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Research Report

Long-term effects of PECS on social–communicative skills of children with autism spectrum disorders: a follow-up study

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Abstract

Background: The Picture Exchange Communication System (PECS) is a popular augmentative communication system frequently used with 'nonverbal' children with autism. Several studies suggested that PECS could represent an effective tool for promoting improvement of several social–communicative skills. Only sparse evidence is instead available on the long-term effectiveness of this treatment system.
Aims: To test the long-term effects of PECS, for which a follow-up study was conducted by assessing social–communicative skills in nonverbal preschool children with autism after 12 months from treatment completion.
Methods & Procedures: Two groups of children ($N = 14$) were assessed; one group had completed the PECS training and the other conventional language therapy (CLT). At follow-up all children received the same pre- and post-treatment assessment. Outcome measures were the following: Communication and Social domains of Autism Diagnostic Observation Schedule (ADOS); Language and Personal–Social subscales of the Griffiths' Mental Developmental Scales (GMDS); Communication and Social Abilities domains of the Vineland Adaptive Behavior Scales (VABS); and several social–communicative variables coded in an unstructured setting.
Outcomes & Results: The PECS group showed significant improvements compared with the CLT group on ADOS severity scores (Communication, Social and Total), on GMDS Social domain and on VABS Communication and Social domains. PECS-related gains on the VABS Social domain and on specific social–communicative measures coded during free-play, i.e. frequency of joint attention and initiation, and duration of cooperative play, were stable after 1-year follow-up. Cooperative play continued to improve on follow-up with respect to both post- and pre-treatment assessment.
Conclusions & Implications: These findings demonstrated that PECS training can promote long-term enhancement of specific socio-communicative skills in children with autism.

Keywords: Picture Exchange Communication System (PECS), autism spectrum disorders, long-term effects, social and communicative skills.

What this paper adds?

What is already known on this subject?

The Picture Exchange Communication System (PECS) is an augmentative communication system designed to teach individuals to communicate by exchanging picture symbols. Recent studies suggested that PECS can enhance social–communication skills in autism spectrum disorders. In the literature only a few studies are available on the long-term effects of PECS training on social–communicative skills in autism.

What this study adds?

The study investigated the long-term effects of PECS training on social–communicative skills of children with autism spectrum disorders by assessing participants both in structured and unstructured settings 1 year after treatment ended. Results demonstrated that post-treatment PECS-related gains on the VABS Social domain and on several social–communicative measures coded during free-play were stable on follow-up, and children's cooperative play showed a progressive improvement from pre-treatment to follow-up.

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Introduction

Deficits of social and communication skills are core and prognostic indicators of autism spectrum disorders (ASD) (Howlin and Moore 1997). Social–communicative impairments distinguishing ASD from typical development and developmental delay include abnormality in initiation of communication, reciprocity in interaction, social/affective signalling, joint attention, symbolic behaviour, motor imitation, language understanding and conventional use of gestures (Landa *et al.* 2011, Rogers *et al.* 2003, Wetherby *et al.* 2007). Over the past decade, comprehensive early intervention programmes have focused on treating defects of joint attention, imitation and play skills in young children, proving to be successful at ameliorating these social and communication impairments (Greenspan *et al.* 1998, Rogers and Dawson 2010); without effective interventions, instead, these deficits tend to persist and may also lead to poor long-term outcomes and/or to internalizing (e.g., anxiety, depression and somatic complaints) and externalizing (attentional difficulties and aggressive conducts) problematic behaviours (Hartley *et al.* 2008).

Recent evidence showing social and language improvements following early interventions for ASD highlighted the importance of designing therapeutic opportunities to practise joint processing of self-other experiences within social communicative exchanges (Klin *et al.* 2002, Koegel *et al.* 2001, Lerna *et al.* 2012). According to Mundy *et al.* (2009), joint processing of one's own and others' actions and objects of attention gives way to an automaticity that is likely fundamental to symbolic and social cognitive learning. Thus, early interventions directly targeting socially engaged imitation, joint attention and affect sharing could have strong effects on later development of language, communication and social skills (Bono *et al.* 2004, Sigman and Ruskin 1999, Toth *et al.* 2006).

The Picture Exchange Communication System (PECS), originally developed by Bondy and Frost (1994), has proven to be a key intervention to enhance social and communicative skills (e.g., initiations, requests, joint attention, social interaction with peers and turn-taking) in 'nonverbal' children with autism (for a recent review, see Preston and Carter 2009). However, only a few studies provided evidence of long-term effects of PECS intervention (Preston and Carter 2009), and the only two randomized control trials including data on maintenance reported mixed results. Yoder and Stone (2006a) compared the efficacy of PECS and Responsive Education and Prelinguistic Milieu Teaching (RPMT) on spoken communication in 36 preschoolers with ASD. Results showed that PECS was more successful than RPMT in increasing the number of non-imitative spoken communication acts and the number of different non-imitative words used at the post-treatment period. However, when considering outcome measures across pre-treatment, post-treatment and 6-month follow-up, increase of non-imitative words was faster in the PECS group for children who began treatment with high object exploration; on the contrary, increase was faster in the RPMT group for children who began treatment with relatively low object exploration. Howlin *et al.* (2007) demonstrated in a group of 26 children with autism that increased rate of communicative initiations and PECS usage after the training was not maintained on a 10-month follow-up.

Recently, Lerna *et al.* (2012) investigated effects of PECS on social–communicative skills of nonverbal children with ASD by means of formalized measures (standardized psychometric data and standardized functional assessment of adaptive behaviour) and social–communicative outcome variables coded in an unstructured setting. Results showed a significant improvement of the PECS group with respect to the control group (which underwent to a conventional language therapy) on the Social domain score of the Vineland Adaptive Behavior Scales (VABS) and on several social–communicative abilities, such as joint attention, request, initiation and cooperative play. In the present study, we aimed at testing long-term effects of PECS intervention on social–communicative skills in a subsample of the nonverbal children with ASD recruited for the Lerna *et al.*'s study; to this aim, the same social–communicative abilities measured in the previous study were assessed after 12 months from treatment completion.

Following Howlin *et al.*'s (2007) evidence showing an improvement of Communication and Reciprocal Social Interaction domains of the Autism Diagnostic Observation Schedule—Generic (ADOS-G; Lord *et al.* 2000) after a 10-month follow-up, we hypothesized that ADOS could detect more global changes after PECS intervention over a longer period. On the contrary, no clear-cut data are available on adaptive behaviour assessed by the VABS. Actually, in a longitudinal study on high-functioning autism, Szatmari *et al.* (2003) showed that VABS Socialization score decreased over time, whereas the Communication score remained more stable. Klin *et al.* (2007), instead, demonstrated that both VABS Communication and Socialization scores decreased significantly with age in high-functioning autism. On these bases, no straightforward prediction can be made on how VABS scores can change over time. Analogously, although several structured observational procedures have been developed to assess children's early social–communication skills, the few data available in literature (Charlop-Christy *et al.* 2002, Yoder and Stone 2006b) do not allow to build specific predictions on possible changes over time of social–communication skills

measured in an unstructured setting (i.e., a free play interaction of the child with an adult).

Method

Participants

Participants were a subsample ($n = 14$) of children from the Lerna *et al.*'s (2012) study conducted at the 'Eugenio Medea' Scientific Institute, Regional Branch of Ostuni (BR), Italy, an institute for diagnosis and rehabilitation of developmental disorders. All children were originally selected according to the following inclusion criteria: (1) a formal clinical diagnosis of autism made by a child psychiatrist and a clinical psychologist according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association 2000) and to results from ADOS (Lord *et al.* 1999); (2) to be aged between 18 and 60 months; (3) to have little or no functional language; (4) not to be using PECS or other alternative augmentative communication systems (Schuler *et al.* 1997); and (5) to have no evidence of severe sensory, motor deficits or of known co-morbid medical conditions. Children were assigned either to the PECS group ($n = 7$; mean chronological age = 71.1 months, SD = 11.9) or to the Conventional Language Therapy (CLT) group ($n = 7$; mean age = 66.2 months, SD = 11.8) after parents had provided written informed consent (for further details regarding inclusion criteria and sampling procedures, see Lerna *et al.* 2012).

Procedure

Families of the 18 participants in the Lerna *et al.*'s (2012) study were recontacted 12 months after treatment completion (the actual period of the follow-up ranged from 12.1 to 12.6 months); four out of 18 families participating in the original study dropped out the follow-up due to familial reasons; more precisely, three participants moved with their families to northern Italy and one participant suffered a family bereavement. All the 14 participants were assessed at three time points: at baseline (pre-treatment; time 1), immediately after 6 months of PECS training (post-treatment; time 2) and 1 year after treatment completion (follow-up; time 3). The same dependent variables (Outcome Measures) were measured at baseline, post-treatment and follow-up by examiners who were blinded to child assignment and to the purposes of the study.

Outcome measures

The main outcome measures were standardized assessments of social–communicative abilities and several behavioural measures derived from observation of a free-play session with an examiner.

Griffiths' Mental Developmental Scales (GMDS; Griffiths 1984)

Language subscale (assessing receptive and expressive language), Personal–Social subscale (assessing proficiency in the activities of daily living, level of independence and interaction with other children) and Nonverbal IQ were employed as outcome measures.

Autism Diagnostic Observation Scale (ADOS; Lord et al. 1999)

Communication, Reciprocal Social Interaction and Total scores were used to assess change over time. ADOS Module 1 or 2 was used depending on the child's expressive language abilities.

Vineland Adaptive Behavior Scales, Second Edition (VABS II; Sparrow et al. 2005)

The VABS were specifically used to gather parent report of the child's Communication and Social abilities at home and in the community.

Unstructured Free-Play with Examiner (UFPE)

Social–communicative measures (i.e., joint attention, verbal and nonverbal requests, initiation, cooperative play and eye contact) and their operational definitions were based on Charlop-Christy *et al.*'s (2002) criteria. In particular, in Lerna *et al.*'s study the operational definition of requests was the following: 'labelling object while pointing or reaching for it, handing the therapist PECS cards, and verbal requests'. In the present study, the operational definition was the same, but during the coding phase we decided to distinguish between verbal and nonverbal requests (i.e., pointing or reaching for object and PECS cards exchange). The rationale behind this choice was to try to highlight changes that parents reported to occur during the study in the expressive vocabulary of the children.

Data were collected during observation of a 15-min free-play session (UFPE) with an examiner. UFPE was conducted in the same room, with the same set of toys and using materials and activities that the examiner used, during all the three time points (for further details on materials employed during UFPE sessions, see Lerna *et al.* 2012). Social–communicative variables were derived from videotaped records of the free-play session using the Observer Video Pro software package (Version XT.7; Noldus Information Technology, Wageningen,

the Netherlands, 2007) to transform a standard computer keyboard into point and state events recorders. The point events were behaviours that only took an instant in time, or whose duration was not important, i.e. joint attention, verbal and nonverbal requests, and initiation; these variables were coded in terms of frequency. The state events were behaviours that took a period of time and therefore had duration, i.e. cooperative play, eye contact; these variables were coded in seconds. The duration of the session was exactly 15 min for all children; therefore no correction for the length of the observation was necessary. Reliability of coded variables was analysed on independently coded and randomly selected samples. Two independent observers were trained to use the coding system; each of the observers had a master's degree in clinical or developmental psychology and received training by an experienced clinician using video samples of children not involved in the study. The observers were blind to the purposes of the study and the treatment assignment. Inter-rater reliability was determined by double coding of 20% of the observations and was very good (Kappa = 0.85).

Treatments

PECS and CLT were implemented within a psychoeducation rehabilitation programme based on the TEACCH methodology (Mesibov *et al.* 2004). All the children followed a structured teaching for a total of 12 h a week; children were taught skills including attention, basic discrimination, language and spontaneous communication, daily living, socialization, play, fine and gross motor control and pre-academics (Watson *et al.* 1989). A semi-structured setting was also implemented, using incidental teaching techniques, to enhance generalization, increase motivation, develop social skills and to decrease problem behaviours.

All children were offered 30 min individual therapy sessions (PECS or CLT) three times a week for 6 months (i.e. 72 sessions). Experts leading both PECS and CLT were specialists in speech–language pathology with extensive expertise with ASD.

Phases I–IV of PECS training were implemented according to the standard procedures devised by Bondy and Frost (1994, 1998). Before starting the training, parents were required to record their children's favourite food and toys on a card in order to make picture cards to be included in the communication book, according to the standard procedure. During the training the children were taught physical exchange (phase I), increasing distance (phase II), picture discrimination (phase III) and sentence structure (phase IV).

Conventional Language Therapy (CLT) is a language training based on a systematic, step-by-step teaching technique using prompts and useful reinforcements. In Italy it represents one of the most widely employed methods to treat language and communicative disorders in developmental disabilities in accordance with the guidelines of the Italian National Health System. CLT employs a variety of largely operant approaches to language intervention implemented in accordance with discrete trial training formats (Goldstein 2002, Lovaas 1981, 2002), using didactic, adult directed instructions in a one-to-one interaction (for a complete description of PECS and CLT programmes, see Lerna *et al.* 2012). After 6 months of treatment the children interrupted both PECS and CLT training and only continued the psychoeducation rehabilitation programme with the TEACCH methodology.

Results

Standardized test assessment

We first performed a preliminary analysis to verify whether the two groups differed between each other on the standardized measures collected at time 1 (table 1). Results confirmed Lerna *et al.*'s (2012) data showing that there were no significant group differences at the pre-treatment assessment (all $p > 0.05$). Then, a MANOVA was performed with mean standard scores on formalized outcome measures as dependent variables, and group (PECS or CLT) and time point (time 1, 2 or 3) as independent variables. Results showed a significant main effect of group on ADOS Communication, Social and Total scores, revealing a decrease of all the three severity scores in the PECS with respect to the CLT group; the effect of group was also significant on GMDS Personal–Social and on both VABS Communication and Social domain scores, always showing a better performance of the PECS than the CLT group (table 1). Results also showed on VABS Social domain score a significant main effect of time point, $F(2,36) = 4.023$, $p = 0.026$, $\eta^2_p = 0.183$, and, more relevant here, a significant group by time point interaction, $F(2,36) = 3.295$, $p = 0.049$, $\eta^2_p = 0.155$. No other significant main effect or interaction was found on all the remaining formalized outcome measures (all $p > 0.05$).

Post-hoc comparisons (paired *t*-tests) on the significant effect of the time point on VABS Social domain score showed that, with respect to pre-treatment assessment (time 1; mean = 61, SD = 5.9), the children's score was significantly higher on both post-treatment (time 2: mean = 72.6, SD = 19.7; $t(13) = -2.737$, $p = 0.017$) and follow-up (time 3; mean = 66.9, SD = 8; $t(13) = -3.389$, $p = 0.005$), whereas the difference between time 2 and 3 was not significant ($t(13) = 1.224$, $p = 0.243$). This effect of time point on VABS Social domain score was further specified by the significant group by time point interaction; actually, post-hoc comparisons

Table 1. Means (SDs) of standard scores on formalized outcome measures at times 1–3, separately for the two groups. MANOVA values of the main effect of group on formalized outcome measures

	PECS			CLT					
	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3	$F(1,36)$	p	η^2_p
GMDS									
Language	34.9 (9.2)	42.3 (14.5)	50.6 (22.1)	35.4 (9.8)	33.6 (12.4)	37 (19.5)	2.33	0.136	0.061
Personal–Social	65.0 (9.9)	66.0 (6.9)	59.6 (13.1)	50.7 (14.6)	56.9 (11.6)	50.3 (9.5)	9.95	**0.003**	0.217
Non-verbal IQ	78.4 (17.5)	72.7 (13.2)	65.3 (23.1)	68.0 (15.6)	73.7 (21.9)	58.3 (19.6)	0.89	0.351	0.024
ADOS									
Communication	5.9 (1.2)	4.3 (1.3)	3.9 (2.3)	6.4 (1.8)	6.4 (1.5)	6.9 (0.9)	15.34	**0.0001**	0.299
Social	9.3 (1.9)	7.3 (3.2)	5.7 (3.2)	10 (1.9)	9.6 (1.5)	9.9 (3.6)	8.41	**0.006**	0.189
Total score	15.0 (2.6)	11.6 (3.7)	9.6 (5.1)	16.4 (3.4)	16.0 (2.9)	16.7 (3.8)	14.59	**0.001**	0.288
VABS									
Communication	54.8 (14.2)	64.4 (6.8)	70.6 (15.2)	52.6 (5.9)	55.5 (5.8)	57.8 (13.9)	5.38	**0.026**	0.130
Social	63.3 (7.5)	84.4 (22.5)	70.6 (8.5)	58.8 (2.9)	60.7 (3.6)	63.3 (5.9)	12.73	**0.001**	0.261

Note: Significant values are shown in bold.

(paired t-tests) showed that in the PECS group children gained significant higher scores on post-treatment (time 2: mean = 84.4, SD = 22.5; $t(6) = -3.249$, $p = 0.017$) and follow-up (time 3; mean = 70.6, SD = 8.5; $t(6) = -2.610$, $p = 0.041$) with respect to pre-treatment (time 1; mean = 63.3, SD = 7.5), whereas the difference between time 2 and 3 was not significant ($t(6) = 1.720$, $p = 0.136$). On the contrary, in the CLT group, there were no significant differences among the three time points (time 1: mean = 58.9, SD = 2.9; time 2: mean = 60.7, SD = 3.5; time 3: mean = 63.2, SD = 5.9; all $p > 0.05$).

Unstructured free-play session

The preliminary MANOVA, with behavioural outcome measures coded during free-play at time 1 (table 2) as dependent variables and group as independent variable, confirmed Lerna *et al.*'s (2012) data showing that there were no significant group differences at the pre-test assessment (all $p > 0.05$). Then, a MANOVA was performed with mean scores on behavioural outcome measures as dependent variables, and group (PECS or CLT) and time point (time 1, 2 or 3) as independent variables. Results showed a significant main effect of group on cooperative play, joint attention and initiation, but not on eye contact, verbal and nonverbal requests (table 2). We also found a significant effect of time point on cooperative play, $F(2,36) = 17.406$, $p = 0.0001$, $\eta^2_p = 0.492$, joint attention, $F(2,36) = 5.573$, $p = 0.008$, $\eta^2_p = 0.236$, nonverbal requests, $F(2,36) = 13.063$, $p = 0.0001$, $\eta^2_p = 0.421$, and initiation, $F(2,36) = 5.579$, $p = 0.008$, $\eta^2_p = 0.237$, but not on eye contact and verbal requests (all $p > 0.05$). More relevant here, results showed a significant group by time point interaction on cooperative play, $F(2,36) = 5.755$, $p = 0.007$, $\eta^2_p = 0.242$, joint attention, $F(2,36) = 3.938$, $p = 0.028$, $\eta^2_p = 0.180$, verbal requests, $F(2,36) = 4.531$, $p = 0.018$, $\eta^2_p = 0.201$, and initiation, $F(2,36) = 4.840$, $p = 0.014$, $\eta^2_p = 0.212$, but not on eye contact and nonverbal requests (all $p > 0.05$).

Post-hoc comparisons (paired t-tests) performed to clarify the significant main effect of the time point showed that cooperative play significantly improved from time 1 (mean = 36.9, SD = 32.9) to both time 2 (mean = 159.5, SD = 129.4; $t(13) = -3.625$, $p = 0.003$) and time 3 (mean = 304.6, SD = 238.1; $t(13) = -4.538$, $p = 0.001$), and from time 2 to time 3 ($t(13) = -2.985$, $p = 0.011$). Joint attention did not show significant changes from time 1 (mean = 0.79, SD = 1.1) to time 2 (mean = 2.4, SD = 3.6; $t(13) = -1.981$, $p = 0.069$), and from time 2 to time 3 (mean = 4.2, SD = 4; $t(13) = -2.037$, $p = 0.063$), whereas it significantly improved from time 1 to time 3 ($t(13) = -2.966$, $p = 0.011$). Nonverbal requests improved from time 1 (mean = 0) to both time 2 (mean = 0.3, SD = 0.5; $t(13) = -2.280$, $p = 0.040$) and time 3 (mean = 2, SD = 1.8; $t(13) = -3.978$, $p = 0.002$), and from time 2 to time 3 ($t(13) = -3.453$, $p = 0.004$). Initiation did not significantly changed across time points (time 1: mean = 0.5, SD = 1.2; time 2: mean = 2.4, SD = 3.6; time 3: mean = 4.5, SD = 5.5; all $p > 0.05$). Post-hoc comparisons (paired t-tests) on the significant group by time point interaction showed that in the PECS group cooperative play significantly improved from time 1 to both time 2 ($t(6) = -3.837$, $p = 0.009$) and time 3 ($t(6) = -6.577$, $p = 0.001$), and from time 2 to time 3 ($t(6) = -5.792$, $p = 0.001$). Joint attention significantly improved from time 1 to both time 2 ($t(6) = -2.521$, $p = 0.045$) and time 3 ($t(6) = -3.816$, $p = 0.009$), whereas it did not significantly changed from time 2 to time 3 ($t(6) = -1.782$, $p = 0.125$). Verbal requests significantly improved from time 1 to time 3 ($t(6) = -2.951$, $p = 0.026$), whereas time 1 vs. time 2 and time

Table 2. Means (SDs) of behavioural outcome measures coded during free-play at times 1–3, separately for the two groups. MANOVA values of the main effect of group on behavioural outcome measures

		PECS			CLT					
	Measure	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3	$F(1,36)$	p	η^2_p
Cooperative play	Duration	43.7 (29.4)	238.0 (129.5)	465.4 (175.4)	30.0 (37.2)	81.0 (72.2)	143.7 (178)	19.584	**0.0001**	0.352
Eye contact	Duration	4.4 (4.5)	25.0 (20.6)	41.9 (24.8)	11.1 (18.1)	27.6 (44.6)	11.3 (6.1)	0.927	0.342	0.025
Joint attention	Frequency	1.0 (1.2)	4.4 (4.4)	7.1 (4.1)	0.6 (1.1)	0.4 (0.5)	1.1 (1.9)	17.923	**0.0001**	0.332
Verbal requests	Frequency	1.9 (2.5)	6.6 (5.2)	7.4 (4.6)	4.3 (2.8)	2.9 (2.1)	2.4 (2.4)	3.786	0.060	0.095
Nonverbal requests	Frequency	0 –	0.6 (0.5)	2.4 (1.9)	0 –	0 –	1.6 1.9	1.899	0.177	0.050
Initiation	Frequency	0.1 (0.4)	4.7 (3.9)	7.7 (6.3)	0.9 (1.6)	0 –	1.3 (1.4)	12.618	**0.001**	0.260

Note: Significant values are shown in bold.

2 vs. time 3 comparisons were not statistically significant ($p > 0.05$). Initiation significantly improved from time 1 to both time 2 ($t(6) = –2.97$, $p = 0.024$) and time 3 ($t(6) = –3.156$, $p = 0.020$), whereas it did not significantly changed from time 2 to time 3 ($t(6) = –1.567$, $p = 0.168$). The same post-hoc analyses performed on the CLT group did not reveal significant improvements across the three time points (all $p > 0.05$).

Discussion

In the present study we tested whether the effects of PECS training on social–communicative skills of children with ASD (Lerna *et al.* 2012) could be detected at a 12-month follow-up. To this aim, we collected psychometric data and functional measures of adaptive behaviour by means of standardized tasks, and assessed social–communicative variables in an unstructured setting through observation of children's free-play interactions with an adult. Results from analysis on formalized outcome measures showed lower ADOS severity scores (Communication, Social and Total) in the PECS than in the CLT group, together with higher scores on GMDS Social and VABS Communication and Social scores. On VABS, children in the PECS group gained significant higher scores on post-treatment (time 2) and follow-up (time 3) with respect to pre-treatment assessment (time 1), thus revealing that improvements on VABS domains were retained 1 year from training completion. Analysis on social–communicative measures coded during free-play showed that frequency of joint attention and initiation, and duration of cooperative play were significantly higher in the PECS than in the CLT group, confirming previous data (Lerna *et al.* 2012). Relevant here, although the time point significantly influenced cooperative play, joint attention, nonverbal requests and initiation independently from the kind of treatment (PECS or CLT), analysis of the time point by group interaction showed that in the CLT group there were no significant effects of the time point on the social–communicative variables. On the contrary, in the PECS group cooperative play continued to improve significantly on follow-up with respect to both post- and pre-treatment, joint attention and initiation remained stable from post-test to follow-up, and verbal requests improved in a significant way only when comparing follow-up with pre-treatment.

Charlop-Christy *et al.* (2002) observed that spontaneous speech and socio-communicative behaviours had been maintained or continued to increase for one participant followed up 10 months from PECS training. Yokoyama *et al.* (2006) demonstrated in three participants with ASD maintenance of PECS effects on frequency and intelligibility of vocalizations both in the training room and at home, 6–8 months after training. In a single case study on a deaf child with autism, Malandraki and Okalidou (2007) reported maintenance of spontaneous PECS usage 6 months after intervention. On the contrary, Yoder and Stone (2006a) found that differences in speech variables were not maintained 6 months post-intervention. In the same vein, Howlin *et al.* (2007) showed that for the children assessed at a 10-month follow-up, the increased rate of communicative initiations and PECS usage found immediately post-intervention was not maintained.

The present results are consistent with the findings reported above showing positive effects of PECS on social–communicative skills. It is worth underlining here that in the PECS group cooperative play progressively improved across the three time points. Kasari *et al.* (2012) underlined the importance of early socio-communicative skills, such as joint attention, initiation and cooperative play for later outcomes and development of higher-order skills, such as speech. Accordingly,

previous evidence by Mundy *et al.* (1990) demonstrated that responding to joint attention at age 3–5 years predicted better language outcomes 1 year later (also Sigman and Ruskin 1999). Despite earlier claims that PECS can enhance children's use of speech, the present study did not reveal any increase on the Language domain of GMDS, whereas verbal requests coded in an unstructured setting improved when comparing follow-up with pre-treatment assessment. Recently, Boesch *et al.* (2013) compared PECS training and a speech-generating device (SGD) in a multiple baseline, alternating treatment design on three children with severe autism. Results showed that although relatively little difference was observed between PECS and SGD treatments, PECS training (in particular phase II) proved to be helpful in encouraging social–communicative skills. Data for speech outcomes, instead, did not reveal any increase across participants, and no differences between treatment conditions were observed. On this basis, the PECS-related 'delayed treatment effect' we found here on verbal requests calls for future investigation to test specifically whether extending the training over longer periods can differently affect verbal abilities.

Limitations of the present study include the lack of randomization of treatments and the relatively sample size which, however, although encourage in-depth analyses with larger sample sizes, do not undermine reliability of the results. Moreover, since we assessed outcome variables by means of parent report and examiner-led measures, we did not take into account measures truly representative of the children's real everyday environment. Finally, Boesch *et al.* (2013) showed that social–communicative behaviours occurred more frequently in phase II and less frequently in phases I and III of the PECS training. The authors speculated that opportunities to make eye contact with the communicative partner increased during phase II with respect to phases I and III because in phase II participants had to scan the room to locate the communicative partner prior to engaging in the communicative exchange. This speculation fits both our present and previous results (Lerna *et al.* 2012) revealing that among the social–communicative variables assessed during free-play (cooperative play, eye contact, joint attention, requests and initiation) eye contact only did not show any post-treatment or follow-up improvement. On these bases, we can suggest that future studies should directly assess whether each of the six phases of PECS training can best affect a specific social–communicative skill.

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References

American Psychiatric Association, 2000, *Diagnostic and Statistical Manual of Mental Disorders*, 4th revd edn (Washington, DC: American Psychiatric Association).

Boesch, M. C., Wendt, O., Subramanian, A. and Hsu, N., 2013, Comparative efficacy of the Picture Exchange Communication System (PECS) versus a speech-generating device: effects on social–communicative skills and speech development. *Augmentative and Alternative Communication*, **29**, 197–209.

Bondy, A. S. and Frost, L. A., 1994, *PECS: The Picture Exchange Communication System Training Manual* (Cherry Hill, NJ: Pyramid Educational Consultants).

Bondy, A. S. and Frost, L. A., 1998, The Picture Exchange Communication System. *Seminars in Speech and Language*, **19**, 373–389.

Bono, M., Daley, T. and Sigman, M., 2004, Relations among joint attention, amount of intervention, and language gain in autism. *Journal of Autism and Developmental Disorders*, **34**, 495–505.

Charlop-Christy, M. H., Carpenter, M., Le, L., Leblanc, L. and Kellet, K., 2002, Using the Picture Exchange Communication System (PECS) with children with autism: assessment of PECS acquisition, speech, social–communicative behavior, and problem behavior. *Journal of Applied Behavior Analysis*, **35**, 213–231.

Goldstein, H., 2002, Communication intervention for children with autism: a review of treatment efficacy. *Journal of Autism and Developmental Disorders*, **32**, 373–396.

Greenspan, S. I., Weider, S. and Simons, R., 1998, *The Child with Special Needs: Encouraging Intellectual and Emotional Growth* (Reading, MA: Addison Wesley/Addison Wesley Longman).

Griffiths, R., 1984, *Griffiths' Mental Developmental Scales (GMDS). The 1996 Revision by M. Huntley* (Oxford: Hogrefe, The Test Agency).

Hartley, S. L., Sikora, D. M. and McCoy, R., 2008, Prevalence and risk factors of the maladaptive behavior in young children with autistic disorder. *Journal of Intellectual Disability Research*, **52**, 819–829.

Howlin, P., Gordon R. K., Pasco, G., Wade, A. and Charman, T., 2007, The effectiveness of Picture Exchange Communication System (PECS) training for teachers of children with autism: a pragmatic, group randomised controlled trial. *Journal of Child Psychology and Psychiatry*, **48**, 473–481.

Howlin, P. and Moore, A., 1997, Diagnosis in autism: a survey of over 1200 patients in the UK. *Autism*, **1**, 135–162.

Kasari, C., Gulsrud, A., Freeman, S., Paparella, T. and Hellemann, G., 2012, Longitudinal follow-up of children with autism receiving targeted interventions on joint attention and play. *Journal of the American Academy of Child and Adolescent Psychiatry*, **51**, 487–495.

Klin, A., Jones, W., Schultz, R., Volkmar F. and Cohen, D., 2002, Visual fixation patterns during viewing of naturalistic social situations as predictors of social competence in individuals with autism. *Archives of General Psychiatry*, **59**, 809–816.

Klin, A., Saulnier, C., Sparrow, S., Cicchetti, D., Volkmar, F. and Lord, C., 2007, Social and communication abilities and disabilities in higher functioning individuals with autism spectrum disorders: the Vineland and the ADOS. *Journal of Autism and Developmental Disorders*, **37**, 748–759.

Koegel, R. L., Koegel, L. K. and McNerney, E. K., 2001, Pivotal areas in intervention for autism. *Journal of Clinical Child Psychology*, **30**(**1**), 19–32.

Landa, R. J., Holman K. C., O'Neill, A. H. and Stuart, E. A., 2011, Intervention targeting development of socially

synchronous engagement in toddlers with autism spectrum disorder: a randomized controlled trial. *Child Psychology and Psychiatry*, **52**, 13–21.

LERNA, A., ESPOSITO, D., CONSON, M., RUSSO, L. and MASSAGLI, A., 2012, Social–communicative effects of the Picture Exchange Communication System (PECS) in autism spectrum disorders. *International Journal of Language and Communication Disorders*, **47**, 609–617.

LORD, C., RISI, S., LAMBRECHT, L., COOK, E. H. JR., LEVENTHAL, BL., DILAVORE, P. C. PICKLES, A., RUTTER M., 2000, The Autism Diagnostic Observation Schedule – Generic: a standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders*, **30**, 205–223.

LORD, C., RUTTER, M., DILAVORE, P. C. and RISI, S., 1999, *Autism Diagnostic Observation Schedule* (Los Angeles, CA: Western Psychological Services).

LOVAAS, O. I., 1981, *Teaching Developmentally Disabled Children* (Baltimore, MD: University Park Press).

LOVAAS, O. I., 2002, *Teaching Individuals with Developmental Delays: Basic Intervention Techniques: Autism* (Austin, TX: PRO-ED).

MALANDRAKI, G. A. and OKALIDOU, A., 2007, The application of PECS in a deaf child with autism: a case study. *Focus on Autism and Other Developmental Disabilities*, **22**, 23–32.

MESIBOV, G. B., SHEA, V. and SCHOPLER, E., 2004, *The TEACCH Approach to Autism Spectrum Disorders* (Berlin: Springer).

MUNDY, P., SIGMAN, M. and KASARI, C., 1990, A longitudinal study of joint attention and language development in autistic children. *Journal of Autism and Developmental Disorder*, **20**, 115–128.

MUNDY, P., SULLIVAN, L. and MASTERGEORGE, A. M., 2009, A parallel and distributed-processing model of joint attention, social cognition and autism. *Autism Research: Official Journal of the International Society for Autism Research*, **2**, 2–21.

PRESTON, D. and CARTER, M., 2009, A review of the efficacy of the Picture Exchange Communication System intervention. *Journal of Autism and Developmental Disorders*, **39**, 1471–1486.

ROGERS, S. J. and DAWSON, G., 2010, *Early Start Denver Model for Young Children with Autism: Promoting Language, Learning, and Engagement* (New York, NY: Guilford).

ROGERS, S. J., HEPBURN S. L., STACKHOUSE, T. and WEHNER, E., 2003, Imitation performance in toddlers with autism and those with other developmental disorders. *Journal of Child Psychology and Psychiatry*, **44**, 763–781.

SCHULER, A. L., PRIZANT, B. M. and WETHERBY, A. M., 1997, Enhancing language and communication development: prelinguistic approaches. In D. J. Cohen and F. R. Volkmar (eds), *Handbook of Autism and Pervasive Developmental Disorders* (New York, NY: Wiley), pp. 539–571.

SIGMAN, M. and RUSKIN, E., 1999, *Social Competence in Children with Autism, Down Syndrome, and Developmental Delay: A Longitudinal Study*. Monographs of the Society for Research in Child Development (Chicago, IL: University of Chicago Press).

SPARROW, S. S., CICCHETTI, D. V. and BALLA, D. A., 2005, *Vineland Adaptive Behavior Scales, Second Edition (Vineland—II) Survey Forms Manual* (Circle Pines, MN: AGS).

SZATMARI, P., BRYSON, S. E., BOYLE, M. H., STEINER, D. L. and DUKU, E., 2003, Predictors of outcome among high functioning children with autism and Asperger syndrome. *Journal of Child Psychology and Psychiatry*, **44**(**4**), 520–528.

TOTH, K., MUNSON, J., MELTZOFF, A. and DAWSON, G., 2006, Early predictors of communication development in young children with autism spectrum disorder: joint attention, imitation, and toy play. *Journal of Autism and Developmental Disorder*, **36**, 993–1005.

WATSON, L. R., LORD, C., SCHAFFER, B. and SCHOPLER, E., 1989, *Teaching Spontaneous Communication to Autistic and Developmentally Handicapped Children* (New York, NY: Invington).

WETHERBY, A. M., WATT, N., MORGAN, L. and SHUMWAY, S., 2007, Social communication profiles of children with autism spectrum disorders late in the second year of life. *Journal of Autism and Developmental Disorders*, **37**, 960–975.

YODER, P. and STONE, W. L., 2006a, A randomized comparison on the effect of two prelinguistic communication interventions on the acquisition of spoken communication in pre-schoolers with ASD. *Journal of Speech, Language, and Hearing Research*, **49**, 698–711.

YODER, P. and STONE, W. L., 2006b, Randomized comparison of two communication interventions for preschoolers with autism spectrum disorders. *Journal of Counseling and Clinical Psychology*, **74**, 426–435.

YOKOYAMA, K., NAOI, N. and YAMAMOTO, J., 2006, Teaching verbal behavior using the Picture Exchange Communication System (PECS) with children with autistic spectrum disorders. *Japanese Journal of Special Education*, **43**, 485–503.