Journal of Child Psychology and Psychiatry 48:5 (2007), pp 473–481 doi:10.1111/j.1469-7610.2006.01707.x

The effectiveness of Picture Exchange Communication System (PECS) training for teachers of children with autism: a pragmatic, group randomised controlled trial

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Objective: To assess the effectiveness of expert training and consultancy for teachers of children with autism spectrum disorder in the use of the Picture Exchange Communication System (PECS). **Method:** Design: Group randomised, controlled trial (3 groups: immediate treatment, delayed treatment, no treatment). Participants: 84 elementary school children, mean age 6.8 years. Treatment: A 2-day PECS workshop for teachers plus 6 half-day, school-based training sessions with expert consultants over 5 months. Outcome measures: Rates of: communicative initiations, use of PECS, and speech in the classroom; Autism Diagnostic Observation Schedule-Generic (ADOS-G) domain scores for Communication and Reciprocal Social Interaction; scores on formal language tests. **Results:** Controlling for baseline age, developmental quotient (DQ) and language; rates of initiations and PECS usage increased significantly immediately post-treatment (Odds Ratio (OR) of being in a higher ordinal rate category 2.72, 95% confidence interval 1.22–6.09, $p < .05$ and OR 3.90 (95%CI 1.75–8.68), $p < .001$, respectively). There were no increases in frequency of speech, or improvements in ADOS-G ratings or language test scores. **Conclusions:** The results indicate modest effectiveness of PECS teacher training/consultancy. Rates of pupils' initiations and use of symbols in the classroom increased, although there was no evidence of improvement in other areas of communication. Treatment effects were not maintained once active intervention ceased. **Keywords:** Randomised controlled trial, PECS, autism, intervention, communication.

Recent studies indicate that the prevalence of autism spectrum disorder (ASD), broadly defined, may be as high as 1% (Baird et al., 2006). The economic cost of autism is considerable, with the average UK cost of special school provision alone being estimated as around £11,000 per child per annum (Jarbrink & Knapp, 2001). Many children also require additional interventions, particularly for communication difficulties, since around 25% of individuals with ASD remain without functional speech (Volkmar, Lord, Bailey, Schultz, & Klin, 2004). However, the evidence base for psychosocial interventions for children with ASD is generally weak. Although there are many reports of programmes that facilitate development or modify behaviour problems in children with ASD (Arick, Krug, Fullerton, Loos, & Falco, 2005; Bregman, Zager, & Gerdtz, 2005; Prizant & Wetherby, 2005; Schreibman & Ingersoll, 2005), evaluations of most psychosocial interventions rely mainly on single case or case series studies or on non-randomised group trials (Charman et al., 2003; Lord et al., 2005; National Research Council, 2001). Randomised controlled trials (RCTs) provide the surest evidence-base of the effectiveness of a treatment approach as they are unbiased and most strongly indicative that it is the specific intervention that affected outcome. However, within the ASD field, very few RCTs have been conducted, most with sample size below 15. For example, there are only 4 RCTs of communication-based interventions for preschool children with ASD (Aldred, Green, & Adams, 2004; Drew et al., 2002; Kasari, Freeman, & Paparella, 2006; Yoder & Stone, 2006).

Despite these limitations in the evidence-base, certain therapies have become extensively used. One such intervention is the Picture Exchange Communication System (PECS; Bondy & Frost, 1994, 1998) developed for non-verbal children with ASD. PECS aims to teach spontaneous social-communication skills by means of symbols or pictures and teaching relies on behavioural principles, particularly reinforcement techniques. Behavioural strategies are employed to teach the child to use functional communicative behaviours to request desired objects. The requesting behaviour is reinforced by the receipt of the desired item. Physical prompts are used to teach the child to pick up and exchange a symbol/picture for the desired object and are then faded using 'backward-chaining' techniques. No prerequisite attention or imitation abilities are required to use PECS. By optimising motivation through use of items already identified as reinforcing, PECS aims to

Conflict of interest statement: No conflicts declared.

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teach individuals spontaneously to initiate social communication. Once a child is using symbols with some flexibility, having learned to seek out a communication partner and generalise skills to other adults, training moves on to picture discrimination, 'vocabulary' extension and constructing sentences. These later stages are often paired with verbal prompts from the communication partner (Frost & Bondy, 2002).

Several initial studies have reported that PECS can increase non-verbal communication in children with ASD; some children are also described as acquiring spoken language (Ganz & Simpson, 2004; Kravits, Kamps, Kemmerer, & Potucek, 2002). One RCT has been conducted and found that PECS training increased the rate of requesting in non-verbal children with ASD but the improvements did not generalise to other areas (Yoder & Stone, 2006).

According to the NAS school database, over half of all autism-specific schools and units in the UK claim to use PECS to enhance pupils' communication skills (National Autistic Society, 2005). However, in the majority of cases, teachers using this system are untrained, or have only attended a brief PECS workshop. Relatively few schools have received any on-site, expert training in implementing PECS and fewer still receive ongoing consultation and monitoring. Thus, there are concerns that pupils are not, in fact, provided with the high quality training, nor the necessary modifications to the classroom environment or curriculum that are required if PECS is to be optimally effective. The impact of providing expert PECS training for teachers requires evaluation. We investigated in a pragmatic, group RCT the effectiveness of providing expert training and consultation in the use of PECS to teachers of non-verbal children with ASD delivered in specialist school settings. The study aimed to determine whether expert guidance to teachers in the use of PECS led to increases in spontaneous communication, PECS use and speech for children in the treatment groups.

Method

Ethics approval

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

Design

This was a group RCT with school classroom as the randomisation unit. Classes were randomised into 3 groups: *Immediate Treatment Group* (ITG; receiving PECS training immediately after baseline assessment); *Delayed Treatment Group* (DTG; receiving PECS training 2 terms after initial baseline assessment); and *No Treatment Group* (NTG; receiving no PECS training). DTG children were monitored during the baseline-intervention period, simulating a 'watchful waiting' condition. Limitations on time and resources (KG and GP were responsible for all data collection) was the primary reason for 'staggering' the PECS training across 2 separate phases.

Sample size considerations

Assuming a conservative estimate of intraclass correlation of .25 (i.e., a high degree of within-class correlation in outcomes) an average class size of 5 children would yield a design effect of 2 (Hauck, Gilliss, Donner, & Gortner, 1991). The 3-arm randomised design means that if 6 classes were allocated to each treatment group, then 12 treated classes would be available to compare with 12 untreated classes (treated: ITG at time 2 and DTG at time 3 vs. untreated: DTG at time 2 and NTG). If the odds of the children in the treatment classes achieving a better rating than those in the untreated group were 3.5 then the trial would have 80% power at the 5% significance level to detect this improvement (Campbell, Julious, & Altman, 1995). Assuming a lower intraclass correlation of .10, the study would have the same power to detect an odds ratio of 2.8. The power of the study is further increased via the inclusion of the baseline measurements.

Study inclusion criteria

For inclusion in the study each child was required to:

- have a formal clinical diagnosis of autism and to meet criteria for autism or autism spectrum disorder on the Autism Diagnosis Observation Schedule – Generic Module 1 (ADOS-G: Lord et al., 2000);
- have little or no functional language (i.e., not exceeding single words/word approximations);
- have no evidence of sensory impairment;
- be aged between 4 and 11 years;
- not be using PECS beyond Phase 1 (i.e., able to exchange symbols only if prompted (Frost & Bondy, 2002)).

Each class was required to have a minimum of 3 children meeting the above criteria.

Owing to the widespread use of PECS materials or PECS-type procedures in UK schools for children with ASD, it was not possible to identify adequate numbers of classrooms in which children or teachers were totally naïve to PECS. As this was a pragmatic trial, the aim of the study was to measure the impact of the teacher training and consultation visits on children's communication in addition to any existing use of pictures/symbols in class. As recruitment of 'PECS naïve' classes was not feasible, the requirement for inclusion in the study was that teachers should not have previously received any direct, in-class training/consultancy from PECS consultants. Previous attendance at a PECS workshop was not, of itself, considered grounds for exclusion.

Participant selection and assignment

From the comprehensive list of specialist educational establishments in the UK, published by the National Autistic Society (2001), 38 schools were identified as providing specialist education for children with ASD in

Greater London and South East England. All were contacted to establish their potential suitability. Twenty-four schools that appeared to meet inclusion criteria were then visited. Of these, 18 class groups from 15 schools met inclusion criteria. Most of the classes that were excluded at this stage had fewer than 3 eligible children in the same classroom. Classes were then stratified according to size (⩾6 children; <6 children). In each stratum, classes were randomly allocated to one of the three treatment conditions using an online randomisation programme (http://www.random.org) (see Figure 1).

Treatment

Each class in the treatment groups was invited to send up to six members of staff and six parents to a 2-day PECS workshop. This comprised 13 hours of training in the use of PECS by the leading, expert consultants of Pyramid Educational Consultants UK, following the highly prescribed format of the training manual (Frost & Bondy, 2002). Actual attendance varied from 4–6 staff (teachers, support staff, and speech and language therapists) per class (mean 5.1, SD .6) and 0–7 parents (mean 3.2, SD 2.4). The active treatment period began approximately 1 week later, with PECS consultants making 6 half-day consultation visits to each class once a month over the following 5 months. The consultants recommended and demonstrated strategies for advancing children's use of PECS in the classroom, monitored teachers' progress and provided systematic feedback on their implementation of PECS. Following each visit, class teachers were provided with written summaries, agreed action points and future goals. The PECS consultants encouraged teachers to facilitate children's use of PECS in various sessions across the school day, according to the principles outlined in the PECS manual (Frost & Bondy, 2002). Treatment delivery at consultant level followed a consistent pattern, based on the manualised principles and practice of PECS, and every attempt was made to ensure that teachers, too, adhered to these. However, within each class, teachers' practice varied widely and because of time and personnel

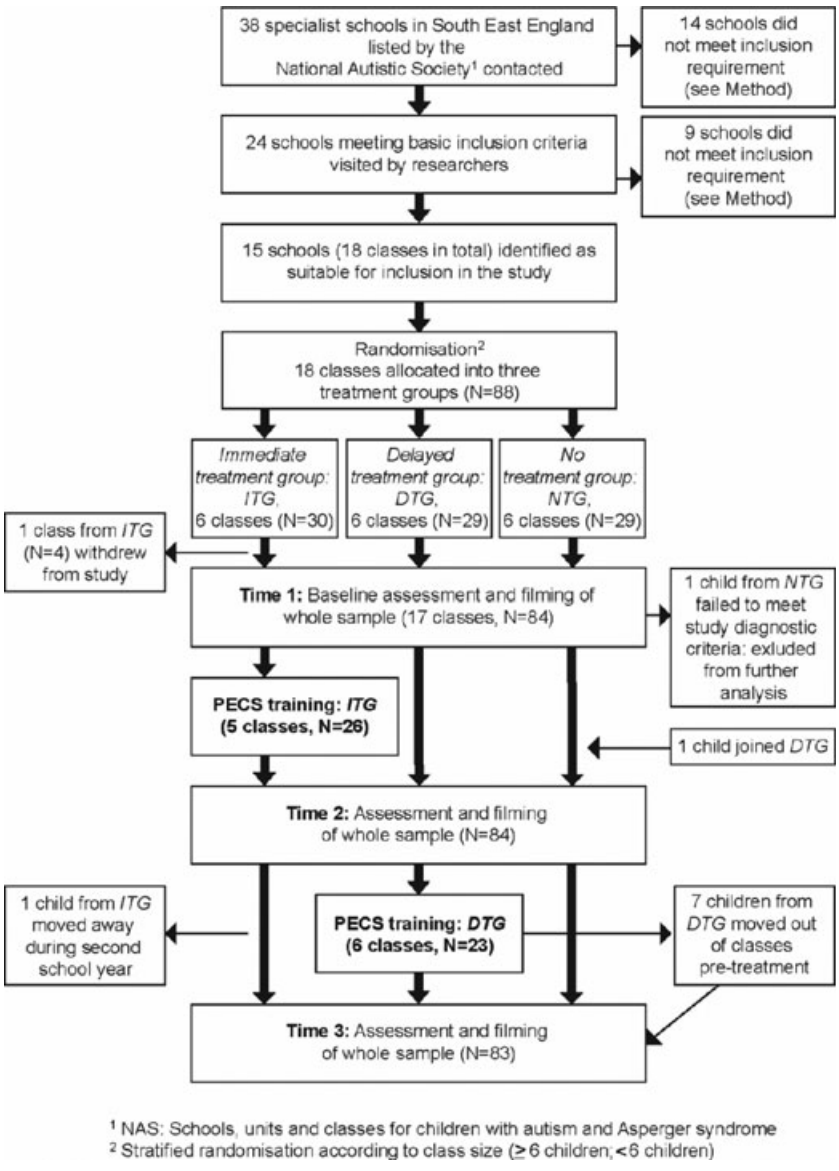

Figure 1 Flow chart illustrating sample selection, randomisation, treatment and assessment

constraints, it was not possible to conduct measures of everyday implementation.

School settings

All children attended autism-specific classes/units or schools, most with a child–adult ratio of approximately 2:1. All children followed the UK National Curriculum, with access to additional therapeutic activities such as speech and language therapy, play and music therapy, etc.). Teaching programmes varied but most classes adopted an eclectic approach incorporating a range of visual and picture systems, and structured teaching, often based on the TEACCH methodology (Mesibov, Shea, & Schopler, 2004). As already noted, class teachers were not completely naive to PECS and some form of PECS or pictures/symbols was evident in all classrooms. However, this was generally minimal, consisting of Phase 1 scaffolded requesting (Frost & Bondy, 2002).

Baseline measures

All children had received a clinical diagnosis of autism prior to enrolment in the study but since diagnostic evaluations had been conducted by different (usually multidisciplinary) centres across the south-east of England, diagnostic status was further confirmed by means of the Autism Diagnosis Observation Schedule – Generic Module 1 (ADOS-G: Lord et al., 2000). Both researchers were formally trained in the use of the ADOS-G and GP is an accredited ADOS-G trainer. Seventy-five children met the ADOS-G algorithm criteria for autism and 9 children met algorithm criteria for ASD. The ADOS-G algorithm was used as a baseline measure of symptom severity and the ADOS-G language rating on the ADOS-G was used as an index of expressive ability (0 =regular phrases; 1 = occasional phrase mostly single words; 2 = single words only, $\geqslant$5 words; 3 = single words only, <5 words; 4 = non-verbal). The Visual Reception and Fine Motor subscales of the Mullen Scales of Early Learning (Mullen, 1995) were used to derive a non-verbal developmental quotient (NVDQ = non-verbal MA equivalent/chronological age $\times$ 100) for each child.

Outcome measures

Owing to the pragmatic school-based nature of the study, both treatment and assessment took place in school. Because of financial and personnel limitations (the whole study was run and coordinated by 2 research staff), assessors (and videotape coders, see below) were not blind to group assignment. All children were filmed and assessed three times throughout the study: first at baseline, and again following the first and second treatment periods. See Table 1.

The principal outcome measures were intended to be ecologically valid measures of communication skills. Researchers videotaped children in their classrooms during their daily snack sessions for a maximum of 15 minutes and requested only that the teachers 'continue as normal' while these sessions were filmed. Snack sessions were chosen because they are time limited (typically around 15 minutes); are very similar in most UK schools for children with ASD; and are typically structured to encourage requesting and to maximise social communication. Three variables were coded: (i) frequency of child communicative initiations; (ii) frequency of use of PECS symbols; and (iii) frequency of speech (including non-word vocalisations).

As the exact length of the actual snack-time sessions varied (mean 11.1 minutes, SD 3.4 mins, range 1.2 to 15 mins), frequencies were expressed as rates per minute. The rates were often zero, with highly skewed distributions that compromised the analysis of the relationship between intervention and outcome measures and could not be transformed to normality. To aid the modelling process, therefore, the variables were recoded into 4 ordinal categories (zero, .01 to .50 per minute, .51 to 1.00 per minute and >1.00 per minute). In order to calculate inter-rater reliability, 25 (approximately 10%) of the videotaped sessions were randomly selected for coding by both researchers. Intra-class correlation coefficients were calculated for each variable: initiations .83; PECS use .98; speech .95 (all $p < .001$).

In addition to the observation of children in the classroom, a number of standardised assessments were also used to monitor change. The Expressive One Word Picture Vocabulary Test (EOWPVT: Academic Therapy Publications, 2000) and the British Picture Vocabulary Scales (BPVS: Dunn, Dunn, Whetton, & Burley, 1997), were used to assess expressive and receptive language. Each measure was administered to all children 3 times during the study. Many children obtained standardised scores of zero on the language assessments, resulting in highly skewed distributions, so raw scores were recoded into ordinal categories (0; 1 to 20; >20). As the ADOS-G has now been used as an outcome measure in a number of social communication intervention studies with preschool children with ASD (Aldred et al., 2004; McConachie, Randle, Hammal, & Le Couteur, 2005),

Table 1 Mean ages at baseline and mean intervals between observations at Times 1, 2 and 3

Treatment group	Mean age (months) at Time 1 (SD; range)	Mean time interval in months (SD)		
		Time 1–2	Time 2–3	Time 1–3
Immediate treatment group	73.1 (15.8; 47.3–106.3)	7.6 (.3) $n = 26$ PECS training (2 terms)	10.4 (.4) $n = 25$	17.9 (.5) $n = 25$
Delayed treatment group	86.6 (12.7; 62.0–113.5))	7.5 (1.3) $n = 29$	7.1 (1.6) $n = 30$ PECS training (2 terms)	14.6 (1.9) $n = 29$
No treatment group	85.6 (13.6; 61.0–122.1)	10.7 (1.2) $n = 28$	4.6 (.7) $n = 28$	15.3 (.7) $n = 28$

the Communication and Reciprocal Social Interaction Domain scores were also used to assess change over time.

Data analysis

Multilevel ordinal regression models were used to investigate patterns between treatment and each of the outcomes. Observations were clustered within individuals (i.e., the measurements taken for each child at Times 1, 2 and 3) who in turn were clustered within class groups and within treatment arms. Multilevel modelling enables within-child and within-class correlations to be taken into account. The outcomes for each child are thus corrected for their baseline assessment. Binary terms representing a measurement immediately following a treatment period (for the ITG and DTG groups combined) and after a time delay (for the ITG only) were entered into the models to quantify the immediate and continued effects of treatment. Three independent baseline variables were added into the analysis: age, NVDQ and ADOS-G language rating. Separate models were used for each outcome and estimates are presented with 95% confidence intervals.

Participants

See Figure 1. Following random assignment, one class (ITG) subsequently withdrew from the study. One girl entered a DTG class one year into the study; thus her data were available from Time 2–Time 3 only. At baseline, one other girl (NTG) failed to meet criteria for ASD. Her data were excluded from further analysis. Seven children moved out of the DTG during the watching-waiting period and did not receive treatment but they were assessed at Times 2 and 3 and their data included in the analyses on an intention-to-treat basis. The final groups were: ITG (5 classes, 26 children, 21 boys, 5 girls); DTG (6 classes, 30 children, 27 boys, 3 girls); NTG (6 classes, 28 children, 25 boys, 3 girls). Table 1 shows the mean ages of each group at baseline, the timings of PECS training and observations. Owing to resource constraints, it was not possible exactly to match the time intervals between assessments for all 3 groups across all 3 time intervals. Differences in age at baseline and times between assessments were controlled for in the analysis.

Results

Baseline assessments and participant characteristics

DTG children had a higher ADOS language impairment score (mean(SD) 3.4(.8)) than those in the ITG (2.7(1.4)) and NTG (2.5(1.5)) groups (Kruskal Wallis Chi-square = 6.32, df = 2, $p < .05$; post hoc Wilcoxon $z = -2.10$ and $z = -2.26$ respectively, both $p < .05$) and children in the ITG had a higher NVDQ (25.9(11.4)) than children in the DTG (22.7(8.2))(Chi-square = 8.21, df = 2, $p < .05$; post hoc Wilcoxon $z = -2.78$, $p < .001$; NTG (27.3(10.2))). These initial group differences were adjusted for in the subsequent analyses. There were no differences in ADOS total algorithm scores (ITG 16.4(2.7); DTG 16.9(2.9); NTG (15.3(3.2)).

Changes in classroom ratings

The ordinal variable for rate of initiation is shown in Figure 2a. There was a significant main effect of treatment on rate of initiations. Immediately post-treatment, children who had received PECS training were 2.73 times (95% confidence intervals 1.22–6.08) more likely to be in a higher initiation rate category than children who had received no training ($p < .05$). At the level of individual children, 51.8% of the treated groups moved up one or more categories, 28.6% showed no change and 19.6% moved down one or more categories following treatment, compared to 25.0%, 35.7% and 39.3%, respectively, for the NTG children across Time 1 to Time 2. This effect was not maintained in the group who had received early treatment: by Time 3, the ITG children were no more likely to be in a higher initiation rate category than children who had received no training (OR = 1.08, 95% CI .30–3.90, $p = .91$).

The ordinal variable for rate of PECS use is shown in Figure 2b. There was a significant main effect of treatment on rate of PECS use. Immediately post-treatment, children receiving PECS training were 3.90 times (95% CI 1.75–8.68, $p < .001$) more likely to be in a higher PECS use category than those who received no PECS training. At the level of individual children, 58.9% of the treated groups moved up one or more categories, 26.8% showed no change and 14.3% moved down one or more categories following treatment, compared to 32.0%, 46.4% and 21.5%, respectively, for the NTG children across Time 1 to Time 2. Again, this effect was not maintained in the group receiving early treatment: by Time 3, the ITG children were no more likely to be in a higher PECS rate category than untreated children (OR = 1.56, 95% CI .46–5.30, $p = .48$).

There was no significant main effect of treatment on rate of speech (OR = 1.10, 95% CI .46–2.62, $p = .83$) (see Figure 2c).

Changes in ADOS-G domain scores

Figures 2d and 2e show ADOS-G Communication and Reciprocal Social Interaction (RSI) domain scores, respectively. There was no significant effect immediately following treatment on the ADOS-G Communication domain scores (OR = .52, 95% CI .24–1.12, $p = .10$) or on ADOS-G RSI domain scores (OR = .55, 95% CI .25–1.19, $p = .13$). However, at the 10-month follow-up of the ITG there was a significant effect for ADOS-G RSI domain scores (OR = .28, 95% CI .09–.89, $p < .05$). The odds ratio indicates that treatment was associated with a decrease in this severity score: at follow-up 10 months after treatment ended children were 3.57 times more

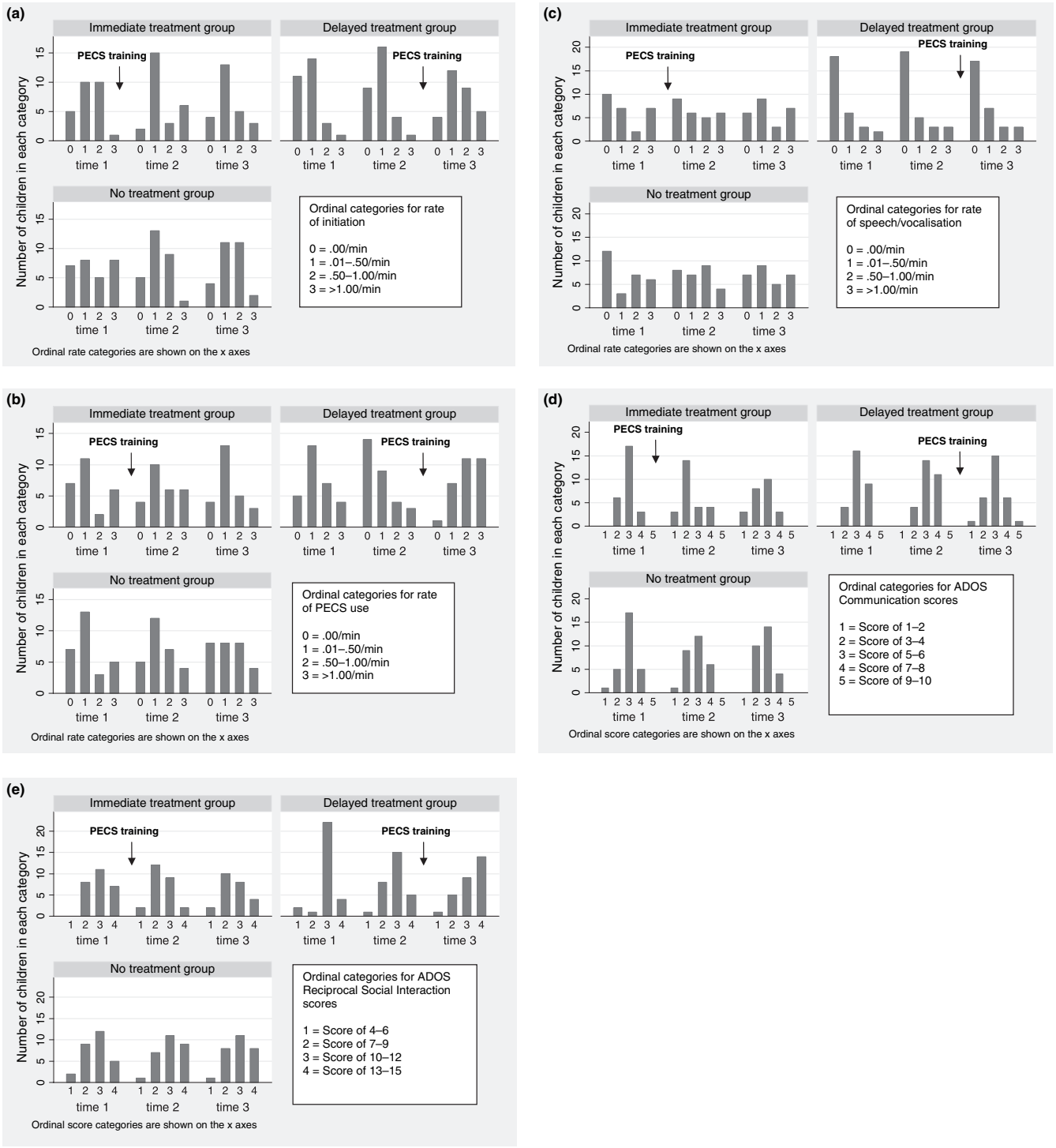

Figure 2 Dependent variables by treatment group by time. Figure 2a: Rate of initiations; Figure 2b: Rate of PECS use; Figure 2c: Rate of speech/vocalisation; Figure 2d: ADOS Communication scores; Figure 2e: ADOS Reciprocal Social Interaction scores

likely to be in a lower ordinal category on the ADOS-G RSI subscale.

Changes in raw scores on standardised language tests

There was no significant effect of treatment on scores on standardised language tests (EOWPVT: OR = 1.01, 95% CI .89–1.15, $p = .87$; BPVS: OR = 1.54, 95% CI .52–4.54, $p = .44$).

Discussion

In the groups receiving PECS training/consultation there were significant post-treatment increases in the rate of their initiations and rate of PECS use in the classroom. However, for the one treatment group (ITG) for whom an additional follow-up period was conducted, the positive effects were not maintained once classroom consultations ceased. As treatment fidelity measures were not taken, we do not know if this was

due to a less reliable or less frequent implementation of PECS by teachers once consultation was no longer available. For this reason, an extended follow-up in combination with treatment fidelity measures will be important for future studies of psychosocial interventions. In addition, the size of the treatment effect has clinical meaning. For the children who received PECS training, from pre- to post-intervention the median rates of initiations increased from ~15 per hour to ~26 per hour, and median rates of picture/symbol use increased from ~12 per hour to ~40 per hour, although within both groups there was some variability in whether children's communication behaviour increased or decreased. Failure to initiate communicative interactions is a cardinal feature of young children with ASD (Mundy, 2003). Thus, even modest improvements may be important in increasing the amount of social and communicative exchanges to which the child is exposed, perhaps enhancing social development.

Despite earlier claims that PECS can enhance children's use of speech, the present study failed to demonstrate any increases in spoken language or scores on language tests and the children continued to show significant impairments and abnormalities in communication. For the ITG who were followed up 10 months after intervention ceased, the odds ratio for the ADOS-G RSI rating indicates that treatment seemed to be associated with a decrease in severity in that domain. However, this finding of an apparently delayed (but not immediate) treatment effect is difficult to interpret and scores remained well above cut-off for autism. Further studies are required to determine whether extending the PECS training/consultation package over longer periods or with younger or more able non-verbal children might produce further gains, for example in spoken language as suggested in case series studies (Ganz & Simpson, 2004; Kravits et al., 2002).

Strengths of the current study

This was the largest fully randomised psychoeducational trial for ASD reported to date and the second RCT of the widely used PECS programme (Yoder & Stone, 2006). This was a pragmatic trial intended to measure the impact of the teacher training and consultation visits on children's communication in addition to any existing use of pictures/symbols in class. That is, it was an 'effectiveness study' of implementation of the PECS training and consultancy, at least as implemented by the Pyramid UK training group. As such, its findings – and the concomitant limitations, including the lack of maintenance of treatment effects once consultancy finished – are likely to be generalisable to similar children in similar school settings. This is encouraging as the settings were deliberately chosen as those in which PECS training and consultancy is sought as a communication intervention for largely non-verbal children with ASD. Lastly, the multilevel regression model adopted allows within-child and within-class correlations to be taken into account and also ensures that outcomes for each child are corrected for their baseline scores on the dependent variables and also on other child characteristics.

Limitations of the current study

The study was conducted as a pragmatic intervention trial and while this has important implications for educational practice, there are inevitable limitations to a trial of this kind compared to a more tightly controlled efficacy study (Lord et al., 2005). Firstly, there were significant restrictions on financial resources and personnel (both in terms of researchers and consultants) as well as time (most children were to move classrooms at the end of the school year in which training took place). Thus, intervention lasted only 2 school terms and it was not possible to determine whether continuing consultancy input might have resulted in further gains in communication. Secondly, we relied on only one measurement point at each assessment period for each child. Furthermore, although the classroom observation assessments had high ecological validity, in order to ensure a degree of comparability across schools the primary measures were restricted to snack times. These, by their nature, were relatively brief periods, when children are often highly motivated to make approaches for food and the findings may not reflect changes in the child's communication in other situations. However, because of the restraints noted above, it was not possible to obtain generalisation data in additional settings such as other classrooms or the home. Furthermore, it is not known whether the behaviour of children or school staff systematically differed from usual when the assessors were filming the snack sessions used at baseline and outcome. Thirdly, it was not possible to collect ongoing measures of treatment fidelity – either with regard to the PECS consultants or with regard to the practice of class teachers. Nevertheless, this is of less importance for pragmatic effectiveness studies than for efficacy studies. Fourthly, the assessors were not blinded to group allocation or treatment phase, as financial limitations precluded the use of additional blinded raters to code all the video recordings. However, every effort was made to ensure the reliability of all codings and the researchers were totally independent of the intervention itself. Finally, while our use of ordinal data was driven by the highly skewed distribution of our primary outcome variables, this might reduce sensitivity to detect change compared to continuous quantitative data.

Relation to literature

The findings corroborate and extend those of previous studies indicating that language impaired

children with ASD can learn to use PECS effectively and that in addition to increased use of the symbol system to communicate, the rate of communicative initiations also increased (Bondy & Frost, 1994; Charlop-Christy, Carpenter, LeBlanc, & Kellet, 2002; Ganz & Simpson, 2004; Kravits et al., 2002; Magiati & Howlin, 2003; Schwartz, Garfinkle, & Bauer, 1998). The evidence-base for PECS now includes multiple uncontrolled group studies, multiple controlled case series and two RCTs (Yoder & Stone an efficacy study; the present study an effectiveness study), with all studies showing some benefits. However, in contrast to some case reports, there was no evidence that 7 months' experience with PECS resulted in increases in spoken language. This may reflect the fact that the current sample showed considerable impairment in terms of their limited communication abilities and low DQ, as well as their being older than in some other trials.

Nevertheless, despite these obvious methodological drawbacks, the trial provides evidence that expert training and consultation in PECS usage for class teachers does lead to improved communication in children. Randomised control trials of other language and communication programmes have shown almost no effect of intervention for children with severe communication disorders (Law, Garrett, & Nye, 2004). Thus, the present findings, albeit limited, are particularly important for informing educational practice for severely impaired, non-speaking children with autism. The study also demonstrates that it is possible to conduct a randomised control trial of educational provision in a *naturalistic* setting, although, clearly, greater resources are needed in order to overcome the methodological limitations of the present research

Clinical implications

The present RCT confirms the potential value of PECS for non-speaking children with autism. Further studies are now required to determine which children benefit most from this form of intervention, and which elements of the programme are most efficacious, as well as to explore the extent of generalisation to other settings, the optimal length of intervention involving expert consultants and whether findings might be different for younger, preschool children. Children with ASD require multi-modal intervention approaches. These should include parent support and education (Jocelyn, Casiro, Beattie, Bow, & Kneisz, 1998) as well as child-directed components. The present study provides some evidence that for non-verbal children PECS can provide one effective element of a wider treatment package, although the failure of treatment effects to maintain suggests that ongoing intervention is likely to be required.

Acknowledgements

We would like to thank all the participating schools, children and their parents, the PECS Consultants Sue Baker and Teresa Webb from Pyramid UK and The Three Guineas Trust for their generous support of this project.

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Manuscript accepted 22 September 2006