

## The effectiveness of Picture Exchange Communication System on learning request skills and the development of speech in Arabic-Speaking children with autism

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**Abstract:** The current study aimed to examine the effects of Picture Exchange Communication System (PECS) on requesting and speech development in children with autism in Jeddah city. The study included six boys who were taught PECS within a delayed multiple baseline design. All participants demonstrated increased levels of requesting after implementation of PECS. Only two participants demonstrated measurable speech during the study. The participants' speech has emerged gradually during phase I, phase II, and phase III of the study. The study indicated generalization of PECS skills across persons and settings. Also The results indicated that all participants were able to maintain the acquired PECS skills weeks after training.

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**Key words:** Autism; Picture Exchange Communication System; PECS, Requesting; Speech.

### 1. Introduction

Autism is a common disability in the Kingdom of Saudi Arabia (KSA). A study conducted in 2006 revealed that the number of children diagnosed with autism was 4-6/1000 births (Al-jarallah, et al., 2006). Most children who are diagnosed with an autism disorder fail to develop functional speech and language skills (Liedel, 2008). Researchers had developed several approaches for teaching augmentative and alternative communication (AAC) have been developed for children with limited or absent speech (Tincani et al.,2006). The American Speech-Language, and Hearing Association (ASHA) defines AAC as "...an area of research, clinical and educational practice. AAC involves attempts to study and when necessary compensate for temporary or permanent impairments, activity limitations, and participation restrictions of persons with severe disorders of speech-language production and/or comprehension, including spoken and written modes of communication." (ASHA, 2005, p. 1). AAC strategies require the use of unaided systems such as sign language, gestures, and facial expression and aided that range from real objects to picture-based systems (Dogoe, 2008). One familiar picture-based strategy is the picture exchange communication system PECS; (Bondy & Frost, 2002).

PECS is an aided AAC technique that has been developed by Bondy and Frost (1994) to help nonverbal individuals with autism develop functional communication skills. PECS is based on the applied behavioral principles. Advocates of these principles use various techniques such as shaping, differential

reinforcement, and transfer of stimulus control help children establish functional communication skills.

PECS is based on the understanding of the nature of individuals with autism spectrum disorders and the way they develop their language and social interaction skills (Bondy & Frost,2002). Unlike many traditional speech programs that require attain attending skills (e.g., eye contact ), PECS reportedly does not have this condition prior to initiation of their program. Further, PECS does not require children's verbal response to the trainer's prompts. In fact, PECS initial instruction begins with addressing the key deficit in children with ASD, namely social. Rather than Labeling, PECS first major concern is requesting which is usually followed by tangible reinforcement (Bondy and Frost, 2001; Ganz & Simpson,2004). Finally PECS requires few complex motor movements on the part of the speaker and does not require the listener to be familiar with an additional language such as sign language (Bondy & Frost, 2002).

The current investigation had two purposes. First, it aimed to examine the effect of PECS on the acquisition of requesting in school-age Arabic-speaking children with autism. Requesting was chosen as the focus of the study because it is the primary skill to be established in the early phases of PECS. In addition, requesting is the least challenging task to these children (Tincani et al., 2006), and it will hopefully lead encourage natural communication. Second, the study intends to examine the effects of PECS on participants' acquisition of speech. Several studies report that a large number of children who learn PECS also develop spoken language. Bondy and

Frost (1994) indicated positive outcomes for 85 children who were taught to use PECS and found that seven of 26 preschool students acquired the use of ten pictures to make requests within an average of three months. Moreover, all children, who joined the program with no functional speech, learned to exchange at least one picture within the first month of training. Liddle (2001) examined the effect of PECS on 21 children with autism and severe learning difficulties. One child failed to achieve phase 1. The results indicated that 19 out of the 20 participants who completed PECS training learned to use PECS to request desired items; 11 of the 20 children learned to use sentence strips to request items. 8 of these 11 children learned to sequence up to four symbols or pictures to request items. The other 9 children have all improved in their ability to interact with others. In addition, nine of the children increased their use of spoken language. Kravits et al. (2002) studied the effect of PECS on spontaneous communication of a school age girl with autism. The results indicated that acquisition and use of PECS resulted in spontaneous speech. Charlop–Christy et al. (2002) examined the acquisition of PECS and the effect of PECS training on speech development in play and academic classes in three children with autism. Their findings indicated that all three children acquired PECS skills and showed improvement in verbal speech and social–communicative behaviors.

Ganz and Simpson (2004) examined the role of PECS in increasing communicative requesting and speech development of three participants with autism and developmental delays. The results indicated that all three participants mastered PECS system rapidly (an average of 23 sessions; 346 trials) and showed improvement in the number of word utterances used to make requests per trial and the mean length of utterance (MLU). The participants also generalized the skills across trainers. In another study, Marckel et al. (2006) investigated the effectiveness of PECS in enhancing spontaneous communication in two children with autism. The results showed that the children learned to request spontaneously with increasing rate throughout training. Furthermore, the participants were able to generalize these skills to stimulus classes.

Tincani et al. (2006) examined the effects of PECS on manding and speech development of two male school-age children with autism. They found that the use of PECS resulted in increased the use and generalization of independent manding. One of these two students was able to develop speech during phase IV of training. In another study, Yokoyama et al. (2006) investigated the efficacy of PECS in the acquisition of basic communication skills by three nonverbal Japanese children with autism. Their results

indicated that all three participants acquired PECS use and were able to maintain and generalize these skills across settings and persons. Carr and Felce (2007) investigated the effects of using PECS on the communicative interactions between students and their teachers in an experimental group of 24 children. Five children in this group increased their total words after treatment compared to one child of the 17 children in the control group who showed similar progress. Finally Dogoe (2008) investigated the efficacy of PECS on the requesting skill of three boys with autism. The results indicated that all boys acquired requesting skills, and were able to maintain and generalize PECS use across settings and people.

The need for this study is obvious. First, the efficacy of traditional programs in increasing verbal communicative has been questioned by many specialist and there is urgent need for programs to help children with autism develop their communicative and social skills. PECS is a program that has been advertised and widely used in the Arab world, but its effectiveness has not been investigated. It is worth noting that these children have different culture and speak different language. The present study is a step to fill this gap.

## **2. Method**

### **Participants and Setting**

Six boys with autism in Jeddah Center for Autism participated in this study. Each boy received three sessions weekly until the completion of the first three phases in the program. Each participant should: (a) have no previous exposure to using PECS, (b) be between five and eleven years, (c) be preverbal or have limited functional speech, (d) not have socially acceptable communicative forms of requesting, (e) be diagnosed with autism, and (f) be in need for PECS system. All children had an extensive history of verbal speech training that was ineffective in helping the participants improve their communicative skills. Each participant received instructions in functional pre-academic and adaptive daily living skills. Table 1 provides demographic information and therapy history for each participant.

The sessions were conducted individually in a room with child–size tables and chairs that enabled the trainer and the child to sit facing each other.

Two categories of requests were recorded: independent and prompted. A request was recorded as independent when the participant exchanged a picture symbol to request a preferred item without prompt. A request was recorded as prompted when the participant required a gestural or physical prompt to pick up the picture symbol, reach the communicative partner, and release the picture symbol in the exchange partner's

hand. An open hand cue was counted as a gestural prompt.

The one category of speech recorded is the vocal approximation. A vocal approximation was recorded when the participant emitted a vocalization item. For example, in response to the presentation of the item 'potato', the participant said "ba", "ba", "tis", or any approximation that was not clearly "potato".

### Dependent Variables

The dependent variable was PECS acquisition and PECS use for requesting desired items. The two dependent measures evaluated during sessions were: (a) percentage of correct responses, and (b) number of trials to meet the criterion.

### Independent Variables

The independent variable was PECS training phases I through III as illustrated in Table 2.

**Table 1. Participants' Demographic information and therapy history**

Participants	Nationality	Age	Diagnosis	Communicative Level	Therapy History
A	Saudi	5 yrs	Autism	Non verbal	Speech, occupational therapy& IEP
Al	Saudi	7 yrs	Autism	Very little word approximations	Speech, occupational therapy& IEP
Z	Saudi	7 yrs	Autism	Very little word approximations	Speech, occupational therapy& IEP
N	Saudi	6 yrs	Autism	Non verbal	Speech, occupational therapy& IEP
O	Saudi	7,6 yrs	Autism	Non verbal	Speech, occupational therapy& IEP
E	Saudi	11 yrs	Autism	Non verbal	Speech, occupational therapy& IEP

**Table 2. Description of each phase of PECS training ( Bondy and Frost,2002)**

Phase	Title	Description
I	Physical exchange	Upon seeing a highly preferred item, the student will pick up a picture of the item, then reach toward the communicative partner, and release the picture into the trainer's hand.
II	Expanding spontaneity	The student goes to his communication book, pulls the picture off, goes to the trainer, gets the trainer's attention, and release the picture into the trainer's hand.
III	Picture discrimination	The student requests desired items by going to a communication book, selecting the appropriate picture from an array, going to a communication partner, and giving the picture.

### Design

The single-subject delayed multiple baseline across participants design was used in this study to examine the effect of PECS (Cooper et al., 2007).

### Procedure

Prior to training, there was an orientation meeting to brief parents about PECS training and to answer their questions. Each parent was asked to complete a reinforcement checklist for his child.

The study comprised five steps: (a) preference assessment,(b) baseline establishment,(c) intervention application, (d) generalization observation, and (e) follow-up.

### Stimulus preference assessment

In preparation for PECS training, a preference assessment was conducted to identify the most

preferred items to each child. These items were used during PECS training. The first step of this assessment was carried out indirectly through asking parents about activities and food items that could be reinforcing to their children. Parents were then given a checklist to indicate food and toys items that their children were most likely willing to get. The Second step was carried out by the investigator to verify the reinforcement effects of the identified items. In ten trials, the identified items were presented randomly to the participant, one item at a time. When the participant reached for an item, he was given a small amount of the item, if edible, or, if not edible, to play with the item 15 seconds. When the child failed to reach for an item, the researcher waited for five seconds before presenting another item. This procedure was repeated

until three to five or more highly preferred items were identified. Items that were included in this study were chosen by participants 80% or more of opportunities given to select the item. Then the items were arranged

from the most preferred to the least preferred. An example of the stimulus preference assessment can be seen in Figure 1. Table 3 summarizes preferred items for all participants.

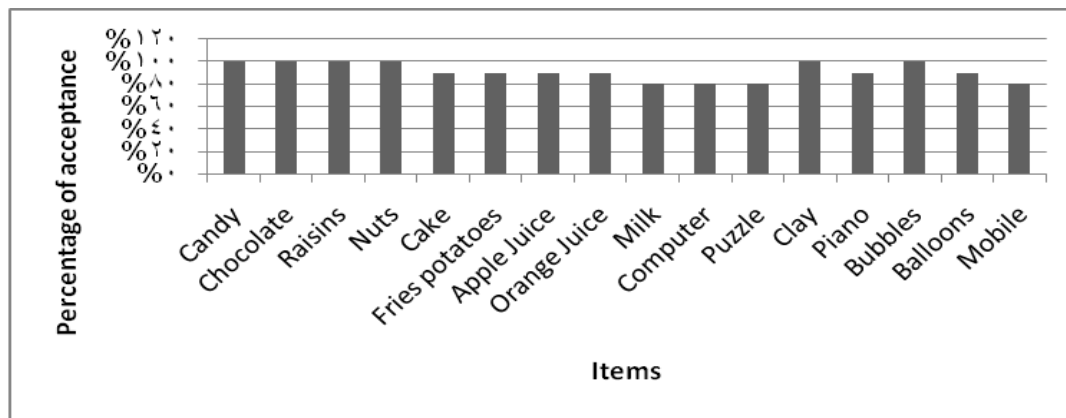


Figure 1. Preference Assessment Results for A

Table 3. Participants' most preferred items

Participants	Preferred Items
A	Candy, Chocolate, Raisins, Nuts, Cake, Fries Potatoes, Apple Juice, Orange Juice, Milk, Computer, Puzzle, Clay, Piano, Bubbles, Balloons, Mobile.
AL	Clay, Cake, Danet, Caramel, Chocolate, M&Ms, Rusk, Fries Potatoes, Apple Juice, Berry Juice, Cars, Bubbles.
Z	Cake, Danet, Caramel, Chocolate, M&Ms, Rusk, Fries Potatoes, Apple Juice.
N	Cookies, Piano, Juice, Clay, Mobile, Computer, Electronic Games.
O	Nuts,, Chocolate, Raisins, Caramel, Berry Juice, Computer, Recorder, Blocks.
E	Nuts, Chocolate, Macaroni, Pizza, Potatoes, Apple Juice, Tea, Balls.

Prior to PECS training, baseline data were collected to confirm that the participant could neither request by exchanging pictures nor by naming the desired item. The trainer placed either a food item or an activity item within the view of the participant, but out of his reach. A communication book containing the corresponding pictures of these items was also placed in front of the participant. The trainer waited for five seconds for the participant to make a request by physically reaching for the item. If the participant placed the picture symbol in the hand of the trainer, or said the name of the item (word approximation) within 10 seconds, the trainer would give access to it. If not, the item was removed and the next item on the list was presented until all items on the list had been presented.

Prompting, shaping, backward chaining and differential reinforcement had been used as specified in the protocol to teach PECS (Bondy and Frost, 2002). The protocol comprised six phases: (a) physical exchange, (b) Expanding spontaneity, (c) picture discrimination, (d) sentence structure, (e) responsive requesting, (f) commenting. Each phase has its own

instructions and correction procedures, in addition to a set of data to be collected.

The protocol described in PECS training manual was applied to help participants learn requesting. All participants were taught PECS phases I through III. The criterion for moving from one phase to the next was 80% or better independent correct responses in three consecutive sessions. The percentage of correct responses was calculated by dividing the number of correct responses by the total number of trials in each session. For the purpose of this study, training was limited to phases I through III.

Following is a brief description of the procedures in each of the first three phases. In phase I, upon seeing a highly preferred item, the student would pick up a picture of the item, reach toward the communicative partner, and release the picture into the communicative partner's hand. In phase II, the student would pull the picture off his communication book, go to the communicative partner, get his attention, and release the picture into his hand. In phase III, the participant was taught to select an appropriate picture

symbol. In phase IIIa, the participant was taught to discriminate picture symbol for preferred and non-preferred items. In phase III b, the participant was taught to discriminate between a set of picture symbols for preferred items.

As for generalization, the purpose of this session was to determine if the participant could use the acquired skills with different communicative partners in different settings. Generalization probes were conducted after mastery of phase III of PECS. As in the training sessions, the communicative partner sat or stood across from the participant and presented a preferred item to the participant one at a time. There were no physical prompts or models provided. Data were collected and recorded as in the training phase.

#### Interobserver Agreement

The trainer and another teacher (as an independent observer) coded the independent variables

for at least 33% of the data of all training sessions. Prior to data collection, the observers discussed the operational definition of the dependent variables to be scored and descriptions of training procedures. The observers went over the scoring sheet and procedures for each session and then practiced the recording and training procedures. During reliability sessions, the observers recorded, on a trial-by-trial basis, whether the participant's request was an independent correct response or prompted. This data was compared to those collected by the trainer. An agreement was counted when the two observers recorded the same response for all categories for each item presentation. A percentage of agreement was calculated at the end of each observation session using the formula: Agreement/(Agreements + Disagreements) X100. The interater agreement for participants in each phase of the study is summarized below in Table 4.

**Table 4. Total number of sessions, trials, and agreement average for each participant**

Phases	Participant					
	A	AL	Z	N	O	E
Phase I	12 sessions (188 trials)	10 sessions (174 trials)	10 sessions (88 trials )	24 sessions (200 trials )	20 sessions (200 trials)	10 sessions (174 trials )
Phase II	12 sessions (224 trials)	8 sessions (154 trials)	8 sessions (90 trials )	14 sessions (215 trials)	15 sessions (115 trials)	8 sessions (160 trials)
Phase III	24 sessions (214 trials)	12 sessions (198 trials)	15 sessions (140 trials)	20 sessions (210 trials)	29 sessions (200 trials)	14 sessions (180 trials)
All phases	48 sessions (626 trials)	30 sessions (526 trials)	33 sessions (318 trials)	58 sessions (625 trials)	64 sessions (515 trials)	32 sessions (514 trials)
Agreement average %	94.6%	96.3%	99%	96%	99.3%	95.3%

Observers scored each speech response by noting the type of trial (spontaneous or imitation). Observers also coded each response by counting the number of utterances emitted. A second observer independently scored 33% of sessions for speech, and the average interobservers agreement across all speech behaviors the sessions observed was 98%.

#### Procedural Integrity:

To ensure that procedures were implemented correctly, a trained observer collected treatment integrity data for 30% of sessions, selected randomly and distributed across training sessions. The trained observer completed a checklist of training procedures using PECS Implementer Skills Sheet (Dodge, 2008) for phases I, II, and III to examine whether (a) the

trainer elicited initiation of requesting opportunities from the participant by holding the item in one hand and aligning the second opened hand with the hand holding the item, (b) the trainer had followed PECS correction procedures, (c) the second trainer accurately provided the designated assistance depending on the participant's response, and, (d) the shaping procedures were appropriately implemented during phase II. A percentage was calculated with a "Yes" response meaning agreement and a "No" response meaning disagreement.

Table 5 shows the percentage of "Yes" responses by independent observers across each phase of PECS training for the six participants.

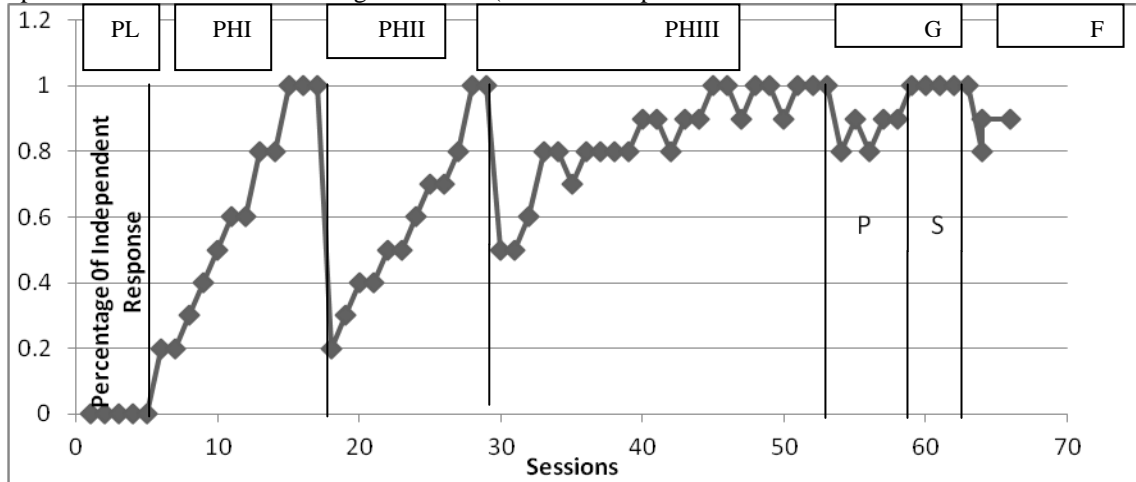
**Table 5. Treatment Integrity: Percentage of "Yes" Responses across participants and phases.**

Phases	Participants						Average%
	A	AL	Z	N	O	E	
I	95	99	95	99	95	95	96.3
II	98	97	98	95	98	98	97.3
III	100	100	95	100	95	100	98.3
Average %	97.6	98.6	97.3	98	96	97.6	

**3. Results:**

All 6 participants met the criterion of 80% correct for each of PECS phases. Requesting results are displayed in figures 2-7. It is worth noting that none of the participants performed any functional requesting skill for PECS items during baseline sessions. Participant **A.** received 48 training sessions (626

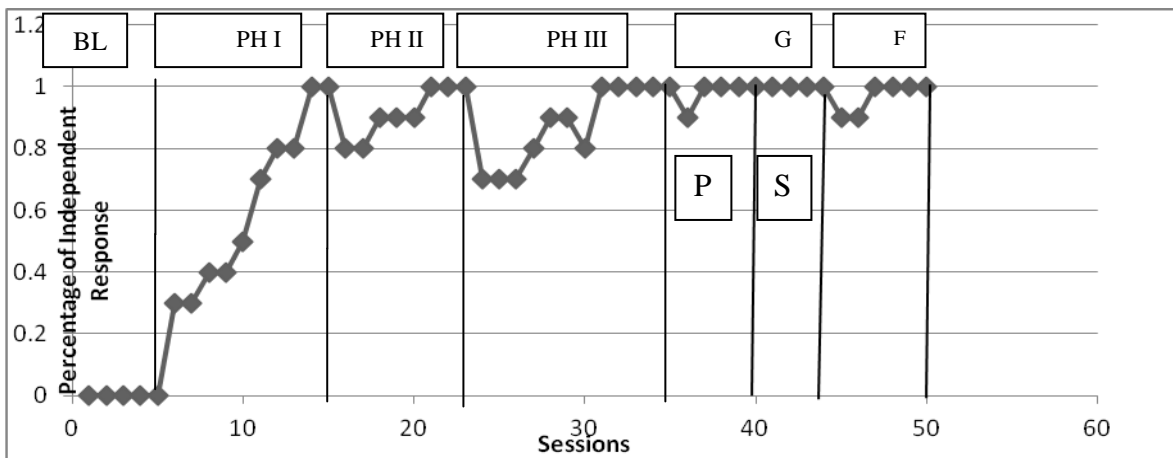
trials), ten generalization probes, and three follow-up sessions. During phase I, he demonstrated an average of 61.6% independent responses in all training sessions. In phase II, he demonstrated an average of 59% independent responses. In phase III, he demonstrated an average of 81.2% independent responses.



**Figure 2. Percentage of Independent Request across Baseline and PECS phases for A.**

**AL.** participated in a total of 30 training sessions (526 trials), nine generalization probes, and six follow-up sessions. During phase I, he demonstrated an average of 62% independent responses. In phase II, he

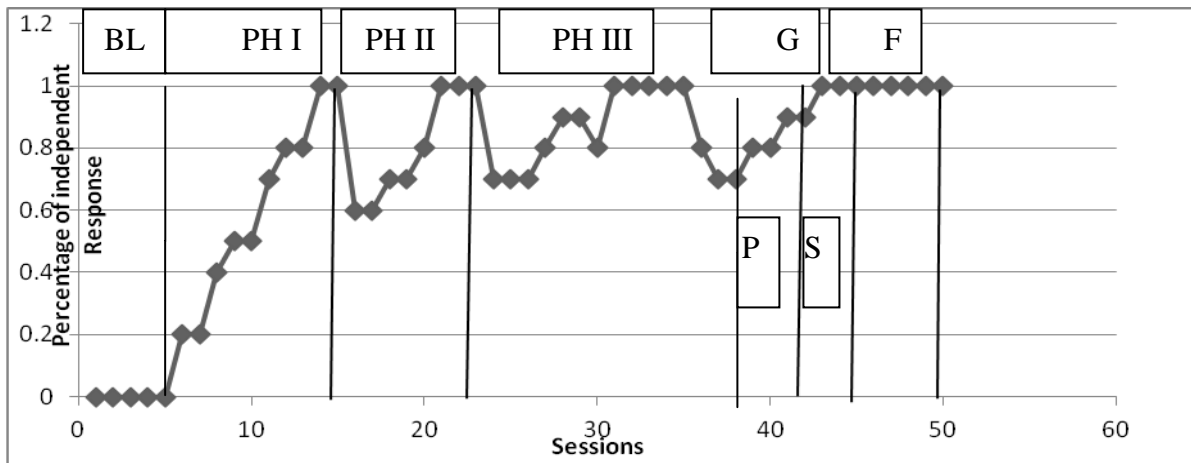
demonstrated an average of 91.2% independent responses, in phase III, he demonstrated an average of 87.5% independent responses.



**Figure 3. Percentage of Independent Request across Baseline and PECS phases for AL.**

**Z.** participated in a total of 33 training sessions (318 trials), seven generalization probes, and five follow-up sessions. He demonstrated an average of

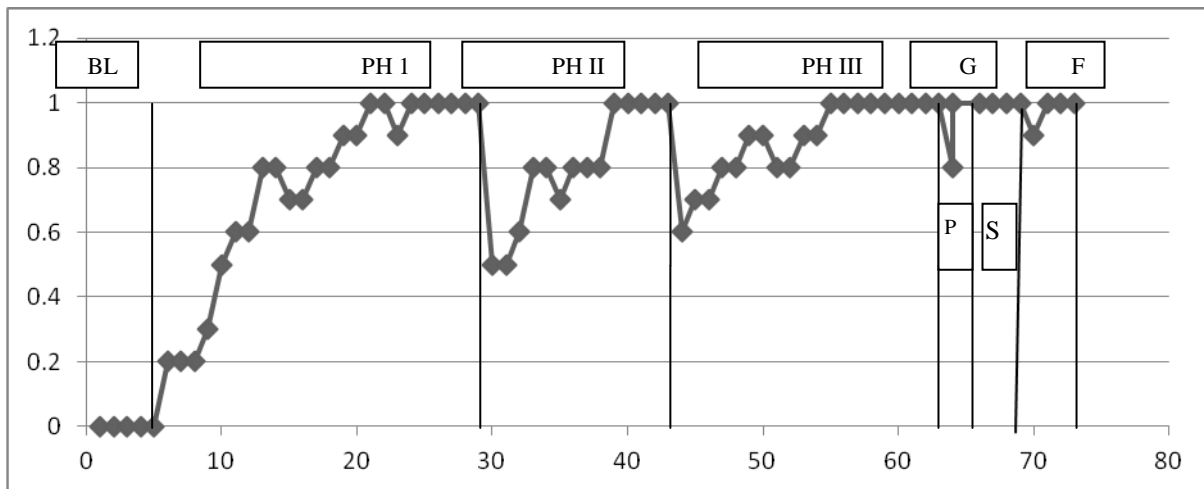
61% independent responses in phase one, 80% independent responses in phase II, and 84.6% independent responses in phase III.



**Figure 4. Percentage of Independent Request across Baseline and PECS phases for Z.**

**Z.** participated in a total of 58 training sessions (625 trials), six generalization probes, and four follow-up sessions. During phase I, he demonstrated an average of 74.6% independent responses; in phase II,

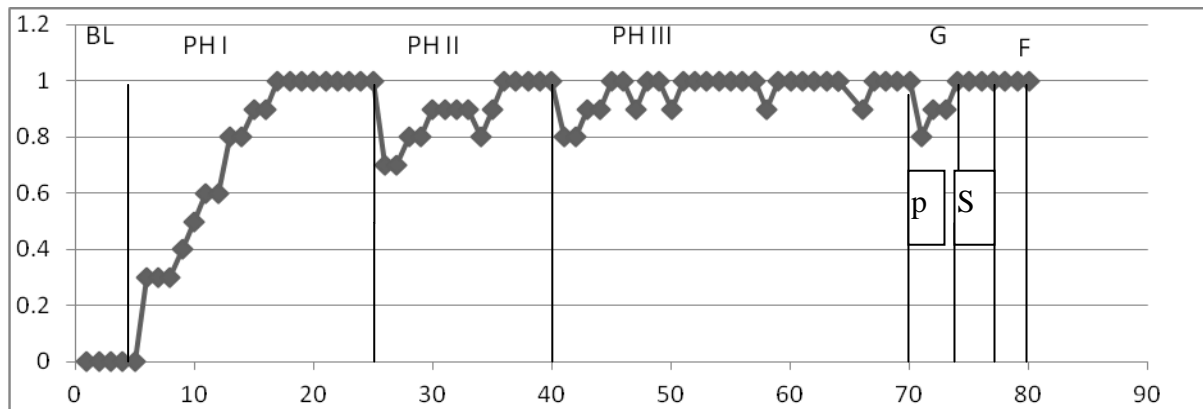
he demonstrated an average of 80.7% independent responses; in phase III, he demonstrated an average of 89% independent responses.



**Figure 5. Percentage of Independent Request across Baseline and PECS phases for N.**

**N.** participated in a total of 64 training sessions (515 trials), six generalization probes, and four follow-up sessions. During phase I, an average of 77% independent responses have been observed. in phase

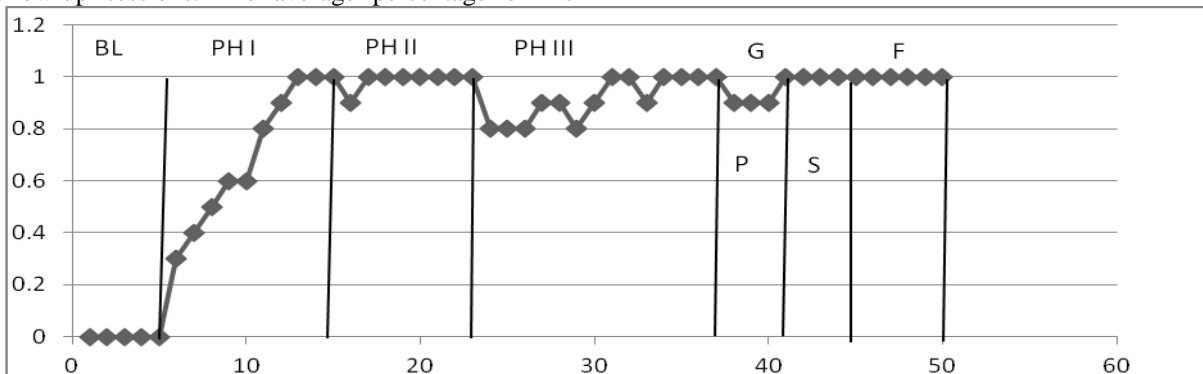
II, He demonstrated an average of 88.6% independent responses and an average of 97.2 % of independent responses in phase III.



**Figure 6. Percentage of Independent Request across Baseline and PECS phases for O.**

E. received a total of 32 training sessions (514 trials), eight generalization probes, and five follow-up sessions. The average percentage of his

independent responses was 71% in phase I, 98.7% during phase II, and 91.4% in phase III.



**Figure 7. Percentage of Independent Request across Baseline and PECS phases for E.**

Generalization of skills across settings and persons is the best indicator of success for any intervention method. Results showed generalization of acquired communication skills post to PECS training across persons and settings. Generalization across persons and settings ranges respectively between 88% and 100%, with generalization across settings being higher for all subjects.

A. was able to generalize his new communicative skills across persons in most of the opportunities (88%) and in all settings (100%). Al. showed generalization across persons and settings with respectively 98% and 100% accuracy. Z. showed generalization across persons and settings with 100% accuracy. N. obtained average of 93% correct responses on generalization across persons' probes and 100% across settings. O. obtained average of 90% correct responses on generalization across persons' probes and 100% across settings. Finally, E. obtained average of 92.5% correct responses on the generalization across persons' probes and 100% across settings.

Maintenance is another factors used to measure the efficacy of intervention methods. To examine the subjects' maintenance of the acquired skills, they were observed for 3-5 follow-up sessions four weeks after the termination of the training program. The indicator for success was 80% or more correct responding on requesting skills using PECS symbols. The results indicated that all participants were able to maintain the acquired PECS skills weeks after training. A performed the basic PECS skills at an average of 86.6% correct responses. Al's performance was at an average of 96.6%. N's performance was at an average of 97.5% and O's performance was at an average of 100%. Finally, E's and Z's performance was an average of 100%.

One of the remarks against PECS has been the fact that this program does not require any level of speech from the subjects to communicate. Advocates of PECS indicate that although speech is not required in any of the program phases, it is encouraged by trainers during the advanced phases. They argue that some nonverbal children were able to develop more or less functional speech. The present study attempts to



investigate this issue. Four of the subjects in the present study were not able to demonstrate any measurable speech during the phases of the study. The other two subjects were able to demonstrate an increased amount of vocal approximations post baseline assessment (See figures 8 and 9 below). It is

worth noting that the vocal approximations were dramatically increased with the advancement of the intervention program. They reached their peak during the generalization and follow up stages (94%, 100% for one subject and 97.1%, 96% for the other).

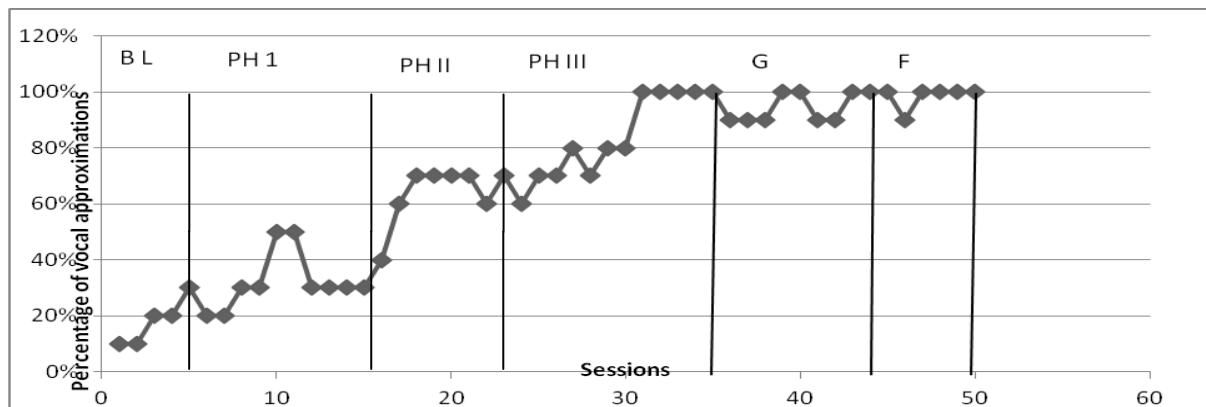


Figure 8. Percentage of vocal approximations for AL across baseline and PECS phases.

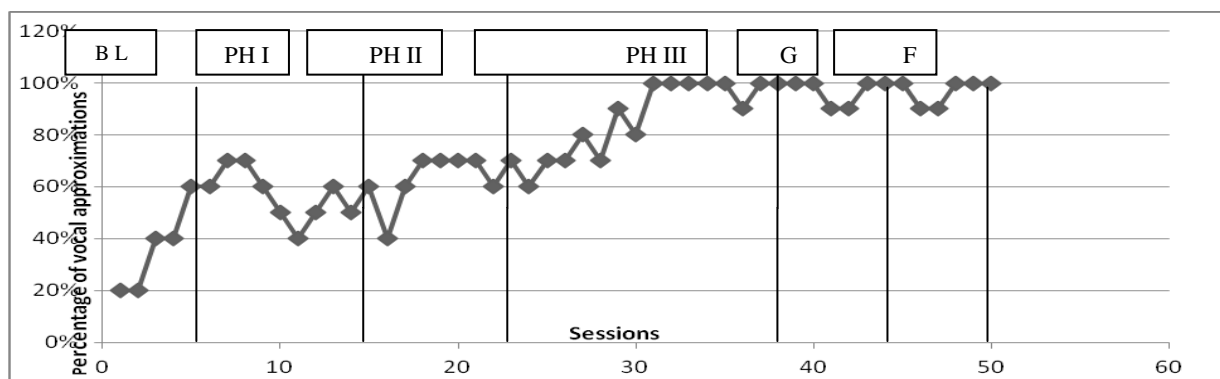


Figure 9. Percentage of vocal approximations for Z across baseline and PECS phases.

Note: PH = phase, P = persons, S = setting, G = generalization, F = follow up

#### 4. Discussion:

In the present study, 6 participants with autism were taught to use PECS for requesting. All 6 participants mastered PECS use within a relatively short period of time. The acquisition of PECS was measured as the percentage of independent correct requesting by the total number of trials in three consecutive sessions. The findings suggest that even though the six participants did not have PECS skills at baseline, they were able to acquire PECS behaviors through phase III in average of 44 of the sessions. Findings of the current study support reports in previous studies (Charlop-Christy *et al.*, 2002; Ganz & Simpson, 2004; Tincani *et al.*, 2006; Dogoe, 2008).

The focus of the present study was on the effectiveness of PECS in developing functional communicative nonverbal skills and generalizing and maintaining these skills. In some previous studies, e.g.,

Charlop-Christy *et al.* (2002), the focus was on the acquisition of speech (spontaneous and imitative speech) and the collateral effects of PECS on social communicative behaviors. Despite these differences, findings of this study are in congruence with the results obtained in previous studies. Subjects were able to develop functional communicative skills. They were able to use pictures to request spontaneously from the trainer during training and generalization sessions and from others in their daily life activities.

Additionally, participants showed generalization of skills with different persons and in different settings. All six participants scored an average of 80% or higher on generalization across persons and settings probes. This finding agrees with findings in other studies (Charlop-Christy *et al.*, 2002; Kravits *et al.*, 2002; Tincani *et al.*, 2006; Yokoyama *et al.*, 2006).

The present study has several clinical implications. First, PECS teaching involves numbers of trials that provides opportunities for applying skills trained by PECS. Second, training parents is critical to their implementation of the program and providing additional opportunities for using PECS behaviors at home and in elsewhere. Success in learning functional requesting might have led to participants' self-reinforcement.

Moreover, the current study showed that all participants were able to maintain the skills obtained four weeks after the termination of training program (80% or highly independent correct responding on probes). This result supports other studies reports that evaluated maintenance data (Yokoyama *et al.*, 2006; Dogoe, 2008). The maintenance of skills might have been due to using natural reinforcers like food and drinks.

Despite the fact that speech is not the primary goal of PECS, researchers reported an increase in speech during PECS training (Bondy&Frost,1994; Charlop-Christy *et al.*, 2002; Ganz & Simpson, 2004; Yokoyama *et al.*, 2006; Tincani *et al.*, 2006). In the current study two out of the six participants showed increase in their speech (vocal approximations). It is not clear at this point if more focus on speech during the training program will lead to more significant progress in speech. This issue is still open for further research.

In conclusion and despite the limited number of subjects, the current research revealed that PECS program could help children who have autism develop functional communicative skills that can be used with different people in different settings. In addition, findings in this study support the hypothesis that aided AAC such as PECS does not inhibit the use of verbal language. In fact, it might encourage speech, at least in some individuals with autism. Although speech is most important means of communication, exchanging pictures to achieve a certain desired item is in itself a major change in the life of the child with autism.

There were two limitations. First, the sample size is small. In addition, all subjects were males. These two limitations will make it difficult to generalize the results. Future research with a relatively large balanced (males and females) sample is needed to generalize the results.

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