The Effects of Trainer-Implemented Enhanced Milieu Teaching on the Social Communication of Children with Autism

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This study examined the effects of Enhanced Milieu Teaching on the social communication skills of preschool children with autism when delivered by trained interventionists. A modified single-subject design across four children was used to assess the children's acquisition, maintenance, and generalized use of language targets and social communication skills as a result of the intervention. Observational data indicated that all children showed positive increases for specific target language use at the end of 24 intervention sessions, and these results were maintained through the 6 month follow-up observations. There was also evidence of positive changes in the complexity and diversity of language for children on observational measures. Three of the four children also generalized these positive language effects to interactions with their mothers at home, with the greatest changes seen immediately after the intervention. Parent satisfaction with the intervention procedures and child outcomes were high.

Autism is a pervasive developmental disorder that is defined by marked difficulties in social interaction and acquisition of adequate social communication skills. Children diagnosed with autism span the range of cognitive abilities; about 70% will test in the mentally retarded range (Edwards & Bristol, 1991). Although individuals with autism vary widely in the extent to which they manifest the symptoms associated with autism, nearly all children with autism will require intervention to support the development of communication skills. Research has demonstrated that systematic intervention cannot only improve the language and social skills of children with autism, but it can also positively influence the behavioral, social, and academic outcomes for these children (Anderson, Avery, DiPietro, Edwards, & Christian, 1987). Conversely, without effective early social communication intervention, the behavioral symptoms associated with autism are likely to be more severe and disruptive to the individual's development and daily living (Durand & Carr, 1992).

Studies have demonstrated that children with autism can benefit from the application of behavioral procedures to teach specific language skills (Koegel, O'Dell, & Dunlap, 1988; Lovaas, 1987; McEachin, Smith, & Lovaas, 1993). Naturalistic teaching methods have also been shown to be successful in teaching new skills to children with autism (Koegel, Koegel, & Surratt, 1992; Koegel, O'Dell, & Koegel, 1987; Laski, Charlop, & Schreibman, 1988; McGee, Krantz, & McClannahan, 1985). Naturalistic strategies begin with the learner's intention to communicate and the trainer's ability to systematically provide models of appropriate communication forms and meaningful social consequences for communication attempts.

It is clear that for language intervention to be effective with children who have autism, it is important that (a) the intervention begins early; (b) the intervention targets the social use of language, not just the content of language; and (c) the intensity and duration of the intervention are sufficient to support the acquisition and generalized use of new skills (Wetherby & Prizant, 1992). Although there are a growing number of intervention studies examining the effects on acquisition of language for children with autism, no known studies to date specifically explore whether those changes in children's lan-

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guage generalize to interactions with their parents. Parents of children with autism frequently report their desire to communicate with their children in ways that are functional for both parent and child (Norton & Drew, 1994). In reality, disrupted parent–child communication interactions are frequent in families of children with autism, and difficulty in communication can exacerbate challenging behaviors exhibited by some children with autism (Landa, Folstein, & Isaacs, 1991; Lemanek, Stone, & Fischel, 1993). Generalization of children's language skills to significant people in their lives cannot be assumed to happen as a result of a language intervention because children with autism have particular difficulty in generalizing social communication skills across settings and people. Given the significance of communication within the context of the family, it is extremely important that any language intervention with children with autism also explore the effects of that intervention with their families.

Enhanced Milieu Teaching

Enhanced Milieu Teaching (EMT) is a hybrid approach to naturalistic, early language intervention. EMT incorporates aspects of both behavioral and social interactionist approaches to language intervention. There are three components of EMT:

1. environmental arrangement to promote child engagement with activities and communication partners (Ostrosky & Kaiser, 1991);
2. responsive interaction techniques to build social, conversational interaction and to model new language forms (Weiss, 1981); and
3. milieu teaching procedures to prompt, model, and consequate the use of new language forms in their functional contexts.

Milieu teaching procedures include elicitive modeling, mands followed by models (Warren, McQuarter, & Rogers-Warren, 1984), time delay (Halle, Baer, & Spradlin, 1981), and incidental teaching (Hart & Risley, 1975). EMT has been shown to be effective in teaching new generalized language skills to children with developmental disabilities (Hemmeter & Kaiser, 1994; Kaiser & Hester, 1994).

Studies of milieu teaching with children with autism have shown that naturalistic language teaching can be effective in teaching them new social communication skills (Gartner & Schultz, 1990; Hunt, Alwell, & Goetz, 1988). Results reported in language intervention studies with children with autism have been generally positive: Children learned, and in some cases, generalized the targeted language responses. Typically, small sets of language skills were taught (e.g., labels, actions, requests); only one study (Scherer & Olswang, 1989) targeted early semantic relations (i.e., two-word commenting utterances). Increases in spontaneous language were observed as a generalized effect of the intervention in some studies (McGee et al., 1985; Scherer & Olswang, 1989).

The definition of *naturalistic language teaching* varies widely in reported research studies from direct and incidental teaching procedures in everyday settings (Anderson et al., 1987; McGee et al., 1985) to responsive interaction strategies (expansions, building turn taking, following the child's lead; Gartner & Schultz, 1990; Hunt et al., 1988; Schreibman, Kaneko, & Koegel, 1991). Two studies have blended prompting language responses with aspects of responsive interaction (Koegel et al., 1987; Schreibman et al., 1991). None of the studies employed the range of responsive interaction techniques that are foundational to EMT. Overall, the descriptions of the intervention procedures in past studies suggests that these procedures were less naturalistic, more structured, and more oriented toward instruction than the application of EMT in the present study. Most important, the majority of reported studies focused only on teaching new language skills rather than building conversational interaction or supporting child participation in social communicative interactions. None of the studies explored the effects of changes in children's language with their parents.

In a previous study (Kaiser, Hancock, & Nietfeld, 2000), we examined the effects of EMT when implemented by six parents of young children with autism. The parents learned to use these naturalistic language intervention strategies during 24 individual training sessions and generalized their use of the strategies to home interactions with their children. Positive effects were observed on the use of communication targets for all children and on the complexity and diversity of productive language for most children. Child effects generalized and maintained for four of the six children, and there was evidence of change on developmental assessments of language for five of six children.

The Kaiser et al. (2000) study provided an important context for the current examination of EMT implemented by skilled therapists, particularly in terms of examining the effect of the intervention on interactions within families. The findings of Kaiser et al. indicated that EMT is an effective early communication intervention for children with autism and that parent–child interactions are positively affected by teaching parents to implement the EMT procedures. In the current study, we focus on the application of EMT by skilled therapists and examine changes in parent–child interactions at home resulting from children's exposure to the EMT procedures in the clinic. Thus, we investigated the indirect effects of naturalistic communication training on children's interactions in the family.

Purpose of Study

The purpose of this study was to examine the effects of trainer-implemented EMT on the language performance of preschool children with autism. Four questions were posed:

1. What changes in child language targets and social communication skills will be observed during the clinic applications of EMT by trained interventionists?
2. Will changes in child language targets and social communication skills be maintained over time?
3. Will changes indicative of child language development be observed?
4. Will changes in child language generalize to interactions with parents at home?

Method

Participants

Four preschool children with autism and their mothers participated in the study (see Table 1). The children were diagnosed as having autism or pervasive developmental delay with autistic symptoms by an independent child evaluation clinic before participating in the study. Each child met the following criteria: (a) The child was between 2½ and 5 years of age, (b) the child had at least a 6-month delay in expressive language as measured by the *Sequenced Inventory of Communication Development* (SICD; Hedrick, Prather, & Tobin, 1983), (c) the child was verbally imitative, (d) the child had an expressive vocabulary of at least 10 spontaneous words, and (e) the child's hearing was within the normal range as measured by an audiometric assessment. In addition, the children's parents met the following criteria: Parents consented to (a) bring the child to the clinic setting twice each week during the intervention phase and once each month for 6 months during the follow-up phase, (b) allow project staff to complete nine home visits over the course of the study, and (c) be videotaped at home with their child and allow their child to be videotaped with the trainer at the clinic.

The children were three boys and one girl (Child B) with a mean age of 44 months (range 35–54 months). All children had expressive and receptive language skills in the 20- to 28-month range (Expressive Communication Age [CA] M = 25 months, Receptive CA M = 21 months) as tested by the SICD. The children's average Mean Length of Utterance (MLU) at entry was 1.29 (range 1.03–2.00), and their measured IQ scores ranged from < 50 to 95.

Three individuals served as interventionists for the four children. One interventionist who worked with two of the four children (Child A and Child D) had a master's degree in special education and had completed 36 hours toward her doctorate in special education. The interventionist for Child B had a bachelor's degree in education and had completed 24 hours toward her master's degree in special education. The interventionist for Child C had

TABLE 1. Participants

Child	CA in mos	Gender	Diagnosis	Language age in months (SICD)	IQ	Targets
A	50	boy	Autism	20–E[a] 20–R[b]	< 50[c]	Agent-action Action-object Attribute-object 2-word request
B	38	girl	PDD	28–E 24–R	95[d]	Agent-action-object Attribute-object Preposition-object 3-word request
C	35	boy	PDD	24–E 20–R	< 50[c]	Agent-action Action-object Attribute-object 2-word request
D	54	boy	Autism	28–E 20–R	52[d]	Agent-action-object Attribute-object 3-word request

Note. CA = chronological age; PDD = pervasive developmental disorder. [a]E = Expressive language age as measured by the *Sequenced Inventory of Communication Development* (SICD; Hedrick, Prather, & Tobin, 1983). [b]R = Receptive language age as measured by the SICD. [c]Mental Developmental Index score (MDI) as measured by the *Bayley Scales of Infant Development–2* (Bayley, 1993). [d]Full Scale IQ score as measured by the *Wechsler Preschool and Primary Scale of Intelligence–Revised* (Wechsler, 1989).

a master's degree in human development and had completed 30 hours toward her doctorate in child psychology. She had 7 years' experience working directly with children with autism and 1 year of experience implementing naturalistic language teaching procedures with preschool children who had disabilities.

Settings

All child training sessions (baseline, intervention, follow up) took place in a small playroom at a university-based clinic setting. The room was equipped with two adult chairs, a small table with child-size chairs, two cabinets for storage of toys and play materials, and a video camera. A variety of age-appropriate toys of interest to the children were provided (e.g., blocks, markers and paper, cars and trucks, balls and chutes, bubbles).

Probes to assess the generalization of children's language skills with their parents were conducted in the families' homes. The sessions were videotaped in a room of the parents' choice, typically in either the family living room or the child's bedroom, using the child's toys. Parents were asked to stay in the same room with their child during the entire session, with the television turned off. The videotaped sample of parent–child interaction was 15 minutes in length.

Measurement

Four classes of variables were assessed in this study: (a) trainer use of the intervention strategies, (b) child social communication during observations, (c) developmental measures of child language, and (d) parent satisfaction with the intervention program.

Trainer Implementation Measures. Measures of implementation by the interventionists reflect the integrity of the intervention delivered to the children in this study. These measures included the key components of the intervention, including correct use of all milieu procedures, talk at the child's target level, expansions, balance of turns, responsive feedback, pause errors, and not following the child's lead. The trainer measures were coded from videotapes during clinic sessions using the *Combined Milieu/Responsive Interaction Code* (Alpert, Keefer, & Fischer, 1992). The Combined Code is a continuous observation system in which each adult and child behavior is coded while watching the videotape of the session.

Child Social Communication Skills. Child social communication skills consisted of the frequency of total child utterances, spontaneous child utterances, total use of targets (prompted plus spontaneous), and frequency of targets used spontaneously. In addition, the diversity (number of different word roots) and the complexity (MLU) of the children's language were determined from transcripts of children's utterances during each observation. MLU and diversity were calculated using the *Systematic Analysis of Language Transcript* program (SALT; Miller and Chapman, 1984).

Child Language Development. Children's language development was assessed before baseline began, at the end of training, and at the end of the follow-up period. Expressive and receptive communication skills were assessed using the SICD, the *Peabody Picture Vocabulary Test–Revised* (PPVT-R; Dunn & Dunn, 1981) and *Expressive One-Word Picture Vocabulary Test–Revised* (EOWPVT-R; Gardner, 1990). Measures of linguistic complexity (e. g., MLU) and diversity of vocabulary were obtained from verbatim transcripts of the language sample sessions. The SALT program was used for the analysis of transcripts and computation of MLU and diversity.

Parent Satisfaction. Parents were asked to complete satisfaction questionnaires at the end of the intervention and again at the end of the follow-up period. The questionnaire consisted of five questions answered using a 5-point scale and six open-ended questions. The questionnaire measured parents' satisfaction with their child's participation in the intervention program and with the changes they observed in their child's communication skills as a result of the intervention.

Interobserver Agreement

Interobserver agreement on the *Combined Milieu/Responsive Interaction Code* was calculated for each adult and child behavior. Research assistants were trained to a criterion of at least 80% interobserver agreement on the data collection system prior to the coding of data in the study. To determine interobserver agreement, a primary observer and secondary observer independently coded the videotapes. A comparison of the coded data sheets was made on a point-by-point basis. An agreement was scored for a behavior that both observers recorded, and a disagreement was scored when only one observer scored a behavior or when the two observers differed on their categorization of a behavior. When the ratings of the two observers did not match, a disagreement was recorded. Interobserver agreement was calculated using an exact agreement procedure in which the total number of agreements was divided by the total number of agreements plus disagreements and multiplied by 100. Interobserver agreement was assessed separately for each category of parent and child behaviors. The verbatim transcriptions of child utterances were verified by a second coder using the videotapes of the same language sample or observational session prior to analysis using SALT. A licensed psychologist verified all testing data and scoring.

Experimental Procedures

Data for this study were selected from a longitudinal study comparing the effects of three different models of naturalistic communication training with children who have significant language delays (Kaiser, Lambert, Hancock, & Hester, 1998). In the larger study, 76 children were assigned randomly to one of three treatment groups (parent-implemented EMT, n = 20; trainer-implemented EMT, n = 20; parent-implemented Responsive Interaction, n = 20; or a control group, n = 16). The data presented here are for all of the children with autism (n = 4) who were randomly assigned to the trainer-implemented EMT condition.

In each of the treatment conditions, baseline, intervention, and follow up, phases were implemented in the context of a single-subject, multiple baseline design across children (Tawney & Gast, 1984). Participants were assigned randomly and equally to a specific number of baselines (five, six, or seven baseline observations). Additional baseline points were collected if any measure of adult or child behavior was not stable at the end of the assigned number of baseline sessions. The multiple baseline design was replicated six times across the 20 families assigned to the trainer-implemented EMT condition. The four children with autism assigned to this condition had baselines consisting of five (Child A), six (Child B), and seven (Child C and Child D) sessions. The graphic data in this study were analyzed using simple visual inspection (Tawney & Gast, 1984).

Prebaseline. All children were pretested on a battery of standardized language tests at the beginning of the study: the SICD, the PPVT-R, and the EOWPVT-R. Two 30-minute language samples were collected during play interactions between the children and a trained research assistant in a clinic playroom. Based on standardized assessments and the language samples, individual language targets for each child were selected (see Table 1). Targets were broad classes of early semantic relationships represented in two-, three-, and four-word utterances (e.g., agent-action, agent-action-object, agent-action-location). Each child had three or four target classes, and in this condition the parents were not informed of their children's language targets until the end of the study.

Baseline. Interventionists and children were videotaped playing together for 15 minutes during each baseline session. From these videotaped sessions, 10 minutes of data were coded. Parents were given general information about their child's participation in each session ("Your child really enjoyed playing with the bubbles today"), and the interventionist would answer any questions or concerns posed by the parents. Parents did not observe their child in the sessions with the interventionist but generally waited in a comfortable sitting area until the session was complete.

Intervention. Following the completion of baseline, intervention sessions were conducted twice each week with each child in the clinic playroom. During the sessions, the interventionist and child played with age-appropriate toys at a small table or on the carpeted floor. The procedures used in intervention are summarized in Table 2. Based on previous implementations of these procedures, criterion levels for each measure were established (see Table 3). Data were monitored weekly to ensure therapists reached criterion levels and to assess child progress. Training sessions were videotaped and lasted approximately 15 minutes. Ten minutes of data on trainer implementation of the intervention procedures and child communication measures were coded from the videotapes of the sessions always starting with the first full minute. Parents did not observe their children during the training session, but parents were given a general report of their child's participation in the intervention sessions.

Follow up. Parents and children returned to the clinic once each month for 6 months after the end of the intervention to assess maintenance of child use of social communication skills. These follow-up sessions were identical to the intervention sessions with interventionists using all of the intervention procedures with the child in the session. Interventionists and children played together in a 15-minute session that was videotaped with 10 minutes of these sessions coded. Parents did not observe their children during the sessions, but a general report of the child's participation in the session was given to the parent after every follow-up session.

Generalization. Nine observations were conducted in the home to assess generalization of the children's use of social communication with their parents. Three sessions were conducted at the end of baseline, three at the end of the intervention, and three at the end of the 6-month follow-up period. Parents were instructed to play and interact with their child as they usually did, using toys and materials from their home. Parents and children were videotaped for 15 minutes each time with 10 minutes of the session transcribed and coded.

Posttesting. Following the last intervention session (average length of time between Pre and Post 1 was 5.2 months) and again following the last follow-up session (average length of time between Pre and Post 2 was 11.5 months), assessments identical to the prebaseline procedures were used to determine changes in the child's performance on standardized language tests and in two 30-minute language samples. At both postintervention and post–follow-up testing sessions, parents completed the

parent satisfaction survey to assess their satisfaction with the intervention program and their children's progress.

RESULTS

Interobserver Agreement

Interobserver agreement on coding using the Combined Code was assessed in approximately 20% of the sessions for a total of 10 times for each family during the course of the study. One assessment occurred for each family during baseline, five during training, one assessment during the follow up, and three during the generalization assessments at home. A second coder verified each transcript of the language sample and of child utterances during the adult–child interaction sessions and all test data were checked for scoring accuracy by a licensed psychologist.

Mean interobserver agreement for all trainer behaviors was 89.5% (range 81%–100%) for milieu teaching episodes, 95.1% (range 74%–100%) for expansions, 95.2% (range 83%–100%) for talk at the target level, and 85.1% (range 70%–92%) for all other adult behaviors. The mean interobserver agreement for child communication behavior was 84.3% (range 68%–98%). Interobserver agreement for total use of targets was 87.4% (range 50%–100%) and for all child behaviors was 94.5% (range 86%–100%). Low interobserver agreement percentages occurred only when the rate of behavior was very low.

Results in the Training Setting

Trainer Implementation. Seven aspects of trainer implementation of the intervention were measured: (a) frequency and percentage of correct use of the four milieu teaching procedures, (b) frequency of expansions and percentage of child utterances expanded, (c) frequency of talk at the child's target level, (d) balance of adult and child turns (turn discrepancy), (e) frequency and percentage of responsive feedback, (f) pause errors, and (g) not following the child's lead. Table 2 details the specific components of the intervention and operating definitions for each procedure. Criteria levels were set for all intervention procedures based on data from past studies of intervention efficacy. Table 3 gives the means for all implementation measures as well as the specific criterion for each procedure. Although there was some variability among the trainers on their use of the procedures, trainers delivered the intervention with a high level of preci-

TABLE 2. EMT Components, Measures, and Definitions

EMT component	Measure	Definition
Milieu teaching procedures	Number and percentage of correct use of four procedures	Correct milieu teaching episodes: (1) begin with child verbal or nonverbal requests; (2) follow a specific sequence of prompts (models, mands, or time delay procedures); (3) include corrective prompts as needed, and (4) end with positive feedback, expansion of the child's utterance, and access to the child's requested object
Expansions	Percentage of child utterances that were expanded	Adult utterance that follows a child utterance, embeds child's utterance into a more complete form, and maintains or extends the child's meaning
Balance of adult and child turns	Turn ratio	Turn ratio was calculated by dividing adult turns by child turns, with a number larger than 1 indicating more adult turns than child turns and a number less than 1 indicating more child turns than adult turns
Not following the child's lead	Number not following child's lead	Adult verbal behavior that does not relate directly to the child's topic or ongoing behavior (e.g., recruiting child's attention to another toy, initiating talk about events outside the play context)
Pause errors	Number of pause errors	Three or more consecutive adult utterances without at least a 3-second pause for a child response
Responsive feedback	Percentage of child utterances followed by responsive feedback	Adult verbalizations that follow a child utterance, are meaningful to child, and directly related to the child's topic
Talk at the child's target level	Number of adult utterances at target level	Adult utterances that included examples from children's target classes and were slightly longer (2–3 words) than child's current productive language

TABLE 3. Trainer Implementation of Intervention Procedures During Clinic Sessions

Condition	Criteria	Child A			Child B			Child C			Child D			All trainers		
		BSL	INT	FU	BSL	INT	FU	BSL	INT	FU	BSL	INT	FU	BSL	INT	FU
# Correct milieu	5–10	0	15.4	12.3	.2	5.0	3.0	0	2.8	5.5	.1	9.6	10.3	.08	8.2	7.8
% Correct milieu	> 80%	0	95.6	100.0	1.8	100.0	94.5	0	100.	98.5	1.8	98.2	100.0	1.0	98.4	98.2
% Expansions	> 50%	2.6	91.2	90.8	4.8	87.2	72.5	0	80.2	84.3	4.4	86.4	89.8	2.9	86.2	84.4
Turn taking ratio (adult : child)	1.00	2.30	.99	.88	2.30	.99	.88	4.90	.96	61.7	4.1	67.2	61.0	6.8	69.5	65.8
% Not following lead	0	14.6	0	0	40.8	0	0	16.3	0	1.05	1.60	1.03	1.09	2.16	1.01	1.00
# Pause errors	< 2	18.2	0	0	23.8	.2	0	26.1	.4	99.3	43.1	97.6	99.3	34.9	98.1	98.5
% Responsive feedback	> 80%	96.5		0	26.5	97.2	96.5	21.1	99	.3	15.1	0	0	20.5	.1	.8
# Adult targets	> 40	3.6	93.6	91.2	3.7	47.8	49.3	7.7	69.6	0	25.0	0	0	24.3	0	0

Note. Parent turns minus child turns: If parent had more turns than child, number is positive; if parent had fewer turns than child, number is negative. BSL = data are the mean of three sessions at the end of the baseline; INT = data are the mean of three sessions at the end of intervention; FU = data are the mean of three sessions at the end of follow up.

sion and were well above the established criteria level for all procedures. Figures 1 and 2 show session-by-session data for the baseline, intervention, and follow-up conditions for use of milieu teaching and expansions. The interventionists depressed their use of the procedures during the baseline phase to resemble levels observed in baseline sessions with parents in the other two parent-implemented intervention groups in the larger study (Kaiser et al., 1998). Parents may demonstrate some of the behaviors being measured during baseline but not at the optimum level needed to affect child language.

In an average intervention session, interventionists engaged the children in eight milieu episodes to prompt target language, responded to 98% of the children's utterances with responsive-type feedback, and expanded 86% of the children's utterances. They also used the children's targeted language forms an average of 69 times in a session. Turn taking between the trainer and child was expressed as a ratio of adult to child turns with a number larger than one reflecting more adult than child turns and a number less than one reflecting more child than adult turns. Intervention sessions revealed approximately equal turn taking between the trainers and children (M = 1.01). During monthly follow-up sessions in the clinic, trainers closely approximated the rates of intensity and precision of implementation delivered during the intervention sessions.

Child Social Communication. After the intervention was introduced, all four children showed increases in their total use of targets (prompted plus unprompted), as shown in Figure 3. The strongest effects were seen for Children B and C. Children A and D had lower levels of target use throughout the intervention. Child A increased his target use in the last half of the intervention condition. All four children continued to use their targets during the clinic follow-up assessments. Three of the four children (A, B, C) showed clear changes in spontaneous use of targets (see Figure 4). Child D showed small changes in use of spontaneous targets during the intervention. All four children maintained similar rates of spontaneous target use during the follow-up period.

Changes in children's communication are summarized in Table 4. All children increased in their frequency of total utterances from baseline to intervention, with Child C showing the largest gains. Two children (A and B) showed further increases in total utterances at follow up. Two children (B and C) increased in their spontaneous utterances from baseline to intervention, with Child C making the largest gains. Only Child B showed an increase in frequency of spontaneous utterances from intervention to follow up; the other three children maintained intervention levels at follow up. Changes in MLU occurred for three children (A, B, C), and changes in diversity (number of different words) were observed for all four children during the intervention. Children B and C showed modest increases in MLU from intervention to follow up. Three of the four children (A, B, C) increased slightly in their diversity at the follow up.

Generalization Settings

Data showing the mean use of targets, spontaneous utterances, MLU, and diversity for the four children during baseline, treatment, and the follow-up phase in generalization sessions at home with their mothers are shown in Table 5. Generalization to home setting was observed for three of the four children, with the greater changes occurring immediately after the intervention than at the 6-month follow up. Two of the four children (B and C) showed large increases on their total use of targets and spontaneous use of targets after intervention. The other two children (A and D) showed modest increases in use of targets analyzed at the 6-month follow up. Three of the four children (B, C, D) increased the frequency of their total utterances and their spontaneous utterances after the intervention. Children B and D had additional increases in total and spontaneous utterances at the follow-up assessment.

Children also showed generalized changes in two general measures of language complexity: MLU and number of different word roots (diversity). MLU increased for two children (B and D) during the postintervention home generalization assessments, and modest increases in this measure were seen at the follow-up home generalization assessments for the other two children (A and C). A similar pattern of effects was observed for diversity of word roots. Increases in diversity of word roots were observed during home generalization observations at the end of the intervention phase for all children, with three of the four children (B, C, D) approximately doubling their diversity from pre- to postintervention assessments. Children maintained their higher levels of diversity in the follow-up observations with their mothers.

Language Development Measures

Six measures of language development were taken at the prebaseline, postintervention, and post–follow-up periods. The results of these measurements are shown in Table 6. Although there is evidence indicating developmental change concurrent with the intervention period, this evidence is variable across the four children. Child B showed changes on all measures at the postintervention assessment, whereas Child A changed positively on five of the six measures. Child D changed on two measures. The post–follow-up assessment revealed a similar positive developmental change for the children, although not quite as strong as was measured pre- to postintervention. Child B showed changes on all measures. Two children (C and D)

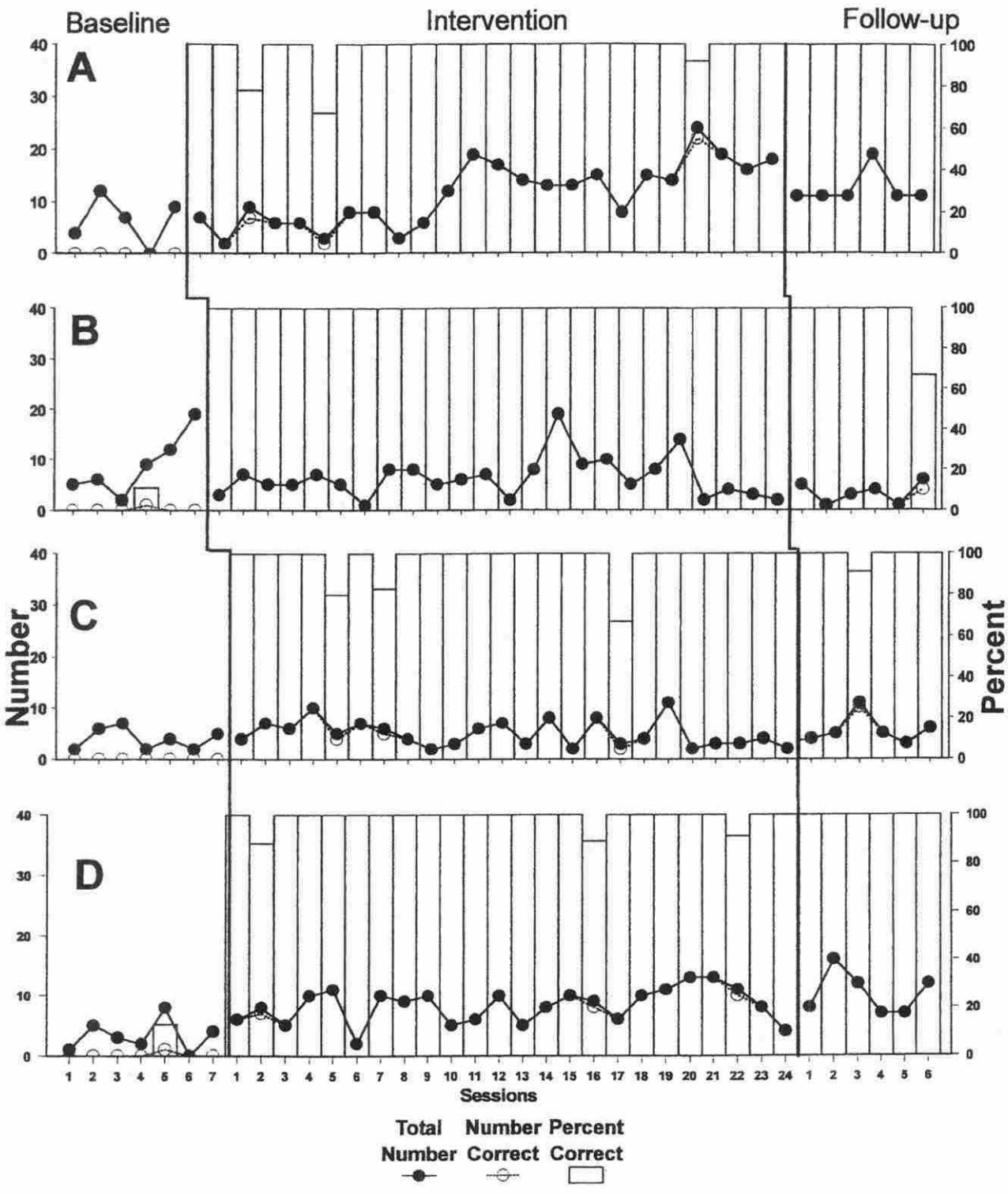

FIGURE 1. Frequency and percentage of correct use of the four milieu teaching procedures by interventionists in the clinic setting.

changed on four of the six measures and maintained the change made from Pre to Post 1 on the other two measures. Child A made changes on two measures and maintained the change from pre- to postintervention on two other measures. Although the overall pattern is one of positive changes in developmental measures associated with the intervention, change on developmental measures is difficult to interpret in the absence of a control group.

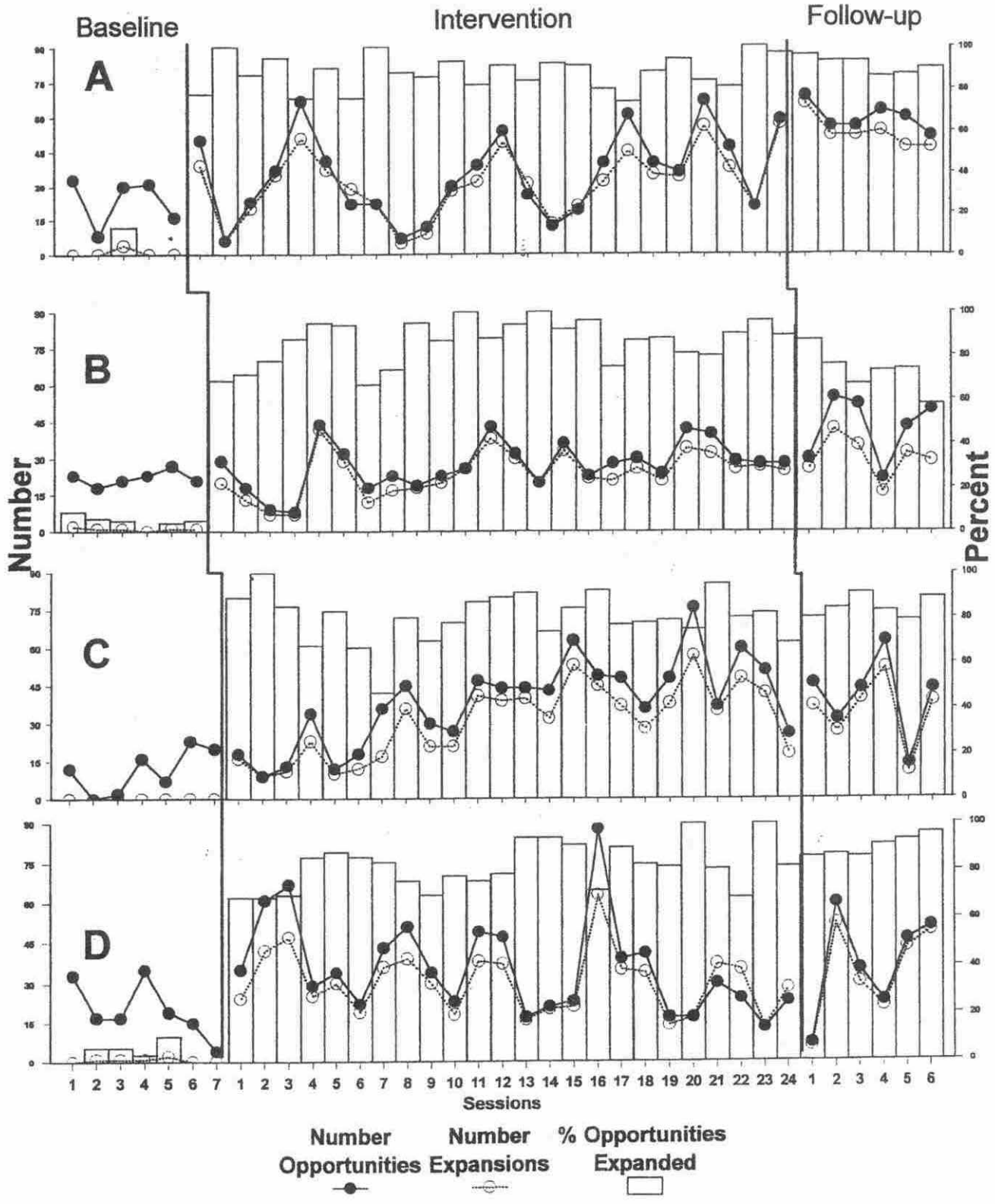

FIGURE 2. Frequency of expansions and percentage of child utterances that were expanded by interventionists in the clinic setting.

Parent Satisfaction

Parent ratings of their satisfaction with the training were very positive. Using a 5-point scale, the mean rating for five scaled items for the four parents was 4.88. All parents rated their satisfaction with improvement in their child's communication skills and their overall satisfaction with the intervention as 5.0. The only question that parents rated with less than a 5-point response concerned the time requirement involved in the training with parents wanting more sessions for longer time periods. Parents also gave very positive responses to the six open-ended questions. All four parents described specific, positive changes in their children's language. One parent said, "Now my child speaks in sentences and can answer questions. The intervention has converted 'babbling' into real speech." Another parent reported that the intervention had helped her child "go from one- and two-word utterances to having meaningful conversation including up to nine-word sentences," with an added benefit that her child now "gets frustrated less frequently" and is "more engaged in the environment and the people in it." The main suggestion offered for improving the training was having the training last for more sessions and for longer than 15 to 20 minutes a session. Because of the design of this study, we could not train the parents in the trainer-implemented condition until the last follow-up session was completed. One parent said, "The wait to be trained as a parent" was what she liked the least about her child's training, "although I realize it had to be that way due to research. I can't wait to learn 'the secret.'"

TABLE 4. Child Language in Clinic Sessions

Child	Measure	Condition BSL	INT	FU
A	Total utterances	48.4	68.0	82.3
	Spontaneous utterances	41.2	46.2	47.5
	MLU	1.32	1.65	1.70
	Diversity	24.4	35.6	46.8
B	Total utterances	44.0	52.2	69.7
	Spontaneous utterances	.8	3.8	10.2
	MLU	1.94	1.94	3.62
	Diversity	50.4	31.4	77.5
C	Total utterances	16.8	68.8	58.8
	Spontaneous utterances	9.2	45.6	43.5
	MLU	1.54	2.29	2.29
	Diversity	11.0	38.2	44.2
D	Total utterances	35.2	50.6	46.2
	Spontaneous utterances	30.4	27.6	31.0
	MLU	1.65	1.56	2.06
	Diversity	20.8	30.6	29.7

Note. BSL = data are the mean of three sessions at the end of baseline; INT = data are the mean of three sessions at the end of intervention; FU = data are the mean of three sessions at the end of follow up; MLU = mean length of utterance; Diversity = mean number of different word roots in each session.

Discussion

These results extend the application of hybrid naturalistic language intervention procedures to children with autism and offer further support for the effectiveness of naturalistic language interventions implemented with this population of children. In this study, children demonstrated positive changes in social communication assessed across settings and measures, and these changes generalized to interactions with their parents. These findings are especially important given the social and communicative difficulties of most children with autism and the likelihood that they will need continued support to acquire and use functional communication skills.

Of particular interest in this study is that when a hybrid naturalistic language intervention is delivered in a precise, high-quality manner, the actual time it takes to effect changes in children's language may not be as long as traditionally thought. In this study, children were engaged in intervention for 24 15-minute sessions for a total of 6 hours of direct intervention. In this particular intervention, the emphasis on responsiveness shifted the

TABLE 5. Child Language in Home Generalization Sessions

Condition	Child A BSL	INT	FU	Child B BSL	INT	FU	Child C BSL	INT	FU	Child D BSL	INT	FU
Spontaneous targets	.7	.7	5.3	2.7	25.0	17.3	0	10.0	9.7	.7	1.0	2.0
Total targets	.7	.7	5.3	3.7	27.0	19.0	.3	19.0	14.0	.7	1.0	1.7
Total utterances	34.7	32.3	37.3	64.0	94.3	107.0	61.0	105.3	85.3	33.0	62.0	75.3
Spontaneous utterances	26.3	26.0	29.3	44.7	81.0	98.3	30.3	58.7	45.3	22.7	32.7	58.0
MLU	1.34	1.34	1.71	1.94	3.54	3.69	1.33	1.56	1.82	1.49	2.15	2.13
Diversity	159.0	35.0	50.0	52.0	98.3	99.7	26.3	56.3	64.7	21.3	46.0	54.3

Note. BSL = data are the mean of three sessions at the end of baseline; INT = data are the mean of three sessions at the end of intervention; FU = data are the mean of three sessions at the end of follow up; MLU = mean length of utterance; Diversity = mean number of different word roots in each session.

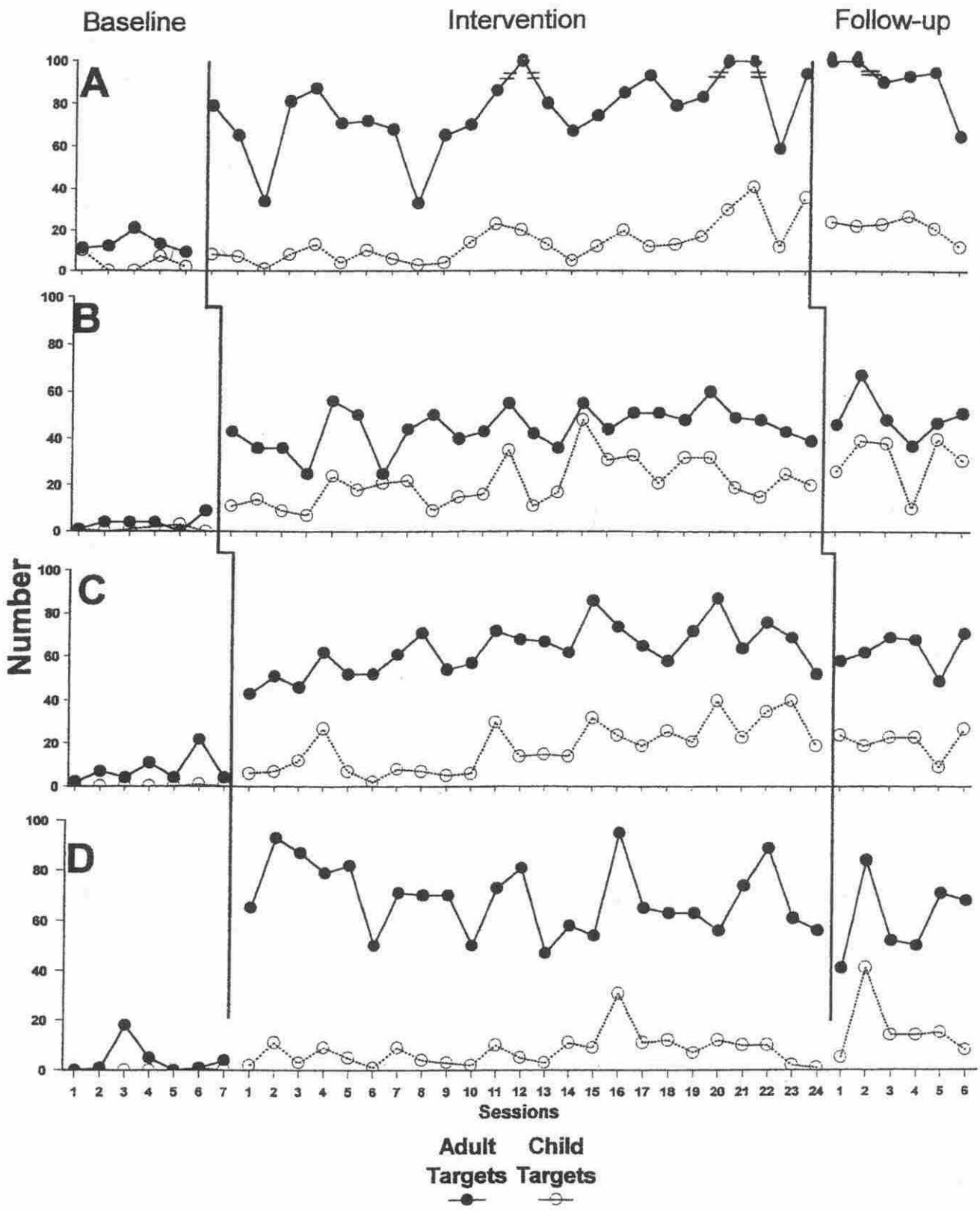

FIGURE 3. Frequency of adult and child communication total target use in the clinic setting.

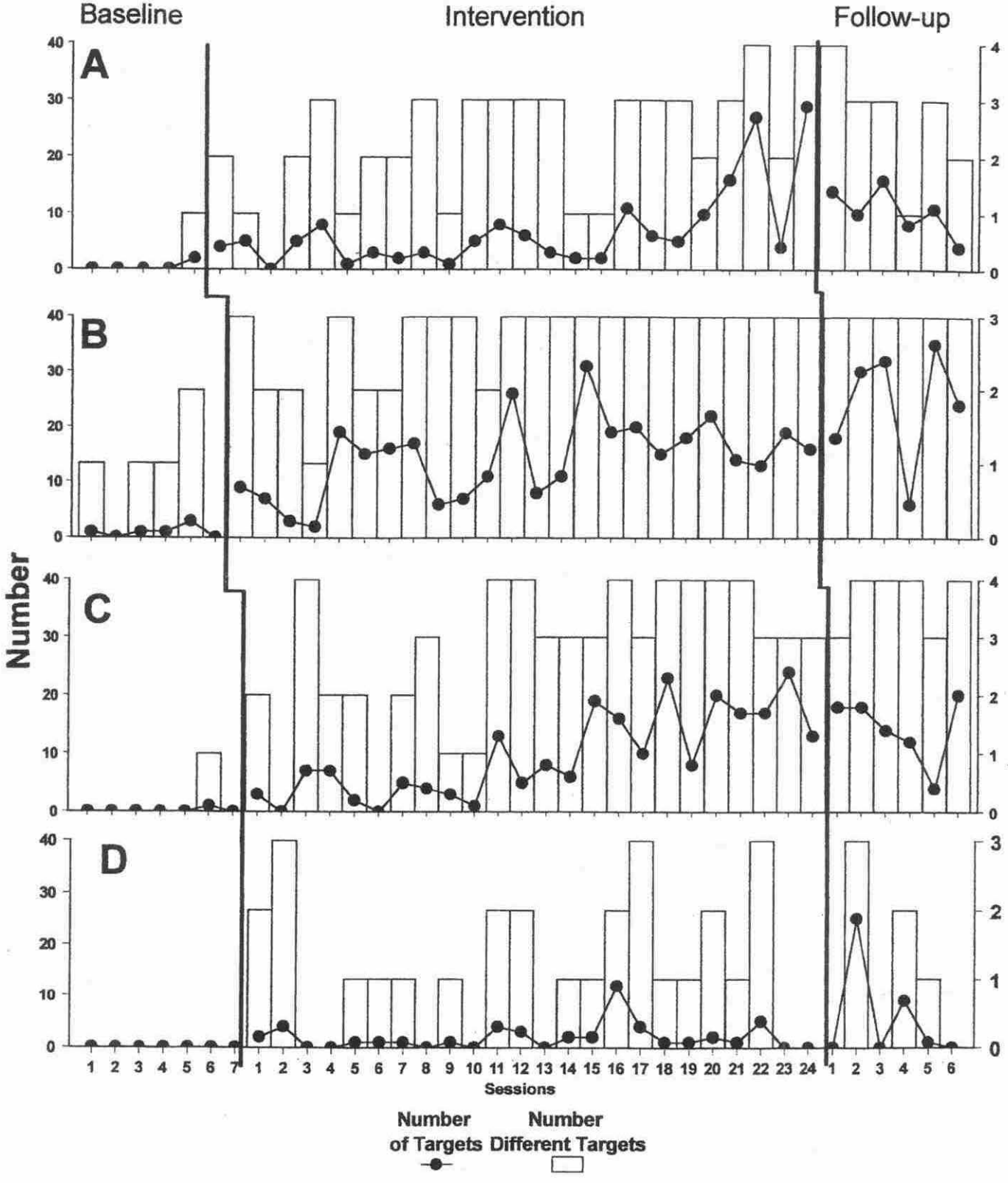

FIGURE 4. Frequency of child communication, spontaneous target use, and number of different classes of targets used in the clinic settings.

TABLE 6. Child Performance on Developmental Language Measures at Preintervention, Postintervention, and Follow Up

Child	SICD-R			SICD-E			EOWPVT-R			PPVT-R			MLU			Diversity		
	Pre	Post	FU	Pre	Post	FU	Pre	Post	FU	Pre	Post	FU	Pre	Post	FU	Pre	Post	FU
A	20	28	28	20	24	24	Nb	Nb	29	Nb	24	23	1.58	1.76	2.01	42	109	93
B	28	36	40	24	36	40	36	54	62	33	40	44	1.79	3.20	4.02	104	143	173
C	24	28	28	20	36	36	Nb	31	34	23	26	30	1.33	1.79	2.08	30	64	77
D	28	28	28	20	20	32	Nb	Nb	30	Nb	23	26	1.64	1.61	2.37	67	108	94

Note. SICD-R = *Sequenced Inventory of Communication Development* (Hedrick, Prather, & Tobin, 1983) receptive communication score in months; SICD-E = expressive communicating score in months; EOWPVT-R = *Expressive One-Word Picture Vocabulary Test–Revised* (Gardner, 1990) score in months; PPVT-R = *Peabody Picture Vocabulary Test–Revised* (Dunn & Dunn, 1981) score in months; MLU = mean length of utterance from two 30-minute language samples; Diversity = mean diversity of vocabulary from two 30-minute language samples; FU = follow up; Nb = no basal established.

focus from proactive teaching to responsive teaching and embedded prompting into conversations and engaged play interactions. When children are engaged with adults in activities of interest to them, there are many opportunities to teach functional skills without disrupting the flow of social interaction. It is possible that for children with autism who may resist a didactic approach and even direct instructions, the use of a responsive engagement strategy may be especially powerful.

Although results of this study indicate this intervention was effective, it is important to remember that the interventionists who worked with these children were highly educated, had years of experience working with children before this study, and received intensive training before and weekly supervision during the intervention period. Also, the children had to meet minimum criteria to be included in the study, specifically the ability to imitate and produce language of at least 10 words. All children were selected to be in the range of language abilities that previously has predicted strong positive outcomes in a milieu teaching intervention (Yoder, Kaiser, Alpert, & Fischer, 1993), so we expected that all children would benefit from the intervention. Results with children in similar interventions could definitely vary depending on the interventionist's training and abilities and the match between intervention content and children's entry skills. The development of intervention and measurement protocols to fit individual children poses a considerable challenge for both researchers and practitioners but is needed to more accurately characterize the effects and effectiveness of naturalistic language intervention.

As is the case in many studies of language intervention with children with autism, the effects of the intervention were variable across individual children. Children in the current study varied according to age, tested IQ, and language ability at the beginning of the intervention. In general, younger children whose language development was less delayed relative to their age showed the greatest increases in acquisition, maintenance, and generalization of language skills. These results are similar to those with parents who were trained to use EMT when interacting with their children with autism (Kaiser et al., 2000). It is possible that the children who were less delayed in their language abilities relative to their age required less adult support both from the interventionist and parent to make positive gains in their language abilities. The child who did not make the same gains as the other three children may have needed more than 24 sessions or sessions longer than 15 minutes to promote positive changes in his language. The limited number of children in this study does not allow a formal analysis of child characteristics that might predict child response to treatment protocol. Future studies could explore the intensity and dosage of language interventions needed to effect positive changes given the different profiles of abilities demonstrated by children.

It is important to note that although there was some variability in language performance among the children, there was also variability across observations for each child. For example, in baseline sessions there was a fairly large range in MLU across these observations for all four children (A, range = 1.13–1.64; B, range = 1.39–2.62; C, range = 1.00–1.86; D, range = 1.23–2.28). Professionals need to be aware that inconsistency in behavior is common in children with autism (Lord, Bristol, & Schopler, 1993), so individualized programming for young children with autism should always include multiple assessments and multiple observations to produce the clearest picture of a child's abilities. Inconsistent responding by children with autism also affects the results of the standardized test and developmental language measures reported in this study. Because there is no way to know in the current design if development may have contributed to the changes in child MLU, diversity, and performance on standardized tests, these results must be interpreted cautiously. Replication with a randomly assigned control

group of children with autism would be required to confirm the developmental findings reported here.

Children in this study generalized positive changes in their language skills to interactions with their untrained mothers immediately after the intervention. Although these changes were maintained at the end of the follow-up period, only one child showed evidence of continued accelerated change in communication at the follow up. If parents had been trained to use simple responsive interaction strategies with their children at home during the follow-up period, they might have been able to continue to support their children's continued language growth.

The design used in the current study has limitations. In order to implement the single subject design within the randomly assigned treatment groups, we needed to restrict the number of baseline sessions to control for pretreatment experience in the clinic across conditions. We selected five to seven baselines based on our previous single subject implementations of EMT indicating that child behavior is typically stable after five sessions. We initiated treatment after the prescribed number of sessions; however, in every case, a clear shift in the interventionist's implementation of the intervention occurred immediately (see Figures 1 & 2), and modest changes in child's total use of targets (Figure 3) were immediately observed. The use of combined single subject and group designs has many advantages but may also constrain the interpretation of the single subject data. Replications of the effects of the EMT intervention were seen with other children assigned to this treatment condition six separate three-tiered multiple baseline applications of the treatment (Kaiser et al., 1998). Notably, the effects with children with autism were very similar to those with other children who had a range of different developmental disabilities and nearly identical language skills at entry.

In the Kaiser et al. (2000) study, the children with autism showed similar changes in language use in training sessions with their parents and slightly stronger generalization to the home setting at the end of intervention and follow up. Child generalization to the home setting appeared to be related to parents' continued use of the EMT procedures. When parents maintained their use of the procedures, children showed further gains in language use.

For children with autism, it is important to consider the range of possible supports for developing communication skills. Interventions that employ both skilled interventionists (e.g., speech–language clinicians, early childhood special education teachers) and parents may help children accelerate their language development and use. Investigations of multiple partner interventions to support communication in everyday settings and to promote generalization and maintenance are needed. ◆

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