

Facilitating Prelinguistic Communication Skills in Young Children With Developmental Delay II: Systematic Replication and Extension

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Four children with mental retardation were studied in the context of a multiple baseline across subjects design. Staff members used a modified version of the milieu teaching method to facilitate intentional requesting. The results replicated the finding that a modified version of milieu teaching was effective in facilitating the use of intentional requesting by children with developmental delays in an intervention context (Warren, Yoder, Gazdag, Kim, & Jones, 1993). This study also extended the Warren et al. (1993) work by (a) documenting that increased intentional requesting generalized to sessions with the children's mothers, (b) demonstrating that mothers who were naive to the purposes of the study were more likely to linguistically map their children's prelinguistic communication after the intervention than before the treatment, and (c) that mothers and teachers who were naive to the purposes of the study linguistically mapped the children's intentional communication more than the children's preintentional communication. We discuss implications of these results for early intervention, the transactional theory of development, and the importance of the distinction between intentional versus preintentional communication.

KEY WORDS: children with mental retardation, prelinguistic communication, intervention, linguistic input, mothers

The present study attempted to replicate the findings of Warren, Yoder, Gazdag, Kim, and Jones (1993) that a modified form of milieu teaching facilitated increases in children's prelinguistic requesting in intervention sessions with staff members. Additionally, the present study attempted to extend the existing support for modified milieu teaching by demonstrating that child intentional requesting generalized to sessions with the subjects' mothers, who had been kept naive of the details of the study. Data were also collected to document the transactional effects of the intervention. This was done by observing whether the subjects' mothers increased the frequency and proportion of child communication that they linguistically mapped. Finally, we tested whether linguistic mapping, one type of language-facilitating behavior, was used more often after intentional prelinguistic communication acts than after preintentional acts.

The term *linguistic mapping of child communication* is used to refer to the adult verbally marking what the child is communicating nonverbally (Warren et al., 1993). For example, if a child reached for a cup and then looked at a teacher, the teacher's verbal response of "You want the cup" is a linguistic map of what the child intended to communicate. Linguistic mapping of child communication may be particularly likely to facilitate vocabulary development because a child is already attending to the

referent of the words an adult is modeling (Nelson, 1989). Past research on teaching vocabulary to children with mental retardation (Yoder, Kaiser, Alpert, & Fischer, 1993) and to children who are typically developing (Tomasello & Farrar, 1986) indicates that children acquire vocabulary more readily when a target word is modelled while a child is attending to the referent for the target word than when a target word is modelled at other times. The term *transactional effect* refers to changes in children caused by the intervention that, in turn, lead adults to use potentially language-facilitating behavior more often, even though they have not been trained to do so.

Warren et al. (1993) conducted one of the first experimental studies with children with disabilities that demonstrated the effect of children on adults' use of language-facilitating behaviors. They found that a staff-implemented intervention facilitated children's prelinguistic, intentional requesting within the intervention sessions. Relatively consistent generalization was seen in sessions with classroom teachers naive to the study's purposes who used nonintervention materials and interaction styles. They also found that naive classroom teachers linguistically mapped more of the children's communicative acts after the intervention than before it. Because the teachers were not informed of the nature of the intervention, the children's goals, or the children's progress during the intervention, it was inferred that changes in the teachers' interactions with the children were due to the changes in the children. The children's effect on the teachers' linguistic mapping of child communication is an example of a transactional effect.

The notion that children affect adults' behavior in ways that affect further child development is a central premise for many early intervention programs (Yoder & Warren, 1993) and the transactional model of development (Sameroff & Chandler, 1975). However, the evidence supporting this notion is almost all correlational (e.g., Smolak, 1987).

Evidence of children's generalization and transactional effects with mothers would lend further strength to the argument that the modified milieu teaching procedures can facilitate important generalization and transactional effects in young children with disabilities. Mothers are likely to be important influences on young children's development as well as one of their primary communicative partners. Therefore, the social and developmental importance of the intervention effects would be greater if generalization and transactional effects were seen with mothers, as well as with teachers. The Warren et al. (1993) study presented data suggesting such an effect on naive teachers, but that study did not include mothers.

It is probable that some changes in children are more likely to evoke adults' linguistic mapping of child communication more than others. We hypothesize that transactional effects may be more likely to occur when children's intentional communication behaviors increase than when preintentional communication behaviors increase.

A distinction between intentional and preintentional communication is long-standing in the scientific literature (e.g., Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). A primary distinction is that intentional communication has either (a) coordinated attention (i.e., evidence of simultane-

ous or alternating attention) between an object and the listener, or (b) conventional or symbolic communicative form (see Sugarman, 1984, for review).

During the prelinguistic period, the most frequently encountered distinction between preintentional and intentional communication is the occurrence of coordinated attention in intentional communication acts. Examples of coordinated attention are a child (a) shifting gaze from an object to a person and back to the object, and (b) showing an object to a person.

The rate of coordinated attention in the prelinguistic period predicts later language level in children who are normally developing (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979). The predictive relation between coordinated attention in the prelinguistic period and language level 12 to 13 months later also has been replicated in children with mental retardation (Mundy & Kasari, 1989; Smith & von Tetzchner, 1986) and in children with autism (Mundy, Sigman, & Kasari, 1990).

One reason why this relation may occur is that coordinated attention may evoke from mothers attributions that their babies are communicating more often than do more subtle cues (Yoder & Warren, 1993). Harding (1983) suggested that when parents attribute communicative value to their infants' behavior, parents are motivated to respond to the behavior.

In a sample of mother-child dyads in which children were typically developing, Yoder and Munson (1994) found a positive relationship between the amount of coordinated attention the children showed and the number of times the mothers said their babies communicated during a videotaped mother-child play session. The mothers also responded to their babies' communicative acts more often if the acts contained coordinated attention than if they did not (Yoder & Munson, 1994).

One type of adult response to infant communication that frequently occurs is linguistic mapping of child communication. This response is particularly likely to facilitate future vocabulary development (Nelson, 1989). Therefore, an increase of coordinated attention may result in proportionally more adult responsiveness to children's communicative acts, which in turn may influence children's later language development. This pattern may account, in part, for the relationship between early frequency of coordinated attention and later language.

However, it has never been established that mothers and teachers of children with disabilities are more likely to linguistically map children's communicative acts that have coordinated attention than those that do not. In fact, Yoder and Feagans (1988) advanced a theory that would predict a pattern of responding in mothers of children with disabilities that is different from the pattern seen in mothers of children without disabilities. Yoder and Feagans (1988) suggested that because children with disabilities remain in the prelinguistic stage so long, mothers may adapt to their babies' developmental level by attributing communication to and responding to very subtle communicative cues. The current study tested whether teachers and mothers, both naive to the purposes of the study, linguistically mapped intentional communication (most of which had coordinated attention) more

TABLE 1. Subject description on cognitive, communication, and SES variables.

	Subjects			
	A	B	C	D
Chronological age	23 mo	27 mo	21 mo	26 mo
Bayley:				
MDI	58	55	<50	<50
MA	17 mo	17 mo	10 mo	11 mo
CSBS:				
Rate of requests	.4/min	.59/min	0	.39/min
Rate of communication	1.52/min	.68/min	.73/min	1.67/min
Diagnosis	Down Syndrome	Developmental delay	Prematurity; Developmental delay	Down Syndrome
Mother's age	36 yr	32 yr	24 yr	45 yr
Family income/yr	\$41,796	\$3,500	\$6,000	\$19,536

Note. CSBS = Communication and Symbolic Behavior Scales (Wetherby & Prizant, 1990).

often than preintentional communication (none of which had coordinated attention).

In summary, the current study tested the following hypotheses: (a) Modified milieu teaching facilitates increased use of intentional requests in intervention sessions with members of the project staff and in generalization sessions with mothers. (b) Mothers, who did not know the specifics of the intervention or the children's progress in the intervention sessions, would linguistically map a greater number and proportion of the children's communicative acts during the intervention phase than during the baseline phase. (c) Classroom teachers and mothers would be more likely to linguistically map intentional communication acts than preintentional communication acts.

Methods

Subjects

All subjects were recruited from a university-based school for toddlers and preschoolers with developmental disabilities. They were selected on the basis of (a) presence of mental retardation as determined by the Bayley Scales of Infant Development (Bayley, 1969) Mental Development Index (MDI) < 70, (b) absence of speech, and (c) delayed production of intentional requesting as determined by performance in baseline sessions. Intelligence and prelinguistic status selection criteria were provided to administrators, who sent out consent letters to prospective subjects. After receiving signed consent letters, we further screened potential subjects to find four that attended school regularly and met our criteria on delayed intentional requesting assessed during three adult-child communication sessions. Once children were selected, one of our trained research assistants administered the Communication and Symbolic Behavior Scales (i.e., CSBS, Wetherby & Prizant, 1990). The Bayley was administered by a research assistant under the supervision of a licensed psychological examiner.

Specific information for each of the four subjects and their mothers is provided in Table 1. The mean age just before

intervention was 24.3 months (range 21–27 months). The subjects' Bayley MDI assessments indicated that all were functioning in the mild to moderate range of mental retardation. The children's rate of communication measured by the CSBS was much less than one would expect for children who were about 2 years old. The rate of requesting objects, actions, and routines and the rate of communication in general for children in the single-word stage in Wetherby and Prizant's (1990) sample is .97/min and 2.09/min, respectively. Given these data, these subjects communicated well below that expected for their chronological age. Additional information about their mothers is presented in Table 1.

Procedures

Design. A multiple-baseline design across subjects (Barlow & Hersen, 1984) was used to evaluate the effectiveness of the intervention. After a baseline measurement period, intervention was sequentially applied to teach prelinguistic requesting to all four subjects.

Setting. All subjects attended a university-based early intervention program for children (age birth to 3 years) at risk for developmental delays. All baseline and intervention sessions took place in a large playroom immediately adjacent to their classrooms. It was equipped with a children's kitchen area, a blackboard, a functioning sink, a wide variety of toys, and other age-appropriate play materials.

Baseline. Several baseline sessions were observed to determine the children's pretreatment communication levels for purposes of target selection and treatment evaluation. Baselines with members of the project staff were taken to help evaluate primary intervention effects. Baselines with the mothers were taken to increase representativeness of the baseline sessions and to evaluate generalization and transactional effects. During baseline sessions with staff, the staff member engaged in play activities with each child, but did not specifically direct or encourage communication. However, many opportunities to communicate were present during all baseline sessions. For example, while children were playing with some toys, other toys were just out of reach or clearly

visible, thus providing request opportunities. Mothers were instructed to "play with and talk to" the child during the generalization sessions throughout the study.

The length of the baselines varied by child as part of the multiple baseline design. For Subject A, the baseline period extended over 4 staff sessions and 2 mother sessions for a total of 6 sessions on six different days. For Subject B, the baseline period extended over 6 staff sessions and 2 mother sessions for a total of 8 sessions on eight different days. For Subject C, the baseline extended over 8 staff sessions and 3 mother sessions for a total of 11 sessions on nine different days (two staff and mother sessions occurred on the same day). For Subject D, the baseline extended over 10 staff sessions and 2 mother sessions for a total of 12 sessions over eleven days (one staff and mother session occurred on the same day).

Pretreatment use of the training target. Each child's rate and function of prelinguistic, intentional, and preintentional communication were assessed during the initial baseline period. During the baseline period, prelinguistic requesting with staff and mothers was below expected levels for all four subjects.

Subject A had 1 instance of intentional requesting in 60 minutes of baseline observations (.02/min). Subject B had 3 instances in 80 minutes of baseline observations (.04/min). Subject C had 3 instances in 110 minutes of baseline observations (.03/min). Subject D had 11 instances in 120 minutes of observations (.09/min).

Intervention. The intervention was implemented by two members of the project staff. These individuals had substantial experience using milieu teaching approaches to facilitate the acquisition of prelinguistic requesting and commenting, 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, 1992; Warren & Bambara, 1989; Warren & Gazdag, 1990; Warren et al., 1993). Each subject had a primary and secondary trainer. The child's primary trainer (the same individual for all four subjects) conducted intervention sessions 3 days per week. The secondary trainer conducted intervention sessions 1 day per week. Two trainers were used to facilitate across-person generalization.

Training sessions were conducted 4 days per week for about 25 minutes each. A total of 56 training sessions were conducted with Subject A, 61 with Subject B, 54 with Subject C, and 35 with Subject D.

During intervention sessions, environmental arrangement, following the child's attentional lead, and social routines provided enabling contexts for using direct prompting techniques to facilitate intentional requesting. 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 known. 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 toys, 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 of interest to the child and in a manner similar to the child's play.

Social routines were familiar turn-taking 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 routines were used to evoke communication and to create a context in which children were presumed to be most likely to attend to instructional episodes.

Once the child was well engaged in an activity, the trainer used various direct prompts to 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 restart the activity) or "Do you want this?" while holding an object the child needed to resume the activity. If the child did not respond or gave an incorrect or incomplete response, the trainer assisted in completing or correcting the child's response. For example, if the child looked at the toy and displayed a discrete action or vocalization but did not look at the trainer, the trainer prompted the child to look at the adult (i.e., moved the desired object toward the adult's face and said, "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 child communication—for example, by saying "What?" to indicate 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 behavior. As the intervention proceeded, intentional requests could be elicited simply by stopping the routine.

Testing for generalization and transactional effects. Sessions to test for generalization were conducted with mothers during the baseline and intervention phases and with teachers during the intervention phase. Sessions with mothers were conducted to assess generalization of child communication across adult interactors, setting, materials, and interaction style. Additionally, these 10-minute sessions provided the context to measure changes in the mothers' linguistic mapping of child communication. It was not possible to conduct generalization sessions with the same teacher during the baseline period and intervention periods because the children unexpectedly changed classrooms during the early part of the intervention phase. Therefore, we could not assess treatment effects on child requests with their teachers. However, data from the generalization sessions with the teachers during the intervention phase were combined with data from the generalization sessions with mothers to compare the extent to which naive adults linguistically mapped various types of child communicative acts.

In order to assess whether increases in linguistic mapping of child communication from the mothers were in response to increases in child communication skills, mothers were kept naive to the intervention, research design, and study results. Mothers were not allowed to observe the intervention sessions. They did not know when the intervention sessions began. They were never shown the children's increased rate of requesting in the intervention sessions. Finally, they did

TABLE 2. Behavioral definitions.

Variables	Definitions	Examples
Linguistic mapping	Adult verbally states the noun or verb or routine referent of the child's immediately preceding communicative act and preintentional signal	C: when leaving the room the child waves A: "bye-bye" C: When child looks at ball and points A: "ball"
Requests for communication	Adult uses verbal, vocal, and/or gestural means to encourage the child to communicate	A: in a give-and-take game, adult holds up toy and waits expectantly for child to request A: in a block building game, adult withholds a block, shows it to the child and says "What do you want?"
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 his/herself, but not as a request. This category includes comments, 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) C: says "ba," looks at the adult and the toy
Preintentional signal	Child tries to convey a request, comment, or protest, using a behavior that misses one critical component (e.g., a look to the object, look toward the adult, discrete action, or vocalization) of the definition for intentional communication.	C: vocalizes and looks at adult (without a look at object) C: reaches toward objects and looks at object (without a look at adult) C: vocalizes and looks at object (without a look at adult)
No codeable behavior	No codeable behavior occurs for at least 5 seconds	C: plays and babbles to self for 30 seconds A: washes hands at sink for 1 minute

not know that child intentional requesting was the intervention goal.

Generalization sessions with the children's classroom teachers were held in the child's classroom. Generalization sessions with the children's mothers were conducted in the intervention setting.

The materials used represented different examples of the same types of toys used in the intervention. For example, training occurred with certain musical instruments (e.g., drum, xylophone), but a piano was not included in the training materials. In the generalization sessions, a piano was included in the test materials.

Data collection. Videotape was used to collect data on a range of adult and child behaviors. Twenty-five percent of all baseline and intervention sessions with members of the project staff were videotaped, and all of the generalization sessions with mothers and teachers were videotaped. To sample the 25-minute baseline, intervention, and generalization sessions, videotaped data samples were collected for the middle 10-minute period of these sessions. Use of a data sample instead of the entire interaction session allowed us to code more observation sessions with the resources we had available than would have been possible if we had recorded and coded all 25 minutes of all the interaction sessions. Given the amount of adult-child interaction in most sessions, this time period was considered sufficient to adequately sample child and adult behavior.

Observation system. Adult behavior was coded for (a) linguistic mapping of an immediately preceding child communication, and (b) requests for child communication. Child behavior was coded for (a) intentional prompted requests,

(b) intentional self-initiated requests, (c) other instances of intentional communication (e.g., comments, protests, greetings), and (d) preintentional signals. When no codeable behavior occurred for at least 5 seconds, this segment 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. A preintentional signal was defined as a behavior that (a) reasonably conveyed a request, comment, or protest, and (b) had only two of the three critical behaviors that defined intentional communication (i.e., attention to object, attention to adult, or discrete action or vocalization). Specific child and adult coding categories are defined in Table 2.

Interobserver agreement. Interobserver agreement on observational coding was assessed by having two observers independently code 23.4% of the observed sessions. These records were then compared on a point-by-point basis for agreement on coding of adult and child behaviors described by the variables listed. A disagreement occurred when the two observers recorded a different code for the same behavior, 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 computed by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100.

The mean reliability for intentional requesting for all subjects was 90.9% (range: 85.7–100%). The reliability for other

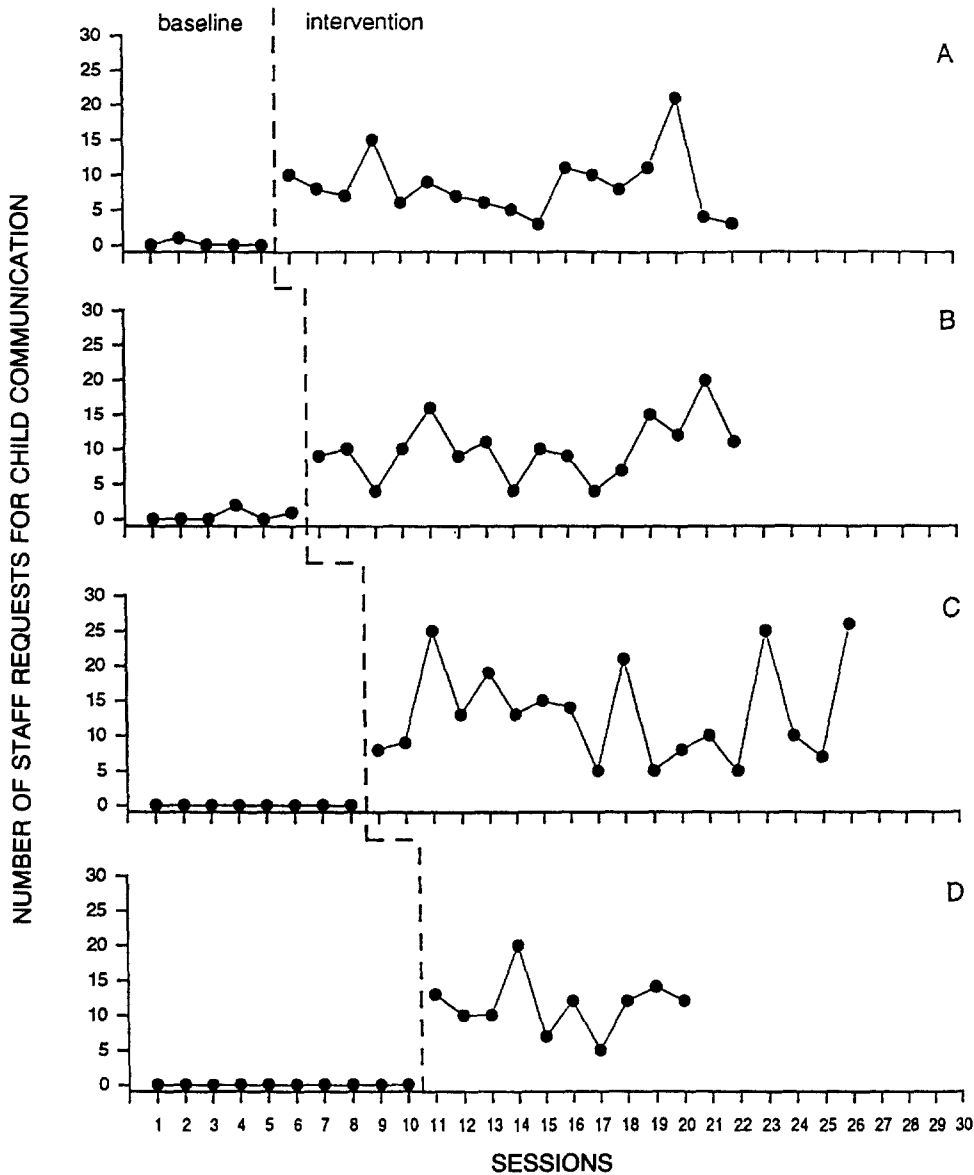


FIGURE 1. The number of staff requests for child communication per intervention session.

intentional communication was 84.9% (range: 83.3–86.4%). The mean reliability for preintentional signals for all subjects was 81.2% (range: 68.8–87.2%). The mean reliability for both teacher and mother linguistic mapping of child communication was 91% (range: 82–100%). The lowest percentage agreement was for one subject's preintentional signals (68.8%). Possible consequences for the suggestion of possibly low reliability of coding preintentional signals in some subjects will be reviewed in the Discussion section.

Results

Changes in Interventionists' Behavior

Figure 1 illustrates the number of project staff members' requests for child communication during the baseline and intervention phases per 10-minute sampling. These data

represent our measure of the independent variable. As illustrated, staff members almost never used requests to communicate during baseline, and they used between 5 and 25 requests per 10-minute session during the intervention period. It should be noted that these data include communication prompts of all levels of intrusiveness.

Changes in Children's Communication: Intervention and Generalization Effects

Figure 2 illustrates the changes in the number of child intentional requests in the 10-minute samples from baseline to intervention phases. In the intervention sessions with the staff member (represented by the circles), there is an abrupt shift in the intercept and slope for Subjects A, B, and C with the onset of intervention. There is an abrupt shift in the slope for Subject D with the onset of intervention. Both types of

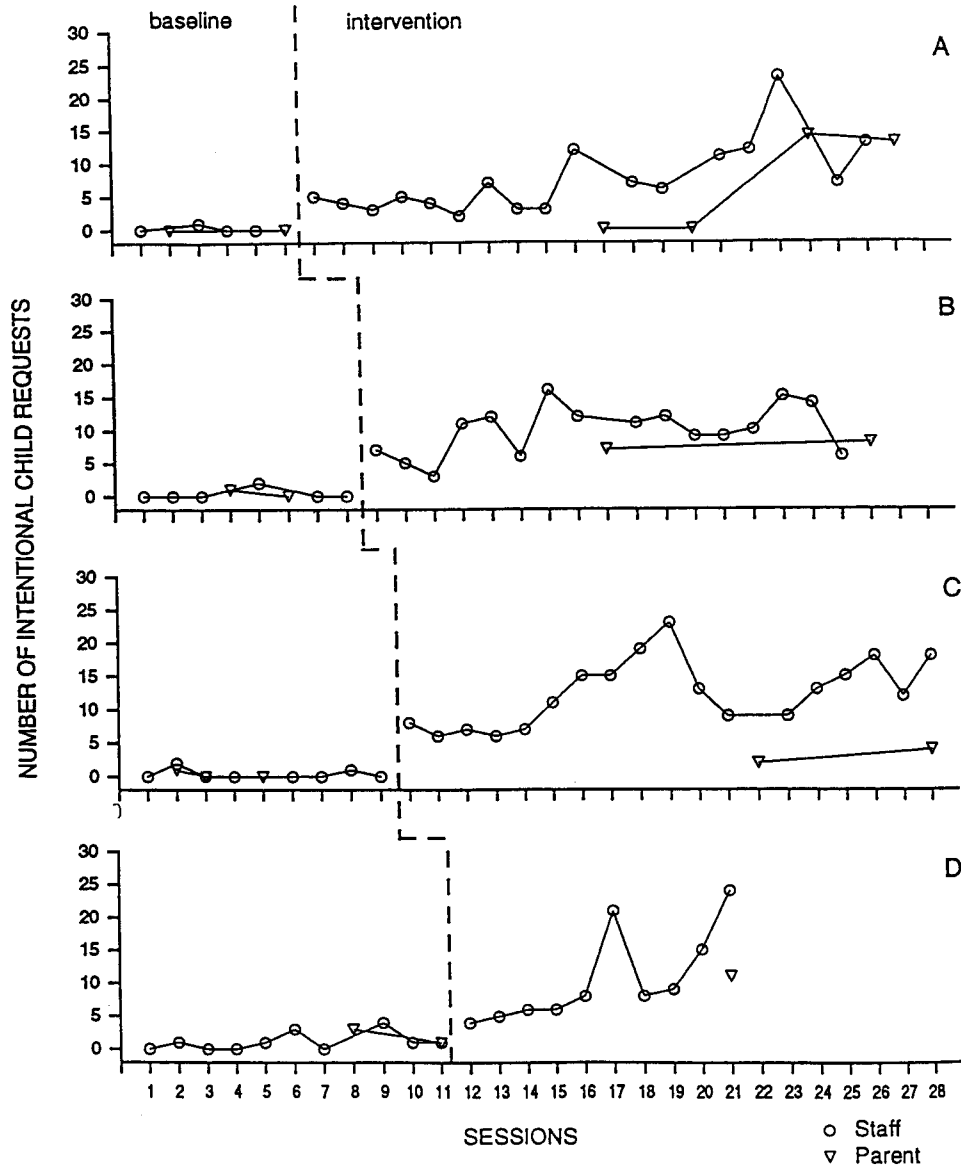


FIGURE 2. The number of child intentional requests to staff (open circles) and mother (open triangles).

shifts represent evidence of an intervention effect within the treatment setting with the interventionists (Barlow & Hersen, 1984).

In the generalization sessions with the mothers (represented by triangles), all four children showed gains in the number of intentional requests. It is noteworthy that for Subjects A and B, the number of requests with mothers near the end of the intervention phase is nearly at the level that occurs with staff members, who frequently prompted requesting.

To determine how much of the requesting seen during the last half of the intervention was due to adult prompts of communication, we computed the proportion of intentional requests that were self-initiated (did not occur after adult prompts) during the last three sessions of the intervention phase. With the staff members, an average of .53 of the

requests were self-initiated ($SD = .04$). With the mothers, an average of .71 of the requests were self-initiated ($SD = .20$).

Table 3 illustrates how the increases in intentional requests may have affected qualitative changes in how the children communicated with their mothers. The data in Table 3 are summed across all baseline sessions with the mother and summed across all generalization sessions with the mother during the intervention phase. Although there were many opportunities for linguistic mapping of child communication during the baseline phase, these communicative acts were rarely linguistically mapped. The proportion of child communicative acts (both intentional and preintentional) that were intentional requests increased in all four children during the intervention phase. Finally, the proportion of child intentional communicative acts (excluding preintentional acts) that

TABLE 3. Changes in the proportion of child communicative acts that are intentional requests in generalization sessions with mothers.

Mother	Phase	No. of total communicative acts/10-min session	Percentage of preintentional and intentional communicative acts that are intentional requests	Percentage of intentional communicative acts that are intentional requests
A	Baseline	17	0	0
	Intervention	20.5	33	48
B	Baseline	6.5	8	20
	Intervention	17.5	43	58
C	Baseline	7	5	25
	Intervention	24	13	60
D	Baseline	24	8	14
	Intervention	48	23	69
Baseline, <i>M</i>		13.6	5.3	14.8
<i>SD</i>		8.4	3.8	10.8
Intervention, <i>M</i>		27.5	28	58.8
<i>SD</i>		13.9	13.9	8.6

were intentional requests also increased in all four children during the intervention phase.

Changes in Naive Mothers' Behavior in the Generalization Sessions: Evidence of Transactional Effects

To describe possible changes in how mothers, whom we did not train, reacted to the changes in their children's communicative growth during the intervention, we coded the number of mothers' utterances that linguistically mapped their children's intentional and preintentional communicative acts. All mothers increased the number of times they linguistically mapped their children's communicative acts. On average, the mothers linguistically mapped their children's communicative acts at a rate of .55 per 10-min (*SD* = 1.13; range = 0-3) session during the baseline phase and 3.8 per 10-min session (*SD* = 3.11; range = 2-10) during the intervention phase. The increase in linguistic mapping of child communication was not due solely to increased opportunities for mothers to linguistically map their children's communicative acts.

Figure 3 illustrates the changes in the percentage of child communicative acts that mothers linguistically mapped. All four subjects also showed increases in the percentage of child communication acts that mothers linguistically mapped during intervention phase generalization sessions. This increase is more dramatic and better documented for Subject A than for the other subjects because of the greater number of generalization sessions for this subject.

Comparing the Probability of Linguistic Mapping After Intentional Versus After Preintentional Communicative Acts

We compared the transitional probability of the teacher and mother linguistically mapping intentional versus preintentional communicative acts. *Transitional probability* is a term used in the sequential analysis literature (e.g., Bakeman & Gottman, 1986) to mean the number of times a particular

consequent event (e.g., linguistic mapping) follows a particular antecedent event (e.g., intentional child communication) divided by the total number of times the antecedent event occurs (e.g., intentional child communication). The data for this comparison were taken from all intervention phase generalization sessions with mothers and with teachers.

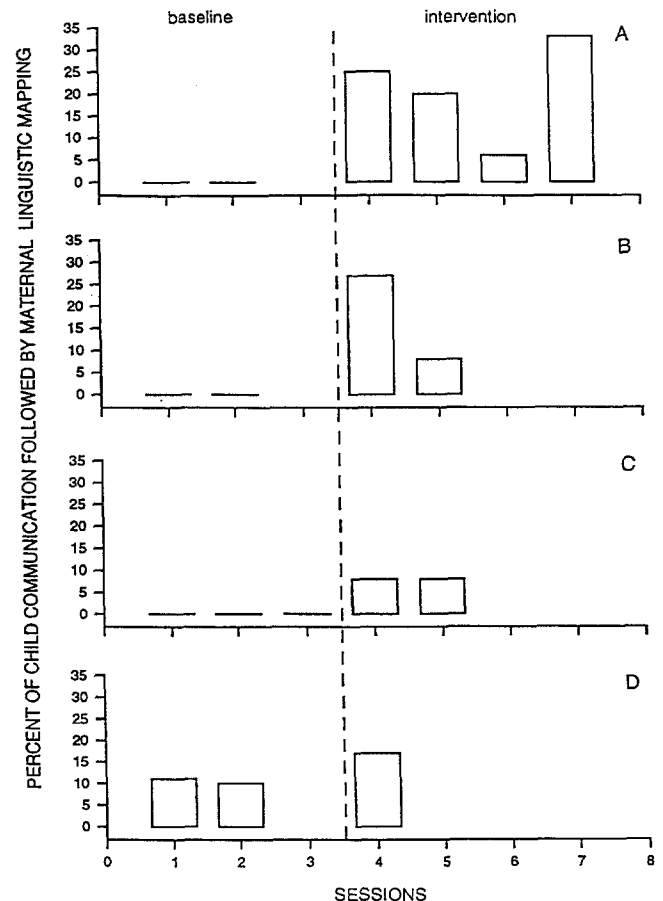


FIGURE 3. The percentage of child communicative acts that mother linguistically maps.

TABLE 4. Transitional probability of adult linguistic mapping after various types of child communicative acts during intervention phase generalization sessions.

	Intentional acts	Preintentional acts
Subject A		
Teacher	.23	.09
Mother	.20	.19
Subject B		
Teacher	.53	.4
Mother	.15	.11
Subject C		
Teacher	.41	.23
Mother	.30	.03
Subject D		
Teacher	.37	.09
Mother	.50	.00
<i>M</i>	.34	.14
<i>SD</i>	.14	.13

Within each dyad, we collapsed the data from the intervention phase sessions to get one, reasonably large denominator per dyad in order to compare the transitional probabilities. We collapsed data from intervention phase sessions instead of using data from individual sessions or baseline sessions because the latter strategy would have resulted in small denominators and therefore widely variable proportions of questionable meaning. Because these transitional probabilities have the same consequent behavior (linguistic mapping of child communication), the base rate of the consequent behavior is the same for all comparisons; thus avoiding the base rate problem that is frequently discussed in the sequential analysis literature (Bakeman & Gottman, 1986). We used the Wilcoxon matched-pairs signed-ranks test to determine whether the observed differences were likely to be a chance pairing of the data. The results indicate that teachers ($z = 1.83$; $p = .035$ using a 1-tailed test) and mothers ($z = 1.83$; $p = .035$ using a 1-tailed test) linguistically mapped intentional communicative acts more than preintentional communicative acts. A one-tailed test was used because we were testing an a priori hypothesis with a small sample. As indicated in Table 4, this hypothesis was supported in all eight teacher-child or mother-child dyads.

Discussion

The results of this experiment replicated the Warren et al. (1993) finding that a modified milieu teaching approach is an effective method for facilitating intentional, prelinguistic requesting in young children with mental retardation in their interactions with teachers. The current study extended these findings by showing that this intervention facilitates generalized prelinguistic communication in children's interactions with mothers, as well as with teachers. This adds to the growing body of literature that demonstrates the efficacy of milieu intervention techniques for teaching early language skills (Kaiser, Yoder, & Keetz, 1992).

It should be noted that the sessions to assess generalization during the intervention phase were conducted well after

intervention had begun. The average number of intervention sessions between treatment onset and the first generalization session with the mother was 38.75 ($SD = 5.6$). The generalization sessions with the mothers were relatively few because it was difficult to get mothers into the laboratory for sessions. Because of the children's retardation and the nature of generalization with these children, generalization effects were not expected to be immediate. Therefore, we chose to schedule the generalizations well into the intervention phase. Nevertheless, we recommend appropriate caution in interpreting treatment effects of multiple baselines when dependent variables of interest change slowly.

Replication of possible treatment effects in the context of multiple baselines across subjects leads us to infer a treatment effect on the generalization of prelinguistic requesting with moderate confidence. The four subjects in this study and the four subjects in the Warren et al. (1993) study all showed increases in intentional requesting in generalization sessions. This increase in eight subjects makes it unlikely that maturation happened to "kick in" during the intervention phase. However, a study with an experimental group and a control group would improve our confidence that the treatment facilitated generalized development of prelinguistic communication because such designs do not require immediate shifts in intercept or slope in the dependent variable at the onset of the treatment to infer treatment effects.

In the current study, general communication also increased in generalization sessions. One possibility is that increased intentional requests, the intervention target, could account for some of the growth in intentional communication in general. This interpretation is supported by the finding that the proportion of intentional communication that was intentional requesting increased from the baseline to the intervention phase. No claim is made here that the intervention resulted in increases in other functions of communication, although this may have occurred. Future research will have to be conducted to determine if a prelinguistic communication intervention that targets requesting results in increased communication for other pragmatic functions.

The current study extended the Warren et al. (1993) finding that teachers increased the number and the proportion of child communicative acts that they linguistically mapped to a similar finding with mothers. It is important to note that the mothers did not know the specifics of the intervention nor did they have information about their children's performance during the intervention sessions. Therefore, it seems reasonable that increases in mothers' linguistic mapping of child communication during the generalization sessions were due to mothers noticing and responding to the induced changes in their children's behavior.

Increasing child intentional requesting may help mothers notice the child's communicative attempts because requests require a response from the mother. In the present study, not only the frequency of intentional requests increased, but also the proportion of communicative acts that were intentional requests increased. Therefore, when children did communicate, they were more likely to ask their mothers to do something. Consequently, the mother may have become more aware of her child's communicative efforts in general and so linguistically mapped a greater proportion of these.

Wilcox, Shannon, and Bacon (1992) have presented longitudinal experimental data suggesting that a prelinguistic communication intervention in which mothers and professionals were taught to interpret, respond, and linguistically map children's communicative cues resulted in long-term gains in children's language levels. The subjects were young children with developmental disabilities. Together with the present results, it is interesting to speculate that adult responsiveness may have shaped children's more frequent intentional communication, which in turn may evoke more adult linguistic mapping of child communication, which in turn may facilitate child language development (Yoder & Warren, 1993). Neither Wilcox et al. (1992) nor the present study directly tested this hypothesis. A longitudinal experiment involving a large group of children who have experienced staff-implemented intervention and a control group, with observations of changes in mothers' linguistic mapping of child communication and children's later language level, will be necessary to provide a strong test of this hypothesis. Such a group longitudinal experiment will strengthen the internal validity of the findings regarding possible transactional effects of the intervention.

The current findings also indicate that mothers and teachers are generally more likely to linguistically map intentional communicative acts than preintentional communicative acts. This difference occurred despite the possibility of fairly high measurement error in the coding of preintentional signals in some children. The preintentional signals of one subject in the reliability sample was coded with only 68.8% reliability. Using a different definition of preintentional signal, Yoder (1987) found that it is quite difficult to obtain uniformly high point-by-point agreement in coding preintentional communication, particularly in children with severe disabilities (Yoder, 1987). Yoder (1987) argued that this was at least in part because the clarity of children's communication tends to decrease as severity of child disability increases. Fortunately, in most cases, increased measurement error reduces the probability of finding systematic differences and patterns in data because there is more nonsystematic variation in the data (Pedhazur, 1982).

The current finding that adults respond to intentional communication more than to preintentional communication corroborates Yoder and Munson's (1994) finding. They report that mothers of normally developing infants interpreted and responded to their babies' behavior more frequently when infant cues involved coordinated attention than when cues lacked coordinated attention. Coordinated attention is the most frequently occurring distinction between intentional and preintentional communication during the prelinguistic period (Sugarman, 1984 for review). Infant communication with coordinated attention may evoke more maternal responses because such infant communication is more salient and more readily interpreted than infant communication without coordinated attention. The results of the Yoder and Munson (1994) study and the current study support Goldberg's (1977) theory that clarity of cue is an important way that children affect mother's responsivity to the children's communication. Such information is valuable in understanding more about those aspects of children's behavior that serve as catalysts for changes in their family systems that will

in turn support future child development (Sameroff & Chandler, 1975).

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