaptive behaviour age equivalents or language and autism severity raw scores (see Table 2). Although standard scores for IQ and VABS Adaptive Behavior Composite (VABS-ABC) did differ, the mean difference in VABS-ABC standard scores was, in terms of *clinical* significance, very small (4 points). As T1 IQ and VABS-ABC were highly correlated ($r = .84$, $p < .001$), T1 IQ only was used as covariate in the ANCOVA analyses.

Group differences at T2

Both groups showed notable increases in mean AE/MA and raw scores from T1 to T2 (see Tables 2 and 3) but standard scores changed little or even decreased slightly, indicating that *rate* of progress continued to be slower than the time period elapsed. There were no T2 group differences in cognitive, play and language skills or severity of autism. The only marginal statistically significant difference – in favour of the EIBI group – was for VABS Daily Living Skills standard scores ($p = .06$). This difference indicated that, on average, EIBI children's standard scores decreased less compared to those of the Nursery children. There was a significant covariate effect for T1 IQ on all T2 outcome variables (all $p < .001$).

Educational placements at T2

At T2, *no* child was in mainstream school without 1:1 support. Twenty-three of the original 28 EIBI children were continuing their home-based programmes – 2 attended mainstream schools for 20 hours per week supported *full-time* by EIBI therapists; 10 attended mainstream school accompanied by EIBI therapists for 11–20 hours and 11 for 1–10 hours weekly. The remaining 5 EIBI children attended special schools (3 in autism specific schools; 2 in generic special needs provisions). Of the original 16 Nursery children, 10 were attending autism-specific schools/classes at T2; 6 were in generic special needs schools.

Individual patterns of change over time

Figure 2a and b illustrate the percentage of children in each change category for cognitive, language, play, adaptive behaviour and severity of autism scores. The degree of change was generally small to moderate for most children; few made major improvements. In all areas assessed, the extent of *individual* variation in progress was evident in both groups.

Identifying the children who improved most and least

All children were assigned ranks according to magnitude of gains made in each developmental domain assessed. A 'total progress rank' variable was created by adding domain ranks for each child. This variable was used to identify the 10% of children who improved most and the 10% who improved least over 2 years ($N = 5$ in each sub-group). All children in the 'most improved' group had initial IQs >70 (4 had an IQ >75); all but one were verbal at T1. *None* of the least improved children had T1 IQ of ≥55 and all were non-verbal at intake (see Appendix 1).

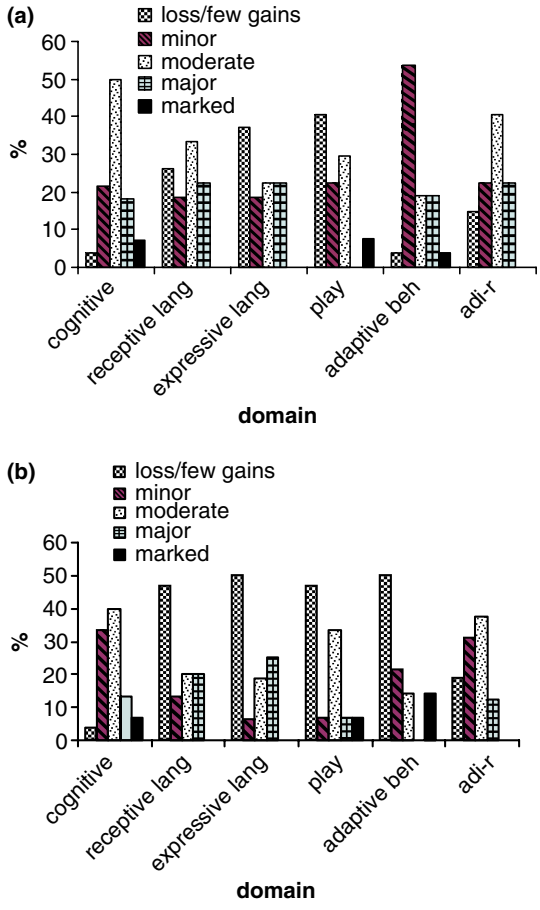

Figure 2 a) Individual differences in gains after 2 years for EIBI group in key outcome developmental domains (% of children). b) Individual differences in gains after 2 years for Nursery group in key outcome developmental domains (% of children)

Predictors of overall progress after 2 years

There were no statistically significant correlations between family SEC/educational status, children's CA at T1, type or intensity of intervention and any of the T2 measures (all r values from –.21 to .22; all p values > .05). A hierarchical multiple regression analysis was conducted to investigate the specific effects of the other intake variables, all of which correlated significantly (all r values > .39; $p < .01$) with the 'total progress rank' variable. T1 IQ was entered as Step 1, since this is one of the most consistent predictors of outcome in autism. The remaining T1 variables (play age equivalent scores; receptive and expressive language raw scores, VABS-ABC SS and ADI-R total raw scores) were entered as Step 2. T1 IQ (Step 1) explained 35% of the sample's variance in total progress ranks ($R^2 = .35$, adjusted $R^2 = .33$, $F(1, 36) = 19.49$, $p < .001$). Step 2 was also significant (R^2 change = .26, F change $(5, 31) = 4.23$, $p < .01$). With all T1 variables entered, initial IQ and receptive language raw scores best predicted progress after 2 years (IQ $\beta = .59$, $t = 4.41$, $p < .001$; receptive language $\beta = .74$, $t = 2.85$, $p < .01$). T1 Vineland SS and ADI-R total raw scores also contributed to the model (Vineland $\beta = .34$, $t = 2.28$, $p < .05$; ADI-R $\beta = .35$, $t = 2.09$, $p < .05$).

Discussion

This prospective outcome study presents follow-up data on 44 children with ASD after two years of community-implemented, home-based EIBI or specialist nursery provision. Both groups showed improvements in age equivalent (or raw) scores in many developmental areas, although standard scores changed little over time. There were no significant group differences in outcome in cognitive, language and play skills or autism severity at follow-up when intake IQ differences were accounted for statistically. Only on the VABS Daily Living Skills did the EIBI children achieve marginally higher standard scores. It is of interest to note that the (unadjusted) effect size of this difference (Cohen's d, Table 3) was fairly large (.83) and the moderate size of the sample, in particular in the Nursery group, might have mitigated against finding significant group differences. Whilst other effect sizes were moderate (for example, for Vineland ABC age equivalent and Socialisation standard score), the ANCOVAs did not approach significance. In part this was because IQ was very strongly related to T2 outcome scores and the EIBI had a significantly higher T1 IQ than the Nursery group. Thus, with T1 IQ covaried in the T2 analysis, apparent trends to group differences are reduced. There were large individual differences in change over time in both groups: some children showed marked improvements on developmental measures and in severity of autism symptomatology; others made little progress. The majority continued to show significant delays in most areas. The extent of progress in the EIBI group was less than that typically reported in university- or clinic-based EIBI studies, but accords with other community-based programmes. (e.g., Bibby et al., 2002; Gabriels et al., 2001).

A few other studies have provided comparative data on children following EIBI vs. autism-specific eclectic educational programmes (Cohen et al., 2006; Eikeseth et al., 2002; Howard et al., 2005, Sheinkopf & Siegel., 1998). Although these generally report superior results for EIBI, the variables reflecting group differences vary considerably. For example, Howard et al. (2005) found significant group differences after 14 months of intervention in standard scores and learning rates for all domains assessed (IQ, language and adaptive behaviour). Cohen et al. (2006), in a community-based study closely resembling our own design, found no significant group × time differences on standard scores for the MPS or language tests, although there were differences in favour of the EIBI group on the VABS and 6 EIBI children were fully mainstreamed in school at follow-up. However, the pre-school programmes in the Cohen et al. study were not autism specific and the school group received only 9–25 hours per week compared with 40 hours in the EIBI group. Moreover, although intervention lasted 3 years, initial gains tended to plateau after 12 months. In the present study, the VABS Daily Living Skills Domain was the only variable that differentiated between the groups after two years, and the mean difference at T2 was clinically small (9 points in group unadjusted means; less than one standard deviation). No child was unsupported in mainstream and *all* continued to require specialist educational support. These differences in outcome between apparently similar studies may be due to various, and largely unexplored methodological issues, including quality, length and intensity of both the EIBI and pre-school programmes; pre-intake experiences; participant characteristics and choice of measures and data analysis.

The present findings also illustrate substantial *individual* differences in response to intervention. The predictive value of cognitive and linguistic levels has been noted in previous intervention studies (i.e., Gabriels et al., 2001; Harris & Handleman, 2000) and here, too, children with initially higher cognitive and language functioning tended to make more progress, regardless of intervention group. Other variables, such as age at intake, intensity of intervention and family SEC were not related to outcome. Unlike other studies (Lovaas, 1987; Harris & Handleman, 2000; Luiselli et al., 2000), we found no relationship between overall progress and age at intake or treatment intensity. This was possibly because of the narrow age range of the participants (23 to 53 months) and the fact that all children

received at least 15 hours weekly of specialist intervention. Different domains of functioning also revealed different patterns of change. Thus, whereas most children showed minor to moderate improvements in MA, changes in language, play and adaptive behaviour were more variable, reflecting continuing impairments in the core areas of deficit in ASD.

Methodological issues

A number of methodological issues may affect the interpretation of our findings. First, recruiting adequate numbers of children meeting inclusion criteria proved difficult. This was particularly so for the Nursery group, since few pre-school children with ASD in the UK attend specialist provisions for more than 15 hours weekly. Second, participants were not randomly assigned to groups. Nevertheless, groups were closely matched and the study offered a naturalistic opportunity to collect information on intervention outcomes in 'real' life circumstances. Third, EIBI programmes were conducted in *community settings in the UK*, run largely by parents in liaison with EIBI professionals. Thus, it is difficult to make direct comparisons to clinic- or university-managed EIBI in the US. Fourthly, outcome data were standardised, norm-referenced assessments, rather than naturalistic observations. However, the range of developmental domains assessed provided a broad assessment of children's functioning. In addition, the same tests were used at intake and follow-up as far as possible, thereby minimising misleading assumptions regarding the extent of change. Finally, treatment fidelity was not directly assessed. Instead, data on type, intensity and duration of intervention were provided by parents and schools; this information indicated that the programmes appeared to be typical of EIBI home-based provision or specialist autism pre-schools in the UK.

Conclusions and implications

The wide variation in progress found in this study is consistent with the heterogeneous nature of ASD and accords with other recent early intervention studies, both home- and school-based. Although conclusions from EIBI research have varied, due to differences in intake criteria, length, intensity and type of intervention, and outcome measures, the results of recent EIBI studies do not support claims that almost 50% of participants achieve 'normal educational and intellectual functioning' (Lovaas, 1987; McEachin et al., 1993) or that they no longer require specialist educational support (Jacobson, Mulick, & Green, 1998). Instead, it is important that factors affecting *individual* children's progress are routinely investigated and identified. Group analyses are important but should not exclude careful study of the variability of change among individuals. It is also crucial to explore whether children with particular pre-intervention characteristics respond well to *any* comprehensive intervention, or whether there are specific factors mediating outcome in specific intervention approaches. The emphasis should be on highlighting individual differences in outcome to determine when, for whom and under what circumstances particular interventions are effective. However, it is difficult to draw conclusions about moderator child, family or environmental variables when most studies involve relatively small numbers of participants and vary considerably in design and methodology. Larger, multi-site studies that are standardised with respect to participants, intervention procedures, measures and analysis are necessary for such investigations to be pursued (Lord et al., 2005).

Despite the methodological limitations discussed above, this study indicates that community-based EIBI is beneficial for some children with autism. However, *specialist*, relatively intensive nursery provision in the UK produced similar outcomes. The findings reinforce the importance of increasing and improving *autism-specific* school-based provision for pre-school children with ASD in order to increase choice and minimise inequalities in access to early intervention. Our data support the growing consensus that no one intervention for children with ASD is universally superior to all others (NIASA, 2003). Successful interventions may share several common elements that can help improve the skills and lives of young children with ASD. Identification of these key elements is the next challenge for research in this area.

Acknowledgements

This paper was part of the first author's doctoral thesis. We are indebted to the children, families, teachers and schools who participated in the study. We wish to thank Dr Samantha Day (for completing many intake assessments) and Dr Judith Gould and Prof. Rita Jordan for their constructive comments at various stages of the study. Action Research funded the intake phase of the study. We thank Jill Rolfe and Margaret Reuben for valuable administrative support. The first author is grateful for financial support provided at various stages of this work by the Greek NATO scholarship foundation, the British Federation of Women Graduates, the Central Research Fund (University of London), and, during the last two years of the project, the Greek State Scholarship Fund IKY.

Correspondence to

Patricia Howlin, Department of Psychology, Institute of Psychiatry, De Crespigny Park, London SE5 8AF, UK; Tel: 020 7848 0243; Email: Patricia.Howlin@iop.kcl.ac.uk; Iliana.Magiati@islingtonpct.nhs.uk

References

Bayley, N. (1993). *Bayley Scales of Infant Development* – Second Edition. San Antonio, TX: Psychological Corporation.

Bibby, P., Eikeseth, S., Martin, N.T., Mudford, O.C., & Reeves, D. (2002). Progress and outcomes for children with autism receiving parent-managed intensive interventions. *Research in Developmental Disabilities*, *23*, 81–104.

Birnbauer, J.S., & Leach, D.J. (1993). The Murdoch early intervention program after 2 years. *Behaviour Change*, *10*, 63–74.

Bondy, A.S., & Frost, L.A. (1994). *PECS: The Picture Exchange Communication System training manual*. Cherry Hill, NJ: Pyramid Educational Consultants, Inc.

Boyd, R.D., & Corley, M.J. (2001). Outcome survey of early intensive behavioural intervention for young children with autism in a community setting. *Autism*, *5*, 430–441.

Charman, T., Howlin, P., Berry, B., & Prince, E. (2004). Measuring developmental progress of children with autistic spectrum disorder on school entry using parent report. *Autism*, *8*, 89–100.

Cohen, H., Amerine-Dickens, M.S., & Smith, T. (2006). Early Intensive Behavioral Treatment: Replication of the UCLA model in a community setting. *Journal of Developmental and Behavioral Pediatrics*, *27* (S2), 145–155.

Dunn, L.M., Dunn, L.M., Whetton, C., & Burley, J. (1997). *The British Picture Vocabulary Scale* – Second Edition. Windsor: NFER-Nelson.

Eikeseth, S., Smith, T., Jahr, E., & Eldevik, S. (2002). Intensive behavioral treatment at school for 4- to 7-year-old children with autism: A one-year comparison controlled study. *Behavior Modification*, *26*, 49–68.

Gabriels, R.L., Hill, D.E., Pierce, R.A., & Rogers, S.J. (2001). Predictors of treatment outcome in young children with autism: A retrospective study. *Autism*, *5*, 407–429.

Gardner, M.F. (1990). *Expressive One-Word Picture Vocabulary Test (Revised)*. Novato, CA: Academic Therapy Publications.

Grove, N., & Walker, M. (1990). *The Makaton Vocabulary: Using manual signs and graphic symbols to develop interpersonal communication*. Camberley: MVDP.

Harris, S.L., & Handleman, J.S. (2000). Age and IQ at intake as predictors of placement for young children with autism: A four- to six-year follow-up. *Journal of Autism and Developmental Disorders*, *30*, 137–141.

Howard, J.S., Sparkman, C.R., Cohen, H.G., Green, G., & Stanislaw, H. (2005). A comparison of intensive behavior analytic and eclectic treatments for young children with autism. *Research in Developmental Disabilities*, *26*, 359–383.

Howlin, P. (2002). Autistic disorders. In P. Howlin & O. Udwin (Eds.), *Outcomes in neurodevelopmental and genetic disorders* (pp. 136–168). Cambridge: Cambridge University Press.

Jacobson, J.W., Mulick, J.A., & Green, G. (1998). Cost–benefit estimates for early intensive behavioral intervention for young children with autism – general model and single state case. *Behavioral Interventions*, *13*, 201–226.

Lewis, V., & Boucher, J. (1997). *The Test of Pretend Play*. Antonio, TX: The Psychological Corporation, Harcourt Brace and Company.

Lord, C., Le Couteur, A., & Rutter, M. (1994). Autistic Diagnostic Interview-Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, *24*, 659–686.

Lord, C., & Schopler, E. (1989). Stability of assessment results of autistic and non-autistic language-impaired children from pre-school years to early school age. *Journal of Child Psychology and Psychiatry*, *30*, 575–590.

Lord, C., Wagner, A., Rogers, S., Szatmari, P., Aman, M., Charman, T. et al. (2005). Challenges in evaluating psychosocial interventions for autistic spectrum disorders. *Journal of Autism and Developmental Disorders*, *35*, 695–711.

Lovaas, O.I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology*, *55*, 3–9.

Lovaas, O.I. (2002). *Teaching individuals with developmental delays: Basic intervention techniques*. Austin TX: Pro-Ed.

Lowe, M., & Costello, A.J. (1988). *Symbolic Play Test* – Second Edition. Windsor: NFER-Nelson.

Luiselli, J.K., Cannon, B.O., Ellis, J.T., & Sisson, R.W. (2000). Home-based behavioral intervention for young children with autism/pervasive developmental disorder. *Autism*, *4*, 427–437.

Magiati, I., & Howlin, P. (2001). Monitoring the progress of pre-school children with autism enrolled in early intervention programmes: Problems of cognitive assessment. *Autism*, *5*, 399–406.

McEachin, J.J., Smith, T., & Lovaas, O.I. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. *American Journal on Mental Retardation*, *4*, 359–372.

National Autistic Society (NAS). (2001). *Approaches to autism: An easy to use guide to many and varied approaches to autism*. London: National Autistic Society.

National Initiative for Autism: Screening and Assessment (NIASA). (2003). *National Autism Plan for Children (NAPC). Plan for the identification, assessment, diagnosis and access to early interventions for pre-school and primary school aged children with ASD*. London: National Autistic Society.

Office for National Statistics. (2000). *The National Statistics Socio-economic Classification*. Available from http://www.statistics.gov.uk/methods_quality/ns_sec/.

Ozonoff, S., & Cathcart, K. (1998). Effectiveness of a home based program intervention for young children with autism. *Journal of Autism and Developmental Disorders*, *28*, 25–32.

Panerai, S., Ferrante, L., & Zingale, M. (2002). Benefits of the Treatment and Education of Autistic and Communication Handicapped Children (TEACCH) programme as compared with a non-specific approach. *Journal of Intellectual Disability Research*, *46*, 318–327.

Sallows, G.O., & Graupner, T.D. (2005). Intensive behavioral treatment for children with autism: Four-

year outcome and predictors. *American Journal of Mental Retardation*, *110*, 417–438.
Schopler, E. (1997). Implementation of TEACCH philosophy. In D.J. Cohen & F.R. Volkmar (Eds.), *Handbook of Autism and Pervasive Developmental Disorders* (2nd edn, pp. 767–795). New York: Wiley.
Shea, V. (2004). A perspective on the research literature related to early intensive behavioural intervention (Lovaas) for young children with autism. *Autism*, *8*, 349–367.
Sheinkopf, S.J., & Siegel, B. (1998). Home-based behavioral treatment of young children with autism. *Journal of Autism and Developmental Disorders*, *28*, 15–23.
Smith, T., Buch, G.A., & Gamby, T.E. (2000a). Parent-directed intensive early intervention for children with pervasive developmental disorder. *Research in Developmental Disabilities*, *21*, 297–309.
Smith, T., Eikeseth, S., Klevstrand, M., & Lovaas, I. (1997). Intensive behavioral treatment for preschoolers with severe mental retardation and pervasive developmental disorder. *American Journal of Mental Retardation*, *102*, 238–249.
Smith, T., Groen, A.D., & Wynn, J.W. (2000b). Randomised trial of intensive early intervention for children with pervasive developmental disorder. *American Journal of Mental Retardation*, *105*, 269–285.
Sparrow, S.S., Balla, D., & Cicchetti, D.V. (1984). *Vineland Adaptive Behavior Scales*. Circle Pines, MN: American Guidance Service.
Stutsman, R. (1948). *Merrill-Palmer Scale of Mental Tests*. Los Angeles: Western Psychological Services.
Sundberg, M.L., & Michael, J. (2001). The benefits of Skinner's analysis of verbal behavior for children with autism. *Behaviour Modification*, *25*, 698–724.
Weiss, M.J. (1999). Differential rates of skills acquisition and outcomes of early intensive behavioral intervention for autism. *Behavioural Interventions*, *14*, 3–22.
Weschler, D. (1990). *Weschler Preschool and Primary Scale of Intelligence-Revised UK Edition (WPPSI-R UK)*. Sidcup, Kent: Psychological Corporation.
Yoder, P., & Compton, D. (2004). Identifying predictors of treatment response. *Mental Retardation and Developmental Disabilities Research Reviews*, *10*, 162–168.

Manuscript accepted 27 February 2007

Appendix 1 Characteristics of children in 'best and least progress' groups

Characteristics	Best progress group ($N = 5$)	Least progress group ($n = 5$)
Gender	4 male; 1 female	3 male; 2 female
Intervention group	4 EIBI; 1 Nursery	2 EIBI; 3 Nursery
Ethnic group	2 White British; 2 mixed ethnic background; 1 Asian British	3 White British; 2 Black British
Time 1 Chronological age	All less than 4 years (range 32–48 months)	All less than 3 1/2 years (range 33–42 months)
Time 1 MA/IQ	Mean MA: 42.6 months (range 25–51); Mean IQ: 105.6 (range 74–137)	Mean MA: 16.4 months (range 13–20); Mean IQ: 43.6 (range 36–52)
Time 1 ADI-R language rating	Only one child classified as non-verbal at intake; 4/5 verbal (ADI-R ratings of 0 or 1)	All children non-verbal (ADI-R rating of 2)
Total intervention hours	2,188–3,625	2,400–4,108
Cognitive gains	13–31 months	1–15 months
Play gains	5–41 months	0–3 months
Language gains	18–39 months	−3 to 0 months
Adaptive behaviour gains	25–28 months	2–4 months
ADI-R total raw score change	−5 to −22	−10 to +7