A PRELIMINARY ANALYSIS OF TEACHING IMPROVISATION WITH THE PICTURE EXCHANGE COMMUNICATION SYSTEM TO CHILDREN WITH AUTISM

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Two young boys with autism who used the picture exchange communication system were taught to solve problems (improvise) by using descriptors (functions, colors, and shapes) to request desired items for which specific pictures were unavailable. The results of a multiple baseline across descriptors showed that training increased the number of improvised requests, and that these skills generalized to novel items, and across settings and listeners in the natural environment.

DESCRIPTORS: improvisation, problem solving, picture exchange communication system, augmentative and alternative communication, autism

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Language and communication are major areas of concern for children with autism (*Diagnostic and Statistical Manual of Mental Disorders*, American Psychiatric Association, 2000). Research has shown that augmentative and alternative communication (AAC) systems, such as sign language, electronic communication aids, and the picture exchange communication system (PECS), can increase the communicative interactions of children with autism and enable them to exercise control over their environments (e.g., by making requests) (Charlop-Christy, Carpenter, Le, LeBlanc, & Keller, 2002; Frost & Bondy, 1994; Schepis, Reid, Behrmann, & Sutton, 1998; Sundberg & Partington, 1998; Wacker, Wiggins, Fowler, & Berg, 1988). When a child is beginning to develop skills with AAC systems, however, communication may be limited to a relatively small number of signs or symbols. On the other hand, as a child's language repertoire expands, communication with some selection-based AAC systems may require more time and effort to locate and select individual symbols from a large array (Sundberg & Partington, 1998) and the number of pictures or graphic symbols that can be accommodated may eventually surpass the system's capacity for efficient use. In either case, the range of stimuli in the environment might exceed the number of corresponding symbols that are available for children to express momentary needs or wants.

To use AAC systems efficaciously in such situations, children may need to learn problem-solving strategies. According to Bijou (1976), "problem solving refers to interactions in which a person cannot respond immediately either to reduce ongoing deprivation of reinforcing stimuli, or to escape or avoid aversive stimuli and therefore sets about to alter the situation so that he can make a reinforceable response" (p. 70). As applied to AAC systems, one problem-solving strategy would be to identify alternative symbols that could be used to generate a reinforceable response (e.g., a mand) when a single specific symbol for a stimulus is not readily available. For example, "purple" and "drink" might be used in the absence of a symbol for grape juice.

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Table 1
Descriptors and Examples of Improvised Requests

	Ike	Khan
Functions	Eat, drink, play	Eat, drink, read, watch, listen
Colors	Red, blue, green, pink, orange, purple, black, white, brown, yellow, gray	Red, blue, green, pink, orange, purple, black, white, brown, yellow
Shapes	Circle, square, triangle, rectangle, heart, moon, star, oval, line, diamond, hexagon	Circle, square, triangle, rectangle, heart, moon, star, oval, line
Preferred stimuli	Crackers, chips, pretzels, water, sandwich, cookie, granola bars, cantaloupe, toys, balloon, books, balls, CDs, tapes	Sausage, cupcakes, milk, bread, pancakes, waffle, chicken nuggets, banana, hot dogs, french fries, water, videos, CDs, books
Examples of trained requests	"I want eat white square" for a sandwich	"I want watch green rectangle" for a video
Examples of untrained requests	"I want play green circle" for toy coins	"I want eat brown rectangle" for sausage

Parsonson and Baer (1978) taught 5 preschool children a similar problem-solving strategy that involved improvisation (i.e., "finding an effective, possibly unconventional, substitute to replace some specifically designed but currently unavailable item," p. 364) as applied to the use of play tools. The children were taught to identify the essential characteristics of the unavailable tool to solve the problem and to search for an effective alternative. For example, in the absence of a hammer, the child could use a brick to pound a peg. Training involved a diverse array of exemplars within one or more of three classes of tools (hammers, containers, and shoelaces). Only novel improvisations were reinforced with descriptive praise. The results of a multiple baseline design across tool classes and participants showed that training increased generalized improvisation within the tool classes trained, although improvisation did not occur across untrained tool classes.

We sought to extend the literature on problem solving by teaching young children with autism to improvise when communicating with PECS. The purposes of the study were to examine (a) the effectiveness of training the use of descriptors in enabling children to make a wide range of requests with a limited number of symbols and (b) the extent to which training resulted in generalized use of improvisation to request items for which specific individual symbols were unavailable.

METHOD

Participants, Setting, and Materials

The director of a clinic for young children with autism had referred 2 boys (Ike, age 5, and Khan, age 4) who met the *DSM IV-TR* diagnostic criteria for autism and the inclusion criteria of (a) color, shape, and action matching-to-sample skills and (b) independent use of PECS stimuli to make requests (although we did not specifically assess participants' independent use of the particular symbols for the preferred stimuli used in the study). The experiment was conducted in the participants' homes. Teaching materials included preferred stimuli and the participant's PECS book. Preferred stimuli were initially identified during interviews with the children's parents and therapists. Stimuli that were confirmed as preferred during baseline were then randomly divided into two sets designated for training and generalization probes, respectively. The participants' PECS books were altered by removing the symbols for identified preferred stimuli and inserting pictures of descriptors (see Table 1).

Experimental Conditions

Baseline probes. Baseline probes were conducted to determine whether the children would improvise to request items for which specific pictures were unavailable in their PECS books. During each of the 10 trials per session, the therapist displayed two to five preferred stimuli in a clear bin in front of the child. Once the child demonstrated interest in one of the stimuli (e.g., by pointing or reaching toward it), the therapist placed the item alone on the table and looked expectantly at the child. If the child did not begin to scan the PECS book within 10 s, the therapist gestured toward the PECS book and asked, "What do you want?" Irrespective of the response, the child was given access to the item for 30 s, and was told, "good trying" if he had attempted to request the item. (In all cases, the child accepted the item, confirming that it was desired.) The next trial was then presented with a different set of stimuli.

Training. Improvisation training was conducted sequentially and cumulatively across three classes of descriptors (functions, colors, and shapes), in a different order for each participant. Training was added for a new descriptor class after the child met mastery criterion of independent improvisations using one or more descriptors from each of the classes previously trained on at least 90% of the trials across three consecutive sessions. Once the child met criterion for functions and training was initiated on colors, for example, the use of color as well as function descriptors was required for an improvised request to be reinforced with provision of the item.

The set of stimuli designated for training was presented in the same manner as during baseline, except that the child was not prompted with "What do you want?" After placing the desired item on the table, the therapist physically prompted use of the appropriate descriptor using the delay procedure described by Frost and Bondy (1994). Prompted or independent correct responses were followed by praise and brief access to the item. Once prompts were faded, an error-correction procedure was used. Following an incorrect response, the child was told to "try again." If the child again made an incorrect response, the therapist prompted the next response and gave the child access to the item, ending the trial. (Temporary adaptations were made for Khan, such as interspersing mastered imitation tasks with training trials; see Frost & Bondy, 1994.) If the child made an improvised request for an item that was not one of the training stimuli, the item was provided and the request was scored as an occurrence of generalization (data not shown).

Generalization probes. After criterion was met for each descriptor class, generalization probes with untrained items were conducted in the same manner as baseline. All descriptors were available during probes except in one case for Ike (shape and color descriptors were inadvertently left out during the probe that followed training criterion for functions). To document the occurrence of improvisation outside experimental sessions, parents and therapists were asked to record any requests the child made (as was done with requests for nontarget stimuli during training).

Measures and Experimental Design

A multiple baseline across descriptors was used to examine the effects of training on the number of requests made independently with a correct improvisation to training and generalization stimuli. An improvised request was scored as correct if the child independently constructed and handed to a listener a sentence strip that contained "I want" and one or more descriptors corresponding to the desired item from each descriptor class. For example, if the child used "eat" and "circle" to request an Oreo® cookie during a generalization probe, a correct response was recorded for functions and shapes but not for colors. A changing criterion design was used to examine the effects of successive increases in the number of descriptors required for reinforcement on the number of unprompted descriptors per independent request. A correct response was scored for every descriptor corresponding to a desired item that the child independently selected and placed on a sentence strip following the "I want" icon (in the aforementioned example, two improvisations were recorded).

Two therapists independently scored responses during 33% and 30% of the sessions for Ike and Khan, respectively. Mean point-by-point agreement was 99% for both children. Treatment integrity, scored from a 13-step checklist for the administration of each trial, was assessed on 30% of the sessions for each child. The mean percentage of applicable steps correctly performed with Ike and Khan was 99% and 100%, respectively. The children's parents and teachers (n = 10 respondents) anonymously rated the social validity of the goals and outcomes of training. On a scale of 1 (*low*) to 10 (*high*), the mean ratings ranged from 7.0 to 9.5.

RESULTS AND DISCUSSION

Figures 1 and 2 show the results of the multiple baseline design for Ike and Khan, respectively. During baseline, improvised requests occurred rarely, if at all. As training was implemented sequentially across each class of descriptors, the number of improvised requests increased steadily and were maintained at high levels. In addition, it should be noted that the mean number of descriptors per independent request increased successively in correspondence with the number of descriptors required for the request to produce the reinforcer (data depicted in the changing criterion design are not portrayed but are available from the first author). Similar to the findings of Parsonson and Baer (1978), generalization occurred within stimulus classes but not across classes. Once all three classes were trained, however, the children used novel combinations from each class to make requests for untrained stimuli during both generalization probes and in their natural environments (e.g., "I want eat white circle" to request a marshmallow). Thus, both children learned to solve problems as defined by Skinner (1968), Bijou (1976), and Becker, Engelmann, and Thomas (1975). Specifically, when presented with a problem (the unavailability of a single specific graphic symbol to communicate a request for a desired item), the children used a novel synthesis of responses or precurrents (selecting descriptors from different stimulus classes) that generated a reinforceable (current) response (a mand that produced the desired item).

Given that within-class generalization occurred with the presentation of multiple exemplars, it might be predicted that between-class generalization ultimately would have developed with additional descriptor classes (e.g., size and other characteristics). Establishing generalization across additional classes of descriptors in the children's repertoires might enhance discrimination of the requested item by listeners who are unfamiliar with the child's typical preferences for items that are not readily visible. Additional procedures also may be needed to teach children to discriminate an item's most prominent characteristics from its insignificant features.

Preferred items were placed in view so that it was apparent what the child was requesting. Improvisations were therefore established as mand-tacts under multiple sources of control (the characteristics of an item that was present as well as the motivating operations that established it as a reinforcer). Improvisation skills might be most needed, however, when the desired item is absent, such that the child has no other way of communicating the request (e.g., by pointing). Therapist and parent recordings of pure mands (see Bondy, Tincani, & Frost, 2004) in situations in which the items were not visible (e.g., in a closet) suggest that generalization of improvisational skills occurred. Further systematic analysis of generalization of improvisational skills is warranted.

Research is needed to further examine these and other effects of improvisation training as applied to communication skills (such as when specific pictures for items are restored). Despite

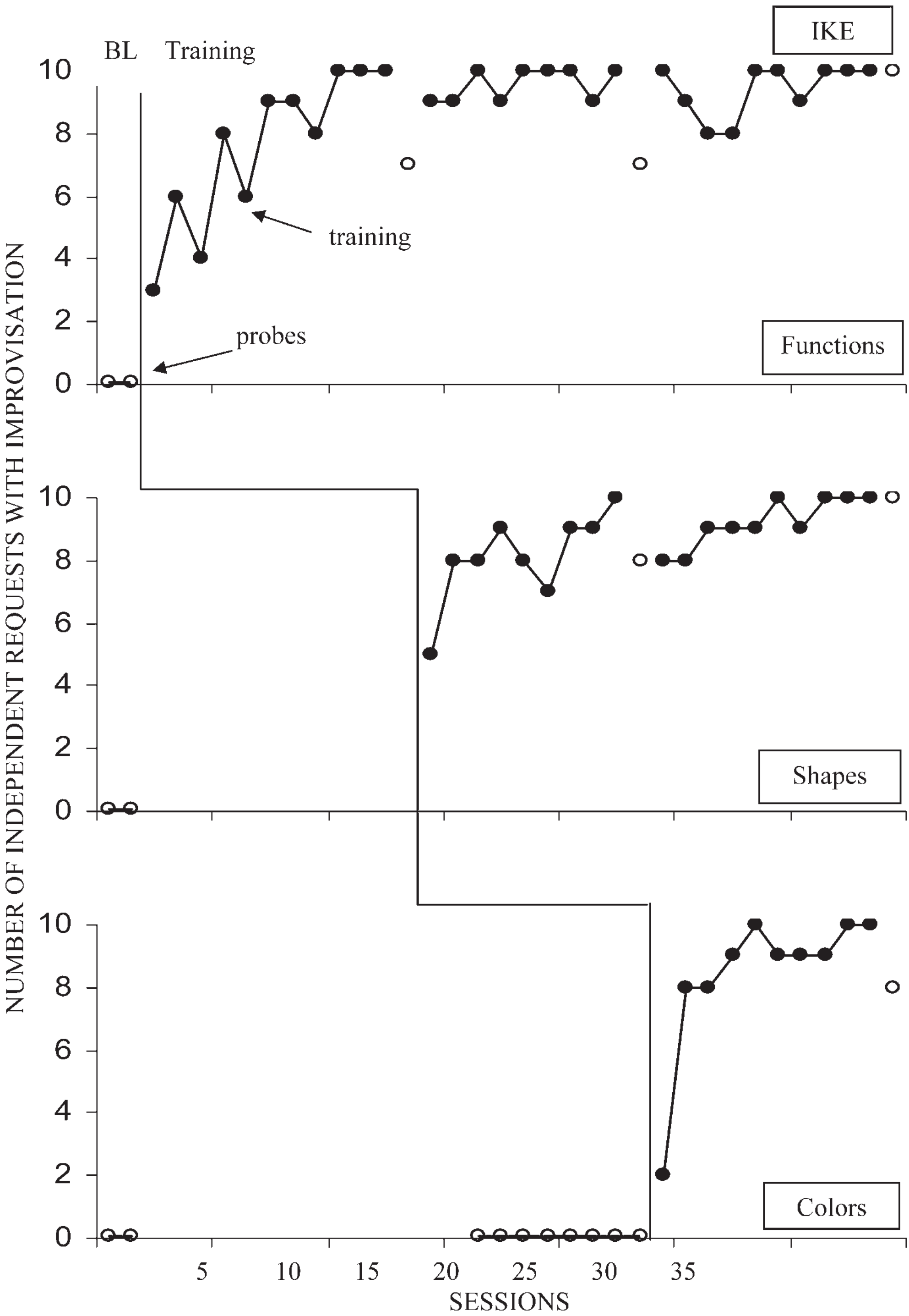

Figure 1. The number of independent improvised requests in the multiple probe across classes of descriptors for Ike. Filled data points represent trained exemplars. Open data points represent untrained requests during baseline and generalization probes.

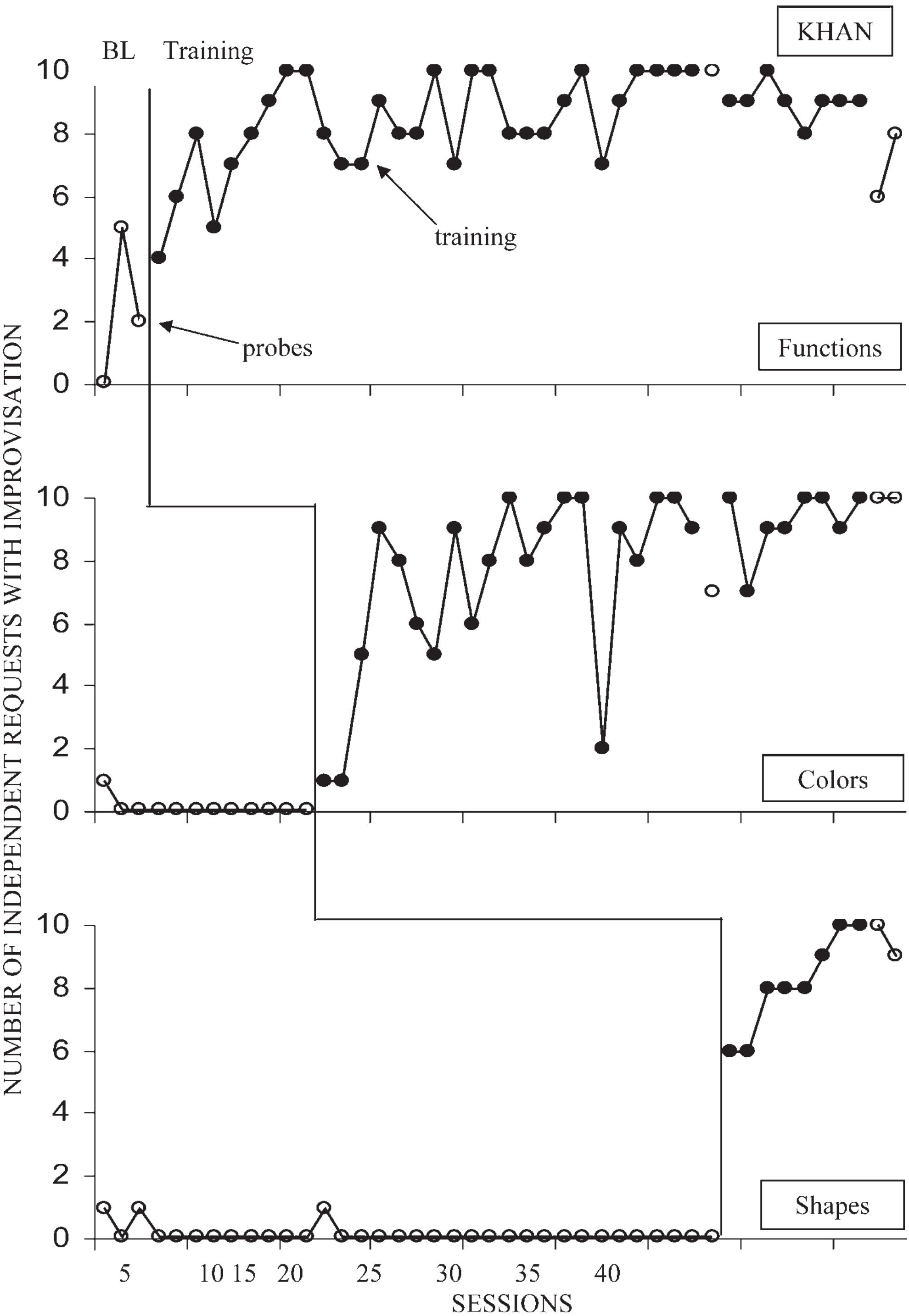

Figure 2. The number of independent improvised requests in the multiple baseline across classes of descriptors for Khan. Filled data points represent trained exemplars. Open data points represent untrained requests during baseline and generalization probes.

several methodological limitations (a possible increasing baseline for functions and the omission of a generalization probe following training on functions for Khan, the omission of a probe for shapes and colors following training criterion for functions with Ike), the current study adds to the growing body of empirical demonstrations that behavior analysis can be applied to complex and creative behaviors (see Glover & Gary, 1976; Goetz & Baer, 1973; Lalli, Zanolli, & Wohn, 1994; Maloney & Hopkins, 1973; Neef, Nelles, Iwata, & Page, 2003; Parsonson & Baer, 1978). As noted by Neef et al., continued research in this area may make more prominent the potential contributions of behavior analysis to the acquisition of complex problem-solving skills of many types.

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