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Procedures for Teaching Appropriate Gestural Communication Skills to Children with Autism

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Four children with autism were taught to use gestures in combination with oral communication. Using a multiple-baseline across-responses design, intervention was introduced successively across three response categories containing gestures representative of attention-directing/getting, affective, and descriptive behavior. Although none of the participants displayed appropriate gestural and verbal responses during baseline, all participants acquired this skill with the systematic implementation of modeling, prompting, and reinforcement. Generalization measures indicated that the children learned to respond in the presence of novel stimuli and a novel setting. Social validity measures revealed that the participants' behavior appeared more socially appropriate at the completion of the study than at the start of the study, and that the participants' behavior was indistinguishable from that of their typically developing peers.

KEY WORDS: Gestural communication; teaching procedure.

INTRODUCTION

The use of gestures is one mode of communication that develops early in life and is associated with the development of language skills (Bates, Camaioni, & Volterra, 1975; Mundy, Sigman, Ungerer, & Sherman, 1987). Although the use of gestural communication develops prior to the development of speech (Ricks & Wing, 1975), it is later used in coordination with spoken language during communicative interactions (Morford & Goldin-Meadow, 1992).

Although gestural communication develops early and in sequence in typically developing individuals, this is not true of individuals with autism. Even though individuals with autism have difficulty speaking, rarely do they use gesture as an alternate means of communication (Loveland, Landry, Hughes, Hall, & McEvoy, 1988; Ricks & Wing, 1976; Wetherby & Prutting, 1984). Numerous studies have found that individuals with autism differ from others both quantitatively and qualitatively in their use of gesture. The number of gestures used by individuals with autism is significantly lower than that used by others (Buitelaar, van Engeland, de Kogel, de Vries, & van Hooff, 1991; Loveland *et al.*, 1988; Landry & Loveland, 1989; Mundy, Sigman, & Kasari, 1990; Sigman, Mundy, Sherman, & Ungerer, 1986). More importantly, those gestures used by individuals with autism are typical of a lower level of development (Attwood, Frith, & Hermelin, 1988; Carr & Kemp, 1989; Landry & Loveland, 1988; McHale, Simeonsson, Marcus, & Olley, 1980; Mundy, Sigman, Ungerer, & Sherman, 1986). Gesture is seldom used as a stimulus to alter another person's orientation or eye contact, to describe objects, or to obtain social consequences. These differences are observed when individuals with autism are compared to normal control subjects (Kasari, Sigman, Mundy, & Yirmiya, 1990; Landry & Loveland, 1989; Landry *et al.*, 1988; Mundy *et al.*, 1986; Sigman, Mundy, Sherman, &

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Table I. Participant Characteristics Including PPVT-R Score and Preschool Language Scale Score

Name	CA	Months in treatment	PPVT-R[a]		Preschool language scale score (AE)
			SS	AE	
Anne	6-5	48	43	3,0	3,2
Oscar	6-4	36	47	3,2	3,4
Kevin	4-5	3	<42	2,0	3,2
Nick	4-5	18	80	3,2	2,2

[a]ss = standard sore; AE = age-equivalent score (years, months).

Ungerer, 1986; Wetherby & Prutting, 1984), mentally retarded control subjects (Attwood *et al.*, 1988; Buitelaar *et al.*, 1991; Kasari *et al.*, 1990; Mundy *et al.*, 1986, 1990; Sigman *et al.*, 1986), and language-delayed control subjects (Landry & Loveland, 1988, 1989; Landry *et al.*, 1988; Loveland & Landry, 1986).

Because gestural behavior plays an important role in the establishment and maintenance of social interactions, difficulties in this area might contribute to the difficulties individuals with autism have during social interactions (Garfin & Lord, 1986; Koegel & Frea, 1993). Because individuals with autism do not use conventional gestures during social interactions, they (as well as their social partners) have difficulty in participating in a reciprocal social situation (Attwood *et al.*, 1988; Buitelaar *et al.*, 1991; Mundy *et al.*, 1986; Prizant & Wetherby, 1987).

It is well known that individuals with autism have difficulty in learning through observation and imitation (Smith & Bryson, 1994). In one study conducted to assess the imitation of gestures, Sigman and Ungerer (1984) found that individuals with autism performed significantly more poorly than individuals with mental retardation or individuals of typical development on the Uzigiris-Hunt vocal and gestural imitation subtests. This deficit in imitation skills may contribute to the difficulties individuals with autism have in using gestural communication (Wetherby & Prutting, 1984). Additionally, individuals with autism may not learn to use gestures that lead to social consequences, because social consequences may not often serve as reinforcers for them in the same way that they do for individuals of typical development.

Although extensive research has defined the extent of the impairment in gestural communication, little research to date has demonstrated that gestural communication can be taught to individuals with autism. Due to the paucity of research in the literature on the systematic teaching of gestural communication to children with autism, the current study focused on teaching three gestural response categories to these children. The three responses categories were chosen to contain gestures that would be appropriate for requesting items or directing the behavior of another, for obtaining social consequences, and for describing characteristics of objects.

METHOD

Participants

Four children with autism participated in this study. All of the children attended classes at the Princeton Child Development Institute (PCDI) and had previously received diagnoses of autism by independent agencies according to the criteria established in the DSM-III-R (American Psychiatric Association, 1987). The children who participated in this study were between 4 and 6 years of age and had been at PCDI from 3 months to 4 years. All of the children had some oral language. None of the children used gestures appropriately to request items, to obtain social consequences, or to describe characteristics of objects. See Table I for a complete description of participant characteristics.

Setting and Apparatus

All sessions took place in a small classroom at PCDI. One desk was placed in the center of the room, with two chairs next to it. Stimulus materials were placed on the desk or on one of the items found at the periphery of the room. To assess generalization of trained responses to a new setting, pre- and

Table II. Gestural and Verbal Responses with Examples of the Nonverbal and Verbal Stimuli Presented During Training and Probe Trials

Category	Gestural response	Verbal response	Nonverbal stimulus[a]	Verbal stimulus[a]
Attention	Point	Look!	Pinwheel	Let's talk about something on the _____
			Globe (P)	Find something new on the _____
	Hand request	Can I have that?	Book	Look at this
			Sparkle gun (P)	See what I have (P)
	Raise hand	I do!	Dinosaur	Who would like _____?
			Xylophone (P)	Anyone want _____? (P)
Affective	Arms up	I won!	Pinball game	You're the winner!
			Dart game (P)	Wow, you did it! (P)
	Shake head	No way	Mustard	Want this _____?
			Buzzer (P)	Do you want _____?
	Hands on face	Uh oh	Break crayon	Look what happened
			Drop puzzle (P)	Oh no! (P)
Reference	Tiny	It's tiny/tiny	Mini book	Look at this little _____
			Mini gun (P)	Check out this little _____
	Huge	It's huge/huge	Large balloon	What do you think of this big _____
			Large pencil (P)	Wow, this is a big _____(P)
	Fast	It was fast/fast	Helicopter	Tell me how that moved
			Exploder (P)	How did ____ move? (P)

[a](p) indicates probe stimulus.

postintervention measures were taken in the children's regular classrooms at PCDI.

Response Definitions

The dependent measure consisted of two components, a gestural and verbal response (e.g., pointing and saying "Look!"). The gestural and verbal responses are presented in Table II. Responses were scored immediately following the first presentation of the stimuli during a session. The responses were scored by independent observers and were scored correct only if they occurred within 5 seconds of the therapist-presented stimuli that signaled the start of each interactive episode.

Stimulus Materials

Nonverbal Stimuli. A total of 144 nonverbal stimuli were used. These stimuli were an assortment of food items, toys, common objects, and activities that were appropriate discriminative stimuli for each target response. Examples of the nonverbal stimuli can be found in Table II. These stimuli were arranged in four stimulus sets, each of which contained 36 items. Within a stimulus set, four stimuli were assigned to each target response. Three of these items were designated as training stimuli and one of these items was designated as a probe stimulus. Training stimuli were associated with treatment, whereas the probe stimuli were never associated with treatment. All stimuli for a specific target response were randomly assigned to stimulus sets, as well as to the training and probe categories.

Verbal Stimuli. A total of 36 verbal stimuli were used. As shown in Table II, these statements were appropriate discriminative stimuli for each target response. Four verbal discriminative stimuli were assigned to each target response. Three of these discriminative stimuli were randomly assigned as training discriminative stimuli and one was randomly assigned as a probe discriminative stimulus.

Experimental Design

A multiple-baseline across-responses design was used. Three response categories were trained. These categories were attention-directing/getting responses, affective responses, and reference responses. Within each response category, three gestural and verbal responses were trained. These gestures were selected after observing 12 preschool and kindergarten-age children in their school classroom and at home. In addition, gestural responses were defined after requesting preschool and kindergarten-age children to show the therapist specific responses with their hands

(e.g., the therapist said "show me fast with your hands").

Intervention was introduced successively across the legs of the design after the mastery criterion was met. This criterion required that accurate gestural and verbal responses remained at 89% or higher for four consecutive training sessions. The order of introduction of treatment across response categories was varied for each child to control for order effects.

Procedure

General Format

At the start of each session, the child was seated in front of a desk across from the therapist. Once the child was attending to the therapist, a nonverbal and verbal discriminative stimulus was presented. A trial consisted of the therapist presenting a nonverbal and a verbal discriminative stimulus to initiate the interactive episode and waiting for a maximum of 5 seconds for a gestural and verbal response to occur. Within each session, there were 27 training and 9 probe trials.

Baseline

During baseline sessions, if the correct verbal and gestural target response occurred within 5 seconds of the start of the interactive episode, the therapist provided verbal feedback. If an incorrect response or no response occurred within 5 seconds of the start of the interactive episode, the trial was terminated. Token reinforcement was provided along with verbal praise for on-task behavior after approximately every third trial.

Treatment Sessions

Two types of trials were presented during treatment sessions. Training trials were associated with treatment and probe trials were not associated with treatment. For training trials, if the correct response occurred within 5 seconds of the start of the interactive episode, the therapist provided token reinforcement and verbal praise to the child. If, however, an incorrect response occurred or no response occurred within 5 seconds of the start of the interactive episode, the therapist modeled the correct gestural and verbal response. If the child did not imitate both components of the response, the therapist physically prompted him/her to emit the gestural response and verbally prompted him/her to emit the verbal response. Following this correction procedure, the trial was presented again. If the child made the correct gestural and verbal response, token reinforcement was provided along with verbal praise and the trial was terminated. If, again, an incorrect response occurred, the correction procedure was introduced again. This process continued until the child independently emitted the correct gestural and verbal response within 5 seconds of the start of the interactive episode.

Within-session generalization of the trained gestural and verbal responses from the training stimuli to a novel set of stimuli was measured by the presentation of probe trials. During these trials, the nonverbal and verbal stimuli that were used to initiate the interactive episode were never associated with the teaching procedure or reinforcement. During probe trials, the therapist initiated the interactive episode, waited for a response to occur, and terminated the trial by removing the stimulus materials. Reinforcement was never provided for correct responses and the correction procedure was never used.

Across Setting and Stimuli Generalization: Regular Classroom Probes

Generalization of the trained gestural and verbal responses to a different setting and in the presence of novel, verbal, and nonverbal discriminative stimuli presented by the therapist was assessed during the regular classroom probes. During these probes, the children followed their regularly scheduled activities. A novel set of stimuli was used during these probes. The set contained nine nonverbal and nine verbal discriminative stimuli that had never been associated with treatment. The therapist initiated an interactive episode by presenting the stimuli. No reinforcement or teaching was provided in the classroom setting. Three generalization probes were conducted in the children's classrooms during baseline conditions and three were conducted in the children's classrooms immediately after treatment was completed for the final response category.

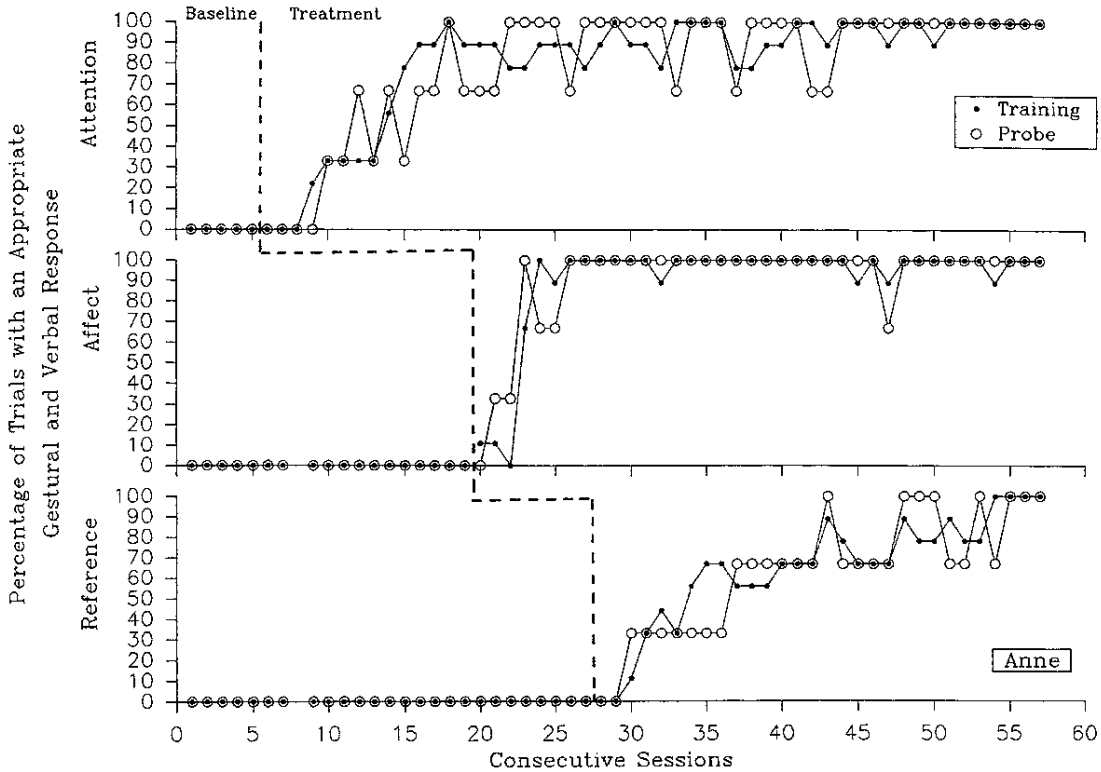

Fig. 1. Percentage of training and probe trials in which Anne produced a correct verbal and gestural response.

Social Validity

Measure 1. To assess change in the students' communication skills from baseline to treatment, the first measure of social validity consisted of presenting 72 videotaped interactive episodes to a group of 11 graduate students. Two episodes for each target response were presented, one was a baseline episode and one was a treatment episode. This was done for each of the four children in the study. Each graduate student was asked to answer the following question: "In which of the two interactive episodes did the child appear more expressive in his/her communication?"

Measure 2. For the second social validity measure, the same group of graduate students was presented with 72 videotaped interactive episodes to assess whether the gestures used by the children in this study were similar to those used by their age-matched peers. These interactive episodes contained the four children in the study and four typically developing children (matched on chronological age). Each graduate student was asked to evaluate each scene and answer the following question: "Was an appropriate gesture and verbalization used by the student?"

Interobserver Agreement

Two observers (the primary therapist and another teacher at PCDI) independently scored a minimum of 40% of the sessions in each of the baseline, treatment, and regular-classroom generalization conditions. Sessions for interobserver agreement (IOA) were randomly selected on a weekly basis from the total sessions for the week. Interobserver agreement was obtained on the percentage of trials containing an appropriate gestural and verbal response. To ensure the integrity of the independent variable, IOA was calculated for the accurate presentation of the nonverbal stimuli, the verbal stimuli, the modeling procedure, and the reinforcement contingencies. Interobserver agreement was calculated on a point by

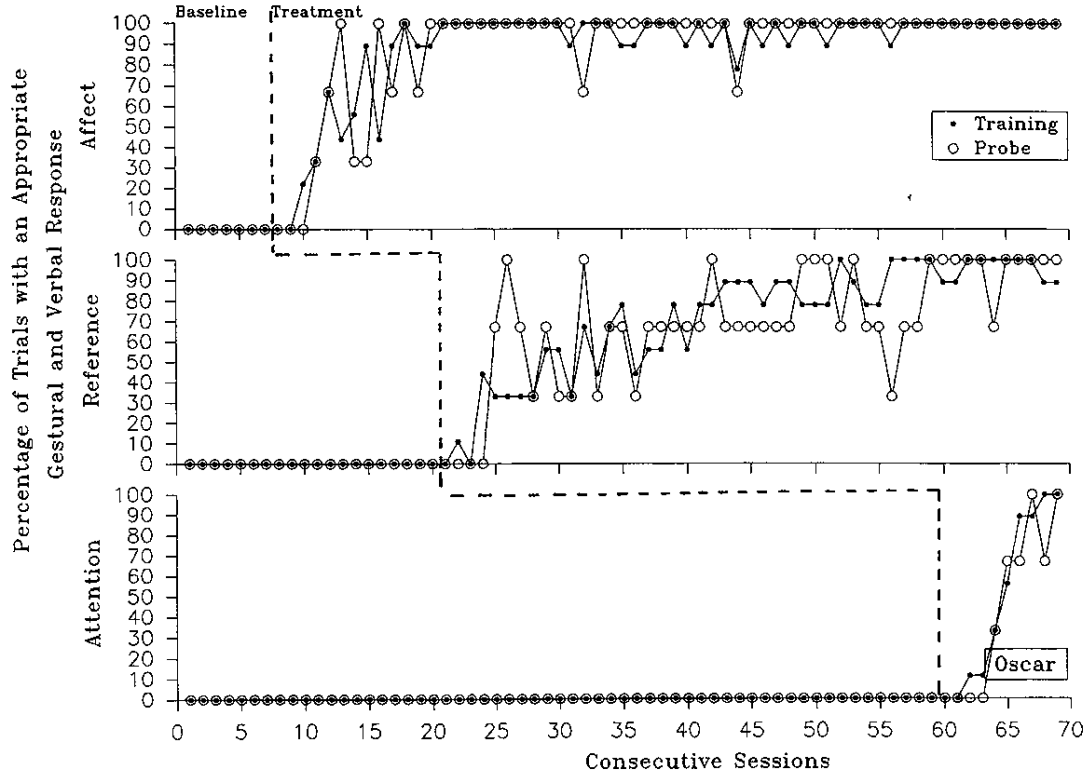

Fig. 2. Percentage of training and probe trials in which Oscar produced a correct verbal and gestural response.

point basis. The number of agreements was divided by the number of agreements plus disagreements and multiplied by 100 to obtain the percentage of IOA.

For the dependent measures, the mean percentage of IOA was maintained at 94% or better throughout all conditions of the study. The percentage of IOA on the correct delivery of the nonverbal and verbal stimuli, on the contingent use of the modeling procedure, and on the contingent delivery of reinforcement was invariably 100% across all conditions and all children.

RESULTS

The individual results for each participant are graphically presented in Figs. 1 through 4.

For each figure, the dashed vertical line represents the point at which treatment was introduced for each response category. Also in each figure, the closed circles represent the data obtained during training trials and the open circles represent the data obtained during probe trials.

The percentage of training and probe trials in which Anne produced an appropriate gestural and verbal response is presented in Fig. 1 by session for all three response categories. During the baseline conditions for all three response categories, the percentage of trials containing a correct gestural and verbal response was 0% throughout all sessions. With the successive introduction of treatment across the three response categories, systematic increases in correct responding in the presence of both the training and probe stimuli were observed. The increases in the percentage of trials containing an appropriate gestural and verbal response were observed only in the response category under treatment. Specifically, the percentage of training trials in which Anne produced an appropriate attention-getting/directing gestural and verbal response increased from 0% during baseline to an average of 100% during the last four sessions of treatment. A similar increase was seen in the probe trials for the attention category. That is, the percentage of probe trials in which Anne produced an appropriate gestural and verbal response increased from 0% during baseline to an average of

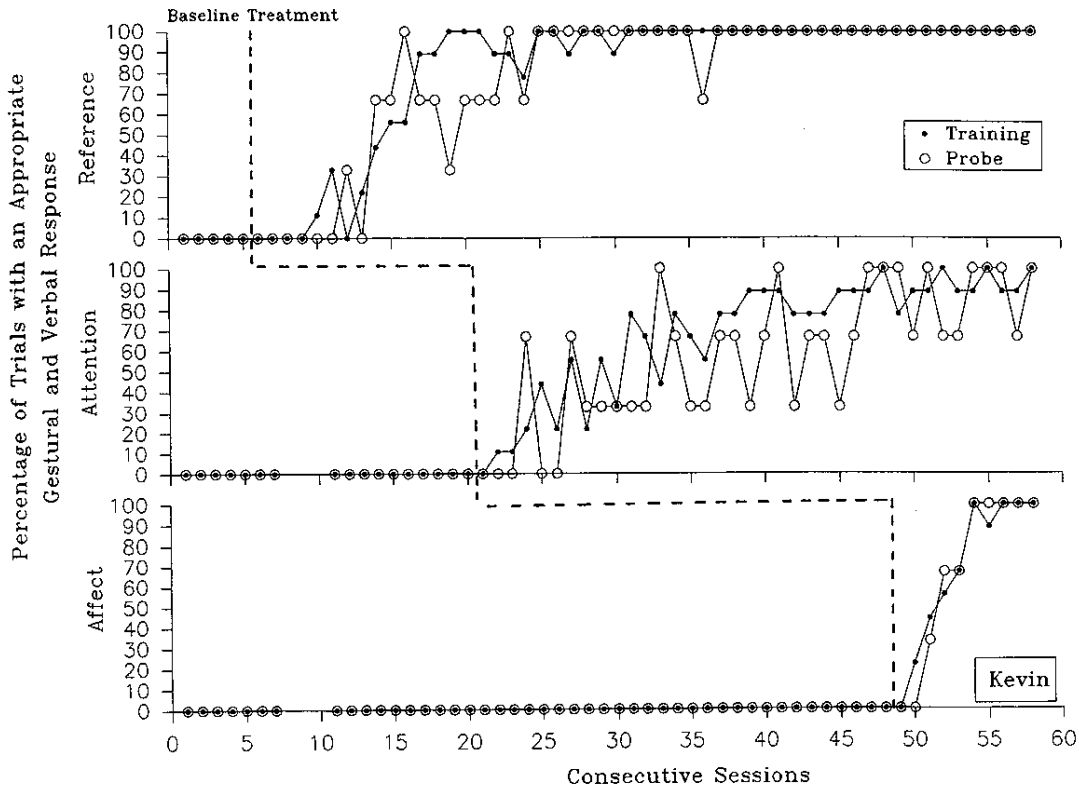

Fig. 3. Percentage of training and probe trials in which Kevin produced a correct verbal and gestural response.

100% during the last four sessions of treatment. For the affect category, the percentage of training trials in which Anne produced an appropriate gestural and verbal response increased from 0% during baseline to an average of 97% during the last four sessions of treatment. Again, this increase in appropriate responding was also observed during the probe trials with the percentage of appropriate gestural and verbal responding increasing from 0% during baseline to an average of 100% during the last four sessions of treatment. Finally, for the reference category, the percentage of training trials in which Anne produced an appropriate gestural and verbal response increased from 0% during baseline to an average of 100% during the last four sessions of treatment. During probe trials in the reference category, the percentage of trials in which Anne produced an appropriate gestural and verbal response increased from 0% during baseline to an average of 92% during the last four sessions of treatment.

The above findings were replicated with three additional children. That is, for Oscar (Fig. 2), Kevin (Fig. 3), and Nick (Fig. 4) low, stable rates of gestural and verbal responding were observed in all three response categories during baseline. With the successive introduction of treatment across each response category, systematic increases in the percentage of training and probe trials containing an appropriate gestural and verbal response were observed for each student.

To assess generalization of the gestural and verbal responses from the stimuli presented during training in the training setting to the presentation of novel stimuli in a novel setting, generalization probes were conducted in the children's classrooms. The percentage of trials in which an accurate gestural and verbal response was observed during the regular-classroom generalization sessions was measured. During the pretreatment sessions, none of the students demonstrated accurate gestural and verbal responding in any of the response categories. Following the teaching conducted in the study, the percentage of accurate gestural and verbal responding increased in the presence of untrained stimuli in a different set-

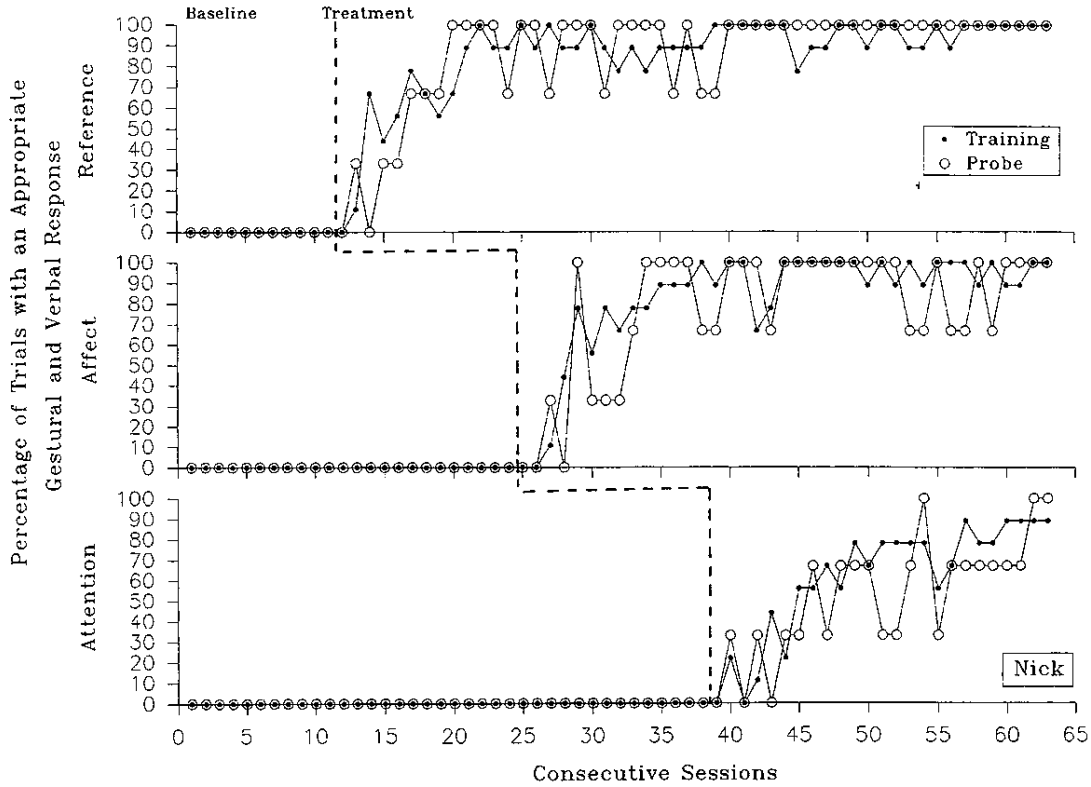

Fig. 4. Percentage of training and probe trials in which Nick produced a correct verbal and gestural response.

ting. By the end of the third posttreatment generalization session, each student made at most one error.

To assess changes in gestural and verbal responding, social validity Measure 1 was calculated. The mean percentage of treatment episodes that were rated as more expressive than the baseline episodes for Anne was 98%, with a range of 89 to 100%. The mean percentage of treatment episodes that were rated as more expressive than the baseline episodes for Oscar was 98% (range 89–100%). The mean percentage of treatment episodes that were rated as more expressive than the baseline episodes for Kevin was 98% (range 89–100%). Finally, the mean percentage of treatment episodes that were rated as more expressive than the baseline episodes for Nick was 96% (range 89–100%).

To ascertain whether the gestural and verbal performances of the children in this study were typical of the gestural and verbal performances of children in their peer group, social validity Measure 2 was collected. The mean percentage of Anne's videotaped episodes scored as containing an appropriate gesture and verbalization was 91% (range 56–100%). The mean percentage of her age-matched peer's episodes scored as containing an appropriate gesture and verbalization was 100%. An independent t test revealed that there was no significant difference between the number of videotaped episodes scored as appropriate between these two individuals, $t(20) = -2.043, p > .025$. The mean percentage of videotaped episodes scored as containing an appropriate gesture and verbalization for Oscar was 93% (range 78–100%). The mean percentage of episodes scored as containing an appropriate gesture and verbalization for his age-matched peer was 96% (range 89–100%). There was no significant difference between the number of episodes rated as appropriate between these two individuals, $t(20) = -1.074, p > .025$. The mean percentage of Kevin's episodes rated as containing an appropriate gesture and verbalization was 100%. The mean percentage of episodes rated as containing an appropriate gesture and verbalization was 97% for his age-matched peer. There was no significant difference between the number of vide-

otaped segments rated as appropriate between these two individuals, $t(20) = 1.936, p > .025$. Finally, the mean percentage of videotaped episodes scored as containing an appropriate gesture and verbalization for Nick was 91% (range 67–100%). The mean percentage of videotaped episodes scored as containing an appropriate gesture and verbalization for his age-matched peer was 89% (range 56–100%). There was no significant difference between the number of episodes rated as appropriate for these two individuals, $t(20) = .363, p > .025$.

DISCUSSION

The four children with autism who participated in this study used little or no gestural communication prior to the present intervention. With the introduction of an intervention package that contained modeling, prompting, and reinforcement, all four of the children learned to use gestural and verbal responses in the presence of nonverbal and verbal discriminative stimuli presented by the therapist during an interactive episode.

Fluently combined gestural and verbal responses occurred not only in the presence of the training stimuli but also in the presence of the probe stimuli. The occurrence of responding in the presence of probe stimuli suggests that the gestural and verbal behavior of the children was not only under the control of the training discriminative stimuli but also under the control of other stimuli that resembled those stimuli (Bijou & Baer, 1961; Catania, 1992).

Generalization of the gestural and verbal responses from the training setting to a novel setting was also assessed in the current experiment. The findings suggest that generalization of the trained responses did occur to some extent in the presence of novel stimuli presented in a novel setting. By the final generalization probe in the regular classroom, only one error occurred in one response category for each child. These results are consistent with the findings in the training setting. That is, the greatest level of generalization of the trained responses from the discriminative stimuli presented by the therapist in the training setting to novel discriminative stimuli presented in a different setting occurred for those responses that the children had the least difficulty acquiring.

The social validity measures taken in this study suggest that the participants' behavior appeared more socially appropriate after treatment. Graduate students consistently rated posttreatment video scenes as more socially appropriate than baseline video scenes. In addition, the ratings obtained from comparison of typical children to the participants in this study suggest that the children with autism were indistinguishable from their peers in their use of appropriate gestures and verbalizations in the scenarios presented.

The responses taught in this study were representative of various levels of gestural competence (Barten, 1979). That is, the gestures that the children learned could be used to obtain tangible consequences in a socially appropriate way, to obtain social consequences, to display affective behavior, and to describe characteristics of objects.

Through the gestures in the attention category, the children learned to request items in a more appropriate manner and alter the orienting behavior of others in their environment (Kasari *et al.*, 1990; Loveland & Landry, 1986; Mundy *et al.*, 1990). By teaching children to use requesting gestures (e.g., "hand request") that are more socially acceptable than those gestures often used by individuals with autism (e.g., grabbing), it increases the probability of their gaining access to reinforcers in their environment (Carr & Kemp, 1989; Prizant & Wetherby, 1987). In addition, by teaching children with autism to point and say "look" rather than to only label an object, they are learning a necessary joint attention skill (Pierce & Schreibman, 1988).

The gestures that the children learned in the affective category provided the children with behavior that could be used to recruit social responses from others in their environment. Because children with autism have deficits in social interaction skills, teaching them to use gestures to recruit social responses from others is a useful way to increase the probability of successful social interactions between themselves and others in their environments (Loveland *et al.*, 1988; McHale *et al.*, 1980; Mundy *et al.*, 1986; Ricks & Wing, 1975; Sigman *et al.*, 1986; Wetherby & Prutting, 1984; Wetherby, 1986). These gestures were considered to be affective responses because they are so often associated with the description of affective states, another large deficit area for children with autism (Attwood *et al.*, 1988; Kasari *et al.*, 1990).

Finally, the gestures that the children learned in the reference category provided them with responses to describe objects. The majority of the vocal and gestural behavior of children with autism is used to

label and request items (Landry & Loveland, 1988; Partington, Sundberg, Newhouse, & Spengler, 1994; Shah & Wing, 1986; Wetherby & Prutting, 1984). These responses, however, enable children with autism to increase the complexity of their communication and, thereby, strengthen their overall communication skills.

Vocal and gestural behavior are two important contributors to social behavior (Bijou & Baer, 1965; Garfin & Lord, 1986; Prizant & Wetherby, 1987). By teaching use of gesture, alone or in combination with vocal behavior, children with autism acquire another skill that is a needed component of social interaction. More important, teaching gesture in the presence of varying nonverbal and verbal discriminative stimuli should help to provide the context in which gestural communication should be used (Shah & Wing, 1986). With the addition of gestural behavior under the control of appropriate social stimuli to the communication repertoires of individuals with autism, hopefully these individuals will appear more "typical" in their social interactions and in turn become more reinforcing to their social partners (Koegel & Frea, 1993).

In the current study, children with autism were able to expand their communicative repertoires by learning gestures and verbalizations that could be used under a variety of conditions in which the teacher presented nonverbal and verbal discriminative stimuli. Although these discriminative stimuli were chosen to closely represent those that would occur in a child's natural setting, future research efforts should investigate the spontaneous use of gestures and verbalizations (learned during discrete trial teaching) in the child's natural environment. Such efforts should lead to the development of more "natural" teaching paradigms (e.g., incidental teaching) to facilitate generalization of the gestural skills from training situations to novel situations. It would also be interesting to determine whether early intervention efforts that include gestural communication training would ultimately produce generalized imitation of gesture.

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