

## **The Picture Exchange Communication System: Effects on Manding and Speech Development for School-Aged Children with Autism**

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*Abstract: We examined the effects of the Picture Exchange Communication System (PECS; Frost & Bondy, 2002) on the manding (requesting) and speech development of school-aged children with autism. In study 1, two participants, Damian and Bob, were taught PECS within a delayed multiple baseline design. Both participants demonstrated increased levels of manding after implementation of PECS. Only Damian demonstrated any measurable speech during study 1. His speech development occurred primarily during phase IV of PECS. Because of the positive relationship between Phase IV and increased speech for Damian, study 2 was conducted to confirm a functional relationship between phase IV procedures and speech development for an additional participant. Carl received phase IV training procedures in two conditions, administered in an ABAB design. In condition A, no reinforcement was provided for vocalization; in condition B, reinforcement was provided for vocalization after a delay of 3- to 5-s. The vocal reinforcement procedures in phase B differentially increased Carl's speech. Results are discussed in terms of research on augmentative and alternative communication and speech development for children with autism.*

Autism is one of the fastest growing disability categories in the United States. Since 1990, the number of children with autism who receive special education services has grown by more than 400% (U.S. Department of Education, 2002). International estimates of prevalence reflect similar trends (Frombone, 2003). Rapid growth, combined with the unique educational characteristics of children with autism, highlights the need for effective teaching strategies. Many children with autism experience difficulties learning speech (American Psychiatric Association, 2000). A variety of approaches to teach augmentative and alternative communication (AAC) have been developed for children who have delayed or absent speech (see Mirenda, 2003). These strategies consist of unaided systems, including manual communication and Amer-

ican Sign Language, and a variety of aided systems, including Voice Output Communication Aides (VOCAs), and picture-based strategies. One popular picture-based strategy, the Picture Exchange Communication System (PECS; Frost & Bondy, 2002), has shown promise for teaching functional communication to non-vocal learners.

PECS is an instructional system, which teaches aided communication through the exchange of graphic picture symbols (see Frost & Bondy, 2002). PECS progresses over several phases that seek to establish increasingly complex forms of communication. The system begins with teaching manding (requesting) of desired items, and then progresses through sentence use, basic conversational skills, and commenting. Descriptive studies suggest favorable outcomes for PECS (Bondy & Frost, 1994; Schwartz, Garfinkle, & Bauer, 1998). Potential benefits include increased spontaneous communication, expanded vocabularies, and the development of speech. To date, however, few experimental or quasi-experimental studies have examined the efficacy of PECS (Charlop-Christy, Carpenter, Le, LeBanc, & Kellet, 2002; Ganz & Simpson, 2004; Magiati &

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Howlin, 2003; Tincani, 2004). Although descriptive and experimental studies suggest promising results, at least two questions remain about the system. First, most of the participants in these studies were preschool, kindergarten, or younger primary grade children with autism and related disabilities. Therefore, the applicability of PECS for older children with autism has not been well established. Second, speech development, particularly during phase IV of PECS, has been reported for some users. Ganz and Simpson, for example, found a strong correlation between phase IV of PECS and increased levels of speech for three children with autism. More evidence is needed to confirm the relationship of AAC systems, including PECS, to speech development for children with autism.

Given the widespread use of PECS and the need for evidence based practices in AAC (Schlosser, 2003), the development of an empirical base to support the effectiveness of the system is critical. The current investigation had two purposes. The first was to examine effects of PECS on the acquisition of manding for school-aged children with autism. Manding was chosen as the focus of study because this is the primary response taught within the initial phases of PECS. Moreover, teaching manding to children with autism has a number of potential benefits, including reductions in challenging behavior (Durand & Merges, 2001) and increases in spontaneous communication (Charlop-Christy et al., 2002). The second purpose was to examine effects of PECS on participants' acquisition of speech. Although the primary focus of PECS and other aided AAC systems is the establishment of functional communication, the development of speech is a secondary, but highly desirable benefit.

The investigation consisted of two studies. In study 1, two school-aged children with autism, Damian and Bob, were taught PECS within a delayed multiple baseline design. Participant's levels of picture exchanges and speech were recorded. Damian demonstrated an increased level of speech during phase IV of PECS. Study 2 was conducted to confirm a functional relationship between the vocal reinforcement procedures in phase IV and increased speech for an additional participant. Carl received instruction in phase IV of PECS

with and without reinforcement for vocalization, administered in an ABAB design. As in study 1, mands and speech were recorded.

## Study 1 Method

### *Participants and Setting*

Participants were two school-aged boys attending a self-contained public school classroom for children with autism. Each participant was educationally classified as autistic, and received instruction in functional pre-academics and adaptive daily living skills. Participants were nominated by the teacher to participate in the study because they did not demonstrate functional speech nor did they use an augmentative communication system. Damian was a 10-2 year-old African-American male, and Bob was an 11-9 year-old Caucasian male. Prior to the study, no formal instruction in augmentative and alternative communication was conducted in the classroom. Teacher reports and observation by the first author prior to the study indicated that neither participant used speech to communicate in the classroom. Study sessions took place in the self-contained classroom or in a separate room with a table and chairs, depending on the availability of space. All sessions were videotaped for the purposes of collecting data.

### *Target Behaviors*

*Manding.* Two categories of mands were recorded: independent and prompted. A mand was recorded as independent when the participant exchanged a picture symbol to request a preferred item without prompts. A mand was recorded as prompted when the participant required a gestural or physical prompt to pick up the picture symbol, to walk to the exchange partner, or to place the picture symbol in the exchange partner's hand. An open hand cue (i.e., extending one's open hand as a prompt to exchange a picture symbol) was counted as a gestural prompt.

*Speech.* Two categories of speech were recorded: word vocalizations and vocal approximations. A word vocalization was recorded when a participant clearly said the correct name of the item he was manding (e.g., "cookie"). A word vocalization was not re-

corded when a participant did not clearly say the name of an item, said an incorrect approximation of an item (e.g., “cook”, “c”, or “kee”), said the name of another item (e.g., “apple”) or said nothing. A vocal approximation was recorded when a participant emitted a vocalization that was *not* clearly the name of the manded item. For example, in response to the presentation of a cookie, the participant said “cook”, “ba”, “da”, “kee”, “a”, or any approximation that was not clearly “cookie.”

#### *Measurement and Recording Procedures*

Manding and speech were measured with event recording by the first, second, and third authors, who rotated in quasi-random order. Data were analyzed as a percentage of response opportunities. A response opportunity occurred each time a preferred item was presented to a participant.

#### *Interobserver Agreement and Procedural Integrity*

Interobserver agreement data were collected by the first, second, and third authors, who rotated in quasi-random order, for 98.9% of all sessions in study 1 and 2. Interobserver agreement was calculated for each target behavior by dividing agreements by agreements + disagreements and multiplying by 100 (Cooper, Heron, & Heward, 1987). For manding, interobserver agreement averaged 98.4% across participants. For speech, interobserver agreement averaged 80.3% across participants.

To ensure that procedures were implemented as described, procedural integrity data were collected for 27% of sessions, selected at random and distributed equally across baseline and all phases of PECS in study 1 and 2. A primary observer completed a checklist of experimental procedures from viewing videotapes of sessions. On average, 98.6% of steps were implemented as described. To ensure the believability of data, a second observer also collected procedural integrity data for 50% of these sessions, selected at random. Interobserver agreement for the primary and secondary observers, calculated by dividing agreements by agreements + disagreements and multiplying by 100, averaged 98.5%.

#### *Experimental Conditions*

*Preference assessment.* As recommended by Frost and Bondy (2002), an assessment was conducted to select reinforcing/preferred items prior to PECS training. Preference assessment consisted of two parts. First, parents were asked to complete a written survey in which they identified at least three preferred foods, beverages, toys, and activities for their child. A list of preferred items was generated for each child. Next, items were presented to participants in single and multiple presentation preference assessments (Pace, Ivancic., Edwards, Iwata, & Page, 1985; Fisher, Piazza, Bowman, Hagopian, & Slevin, 1992). Items were then ranked in order of preference according to participants' responses to each item. For Damian, six items emerged as highly preferred; for Bob, five items emerged as highly preferred. These items were used in PECS training.

*Baseline.* Prior to PECS training, baseline data were collected to confirm that participants could neither mand by exchanging pictures nor by saying the names of desired items (i.e., word vocalizations). During each baseline session, items identified in the reinforcer assessment were presented to participants one at a time in random order. Following a brief period of non-contingent access (10–20 s), each item was removed from the participant and represented within view, but out of arm's reach. A laminated, 2" × 2" picture symbol of the item was placed in front of the participant. Any attempts to reach for the item were blocked. If the participant placed the picture symbol in the hand of the experimenter, or said the name of the item (word vocalization) within 10 s, the experimenter gave 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.

*PECS training.* During each PECS training session, preferred items were presented one at a time to the participant in quasi-random order. As in baseline, participants were given a brief period of noncontingent access to each item. If the participant did not reach for, eat, drink, or play with the item, the experimenter moved to the next item on the list. Training proceeded for each item for up to 10 trials (response opportunities), or until the partici-

pant appeared to satiate on the item (e.g., pushed it away). Each training session consisted of up to 30 response opportunities. Speech was neither prompted nor reinforced during phases I–III of PECS. During phase IV, speech was reinforced using the procedure described below.

The protocol described in Frost and Bondy's (2002) *The Picture Exchange Communication System Training Manual* was followed for teaching manding to participants. Damian was taught phases I through IV of PECS, while Bob was taught phases I and II of PECS. The criterion for moving from one phase of PECS to the next was 80% or better independence during *at least* one training session. In brief, the procedures for each phase were as follows. In Phase I, each participant was taught to pick up and exchange a picture symbol to mand a preferred item. In phase II, the picture symbol was placed on a communication book, and the book and communicative partner were gradually moved a distance of up to 15 feet from the participant in order to promote spontaneous requesting. During phase III, the participant was taught to select (i.e., discriminate) an appropriate picture symbol from an array of picture symbols. In phase IIIa, the participant was taught to discriminate picture symbols for preferred and non-preferred items. In phase IIIb, the participant was taught to discriminate between an array of picture symbols for preferred items. Finally, in phase IV, the participant was taught to assemble a sentence strip, consisting of an "I want" picture symbol placed before the preferred item picture symbol, to exchange with the communicative partner. Additionally, a 3- to 5-s delay was used to reinforce either a word vocalization or a vocal approximation of the requested item. Specifically, after the sentence strip was placed in the hand of the exchange partner he or she waited 3- to 5-s before delivering the item. If speech (either word vocalization or approximation) occurred before the 3- to 5-s, the participant was given immediate access to the item. If no speech occurred, the participant was given access to the item after the 3- to 5-s delay. Across all phases, the first, second, and third author rotated as prompters and exchange partners to promote generalization. For procedural details of PECS phases, includ-

ing error correction procedures, see Frost and Bondy (2002).

*Generalization.* During the last four sessions of the study, the participants' teacher implemented PECS. The purpose of this phase was to assess generalization of PECS to another person, and to encourage the teacher to continue PECS after the study. For Damian, the teacher implemented phase IV; for Bob, the teacher implemented phase II. All procedures were the same as described above.

### *Experimental Design*

A delayed multiple baseline design (Cooper et al., 1987) was used to evaluate the effects of PECS training. In this design, "... an initial baseline and intervention are begun, and subsequent baselines are added in a staggered fashion." (p. 214). Short baselines (3 sessions) were used to minimize participants' frustration levels and to minimize reactivity to experimental procedures and materials. Because the intervention also involved gradually increasing response requirements across phases I–IV of PECS, the study also incorporated a changing criterion design.

## **Results**

### *Manding*

Results for mands are displayed in Figure 1. Damian demonstrated an average of 10.3% independent mands during baseline. During the large majority of response opportunities he was neither able to pick up nor exchange a picture symbol to request a desired item. Moreover, his level of independent mands declined to 0% in the absence of teaching procedures. In contrast, his independent responses increased to an average of 57.2% during phase I, and an average of 79.4% during the remaining phases (I–IV). During generalization, his responding maintained at similar levels (74.5%, on average).

Bob demonstrated an average of 0% independent mands during baseline. His independent mands increased to an average of 46.2% during phase I, with an upward trend until the end of phase I. During phase II, he demonstrated an average of 60.8% independent re-

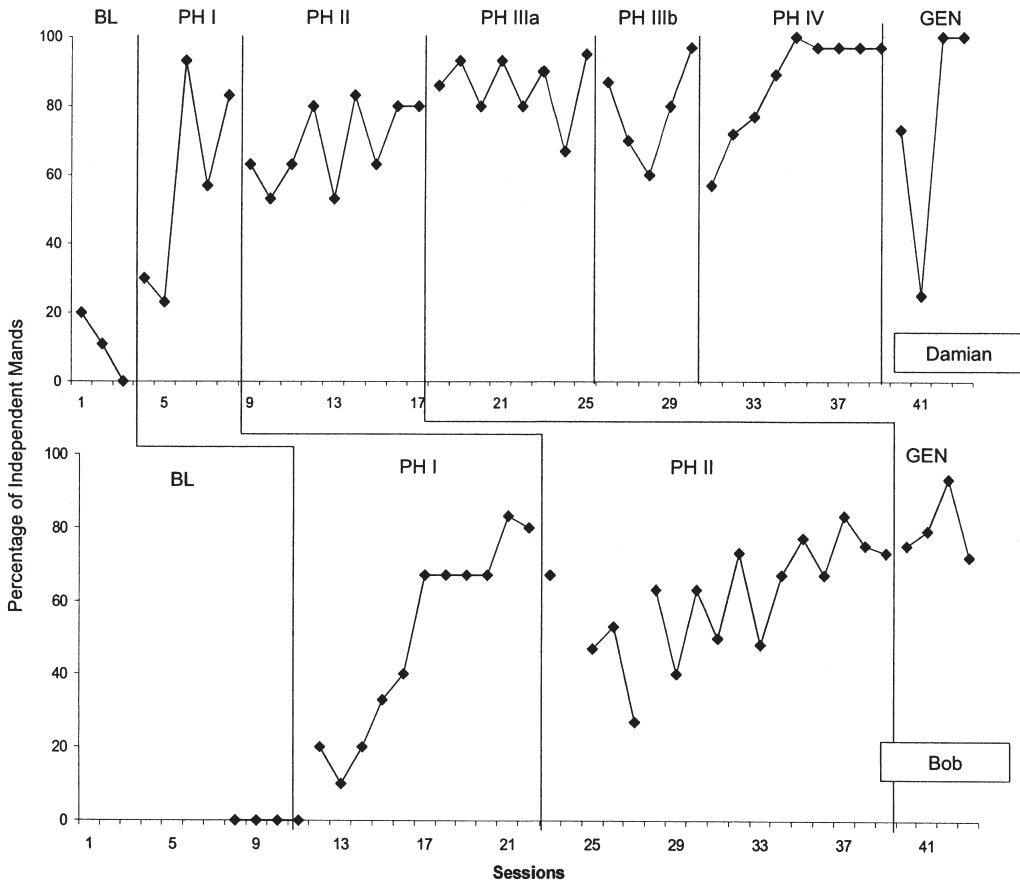


Figure 1. Percentage of independent mands across baseline and PECS phases for Damian and Bob.

sponses, also with an upward trend until the end of phase II. His required more than twice as many sessions to meet acquisition criteria for phases I and II than Damian, therefore, he did not have an opportunity to learn phases III and IV before the end of the experiment. During generalization, his responding maintained at similar levels (79.8%, on average).

### Speech

Bob did not demonstrate any measurable speech during the study, therefore, no speech data are displayed for him. Damian did not demonstrate any measurable word vocalizations, but he did demonstrate vocal approximations, as displayed in Figure 2. He performed an average of 66% vocal approximations during baseline, which de-

clined to an average of 29.6% during phase I, 1% during phase II, and 6.1% during phase III. In contrast, vocal approximations increased dramatically during phase IV, to an average of 87.6%. Vocal approximations maintained at similar levels during generalization (82.3%, on average).

### Study 2 Method

#### Participant and Procedure

In study 1, Damian displayed a substantial increase in speech (vocal approximations) with the implementation of phase IV of PECS. One critical difference between phase IV and the previous phases of PECS for Damian was the use of a 3- to 5-s delay to reinforce vocalizations. A second study was conducted to con-

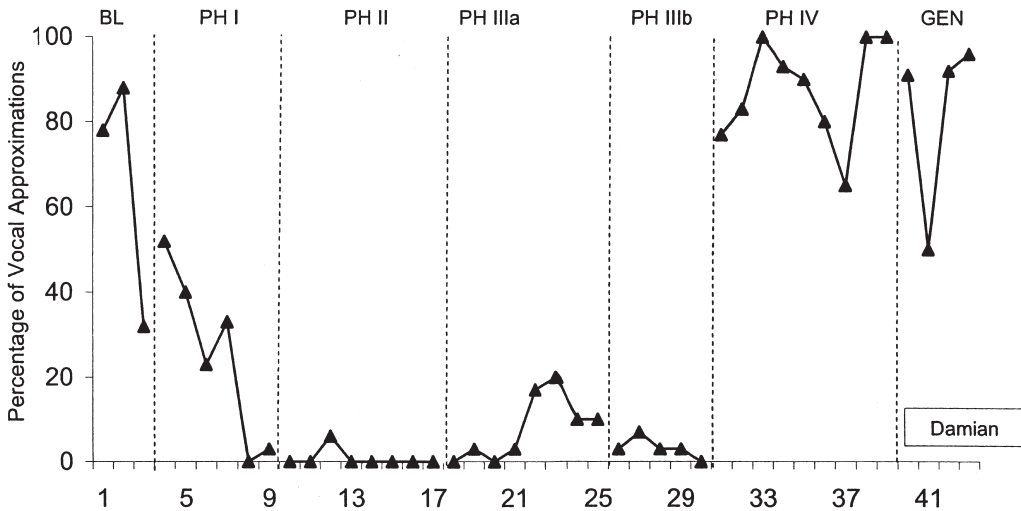


Figure 2. Percentage of vocal approximations for Damian across baseline and PECS phases.

firm a functional relationship between the reinforcement delay procedure and speech development for an additional participant. Carl was a 9-2 year-old Asian boy who was educationally classified as autistic and who also attended the self-contained classroom for children with autism. He had some history of instruction with PECS, but lacked many of the critical skills required to functionally communicate with pictures. For example, he was able to discriminate between pictures symbols as taught in phase III, but he was unable to exchange a picture symbol spontaneously, as taught in phases I and II. Prior to study 2, the first, second, and third authors “cleaned up” his communication skills by teaching him phases I through III of PECS to a criterion of at least 80% independence. The procedures for teaching PECS, including the preference assessment, were identical to those in study 1.

Study 2 consisted of two phases, administered in an ABAB design. In phase A, Carl was taught phase IV of PECS, except no reinforcement for speech was provided. In phase B, phase IV procedures were identical, except that delivery of the requested item was delayed by 3- to 5-s or until the participant performed either a word vocalization or a vocal approximation (as occurred in study 1). Data were evaluated to assess if any differences in speech occurred between phases A and B.

## Results

Results for study 2 are displayed in Figure 3. Carl did not emit any measurable word vocalizations during study 2, therefore, data are displayed for vocal approximations only. During phase A<sup>1</sup>, Carl demonstrated an average of 3% vocal approximations. During phase B<sup>1</sup>, his vocal approximations increased to an average of 83.3%. In phases A<sup>2</sup> and B<sup>2</sup>, he demonstrated an average of 2% and 80.5% vocal approximations, respectively. He demonstrated a differentially higher percentage of vocal approximations while the reinforcement delay procedure was in effect. His percentage of independent mands averaged 78.5% during A phases and 79.4% during B phases, suggesting that the reinforcement delay procedure had little influence on his level of independent mands.

## Discussion

For Damian and Bob, the picture exchange communication system (PECS) increased levels of independent manding (requesting) in study 1. Damian met acquisition criteria for phase IV of PECS, while Bob met acquisition criteria for phase II of PECS. Both participants generalized their manding skills to the classroom teacher. Only Damian demonstrated any measurable speech in study 1. His speech

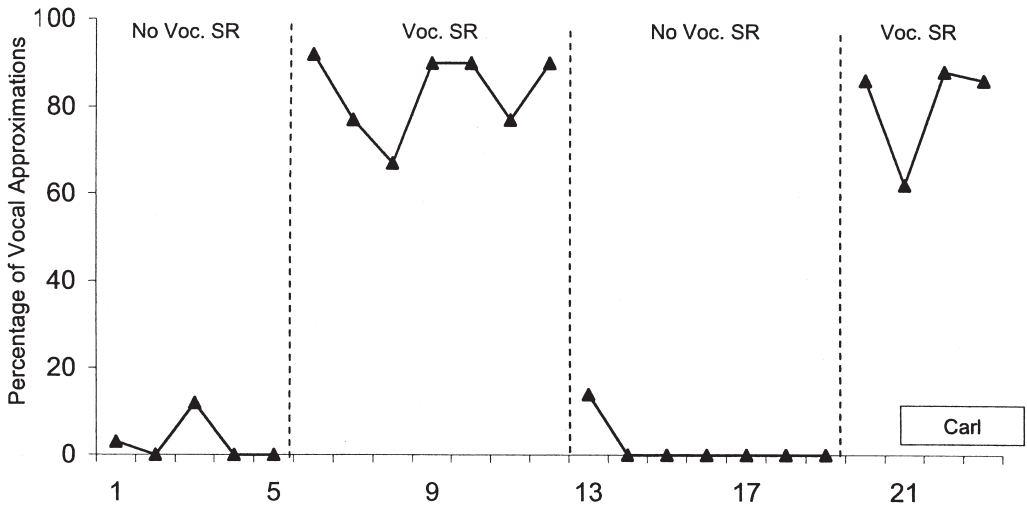


Figure 3. Percentage of vocal approximations for Carl during Phase IV or PECS with and without reinforcement for vocalization.

development occurred primarily during phase IV. An additional participant, Carl, was taught phase IV of PECS in study 2. He demonstrated speech only when explicit reinforcement procedures to promote speech were in effect.

This study extends the research literature on augmentative and alternative communication (AAC) in at least two ways. First, it replicates previous studies on AAC, which suggest that aided communication systems like PECS are effective for teaching basic communication to non-vocal children with autism and related disabilities (Mirenda, 2001). Second, it demonstrates that AAC systems like PECS are useful for promoting speech in some users, even though speech is not the primary goal of AAC systems.

Results of this investigation are consistent with previous studies, which found that PECS increased participants' levels of independent and spontaneous manding (Charlop-Christy et al., 2002; Ganz & Simpson, 2004; Magiati, & Howlin, 2003; Tincani, 2004). Moreover, findings suggest that PECS is a viable system for teaching manding to school-aged children. Damian required an average of 105 trials to reach 80% independence for each phase, while Bob required an average of 358 trials to reach 80% independence for each phase. Although previous investigators have described varying rates of acquisition for PECS phases,

Bob's rate of acquisition was considerably lower than previously reported (Charlop-Christy et al.; Ganz & Simpson). The reasons for this are not known, although during training sessions Bob appeared to satiate more easily on preferred items than Damian, suggesting that his preferred items may have had less reinforcement value than Damian's.

Previous investigators have reported increases in speech during phase IV of PECS (Bondy & Frost, 1994; Charlop-Christy et al., 2002; Ganz & Simpson, 2004). The increases in speech observed for Damian during phase IV appear to replicate this finding. The results of study 2 for Carl strongly suggest that increases in speech observed during phase IV were a function of explicit reinforcement, specifically, the 3- to 5-s reinforcement delay procedure. One possible implication of this finding for AAC systems, including PECS, is that prompting and reinforcement procedures targeted specifically at speech may be necessary to produce increases in speech production. Without such procedures, increases in speech production during AAC training may be less likely.

There were at least two limitations of the investigation that should be considered relative to interpretation. First, the brief baselines used in study 1 did not permit a complete analysis of participants' levels of communica-

tion prior to intervention. This limitation is offset to some extent by the first author's observation and teacher's anecdotal report that participants neither used speech nor AAC systems to communicate. Second, the single subject design employed in the study used only three participants. Replications with additional participants will be necessary to confirm the findings of the study, particularly in relation to speech development.

Further research is needed to confirm the role of PECS in communication development for children with autism. Of primary importance is replication of the current study's finding of a functional relationship between the reinforcement delay procedures in phase IV and speech development. Moreover, future studies could examine the role of PECS in promoting spontaneous communication for older individuals, including adults. Future research could also examine the role of PECS in promoting other types of communication in addition to manding, including commenting and basic conversation skills.

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