

Facilitating Prelinguistic Communication Skills in Young Children With Developmental Delay

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Very little research has focused on the development and evaluation of intervention strategies designed to facilitate the acquisition of prelinguistic communication skills. We conducted two experiments to determine the effects of a milieu teaching approach on the acquisition and generalization of specific prelinguistic communication skills. In the first experiment, we utilized this intervention approach within a multiple baseline design to teach prelinguistic requesting, commenting, and vocal imitation to a single subject with Down syndrome and language delay. The results indicated that the intervention approach was effective at facilitating the child's use of these skills within the treatment setting. Therefore, in the second experiment we conducted a more comprehensive analysis of this approach with 4 subjects with mental retardation. Three of these subjects were taught to request, and 1 subject was taught both to request and to comment. The effects were experimentally evaluated with multiple baseline across subjects design. The results indicated that the intervention was effective in eliciting the intervention targets within the training setting for all 4 subjects. All 4 subjects showed evidence of generalization across stimulus materials, setting, teachers, and interaction style. There was also evidence of reciprocal effects on how classroom teachers in the generalization setting interacted with the subjects as a result of changes in the child's communication behavior.

KEY WORDS: prelinguistic, intervention, developmental delay, communication, generalization

Over the past 25 years a substantial number of studies have investigated the effects of various intervention strategies and procedures on early linguistic development (see Fey, 1986; Goldstein & Hockenberger, 1991; Warren & Kaiser, 1988, for reviews). In contrast, very little research has focused on the development and evaluation of intervention strategies designed to facilitate prelinguistic communication, despite the importance of communication to the child's general adaptive behavior and the possible relationship of prelinguistic development to later language competence. In this paper we will report on two studies intended to determine the effects of a prelinguistic milieu teaching intervention on selected communicative skills of 5 young children with evidence of developmental delays.

The existing experimental literature on prelinguistic communication interventions is quite limited. It has been shown that prelinguistic requesting and commenting can be facilitated by experience in full-time day care in low-socioeconomic-status 20-month-old infants (O'Connell & Farran, 1982). Additionally, treatment techniques and approaches explicitly designed to facilitate prelinguistic communication in children with developmental delays are beginning to be developed and tested (e.g., Mahoney & Powell, 1988; McCollum & Stayton, 1985; Rosenberg & Robinson, 1985; Wilcox, in press). However, none of the published intervention studies with such children has used adequate control groups or the within-subject design controls necessary to

warrant strong inferences of intervention effects nor have they measured generalization effects (see Yoder & Warren, *in press*, for a review).

The development and design of efficacious prelinguistic intervention strategies for young children with developmental delays raises a number of complex issues. Designing intervention strategies drawn exclusively from the literature on mother-normally developing child interaction may not be sufficient because of the learning strategies and characteristics of these children. For example, as degree of mental retardation increases, the frequency (Brooks-Gunn & Lewis, 1984; Yoder & Feagans, 1988) and clarity (Yoder, 1987) of naturally occurring prelinguistic communication tends to decrease. Thus, if we were to wait for a clear communicative act on the child's part to begin a teaching episode, learning opportunities might be too few. Therefore, it may be necessary to use well-timed prompts to communicate to create sufficient opportunities for effective teaching of communication skills. It may also be necessary to enhance the salience of communication models for efficient learning to occur. The value of social interaction routines and linguistic mapping, which are purported to enhance the salience of adult's input to children (Snow, Perlmann, & Nathan, 1987), may be even greater for young children with developmental delays than for typically developing children because these children often evidence poor attention to relevant stimuli (Soraci, Deckner, Baumeister, & Carlin, 1990). Finally, we have substantial evidence that children with mental retardation often have difficulty spontaneously generalizing newly acquired communication skills (see Kaiser, Yoder, & Keetz, 1992; Tannock & Girolametto, 1992, for reviews), suggesting the need for explicitly including techniques in our interventions that are known to facilitate generalization.

In order to balance the needs of the learner with the goal of facilitating optimal communication development, an effective prelinguistic intervention approach might combine certain aspects of typical mother-child interaction that appear to facilitate prelinguistic communication in typically developing children (i.e., contingent imitation, responsivity, following the child's lead, linguistic mapping, and social routines) with procedures designed to address the special learning characteristics of children with developmental delays. With modifications designed to make it appropriate for developmentally younger children, the milieu teaching model (Kaiser et al., 1992; Warren, 1991; Warren & Kaiser, 1988) may represent an appropriate blend of procedures.

Milieu teaching utilizes several behavioral principles or techniques that have been shown to contribute to the facilitation of communication development: (a) It increases the number of opportunities for responsively teaching new skills by eliciting child communication through the use of various indirect techniques (e.g., environmental arrangement) in combination with other techniques (e.g., the mand-model and time-delay procedures) intended to directly elicit target behavior (e.g., Oliver & Halle, 1982; Warren, McQuarter & Rogers-Warren, 1984). (b) It increases the child's attention to models of the new communication behavior by encouraging spontaneous and prompted imitations (e.g., Warren & Bambara, 1989). (c) By embedding teaching in typical developmentally appropriate activities, milieu teaching enhances the

probability of generalization by minimizing differences between training and generalization contexts (Warren & Kaiser, 1986).

From a developmental perspective, several elements assumed to be critical for communication and language learning are implicit in the milieu teaching approach: (a) In light of the empirically supported assumption that children are better able to attend to and learn from adult communicative models presented when the child is already attending to the referent (Akhtar, Dunham, & Dunham, 1991; Bruner, Roy, & Ratner, 1980; Tomasello & Farrar, 1986), the milieu teacher follows the child's attentional lead and teaches to his or her interests and communicative intentions. (b) To increase the probability that an easy-to-difficult sequence of skills is followed, the normal developmental sequence of skill acquisition is used as a guide for target skill selection and sequencing. (c) Selection of appropriate targets slightly in advance of the child's productive competence and the explicit use of linguistic mapping contingent on the child's communicative behavior ensures that there will be a communicative match between the adult and the child (see Newport, Gleitman, & Gleitman, 1977; Snow, Perlmann, & Nathan, 1987, for reviews). Both developmentally and behaviorally oriented researchers assume that learning can be enhanced by increasing a child's rate of appropriate engagement with people and objects (see McWilliam, 1991, for review). Milieu teaching explicitly attempts to increase engagement with people (via mand-model, time-delay, and incidental teaching techniques) and objects (via teaching around objects and activities that are moderately novel and of interest to the child).

A substantial amount of experimental research has shown the milieu teaching approach to be particularly effective at facilitating the development of early language skills (see Kaiser et al., 1992; Warren & Kaiser, 1986, for reviews). Most of this research has been with children learning early productive vocabulary or slightly more sophisticated skills such as basic semantic relationships (e.g., action-object). With some modification many elements of the milieu teaching model should also be appropriate for facilitating the development of intentional prelinguistic skills such as requesting and commenting. Procedures such as arranging desired materials in ways that indirectly elicit responses, teaching to the child's attentional lead, and prompting target behaviors with mands and time delays may be equally useful with prelinguistic forms of requesting and commenting as they are in teaching vocabulary. However, some additional procedures may be necessary and appropriate. Specifically, contingent exact or modified imitation of the child's vocal or nonvocal behavior might be used to build interactive routines and encourage vocal imitation. Physical prompting might also be used to teach components of prelinguistic requesting. These procedures could be incorporated with other components and embedded within the eliciting context of playful social interaction routines. Routines have been shown to elicit communication in children with (Yoder, Davies, & Bishop, 1992) and without (Bakeman & Adamson, 1984) developmental delays.

Determining the instructional targets is of equal importance with the design and development of prelinguistic intervention procedures. Because of their well-established importance to

early communication development, intervention might most profitably target the communicative functions of requesting and commenting and the multifaceted skill of vocal imitation.

Requesting and commenting episodes provide the earliest contexts in which intentionality and referencing are demonstrated (Bates, O'Connell, & Shore, 1987). Requesting or instrumental communication has been defined as behavior that clearly indicates the child wants something; it is sustained until the goal is reached or becomes unreachable (Rogoff, Mistry, Radziszewska, & Germond, 1988). Commenting, also termed referencing or indicating, is the act of drawing another's attention to a single object of interest (Bates et al., 1987). These functions are the fundamental pragmatic building blocks of both prelinguistic and linguistic communication (Bruner et al., 1980). They are also the two most frequent functions expressed during the prelinguistic period (Wetherby, Cain, Yonclas, & Walker, 1988).

Vocal imitation may be a priority for prelinguistic intervention because of its multifaceted relationship with early language development (Speidel & Nelson, 1989). There is growing consensus that children learn the conventional communication behaviors specific to their culture via imitation (see Snow, 1989, for review). Although controversy exists over more complex roles imitation may play in facilitating language development (i.e., cognition, pragmatic function, information processing, learning), vocal and gestural imitation have been positively correlated with language level in samples of normally developing children (Snow, 1989).

This paper reports two studies intended to explicate the short-term effects of a modified milieu teaching approach on the development of prelinguistic communication skills in young children with developmental delays. In the first experiment, we piloted this intervention by facilitating a single subject's use of requesting, commenting, and vocal imitation in the intervention sessions. We then extended this approach in a second experiment by teaching prelinguistic requesting to 3 children and requesting and commenting to a fourth child. In this second study, we conducted an extensive evaluation of the generalized effects of the intervention along a number of dimensions. We also examined how classroom teachers in the generalization setting responded to changes in the subjects' prelinguistic skills.

The overall intent of this research is to lay the groundwork for the further development and evaluation of prelinguistic milieu teaching, one of several possible approaches to prelinguistic intervention. Effective, scientifically validated prelinguistic intervention procedures will provide a basis for intervening with very young children at-risk for developmental delays and disabilities. Furthermore, such procedures will provide the basis for longitudinal studies of the effects of prelinguistic intervention on the later development of language skills.

General Methods

Setting

All subjects attended a university-based early intervention program for children (age: birth to 3 years) at-risk for devel-

opmental delays. All experimental sessions took place in a large playroom immediately adjacent to their classrooms. It was equipped with a children's kitchen area, blackboard, functioning sink, a wide variety of toys, and other age-appropriate play materials.

Subjects were seen individually during all baseline and intervention sessions. All baseline and intervention sessions were conducted by one of three trainers. All these individuals had substantial experience utilizing milieu teaching approaches to facilitate the acquisition of initial vocabulary and basic semantic relationships in young children with mild to moderate levels of mental retardation as part of an earlier set of studies (Warren, in press; Warren & Bambara, 1989; Warren & Gazdag, 1990). Each subject had a primary and secondary trainer. The child's primary trainer (the same individual for all 4 subjects) conducted intervention sessions 3 days per week. The secondary trainer conducted one session weekly. Two trainers were used to facilitate across-person generalization.

Training Targets

Each child's rate of prelinguistic requesting, commenting, and vocal imitation was assessed during the initial baseline period. Training targets were then selected for each child. These behaviors are explicitly defined in the observational measurement section below.

Observation System

Data were collected via videotape on a range of adult and child behaviors in the experimental setting and during Experiment 2 in the generalization setting. Adult behaviors coded were contingent vocal imitation, linguistic mapping of the child's previous communicative behavior, requests for communication, and turntaking. Child behaviors coded were vocal imitation, turntaking, the communicative acts of commenting and requesting, and other intentional communication (e.g., greetings, protests). In addition, when no codable behavior occurred for at least 5 sec, this was coded as a "nonoccurrence." Our operational definition of intentional communication required that children include either (a) sequential or simultaneous attention to the adult and object with a co-occurring discrete action or vocalization or (b) a conventional gesture (e.g., point, nod, shrug), word, or sign.

Specific child and adult coding categories are defined in Table 1.

Observers coded each occurrence of defined adult or child behavior in sequence. Although experimental sessions typically lasted 25 min, data were collected for a 10-min portion of each session. That is, each individual data point represented a 10-min sample of data. Given the amount of adult-child interaction in most sessions, this time period was considered sufficient to adequately sample child and trainer behavior. The 10-min sample was always made during the middle of the session to assure consistency.

Reliability. Interobserver agreement on the observational code was assessed by having two observers independently code each 10-min segment of videotaped data. These rec-

TABLE 1. Behavioral definitions, adult and child.

Adult		
Behavior	Definitions	Example
Contingent vocal imitation	Adult immediately (with or without modifying syllable number) imitates the child's previous vocalization.	C: While playing with blocks, the child babbles, "ba, ba." A: "ba, ba"
Linguistic mapping	Adult says the word that labels the object of the child's immediately preceding communicative act or the act itself.	C: When leaving the room the child waves. A: "bye-bye"
Requests for communication	Adult uses verbal, vocal, and/or gestural means to encourage the child to communicate.	A: In a give-and-take game, A holds up toy and waits expectantly for child to request. A: In a block-building game, A withholds a block, shows it to the child, and says, "What do you want?"
Turntaking	Adult executes a behavior or role in a previously identified predictable turntaking routine. The adult's turn must be preceded or followed by a child's turn to be coded as turntaking.	C: pushes car A: pushes car C: kisses doll A: hugs doll
Child		
Behavior	Definitions	Example
Vocal imitation	Child immediately imitates the preceding vocalization of the adult. The imitation may be partial or total but may not include novel sounds.	A: "ba bo" C: "ba" A: "See the ball." C: "ba"
Commenting	Child intentionally tries to draw the adult's attention to an object or event. (Intentional communication is defined in the text.)	A: not looking at the child C: says "ba," looks at the adult and the toy
Requesting	Child intentionally asks for a specific object or that a specific action be carried out.	A: plays with a ball C: looks at ball and adult, and reaches toward the ball
Other intentional communication	Child intentionally expresses him- or herself, but not as a comment or a request. This category includes greeting, protests, and yes-no answers to questions.	C: "hi" C: "stop" C: pulls away from adult, cries "no" A: "Is this yours?" C: shakes head "no"
Turntaking	Child executes a behavior or role in a previously identified turn-taking routine. The child's turn must be preceded or followed by an adult's turn to be considered turntaking.	C: pushes toy A: spins toy A: bangs drum C: bangs table
Not applicable	No codeable behavior occurs for at least 5 sec.	C: plays and babbles to self for 30 sec A: washes hands at sink for 1 min

ords were then compared on a point-by-point basis for agreement on exact coding of adult and child behaviors. A disagreement occurred when one observer recorded a different code from the other or when one observer coded the occurrence of a behavior and the other observer failed to code any occurrence or coded a nonoccurrence. The percentage of interobserver agreement was then computed by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100.

Intervention Procedures

Environmental arrangement, following the child's lead, and social routines provided enabling contexts for using more

direct techniques to teach requesting, commenting, and vocal imitation. Environmental arrangement was employed to focus the child's interest on one activity or toy at a time. Initially the child was offered access to three different toys or activities. The two unselected toys or activities were placed out of reach after the child made his or her selection. As the child's interest naturally waned in the first activity, he or she was offered a choice between two other activities. Typical activities included music play, dress-up, farm, cars, ball, and water play. Following the child's attentional lead was employed to sustain the child's interest in the activity. The trainer played with the toys or engaged in activities based on the child's interest and in a manner similar to the child's play. Social routines were familiar turntaking games. These were

initially established by contingently imitating the child's actions (e.g., pushing a toy back toward the child after the child had pushed it). These were used to elicit communication and create a context in which children were presumed to be most likely to attend to instructional episodes.

Various prompts (coded as requests for communication) were used by the trainer to directly teach requesting. The trainer would engage the child in a routine activity, then stop the action and ask the child a question such as, "What do you want?" (i.e., to start the activity), or "Do you want this?" (while holding an object the child needed to resume the activity) and wait for the child's response. If no response or an incorrect or incomplete response ensued, the trainer provided assistance to complete or correct the child's response. For example, if the child looked at the toy and displayed a discrete action or provided a vocalization but did not look at the trainer, the trainer then provided a prompt to look at the adult (i.e., "Look at me."). This prompted the missing behavior component needed to meet the criteria for intentional communication. If the child exhibited an incomplete response by not including a vocalization or a discrete action, the trainer provided a request for communication such as "What?," which indicated the need for additional information. The trainer provided demonstrations or physical assistance as needed to complete the communicative act. Fewer physical prompts and demonstrations were used as the children acquired the target. As the intervention proceeded, intentional requests could be elicited simply by stopping the routine (i.e., time-delay).

Intentional commenting was taught in a decidedly different manner from requesting. Early in the training of this skill the adult frequently modeled "commenting" by focusing on an object that both the trainer and child were jointly attending to and vocalizing (e.g., "Wow."). The trainer added novel toys and other items to training on a daily basis. These novel toys created opportunities for commenting. In these situations the trainer also modeled commenting. As the child's imitation of comments increased, a third technique was introduced concurrent with a decrease in the modelling of commenting. Now the trainer began to physically back away from the child when novel objects were introduced and focus her attention elsewhere. This created a natural opportunity for the child to comment vocally on the novel item so as to recruit the adult's attention to it; then the adult could respond. A variation of this procedure, used frequently, was to give the child free access for a few minutes to a large part of the classroom while the trainer stood off to the side. As the child moved around this environment he would frequently comment (vocalize and look at the trainer while pointing to some item).

Vocal imitation was taught primarily by the trainer's use of immediate, contingent vocal imitation of the child's own vocalization. These contingent imitations were provided as the trainer followed the child's attentional lead or were embedded in the social interaction around the activity the child was engaged in. For example, if the child said "ba," the trainer might say "ba" or "ba, ba." The trainer also occasionally "modelled sounds" by pairing them with actions. For example, the trainer might say "push" while pushing a toy car. No explicit pressure was put on the child to respond to either contingent vocal imitations or modeled sounds.

EXPERIMENT 1

Method

Subject

Gary was a 20-month-old boy with Down syndrome. He was born prematurely at 34-weeks gestation. Gary had a history of recurrent otitis media that was treated with antibiotics. No visual or auditory loss or severe physical disabilities were present. On the Bayley Scales of Infant Development administered at 18 months Gary attained a mental development index of 97, with a concomitant mental age (MA) of 15–16 months. Therefore, Gary's estimated level of intellectual functioning at 18 months was within the average range. Children with Down syndrome occasionally score relatively high on the Bayley early in development before the effects of this syndrome on higher level cognitive development becomes apparent (Jon Miller, personal communication). On the Receptive-Expressive Emergent Language (REEL) test (Bzoch & League, 1971) that was also administered at 18 months, Gary attained an expressive age of 11 months and a receptive age of 14 months. These results indicated that Gary's expressive language skills were delayed with respect to his mental and chronological ages. The majority of Gary's communicative acts were expressed with gestures.

Experimental Design

A multiple-baseline design across training targets was utilized (McReynolds & Kearns, 1983). Initial baseline observations indicated that requesting, vocal imitation, and commenting were all absent from Gary's communicative repertoire during interactive play. Thus, these target skills were sequentially intervened upon in accordance with the multiple-baseline design.

Data Collection and Reliability

Data collection was limited to the experimental sessions and to the child's portion of the observation code described above. Data were collected for 10-min periods of all baseline sessions and for 70% of the intervention sessions.

Reliability assessments, evenly distributed across all conditions, were conducted on 26% of all data sessions. Overall, reliability for the three dependent variables was 95% for requesting, 84% for vocal imitation, and 81% for commenting.

Procedures

Baseline

Baseline involved 6 sessions for the first training target, 17 sessions for the second target, and 39 sessions for the third target. During the initial baseline condition the trainers engaged in interactive play activities with Gary. They did not utilize any training techniques. Gary did not exhibit any

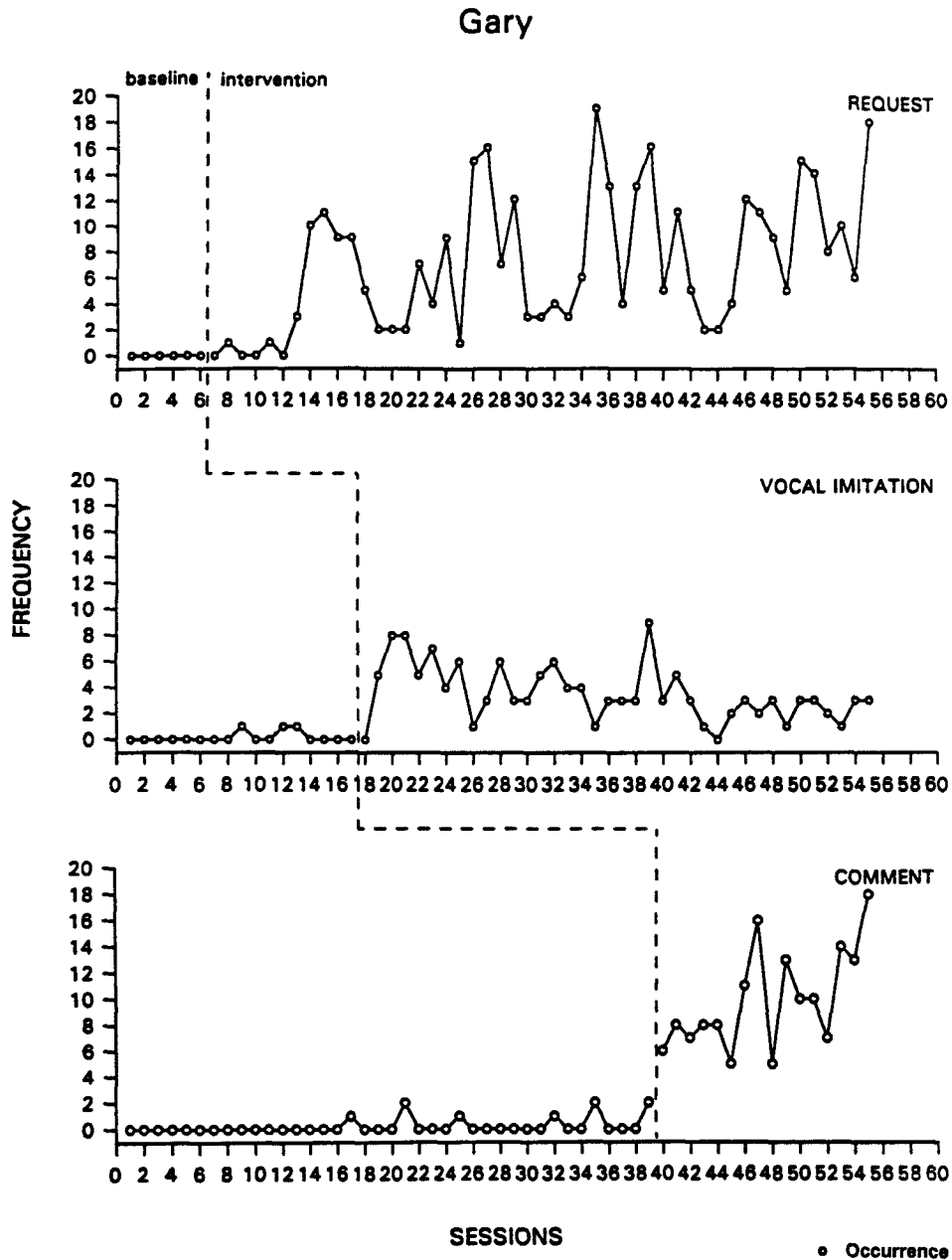


FIGURE 1. The frequency of requests, vocal imitations, and comments by Gary per experimental session.

requesting behavior, and only a few occurrences of vocal imitations and comments were produced.

Intervention

Training sessions were conducted 4 days per week for 25 min each. Each of the three targets were taught using the procedures described in the general methods section.

Results

The results of the intervention are presented in Figure 1. During initial baseline Gary made no requests. There was an

abrupt shift in slope in Gary's frequency of requesting soon after intervention began. By the last three intervention data sessions Gary averaged 11.3 unprompted requests per 10-min session (a rate of 1.1 per min). This is well above the average rate (.49) of prelinguistic requests per min for typical children reported by Wetherby et al. (1988) in a similar interactive play context. (Since Wetherby and her colleagues consistently report data using a rate per min metric, we too have followed this practice throughout this paper to facilitate comparisons with their normative data base.)

During the baseline for *vocal imitation* Gary produced only three unprompted vocal imitations across 17 sessions. There was an abrupt shift in slope in Gary's vocal imitation immediately after intervention began. During the last three inter-

TABLE 2. Subject Information.

Subject	Chronological age ^a (In months)	Bayley MDI ^b /mental age (In months)	Etiology	REEL ^c scale: receptive age (In months)	REEL ^c scale: expressive age (In months)	Chronological age ^d	Chronological age ^e
Deb	29	<50/8	high-risk family	8	7	20	33
Sam	23	59/9.5	Down syndrome	11	8	13	28
Joe	30	<50/13	microcephaly, failure to thrive	11	11	24	33
Carl	26	<50/10	agenesis of corpus collosum	8	7	21	31

^aJust prior to intervention. ^bBayley Scales of Infant Development: Mental Development Index. ^cReceptive-Expressive Emergent Language scale. ^dAt administration of Bayley and REEL. ^eAt end of intervention.

vention data sessions, Gary averaged 2.3 unprompted imitations (a rate of .23 per min).

Across the baseline period for *commenting* Gary produced nine unprompted comments (a rate of .23 per min). There was a dramatic increase in the slope of Gary's commenting after intervention. During the last three intervention data sessions Gary averaged 15 comments per 10-min session, a rate of 1.5 unprompted comments per min. This too was well above the average rate of prelinguistic comments per min for typical children (.63) reported by Wetherby et al. (1988).

The results for Experiment 1 indicated that the procedures were effective in facilitating the child's use of requesting, vocal imitation, and commenting in the treatment setting with the trainer using the intervention procedures. Although the frequencies of requesting, vocal imitation, and commenting were quite variable during the intervention, such variability is typical when treatment targets are subject to contextual effects created by different toys, games, and interactional situations. Despite this variability very few data points overlapped with data points collected during baseline, the overall trends in the data were stable, and there was no evidence of the effects reversing. However, the implications of this data are quite limited since no data were collected to assess possible generalization effects.

EXPERIMENT 2

The results of Experiment 1 suggested that a more extensive investigation of this intervention approach was warranted. Therefore, the purposes of the second study were to replicate the within-treatment setting effects; to test whether the effects generalized across classroom teachers, setting, materials, and interaction style; and to examine the behavior of classroom teachers in the generalization setting for changes that might occur in response to changes in the subjects.

Method

Subjects

General information for the 4 subjects is provided in Table 2. The mean age just prior to intervention was 27.0 months (range: 23–30 months). All subjects were tested with the Bayley Scales of Infant Development. Three of the 4 subjects attained a mental development index (MDI) on the Bayley

below 50; the fourth had an MDI of 59. School records indicated that none of the subjects exhibited significant hearing, vision, or behavioral problems. All subjects demonstrated substantial delays in both their expressive and receptive communication skills as measured by the REEL. The subjects' MDI and REEL assessments indicated that all were functioning in the mild to moderate range of mental retardation.

Experimental Design

A multiple-baseline design across subjects was used to assess the intervention effects. After a baseline measurement period, intervention was sequentially applied to teach prelinguistic requesting to all 4 subjects.

Training Targets

Prelinguistic requesting was selected as a training target for all 4 subjects because it did not occur in the baseline of any of the children. Commenting was also taught concurrently to Joe because of its absence in his baseline. Since only 1 child was taught this skill, it was not possible to replicate treatment effects across subjects. The other children all had relatively high rates of commenting in their baselines. Vocal imitation was also excluded as a target because all 4 subjects showed clear evidence of this function during baseline assessment.

Generalization

Throughout the study, 10-min play sessions were conducted approximately twice per month to permit assessment of generalization across classroom teachers, setting, materials, and interaction style. Generalization sessions were conducted by the child's regular classroom teacher and were held in the child's classroom. The materials used represented different examples of the same themes used in the intervention. For example, training occurred with musical instruments (e.g., drum, xylophone), but a piano was not included in the training materials. Therefore, in the generalization sessions a piano was included in the test materials.

Teachers were instructed to use the same procedures the trainers used in the baseline period. That is, they were asked not to teach, model, or directly prompt communication, but only to play with the child and have fun. During the general-

ization sessions, opportunities to request and comment were available continuously.

Two subjects, Deb and Carl, were tested in the generalization sessions with two different teachers. When a new school year started, Deb was transferred to a more advanced class. Her two generalization tests with her new teacher included new classroom materials and a new classroom setting. Carl's two tests of generalization were with a second teacher in his classroom. This was necessary because his previous teacher moved to a different class at the start of the new school year.

One additional probe of generalization was conducted with Deb and Joe. They were unobtrusively observed in their classrooms with their peers, teachers, and volunteers during snack-time. No specific instructions were given to any of the adults present. This probe occurred near the end of the study for both subjects. For technical reasons it was not feasible to conduct this probe with Carl and Sam.

Data Collection and Reliability

Data were collected during all baseline and generalization sessions and for 50% of all intervention sessions. Videotaped data samples were collected for the middle 10-min period of these 25-min sessions. Reliability assessments, evenly distributed within all experimental conditions, were conducted on 20% of the data sessions. The mean reliability for requesting for all subjects was 96.6% (range was 93.3% to 100%), and reliability for commenting by Joe was 94.1%. The mean reliability for adult turntaking for all subjects' sessions was 98.2% (range was 97.0% to 100%), and the reliability for requests for communication was 88.1% (range was 64.7% to 95.0%). The mean reliability for teacher linguistic mapping was 85.7% (range was 67% to 100%).

Procedures

Baseline

The baseline period extended over three data sessions and two generalization sessions for Deb, five data sessions and two generalization sessions for Sam, seven data sessions and two generalization sessions for Joe, and nine data sessions and two generalization sessions for Carl. During baseline sessions, environmental arrangement was minimal. The trainer engaged in play activities with each child, but did not specifically direct or encourage communication. However, there were many opportunities to communicate during all baseline sessions. For example, while playing with one toy, a child might want others just out of reach; thus, opportunities for requesting abounded.

Intervention

Training sessions were conducted 4 days per week for about 25 min each. A total of 43 training sessions were conducted with Deb, 43 with Sam, 37 with Joe (during which both requesting and commenting were taught), and 61 with Carl.

Results

As indicated in Figure 2, all the trainers showed increases in requests to communicate and prompts for specific behaviors that would improve the conventionality of the communicative response during the treatment sessions. In addition, the trainers of 3 of these subjects (all but Deb's) showed increases in their turntaking behaviors during the treatment sessions. In all three cases the frequency of turntaking episodes was quite variable. It should be noted that adult turntaking could only be coded if it was either preceded or followed by a child's turn. For example, if the adult initiated but the child did not respond, no turntaking instance was coded. Therefore, it is probable that the variability in turntaking was due to the degree to which the child responded to adult turntaking attempts during any given session.

As indicated in Figure 3, all subjects showed abrupt and immediate shifts in the frequency of their requesting within the treatment sessions. These effects were relatively stable and well above baseline levels for all subjects throughout the intervention. While all subjects also showed some evidence of stimulus generalization, 3 of the 4 children (all but Carl) demonstrated particularly dramatic increases in the slope of frequency of requesting in the generalization sessions. Deb and Carl showed evidence of generalization to a second classroom teacher. Deb and Joe showed evidence of generalization in a snack-time probe.

As indicated in Figure 4, Joe, the one child with commenting as an intervention goal, showed abrupt and immediate shifts in the frequency of commenting in the treatment sessions. In the generalization sessions, a dramatic increase in commenting also occurred. We did not have the opportunity to replicate this effect because the other 3 children already had substantial commenting in their baselines.

All subjects were tested before and after the intervention on the Communication and Symbolic Behavior Scales (CSBS) (Wetherby & Prizant, 1990). The CSBS has a standard assessment protocol and has been used in studies with children who are developing typically (Wetherby et al., 1988) and those who are developmentally delayed (Wetherby, Yonclas, & Bryan, 1989). Wetherby et al. (1988) report prelinguistic and single-word stage means per min for a number of basic communicative functions based on the CSBS. The means for their normal sample of subjects ($N = 15$) are reported on the right side of Table 3 for intentional communicative acts, requesting, commenting, percent of communicative acts that were requests, and percent of communicative acts that were comments to aid interpretation of the present subject's performance. Pre- and postintervention data for the 4 subjects are provided in the left columns.

The data in Table 3 indicate that all 4 subjects made substantial gains in rates of intentional communicative acts per min, rates of requesting, and rates of commenting during the intervention. An exception to this was the relatively small gain made by Sam in his rate of requesting as assessed by the CSBS. It should be noted that Sam's requesting in the generalization sessions was somewhat variable but generally higher than that seen in the CSBS. To a substantial degree, the subjects' postintervention assessment rates and proportions of these communicative functions also compared

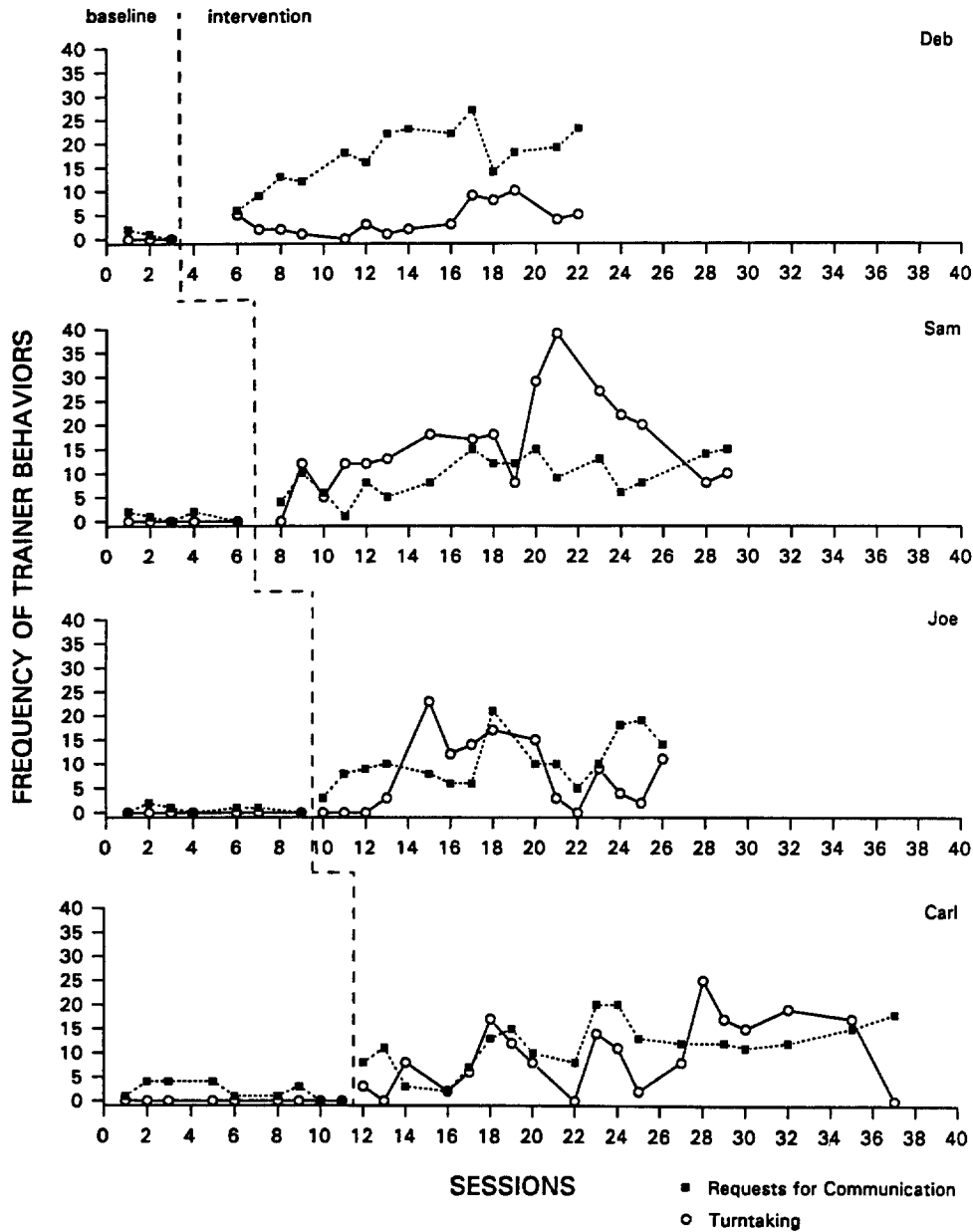


FIGURE 2. The frequency of trainer requests for communication (darkened squares) and turntaking episodes (open circles) per session in the intervention setting.

reasonably well to the means for Wetherby's normal group at both the prelinguistic and single-word period.

Figure 5 indicates the changes in the classroom teachers when interacting with the children. The teachers did not know the children's intervention goals, nor were they trained to use the intervention techniques. Therefore, any abrupt and replicated changes in their behavior from baseline to intervention should be in response to changes in the child's behavior. Note that requests for communication and turntaking behavior were almost nonexistent during the baseline for all 4 of the subjects' teachers. All 4 subjects' classroom teachers (four different individuals) showed increases in requests for communication. The increase was dramatic with Joe, more moderate with Deb and Sam, and slight with Carl. For adult turntaking behaviors, all adults showed an increase from

baseline. This increase was dramatic with all subjects except perhaps Joe.

Another indicator of change in the teachers' behavior toward the subjects was the proportion of intentional comments and requests on the part of a child that were followed by linguistic mapping by the teachers. Linguistic mapping was defined as "adult expresses the word that labels the object of or the act itself of the child immediately before the communicative act." Linguistic mapping is analogous to expansions and may constitute a particularly powerful facilitator of language acquisition (see Nelson, 1989). The proportion of child requests and comments followed by adult linguistic mapping in the generalization setting is shown in Table 4.

For the baseline sessions in the generalization setting, no child requests occurred. However, all 4 of the subjects did

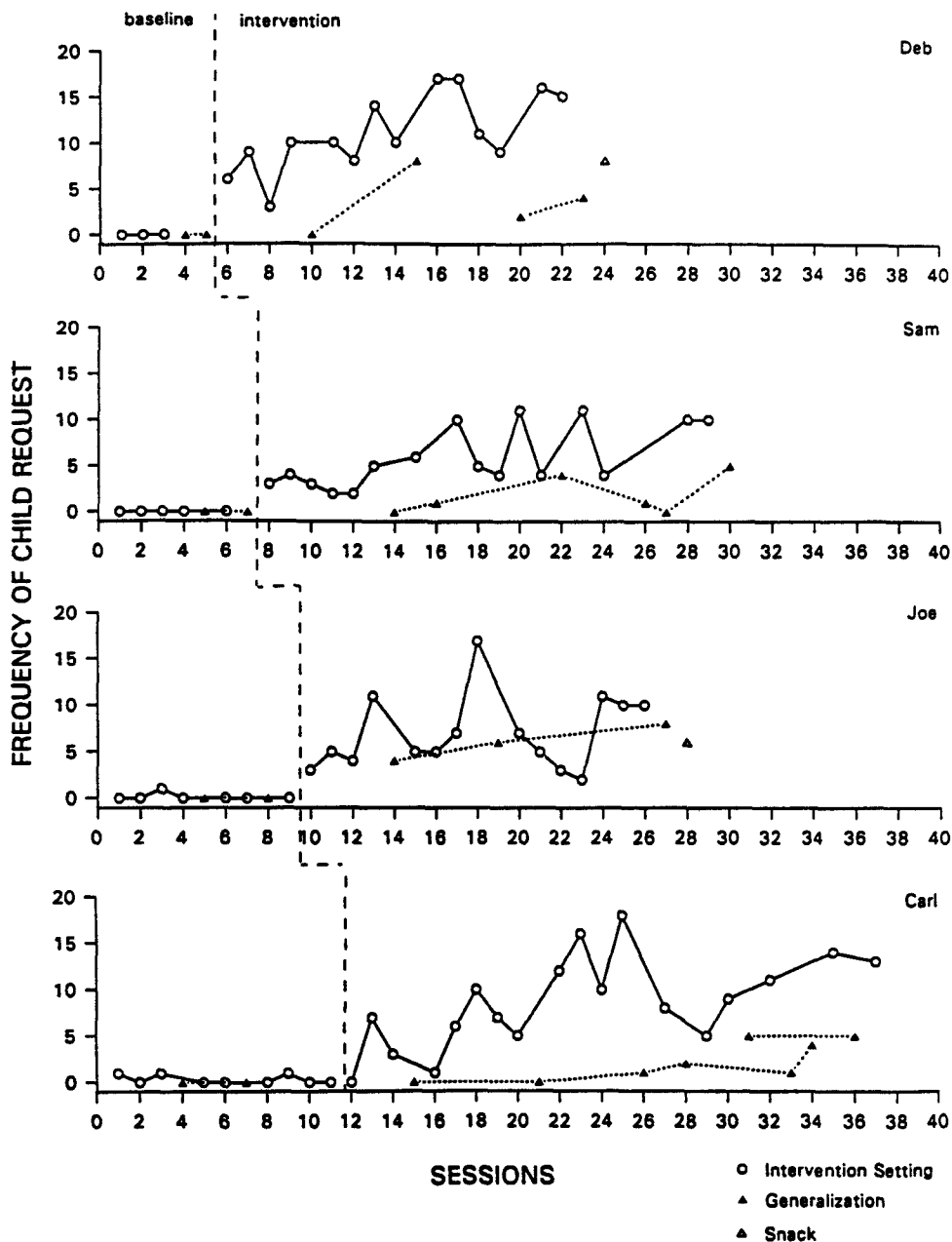


FIGURE 3. The frequency of child requests in the intervention setting (open circles) and generalization setting (darkened triangles). The break in the generalization data presented for Deb and Carl indicates data for different teachers. The open triangle on Deb and Joe's graphs indicate data taken during a snack time probe.

comment. Out of a total of 38 comments across the 4 subjects, only 2 comments (by Deb) were followed by linguistic mapping (5%).

During the intervention, all 4 subjects engaged in commenting and requesting in the generalization setting. Of a total of 177 intentional comments or requests, 44 (or 25%) were followed by linguistic mapping. Individually, this represented a slight increase for Deb (from 18% to 22%) and large increases for Sam, Joe, and Carl (from 0% to 12%, 44%, and 33%, respectively).

The increases in the proportion of child intentional comments and requests receiving adult linguistic mapping in

the generalization sessions are even more interesting when we compare the proportion of requests that receive linguistic mapping to the proportion of comments that receive linguistic mapping. Again, there were no instances of requests in the baseline; therefore, we can compare only the relative extent to which requests versus comments were followed by linguistic mapping in the intervention phase. For 3 of the 4 subjects (Deb, Joe, and Carl), the proportion of requests followed by linguistic mapping ($M = .41$; $SD = .08$) is approximately twice as much as the proportion of comments followed by linguistic mapping ($M = .20$; $SD = .08$).

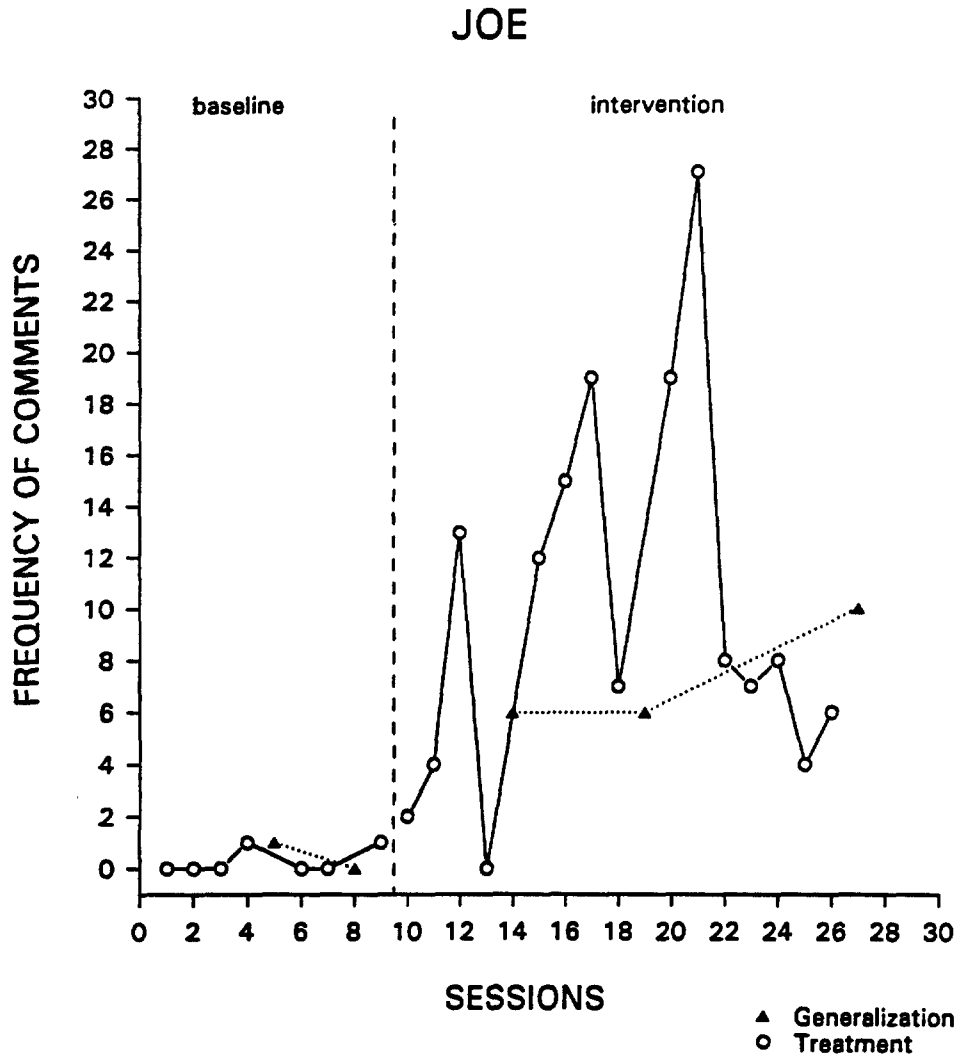


FIGURE 4. The frequency of comments in the Intervention setting (open circles) and generalization setting (darkened triangles) by Joe.

TABLE 3. Pre- and Post-CSBS data.

		Subjects				Prelinguistic stage ^a	Single-word stage ^a
		Deb	Sam	Joe	Carl		
Rate of intentional communication acts per min	Pre	2.4	.75	1.38	.92	1.30	2.09
	Post	4.05	2.11	4.17	3.54		
Rate of requests ^b per min	Pre	.26	.04	.71	.28	.49	.97
	Post	1.1	.17	1.61	1.04		
Rate of comments per min	Pre	.83	.11	.50	.15	.63	.81
	Post	1.57	.72	2.26	1.96		
% of communication acts that are requests	Pre	17.9	9.5	51.5	33.3	38.0	46.64
	Post	29.4	10.5	38.5	29.4		
% of communication acts that are comments	Pre	33.9	14.3	36.4	16.7	48.98	39.18
	Post	38.8	34.2	54.2	55.3		

^aAs defined in Wetherby et al. (1988).

^bRequests = requests for objects, actions, and routines.

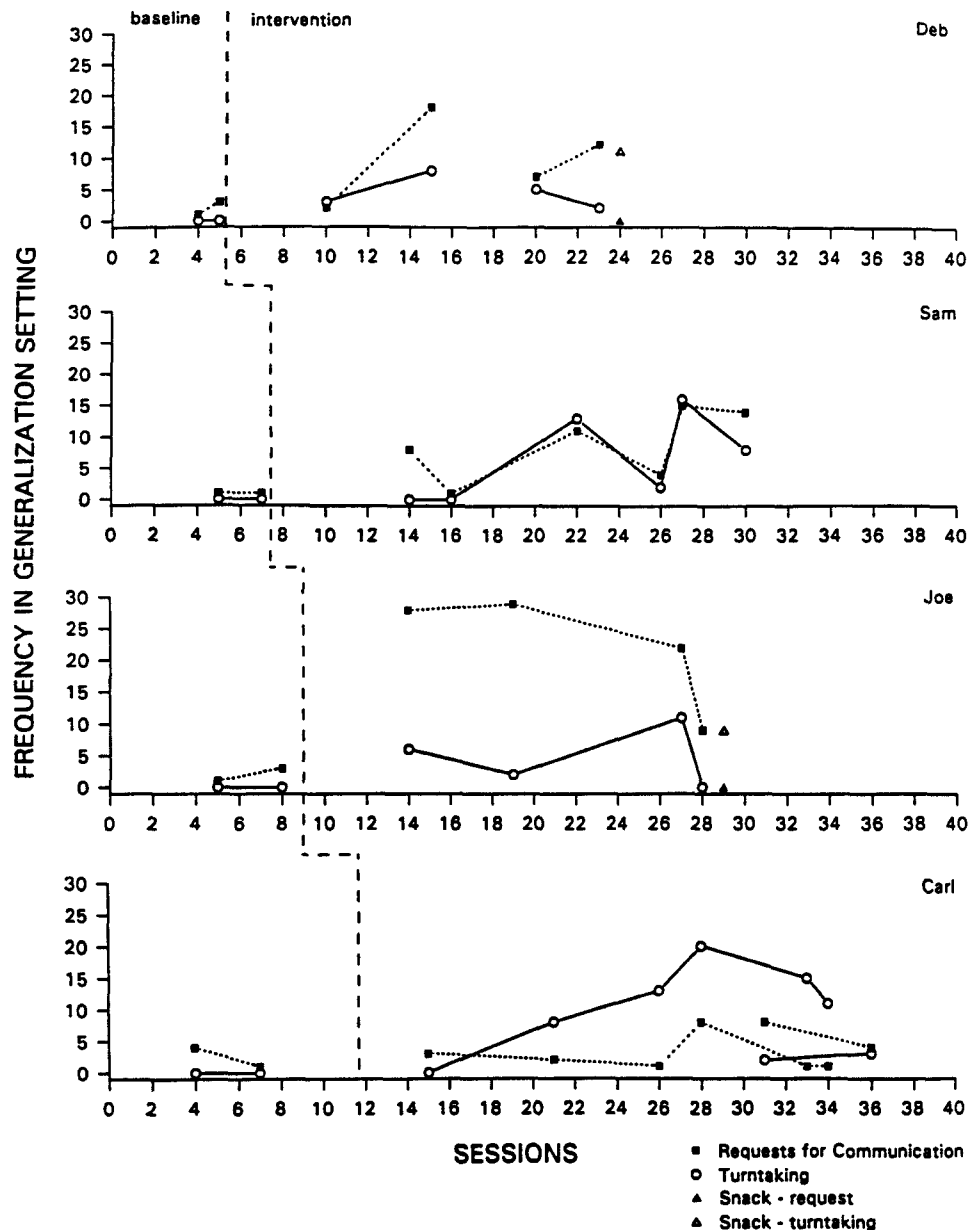


FIGURE 5. The frequency of requests for communication (darkened squares) and turntaking episodes (open circles) by classroom teachers in the generalization setting. Breaks in the data during intervention indicate data for different teachers for Deb and Carl. The open triangle on Deb and Joe's graphs indicate adult turntaking data taken during a snack time probe. The darkened triangles on Deb and Joe's graphs indicate adult requests for communication during the snack time probe.

General Discussion

The results of these two experiments suggest that a modified milieu teaching approach is a viable method for facilitating prelinguistic communication skills in young children with developmental delays. Based on applications of these procedures with children with mild to moderate mental retardation (like these subjects) in the early stages of prelinguistic language development, their effects on intentional prelinguistic functions like commenting and requesting should not be surprising. Several studies have demonstrated the efficacy of milieu intervention techniques for teaching

basic vocabulary (Kaiser et al., 1992) and for facilitating the development of the pragmatic forms of requesting and commenting (Warren & Bambara, 1989). Thus the present study represents an extension of the milieu intervention model to the period of communication development that immediately precedes initial word acquisition. Various procedural modifications were necessary to apply the milieu model at the prelinguistic level. However, the distinguishing characteristics of this model (i.e., a focus on following the child's attentional lead, embedding instruction within ongoing interaction, arranging the environment to elicit child responses, focusing on specific target behaviors, and using discrete

TABLE 4. Percentage frequencies of child requests and comments followed by adult linguistic mapping in the generalization setting.

Subject	Comments		Requests		Total	
	Baseline	Generalization	Baseline	Generalization	Baseline	Generalization
Deb	18% (2/11)	16% (3/19)	NA	38% (3/8)	18% (2/11)	22% (6/27)
Sam	0% (0/5)	12% (8/65)	NA	09% (1/11)	0% (0/5)	12% (9/76)
Joe	0% (0/9)	32% (7/22)	NA	64% (9/14)	0% (0/9)	44% (16/36)
Carl	0% (0/13)	28% (9/32)	NA	50% (4/8)	0% (0/13)	33% (13/40)
Group <i>M</i>	5%	20%	NA	41%	5%	25%

prompts when deemed necessary) were maintained in the present study.

Did the intervention facilitate fluency of existing skills simply by increasing their frequency or teach new skills that did not exist in the subjects' repertoires prior to the intervention? This is a difficult question to answer for a variety of reasons. All 4 subjects did request at least once during the CSBS administration. However, to be credited with a prelinguistic request using CSBS guidelines (Wetherby & Prizant, 1990), the child must direct a behavior to the adult (e.g., vocalize while looking at the adult) but not to both the adult *and* the object. In contrast, our definitions required "sequential or simultaneous attention to the adult *and* the object." That is, our definition requires evidence of coordinated attention, while the CSBS definition does not. We believe this distinction accounted for the difference between the subjects' performance on the CSBS and their performance during baseline. With the exception of one occurrence for Joe (which could have been accidental) and three for Carl, the subjects did not request in either the intervention or generalization settings during baseline. In short, we believe we did teach 3 of the subjects to intentionally request, but they were certainly "ready" to learn this function in the sense that they possessed many of the components of the skill, as indicated by their performance on the CSBS. We probably facilitated fluency, not acquisition, of requesting for Carl (given his display of three requests in baseline). But facilitating more frequent use is also important because doing so increases the opportunities for linguistic mapping.

The most important findings in Experiment 2 are the generalization effects demonstrated by the subjects. All 4 subjects demonstrated generalization from trainer to classroom teacher and across settings, materials, and adult interaction style. Two of the subjects demonstrated similar effects with other classroom teachers, and 2 demonstrated these effects in a snack-time probe. Since no baseline data were taken with these other teachers or at snack-time, the data are essentially anecdotal. Nevertheless, the extent of the generalization effects shown suggests that the subjects had substantially enhanced their repertoires of prelinguistic requesting in the course of the intervention. Furthermore, the

postintervention results of the CSBS assessment supports the generality of this effect. They suggest that the intervention may have had an overall impact on the subjects' communication. The effects obtained with vocal imitation in Experiment 1 and with commenting in both experiments were not replicated across subjects within an experimental design. Therefore, no conclusions should be drawn about the facilitation of these skills.

The extent of the changes in the teachers' behaviors in the generalization setting concurrent with the changes in the subjects' behaviors represented some of the most encouraging aspects of the results. We went to great lengths to ensure that the teachers remained naive to the specific goals of the intervention, the timing of the intervention for each child, and the intervention techniques and procedures being used. For this reason, the changes in the teachers' behaviors from baseline in the generalization settings appear most likely to be effects of changes in the subjects' interactive behaviors in the generalization setting. The fact that these effects occurred across four different teachers observed in the generalization settings with the subjects strengthens this interpretation of these effects.

Intriguing changes were also measured in the teachers' linguistic mapping of child intentional communications. The average increase in proportion of intentional communication followed by linguistic mapping was by an increment of .23. In light of the fact that three of the four classroom teachers were not linguistically mapping any intentional communicative acts during baseline, this increase is substantial. Linguistic mapping may be particularly important because it constitutes a behavior that is very similar to semantic expansions (Nelson, 1989). Such expansions have been found to be facilitative of language development in typically developing children and those with language impairment (Nelson, 1989).

The probability that adults would linguistically map child communication may have increased because child communicative acts became clearer and easier to interpret (Goldberg, 1977). This possibility is supported by the finding that proportionally more requests received linguistic mapping than did comments. Clinical experience suggests that it is often unclear what children really want from adults (e.g.,

labelling, verbal comment, acknowledgement, attention) when they comment, whereas it is usually more evident what a child wants when he or she requests. Thus, an increase in child requests should cause an increase in linguistic mapping, which is exactly what we observed. If adults linguistically map more communicative acts on the part of children, then the children receive more linguistic input that may further facilitate language development. Although this effect seems logical, further study is needed to determine the extent to which it actually occurs.

The changes in teacher behavior in the generalization settings most probably occurred because of the reciprocal nature of communication. As children began to request and take turns in thematic activities, their classroom teachers probably noticed these changes and responded with increased requests for these new skills. If they had not, then the generalization effects on child communication would probably have been transitory. These reciprocal effects on the teachers' behaviors, then, reflect appropriate adjustments of the social environment to changes in the child's repertoires. They may be necessary for generalization effects to persist, but they are unlikely to be sufficient to cause it to occur. If they were, training would not have been necessary in the first place.

An alternative interpretation of the generalization effects obtained is that the teachers knew the goals of training, knew how to elicit these behaviors, and that all four of them were successful at doing this when the intervention began even though we provided no training to these individuals and maintained our instructions to them from baseline through intervention. Although this alternative interpretation is plausible, it seems highly unlikely. Nevertheless, in one sense the teachers were clearly biased to achieve the same effects as the trainers in the treatment settings. That is, the fundamental task of these teachers was to support and enhance the development of the children. They did this not by specifically attempting to teach anything, but by responding to improvements in the children's behaviors with further requests for communication, with reciprocal turntaking in interactive formats, and with linguistic mapping.

The children's effects on the teachers observed in this study should be interpreted cautiously until they have been replicated. Nevertheless, it is worth considering the possibility that effects like those measured here may be particularly likely to occur during prelinguistic development for two reasons. First, any changes in the behavioral repertoire of a child at this stage will be relatively greater than changes that occur later when the total repertoire is larger. That is, because the child's repertoire of intentional behavior is so minimal in a relative sense at this point in development, changes are likely to be much more obvious to teachers, parents, and others. Second, teaching a child a basic function, such as to intentionally request, would logically seem likely to have a greater impact on others in the child's environment than teaching the child a new form for an old function later in development. If this were to be confirmed by further investigation, it might substantially buttress the case for very early intervention. In any case, experimental evidence supporting the causal effect of the child on the teacher's use of behaviors that may facilitate subsequent

development lends support to a central tenet of the transactional model of development (Sameroff & Chandler, 1975).

We noted at the outset that relatively little research has investigated the effects of prelinguistic intervention. The present study demonstrated clear effects of prelinguistic intervention with 5 young children who were developmentally delayed. Future investigations should attempt to replicate and extend this approach with other skills (e.g., protesting). Extensive analysis of reciprocal effects on teachers and parents is clearly warranted. Because of the fundamental role that intentional prelinguistic functions play in establishing early interactive communication, reciprocal effects with parents, teachers, and others may be more likely (or at least more observable) during this period of development than during later stages of the language acquisition process. Finally, longitudinal investigations of the effects of prelinguistic intervention on later linguistic functioning should be conducted. To ask this question it is necessary to first demonstrate that prelinguistic intervention has the type of generalized short-term effects evident in the present study. Unambiguous evidence of longitudinal effects (or the lack of them) will ultimately have important implications for our theories of how prelinguistic and linguistic development are related, as well as for policies governing very early communication intervention.

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