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An Exploratory Comparison of Milieu Teaching and Responsive Interaction in Classroom Applications

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An exploratory study was conducted to compare 2 naturalistic language intervention methods: milieu teaching and responsive interaction. Classroom teachers implemented the treatment methods in 6 classrooms. Thirty-six children were matched on 4 pretreatment language measures and assigned to 1 of the 2 treatments. No main effects for treatment were found. However, milieu teaching was more effective than responsive interaction in facilitating receptive language and expressive vocabulary, if the children began intervention with relatively low receptive or expressive language levels. In contrast, responsive interaction was more effective than milieu teaching in facilitating receptive language and expressive vocabulary if the children began intervention with relatively high receptive or expressive language levels. The explanations for these results suggest several directions for future research and highlight the increasingly common finding that no 1 intervention is superior for all children.

The development of naturalistic language interventions such as incidental teaching (Hart & Risley, 1975), milieu teaching (Hart & Rogers-Warren, 1978), and responsive interaction (Weiss, 1981) has led to recommendations that early language intervention can and should occur within classroom settings. Studies examining the generalization resulting from direct instruction outside the classroom setting (Stremel-Campbell & Campbell, 1985; Warren & Kaiser, 1986) and from applications of milieu teaching (Kaiser, Yoder, & Keetz, 1992) suggest that generalization is more likely to occur when language is taught

in naturalistic contexts than in isolated therapy rooms. In addition, it has been argued that teaching in the context of conversational interactions more closely resembles the conditions under which language is typically learned by young children than teaching outside conversational interactions. Thus, naturalistic language teaching incorporated into classroom activities may offer opportunities to learn functional language, promote generalization, and provide a more normalized occasion for language learning than traditional pull-out models of intervention.

Naturalistic teaching, according to Carrow-Woolfolk (1988), occurs in informal settings including activities not primarily designed for language intervention. Input to children is also naturalistic but addresses topics of interest to the child and includes linguistic input appropriate for the child's level of language functioning. Continuation of the activity and of the communication episode are the consequences for child communication. Naturalistic interventions may use a range of specific language-facilitating techniques including modelling linguistically and pragmatically appropriate language, expanding child utterances to provide elaborated models of language, balancing the length and frequency of adult and child turns; responding nonverbally to the child's ongoing play and communicative actions, incidental prompting of elaborated child responses (e.g., using milieu teaching procedures), and conversational consequation of child language use incorporating contingent semantic and functional feedback.

Although a range of arguments and modest research literature support the use of naturalistic approaches to language teaching in preschool classrooms, no research has compared the changes in children's language that result from applications of conceptually different approaches to naturalistic language teaching. In the current study, two naturalistic language interventions were selected for comparison: responsive interaction and milieu teaching. The models were selected because they are derived from conceptually different approaches to the facilitation of children's language and differ significantly in their relative emphasis on prompting children to produce new linguistic forms.

The responsive interactive model of early language intervention is based on the premise that children will learn new language or learn to use their existing language in conversation when they hear appropriate models of language in the context of adult-child interactions. The critical features of responsive interaction consist of (a) contingent verbal and nonverbal responsiveness to child communication attempts, (b) systematic use of expansions that model a linguistically more sophisticated utterance contingent on child utterances, (c) self-talk (the adult talking about what he or she is doing), (d) parallel talk (the adult talking about what the child is doing), and (e) following the child's lead in conversation and play including the use of topic-continuing talk. Research on classroom applications of responsive interaction is somewhat limited. The INREAL (INclass REActive Language) model of responsive interaction has been widely applied, but only two studies examining its effects on children's language in the classroom have been published (Rogers, Herbison, Lewis, Pantone, & Reis, 1986; Weiss, 1981). These studies demonstrated that children with a range of language delays (i.e., children at-risk for developmental delays, children with identified language delays, and children with autism) made significant gains in language development when the INREAL model was implemented in their preschool classrooms. Other applications (Tannock & Girolametto, 1992) suggest that positive changes in children's social communicative interactions occur when parents are adept in applying responsive interaction interventions. Studies by

Mahoney (1975) and by Mahoney and Powell (1988) offer modest additional support for the effectiveness of the responsive interaction intervention model.

In milieu teaching, children are presumed to learn their language goals as a result of verbal and nonverbal prompts to produce language targets, in combination with adult feedback following child communication attempts. Adults' prompts are embedded in ongoing interactions, occur in response to the child's interest in the activity and the conversational partner, and are intended to facilitate functional language-based control over the environment. Prompts may include models (requests to imitate), mands (i.e., questions, instructions to verbalize, or presentation of choices), or nonverbal cues for responses (i.e., time delays). The prompts for child production of target language follow a sequence of progressively more supportive cues. Child responses to these prompts result in functional consequences (e.g., access to the requested object), feedback about the correctness of the response, and expansions or extensions of the child's communicative utterance.

The effects of applications of milieu teaching by classroom teachers on children's language have been analyzed in a number of studies (see Kaiser et al., 1992; Warren & Kaiser, 1986, for comprehensive reviews). In general, these studies have shown that children learn specific language targets and increase their frequency of communication when milieu teaching is applied in the classroom. Generalization across settings and conversational partners has been reported in several studies. With the exception of the study by Yoder, Kaiser, and Alpert (1991), studies of milieu teaching have included only limited assessments of the effects of the intervention on children's global language skills measured outside the intervention setting with a nonteaching conversational partner. Thus, although there is consistent and positive evidence that milieu teaching facilitates performance of specific language in the classroom, the effects of classroom-based milieu teaching on children's general language development have not been well assessed.

Both responsive interaction and milieu teaching prescribe following the child's lead in the language interaction. Teaching in both models occurs contingently on the child's expressed interest in the environment and in interacting with the adult. In both interventions, language appropriate for the child's developmental level is modeled in the context of ongoing activities. Ideally, both interventions should be embedded in the ongoing flow of conversation and classroom activity. The primary differences between the two interventions are (a) the emphasis on elicited production in milieu teaching and (b) the emphasis on nonobligatory language modeling in responsive interaction.

Our previous research (Yoder et al., 1991) and other studies (Cole, Dale, & Mills, 1992; Connell, 1987; Friedman & Friedman, 1980) have suggested that the effectiveness of a particular language intervention might depend on the characteristics of the children being taught and the types of goals selected for teaching. Milieu teaching has been demonstrated to be more effective than didactic direct instruction with children in the earliest stages of productive language use (Yoder et al., 1991). Research on responsive interaction has been relatively limited, but variations of this intervention strategy have been used with children across the range of early language acquisition (Brown's Stages 1 through 4 [Mahoney, 1975; Weiss, 1981] and with varying degrees of language delay). Thus, there have been no specific theoretical or empirical grounds for predicting which intervention might benefit children more in various stages of language learning.

The purposes of this study were to compare the effects of these two naturalistic lan-

guage interventions on a range of global measures of child language and to identify the specific child characteristics prior to treatment that were systematically associated with differential treatment outcomes. A third purpose was to examine the outcomes of the two interventions when classroom teachers applied them in the context of ongoing activities in classrooms enrolling young children with disabilities.

METHOD

Participants

Child participants were recruited from six preschool classrooms enrolling young children with mild to severe disabilities in Nashville, Tennessee, and Pittsburgh, Pennsylvania. Classrooms were selected using the following criteria: (a) each classroom enrolled at least six children with expressive and receptive language delays of at least 6 months, (b) parent permission could be obtained to allow these children to participate in the research project, and (c) teachers and classroom instructional assistants were willing to participate in the experimental procedures, which included direct training and monitoring their performance of the intervention procedures. The six classrooms varied in their composition (i.e., including or not including children without disabilities), teacher-to-child ratios, and the disability types of the children enrolled. The characteristics of the classrooms, the children, and the participating teaching staff are summarized in Table 1.

A total of 46 children enrolled in these six classrooms participated in the study. Both naturalistic language treatments were conducted classwide, with three classrooms receiving the responsive interaction intervention and three classrooms receiving the milieu teaching intervention. Because we were not able to randomly assign children to classrooms (and thus to treatments), 36 children were selected from the total population of children enrolled in the six classroom using a matching procedure described below. The data reported in this study are for those 36 children although the intervention was systematically applied to all 46 children. All children participating in the intervention (a) could verbally imitate 8 out of 12 words (selected from the Sequenced Inventory of Communication Development—Expressive Scale, SICD-E, Hedrick, Prather, & Tobin, 1984), as indicated by teacher report or direct observation; or (b) spontaneously used one-word utterances to communicate, as indicated by teacher report or direct observation. The children in these classrooms were between 2 and 7 years old, but typically functioned like children between 1 and 4 years old in the cognitive and language domains. They ranged in degree of delay from nearly normal to severely delayed in the cognitive and language domains.

The 36 children were selected for the final analysis by constructing two subgroups of milieu teaching and responsive interaction intervention participants. Children were selected by constructing matched pairs (one child from the milieu teaching intervention paired with one child from the responsive interaction intervention) on the basis of four pretest characteristics. First, all pairs of participants had been assigned language goals at the same level (i.e., single words, semantic relations, simple syntax, or complex syntax). Second, the paired children's mean lengths of utterance (MLUs) at the pretest were within .5 morphemes of each other. Finally, the paired children's (a) expressive and (b) receptive communication ages as indicated by the SICD were within 4 months of each other. Twenty-one of the children who were selected as matched participants for the study were male; the remaining 15 were female. Other characteristics of these two subgroups

TABLE 1
Teacher, Aide, and Student Characteristics Across Sites

Classrooms	Nashville University School #1	Nashville University School #2	Nashville Public School #1	Nashville Public School #2	Pittsburgh Public Classroom #1	Pittsburgh Public Classroom #2
No. of Teachers	2	2	1	1	2	1
Educational Background	BA Special Education; BS Developmental Psychology	BA Education; BA Engineering enrolled in M.Ed. program in Special Education	BA Special Education	BA Special Education	M.Ed. Special Education; BA Elementary Education	BA Elementary Education & Special Education
Teaching Experience	2 years; 5 months	Data not available	6 years	4 years	9 years; 3 years	10 years
No. of Assistants	0	0	1	1	1	1
No. of Students in Classroom	8 D*	8 D*	9 D*	9 D*	12 D* 12 ND**	12 D* 12 ND**
Students' Age Range in Years	2–3	2–4	5–7	4–6	3–5	3–5
Students' Degree of Developmental Delay	Mild to Severe	Mild to Moderate	Mild to Moderate	Moderate to Severe	Mild to Severe	Mild to Severe
Treatment	Milieu	Milieu	RI	RI	Milieu	RI
No. of Participants Selected From Class	5	6	4	5	7	9

* D refers to children with disabilities

** ND refers to children without disabilities

of children are summarized in Table 2 and described further below.

Pretreatment

The children in the study varied greatly in their developmental level. To test whether treatment efficacy varied by child language level required that we use measures that quantify language level across a wide developmental range. Global language measures are such measures. The utility of global language measures across the wide developmental range represented in the present study more than compensated for the fact that global measures do not indicate what aspects of language the children understood and used. The particular global measures selected for the current study were selected because they have been found (a) to be concurrently valid with other tests of language development and (b) to change during the developmental range represented in the current sample of children (Yoder et al., 1991; Kaiser et al., 1994.).

All children participating in the study were

TABLE 2
Description of Matched Groups

Pretreatment Variables[1]	Milieu Teaching (n = 19)		Responsive Interaction (n = 19)	
	M	*SD*	*M*	*SD*
Mean Length of Utterance (MLU) in Morphemes	2.46	.85	2.39	.79
SICD-R[2] Score in Months	30.95	6.37	30.95	4.96
SICD-E[3] Score in Months	30.31	6.30	30.74	6.40
PPVT-R[4] Score in Months	33.58	7.6	31.37	6.29
EOWPVT[5] Score in Months	34.28	12.5	32.17	11.4
Number of Utterances/Minute	5.66	2.6	5.61	2.9
Number of Different Words/Total Number of Words	.24	.11	.23	.08
Chronological Age in Months	53.6	14.1	46.0	6.23

[1] Participants in the two groups did not differ significantly on any of these variables based on paired *t*-tests ($df(18)$, $p > .05$).

[2] Sequenced Inventory of Communication Development—Receptive Scale (Hedrick et al., 1984)

[3] Sequenced Inventory of Communication Development—Expressive Scale (Hedrick et al., 1984)

[4] Peabody Picture Vocabulary Test—Receptive (Dunn & Dunn, 1981)

[5] Expressive One Word Picture Vocabularly Test (Gardner, 1979)

given three language tests: the Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 1981); the Expressive One Word Picture Vocabulary Test (EOWPVT; Gardner, 1979); the Sequenced Inventory of Communication Development (SICD, Hedrick et al., 1984). In addition, two 30-minute language samples were collected during play with trained research assistants. A standard set of toys and a standardized interactional protocol were used during the language sampling to ensure comparability of context across children and from pre- to posttesting.

From these standardized assessment protocols, we derived seven variables to be used in the analysis. Mean length of utterance (MLU) in morphemes, the number of different utterances per minute, and the ratio of the number of different words to the total number of words were derived from the language sample using the Systematic Analysis of Language Transcripts (SALT; Miller & Chapman, 1983). MLU in morphemes was selected as an index of the syntactic level. Number of different utterances per minute was an index of the rate of talking. The number of different words in ratio with the total number of words produced measured expressive vocabulary diversity.

The remaining four variables were derived from the results of standardized assessments. The SICD yielded indices of general expressive and receptive language levels: the age equivalency on the expressive (SICD-E) and receptive (SICD-R) scales. The PPVT age equivalency score was an index of receptive vocabulary, and the EOWPVT age equivalency score was an index of expressive vocabulary.

Selection of Language Goals

Based on the language samples and the SICD, we selected four developmentally appropriate language goals for each child. We used

Bloom and Lahey's (1978) procedure to guide us in selecting and sequencing semantic-syntactic language goals. If the children were developmentally advanced enough to learn complex sentences (i.e., if they had an MLU > 3.5 morphemes), we used Miller's (1981) procedure to guide us in selecting and sequencing such syntactic goals. From a list of developmentally appropriate goals for each child, one goal was selected that also met functionality and teachability criteria as indicated by teacher evaluations of the goal. As children mastered a goal, another goal was selected. The number of goals per child varied because children with faster learning rates were assigned more total goals.

Because the children's developmental levels varied, the nature of the goals for children functioning like younger children were different from the goals of children functioning like older children. However, because the children were developmentally similar in the two intervention groups, the type and distribution of goals were similar between the two groups. The appendix contains the goals for each group.

During language intervention, monthly probes were conducted to determine each child's acquisition of his or her language targets. The mastery criterion was at least 7 correct trials out of the 10 possible correct trials on monthly probes or two spontaneous uses of the target during classroom observations within 1 week. When a child met the criterion on one of his or her language targets, a new target was selected from the original list of developmentally appropriate language targets.

Teacher Training

The 12 participating teachers and instructional aides were trained by research staff members in a series of miniworkshops before the beginning of the intervention phase of the study. Training began by providing the teachers with an overview of the intervention they would be implementing and providing them with a training manual prepared by the staff. The contents of the milieu teaching manual were consistent with the principles of milieu teaching as described by Hart and Rogers-Warren (1978). The content of the responsive interaction model was based on descriptions provided by Weiss (1981) and training materials obtained from the INREAL project at the University of Colorado. (Copies of these manuals may be obtained from the first author.)

After teachers had read the manuals, brief lectures on the components of the intervention, videotapes showing examples of the intervention, staff demonstrations, and discussions were used to train the teachers. Specific examples of how to teach various types of child language targets were provided. Suggestions about incorporating the teaching procedures in ongoing classroom activities were provided by reviewing the classroom schedules of activities. Each teacher and instructional aide received an average of 6 hours of training prior to the implementation of the intervention. In addition, a research staff member who was present during 4 half days each week provided daily feedback for teacher implementation. Initially, the consulting research staff member modeled the intervention procedures and coached the teaching staff in implementing the procedures. After the teachers were comfortable with and accurately implementing the procedures, the consulting staff members gradually faded their participation but continued to give regular feedback to the teachers. Staff members and teachers met at least once each week outside class time to discuss implementation and to evaluate individual child progress.

Language Teaching Methods

As indicated in the introduction, milieu teaching and responsive interaction were used to facilitate the children's acquisition and generalization of their language goals. The two

methods differ in their use of explicit prompts for child language use and their relative emphasis on nonobligatory language modeling techniques. Both methods encourage teachers to follow the child's attentional lead. In both methods, teachers begin teaching episodes contingent on the child's expressed interest in an activity, event, or adult.

In milieu teaching, teachers were encouraged to prompt the child to request or comment on particular aspects of the events and objects in which they show immediate interest. These prompts included requests to imitate (i.e., obligatory models), mands (i.e., questions, instructions to verbalize, or presentation of choices), or nonverbal cues to talk (i.e., time delays). The prompts were arranged in a hierarchy of support and faded when possible. The prompts targeted the child's language goal. Child responses to prompts resulted in functional consequences (e.g., resumption of activity), feedback on correctness of the response, and expansions or extensions of the child's utterance.

In responsive interaction, teachers encouraged children to converse with teachers through several nonobligatory conversational scaffolding techniques. These nonobligatory scaffolding techniques were (a) contingent verbal and nonverbal imitation of children's prelinguistic communicative attempts, (b) systematic use of expansions, (c) self-talk (adult talking about what he or she is doing), and (d) parallel talk (adult talking about what the child is attending to or doing). Although previous applications of the model from which responsive interaction was derived (i.e., INREAL; Rogers et al., 1986) did not specify language goals, the current application of responsive interaction did target specific language goals.

Fidelity of Treatment

Three strategies were used to ensure a high level of fidelity of treatment in the two language teaching interventions. First, consulting research staff members were present and supported the teachers throughout the intervention phase as described above. Second, during each observation in the classroom, a research staff member completed a fidelity of treatment feedback sheet. This checklist was used to determine if the critical components of each intervention were being implemented correctly and to provide specific suggestions to the teachers about their use of the teaching procedures. Written and oral feedback was provided to the teachers, based on the checklists, after each observation. Third, every 2 weeks, one activity per teacher (a total of 75 observations) was videotaped and coded in detail by project staff members, using an observational code developed for this purpose. (Copies of the fidelity of treatment checklist and the observational code are available from the first author.) Summaries of these coded observations were used to give feedback to teachers.

Reliability on fidelity of treatment for videotaped samples was assessed a total of 20 times throughout the study. For these reliability checks, two staff members completed the checklist while watching a videotape of the same observation period, and the checklists were compared item by item for exact agreement on the use of each component of the procedures.

Reliability on the milieu implementation checklist averaged 90% (range 73–100%) for the number of episodes; 82% (range 78–96%) for the number of correct episodes; 82% (range 44–100%) for the number of episodes of teaching goals; and 92% (range 79–100%) for the correct use of the four procedures. Reliability on the responsive interaction checklist averaged 86% (range 77–100%) for the number of episodes; 86% (range 77–91) for the number of correct episodes; and 94% (range 6–98%) for the number of episodes of teaching goals.

Specific criteria for correct use were devel-

oped for each critical behavior in the two interventions. For responsive interaction, a discrete teaching procedure (expansion, descriptive talk, pause, repeat) was scored whenever the teacher used a particular behavior under the conditions specified in the training manual (e.g., following a child utterance, a teacher could expand, repeat, or seek clarification) and if no sequence errors were made (e.g., three teacher utterances in sequence). For milieu teaching, a teaching episode was judged to be correct if the teacher followed the specific steps of the milieu procedures in order and completed each step correctly.

Across all settings and observations, the average correct implementation of the responsive interaction procedures was 70% (*SD* 16.9). The average correct implementation of the milieu teaching procedures was 69% (*SD* 19.8). During the implementation check sessions, an average of 30 correct responsive interaction episodes occurred per session with an average of 10 goals taught during each session. During the implementation check sessions, an average of 14 correct episodes of milieu teaching occurred with an average of 8 goals being taught during each session. Sessions scored during the implementation checks varied slightly in length, according to the duration of the classroom activity. Thus, direct comparisons of the frequency of implementation of the procedures in the two interventions should not be made.

To address consistency of treatment implementation across Nashville and Pittsburgh, three procedures were implemented. First, the principal investigator of each site sent two tapes to the principal investigator of the other site: one from a milieu classroom and the other from a responsive interaction classroom. Once received, the teacher trainers observed and discussed similarities and differences in how the treatments were being implemented across sites. Follow-up phone conversations between project coordinators in the two cities were used to attempt to reduce discrepancies in treatment implementation across cities. Second, the principal investigator and project coordinator from Pittsburgh came to Nashville for two 3-day visits: once at the beginning and once in the middle of the project. During these visits, the project coordinators in both cities viewed several treatment sessions to stimulate discussions on similarities and differences in treatment implementation and on how to reduce discrepancies when located. Third, monthly telephone calls were conducted to discuss implementation of the research plan. During these discussions, any noted discrepancies in treatment implementation were reviewed with the intent to reduce such discrepancies.

Language Teaching

Teachers implemented the language intervention procedures in at least three activities per day 4 to 5 days each week. Examples of activities in which the intervention was implemented are free-play, snack, breakfast, circle, and small-group activities. Each of these activities lasted between 15 and 30 minutes. Each teacher implemented the language teaching methods for 64 school days. Child attendance at school, and, thus, the number of language teaching sessions each child received, was recorded. Child attendance did not covary with the language teaching method or any other variable in the study.

Posttreatment

The posttest procedure was identical to the pretreatment protocol. The SICD, the PPVT, and the EOWPVT were administered to all children. Two 30-minute language samples were collected for each child. The same variables selected at the pretreatment period were derived from the posttest. The examiners administering the posttest were not the children's teachers or research staff consultants. No materials used during training were used

during the posttest assessments. The same language sampling protocol used in the pretest was implemented in the posttest and it did not closely resemble either of the language teaching methods used in the study.

Global measures of language level were used as posttreatment measures because we needed ways to quantify change on several different language aspects at several different developmental levels. The children in the study varied greatly in their developmental level and language goals. Additionally, outcome measures that were more specific to the children's goals would not have been comparable to each other, because the relative difficulty of goals differ for children at different developmental levels. Therefore, despite the relatively low sensitivity of global measures to changes in language level, such measures best fit our research questions and sample. Because global measures are less sensitive to changes in language than are goal-specific measures, using global measures reduces the probability of finding differential treatment effects. Therefore, any differential treatment effects in the form of main effects for treatments or child characteristic by treatment interactions occurred despite the use of global measures, not because of them.

Reliability of Variables

To estimate the reliability of variables derived from the language samples, 20% of the transcripts were transcribed and coded by a second independent observer. An intraclass coefficient was used to quantify the interobserver agreement at a summary level. The intraclass correlation technique, or the *g* coefficient, is a method of estimating reliability that controls for chance agreement due to little between-subject variance (Mitchell, 1979).

Interobserver reliability on the pretreatment variables averaged .94 (*SD* = .05). Interobserver reliability on the posttreatment variables averaged .94 (*SD* = .04). Interobserver agreement on correctness of child responses to standardized test items was assessed on 26% of the pre- and posttests and was virtually perfect (SICD-receptive mean = .99; SICD expressive mean = .98; PPVT mean = .99; EOWPVT mean = .998).

RESULTS

Pretest Comparisons

Paired *t*-tests were conducted to compare the groups' pretreatment performance. No significant between-group differences on the pretreatment variables were found. This indicated that the matching procedure was effective in creating equivalent groups on the pretreatment variables MLU, SICD-E, SICD-R, PPVT-R, EOWPVT, number of utterances, and lexical diversity.

Posttest Comparisons

Paired *t*-tests were applied to analyze differences in group means at posttest. As can be seen in Table 3, group means did not differ significantly at posttest for any outcome.

Pre- to Posttest Comparisons

Matched *t*-tests were applied to determine whether average gains in the language levels of children in each group were significant. Table 4 indicates that there were significant increases in both groups on five of the seven variables measured at the pre- and posttest periods (MLU, SICD-R, SICD-E, PPVT, and EOWPVT). There were no changes on number of utterances or lexical-diversity measures.

Interactions between Pretest Characteristics and Treatment

To determine whether pretest characteristics predicted differential effectiveness of the two language teaching methods, we conducted separate hierarchical multiple regression anal-

TABLE 3
Posttest Scores of Matched Groups

Variables	Milieu Teaching (n = 19)		Responsive Interaction (n = 19)	
	M	*SD*	*M*	*SD*
MLU in Morphemes	3.1	(1.1)	3.0	(.09)
SICD-Receptive Score in Months	34.9	(5.0)	36.2	(9.7)
SICD-Expressive Score in Months	37.3	(6.9)	36.2	(7.9)
Receptive Vocabularly (PPVT-R) Score in Months	36.9	(8.3)	37.7	(10.2)
Expressive Vocabulary (EOWPVT) Score in Months	40.3	(10.7)	42.5	(14.50)
Number of Utterances/Minute	6.8	(1.9)	6.3	(2.4)
% Different Words	26.8	(32.2)	20.6	(7.5)

Note. No significant differences between the groups, paired *t*-test, *df* = 18.

yses for the five outcome variables for which consistent increases were demonstrated from pretest to posttest. The seven pretest variables were used as predictors in these regressions. The dummy-coded group variable was entered first; the pretest characteristic variable was entered second; and the cross-product term between group and pretest characteristic was entered last. This analysis procedure allowed us to analyze the effects of the interaction after controlling for intercorrelation between the group and pretest characteristic variables. Seven of the 35 interactions were significant. Table 5 presents the test statistic, probability level, and proportion of variance the significant interaction terms account for in the indicated posttest score.

As is shown in Figures 1–7, the regression lines intersect within the range of language abilities demonstrated by these preschool chil-

TABLE 4
Changes From Pre- to Posttreatment Periods in Milieu Teaching and Responsive Interaction Groups

Variables		Milieu Teaching		Responsive Interaction	
		Pre	Post	Pre	Post
MLU	*M*	2.45	3.14*	2.39	2.95*
	SD	(.85)	(1.07)	(.79)	(.95)
SICD-R	*M*	30.95	34.95*	30.95	36.21*
in Months	*SD*	(6.37)	(4.96)	(4.95)	(9.66)
SICD-E	*M*	30.31	37.26*	30.74	36.21*
in Months	*SD*	(6.30)	(6.94)	(6.4)	(7.94)
PPVT-R	*M*	33.58	36.89*	31.37	37.74*
in Months	*SD*	(7.55)	(8.3)	(6.29)	(10.2)
EOWPVT	*M*	34.28	41.3*	31.8	42.47*
in Months	*SD*	(12.5)	(10.0)	(11.2)	(14.5)
Utterances/Minute	*M*	5.6	6.8	5.6	6.3
	SD	(2.6)	(1.9)	(2.9)	(2.4)
% Different Words	*M*	.24	.27	.23	.21
	SD	(.11)	(.32)	(.08)	(.08)

* = Significant increase at .05 level; paired *t*-test, *df* = 18.

TABLE 5
F and R^2 Change Values for Significant Interactions Between Pretreatment Characteristics and Groups

Pretreatment Variable	Posttest Variable	R^2 Change for Interaction Term Over Main Effects	*F* for Interaction Term	Adjusted R^2 for Total Model
PPVT-R	PPVT-R	.07	9.77**	.73*
	SICD-R	.17	8.45**	.29*
	EOWPVT	.12	8.16**	.46*
SICD-R	SICD-R	.18	18.81**	.66*
	EOWPVT	.08	5.25*	.48*
EOWPVT	SICD-E	.06	4.50*	.49*
	SICD-R	.08	4.77*	.39*

Note. Interactions tested with hierarchical multiple regressions with group and pretest entered first and interaction term entered last.

* $p < .05$.

** $p < .01$

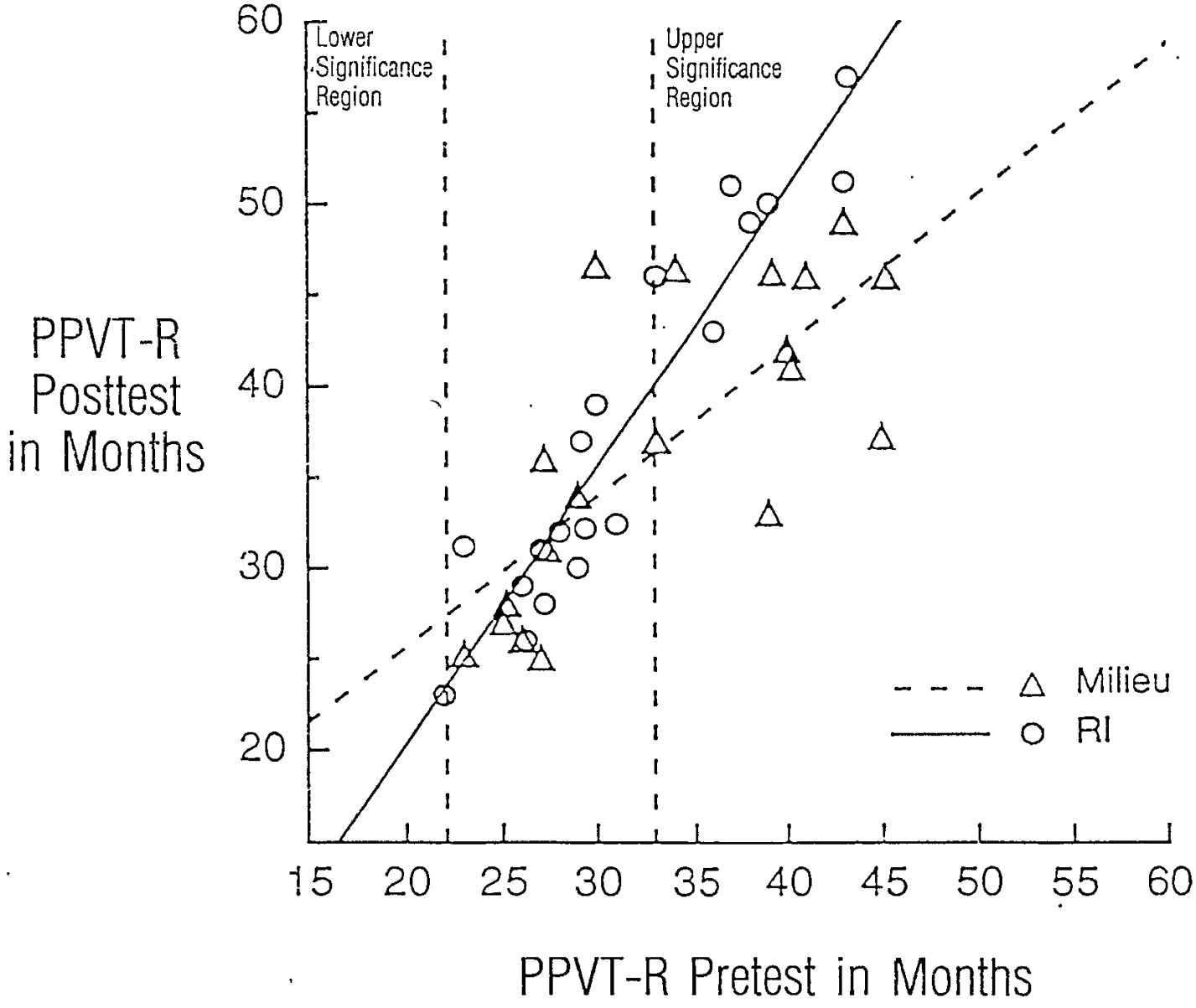
dren. The Johnson-Neyman technique was used to establish the regions of significance for these interactions. This technique specifies the upper and lower values in the range of pretest scores that are associated with superior outcomes for one of the intervention conditions. Ten to 18 of the 36 participants' scores fell within the region of significance for these interactions.

Figures 1-3 indicate that participants with age equivalence scores on the PPVT above 33–34 months at pretest benefitted significantly more from the responsive interaction intervention than from the milieu teaching intervention with respect to growth in receptive vocabulary (PPVT), receptive language (SICD-R), and expressive vocabulary (EOWPVT). Only a few participants fell into the lower region of significance with pretest scores on the PPVT below 22–24 months at pretest. Children with PPVT age equivalence scores under 22–24 months at the pretest benefitted more in the milieu group.

Figures 4 and 5 illustrate that participants with receptive age equivalence scores on the SICD above 35 months at pretest benefitted more from the responsive interaction intervention than the milieu teaching intervention with respect to growth in receptive language (SICD-R) and expressive vocabulary (EOWPVT). Participants in the lower region of significance with pretest scores below 24–26 months benefitted more from the milieu teaching intervention than the responsive interaction intervention; this differential effect was especially apparent on the receptive language measure (SICD-R).

As indicated in Figures 6 and 7, participants with expressive vocabulary scores above 41–45 months at pretest benefitted more from the responsive interaction intervention with respect to growth in receptive and expressive language (SICD-R; SICD-E). Participants in the lower region of significance with pretest scores below 23 months benefitted more from the milieu teaching intervention on the expressive language measure (SICD-E).

FIGURE 1.
Interaction between PPVT-R pretest and group predicting PPVT-R postest.



DISCUSSION

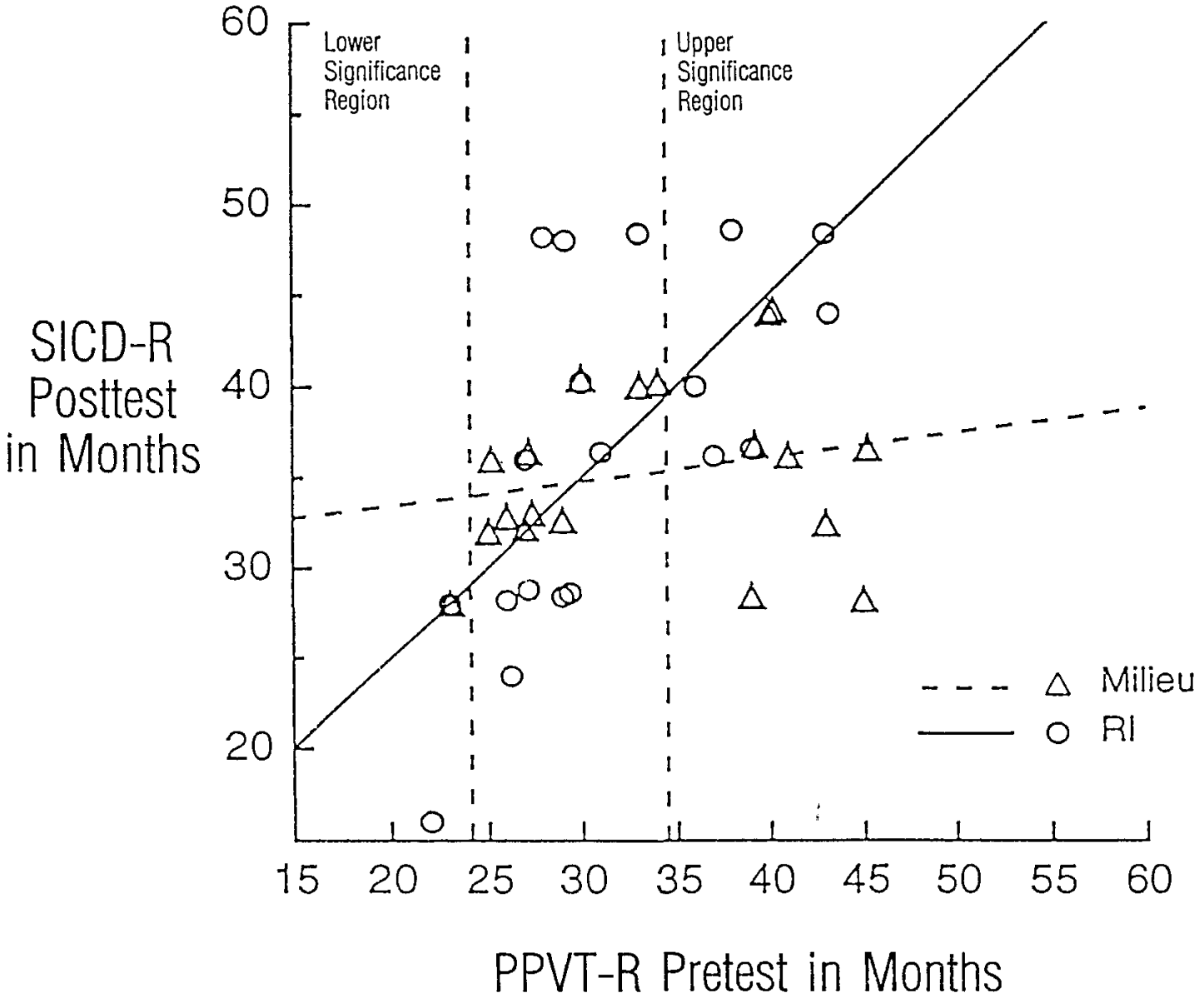
In general, the results of this study corroborate the findings of Yoder et al. (1991). Although the posttest performance of the two groups of children did not differ significantly on any outcome measure, children in the earliest stages of language development tended to show the greatest gains resulting from the milieu teaching treatment. Before we discuss the possible explanations for these findings, we address the limitations of the design of the study in order to provide an appropriate context for examination of the specific findings.

Weaknesses of the Study

Five aspects of the design of the study merit discussion as potential weaknesses affecting the interpretation of the results: the use of a group matching procedure, the use of individuals rather than classrooms as the unit of analysis, the exploratory nature of the study, the natural confound between child developmental level and the aspect of language the children learn, and the limitations of our treatment implementation measures.

Matching is an imperfect method of creating equivalence in groups before a treatment.

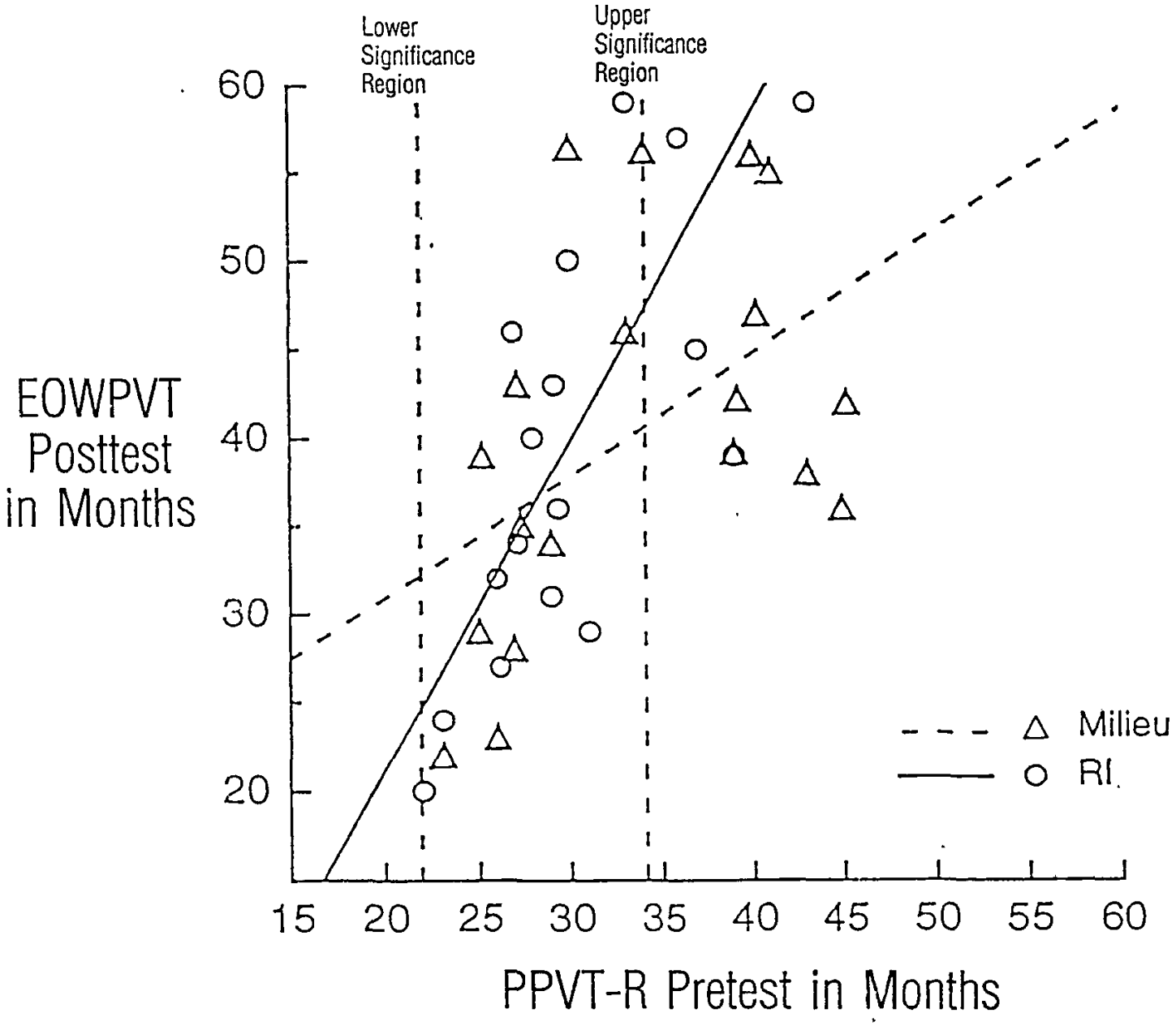
FIGURE 2.
Interaction between PPVT-R pretest and group predicting SICD-R posttest.



In this study, pairs of participants were matched using four pretest variables in an attempt to maximize the equivalence of the language abilities in the two groups. This matching procedure was used because we were particularly interested in examining the differential effects of the two language intervention approaches and we were unable to assign children randomly to groups. Pretest comparisons indicated we were successful in creating equivalent groups based on seven pretreatment variables. However, any matching procedure allows for the possibility that the groups could be different on some unmeasured pretreatment variable that may explain the relative advancement of one group over another. This design weakness should be kept in mind when interpreting the following pattern of results.

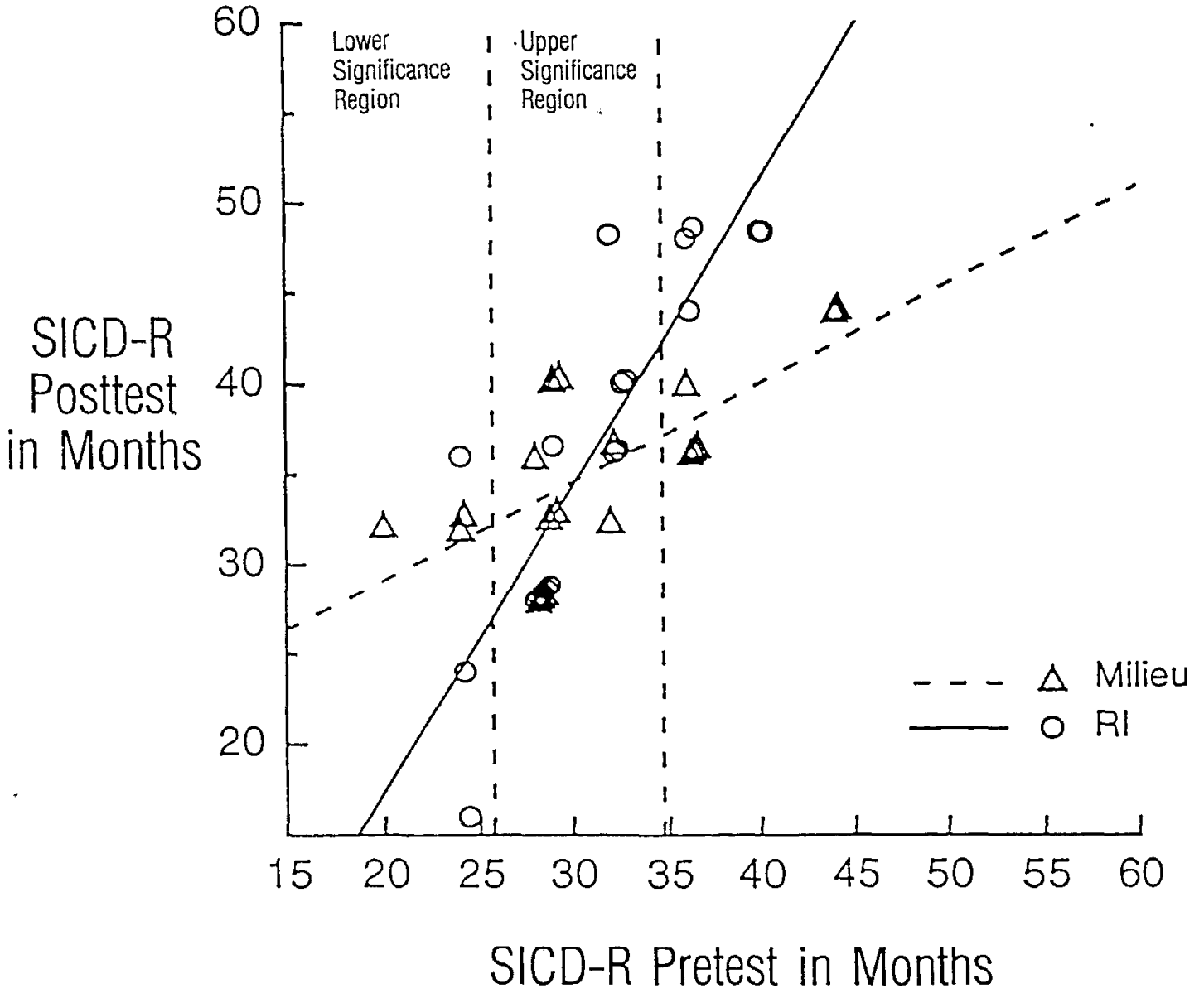
In the current study, individual children were the unit of analysis. There is a debate concerning the proper unit of analysis in studies that implement and test the efficacy of classroom-wide intervention. Cronbach (1976) stated that significance tests based on individual-level analysis are unacceptable when classes are the unit of sampling. He posits that the size of the sample is really the number of classrooms

FIGURE 3.
Interaction between PPVT-R pretest and group predicting EOWPVT posttest.



(six in the present study). Ideally, the individual scores analyzed in classroom-wide interventions are the mean scores from the classroom as a whole rather than those of individual children. Cronbach points out that the type of statistical procedures used in this report assume that scores are independent from each other. Treating individual children as the basis for analysis and sample size assumes that subjects in one classroom do not influence each other any more than do children in different classrooms. On the other hand, Hopkins (1982) and Lindquist (1940) state that using the classroom as the unit of analysis in such studies is often unnecessary (i.e., does not affect the results) and prevents the possibility of investigating subject by treatment interactions, a central focus of the present study. In fact, using classrooms as the unit of analysis would practically prevent researchers from investigating the relative efficacy or efficiency of educational treatments in classroom settings, the most ecologically valid context for education (Hopkins, 1982). Classroom studies, such as the

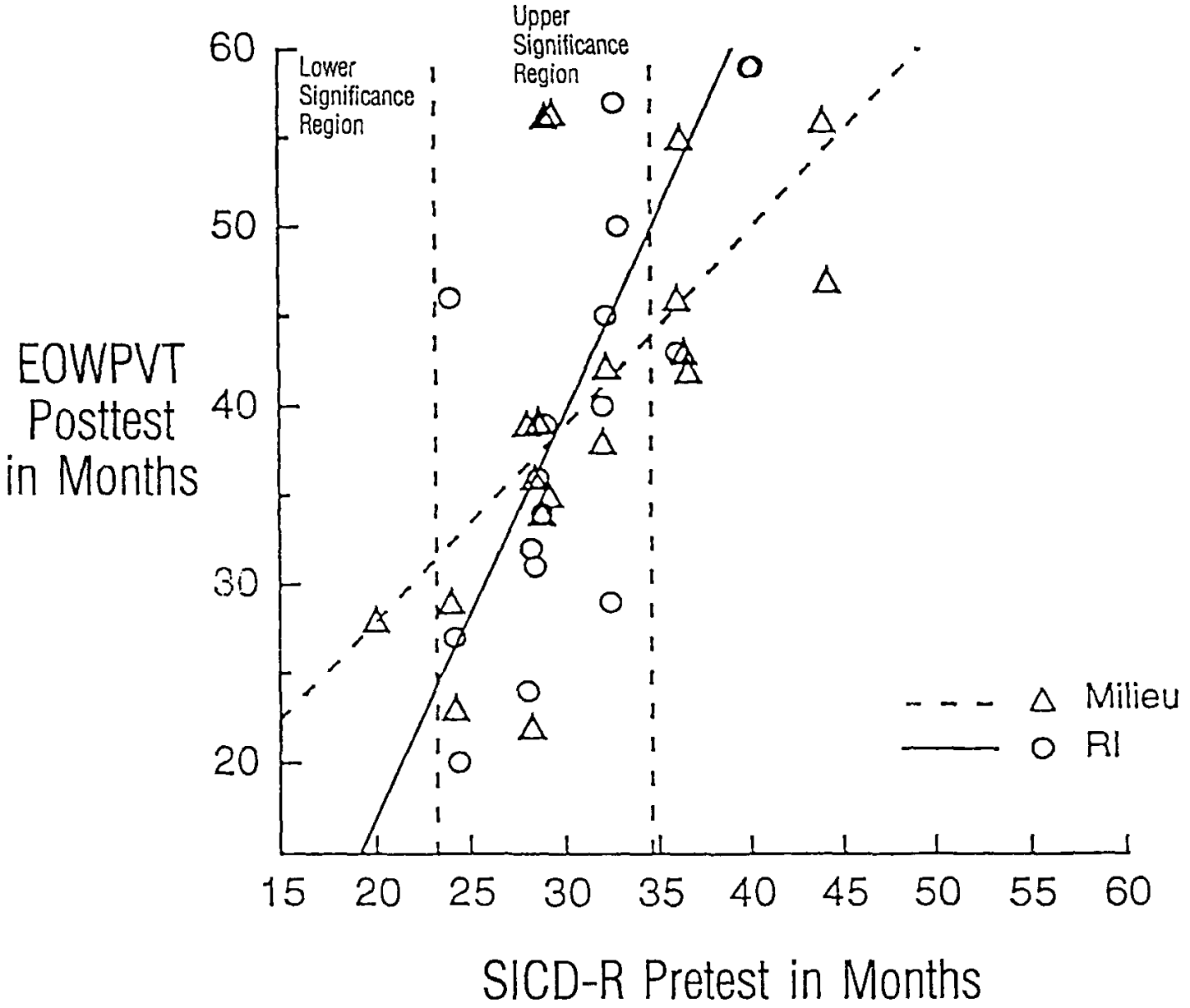
FIGURE 4.
Interaction between SICD-R pretest and group predicting SICD-R posttest.



current one, are needed to extend the external validity of educational studies to educationally relevant settings; their results need to be replicated in internally valid studies in which the unit of analysis is clearly the individual, before generalizations based on the results are made.

We conducted many analyses. The lack of theory and of previous studies comparing milieu teaching and responsive interaction methods prevented us from making specific hypotheses about which pretreatment variables or language outcomes would be involved in aptitude by treatment interactions. Given the context of multiple analyses, our results should be considered exploratory. The analyses accurately describe what occurred for the sample of children that we studied, but we can not generalize our results confidently to children we have not studied. These results do provide the basis for future studies that make specific predictions about the characteristics of children or language goals most likely to benefit from the two teaching methods. However, we consider it worth the effort to attempt to further investigate these general findings, because our own replication study with a sample of parents who implemented milieu

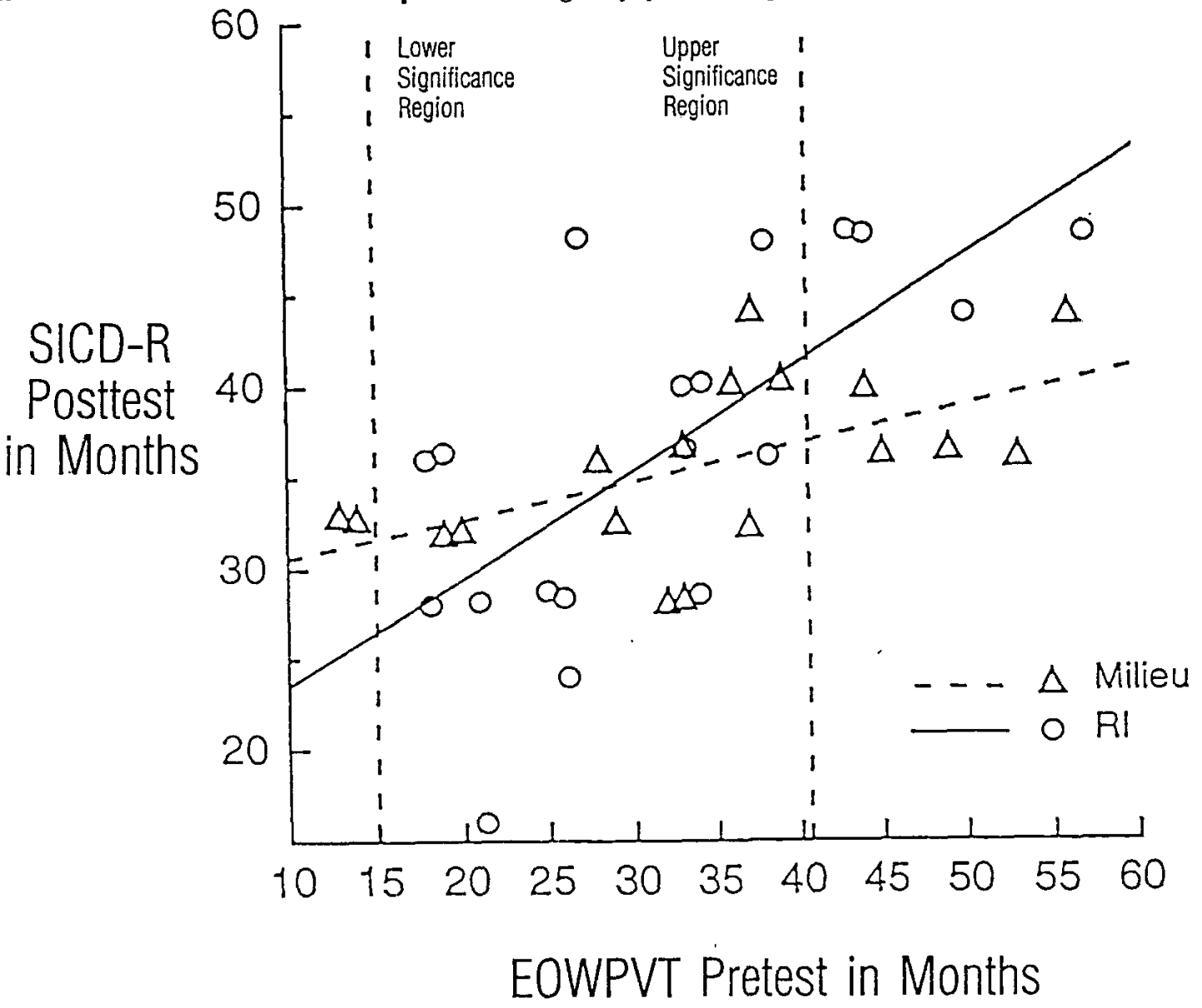
FIGURE 5.
Interaction between SICD-R pretest and group predicting EOWPVT posttest.



teaching or responsive interaction produced very similar results to those found in the current study (Kaiser et al., 1994; Yoder, 1992).

There were only a few children's scores in the regions of significance. This is almost always the case in studies where child characteristics interact with treatments in samples of children with disabilities (e.g., Cole, Dale, & Mills, 1990; Friedman & Friedman, 1980). Disordinal interactions (i.e., those in which the regression lines intersect) are the most easily detected interactions in relatively small samples (Pedhazur, 1982). In disordinal interactions, the regions of significance are almost always in the tails of the distribution of scores for the pretreatment variable (e.g., Friedman & Friedman, 1980; Coleet al., 1990). Small samples are more likely to be unrepresentative of the population than are large samples. Therefore, the interactions seen in the current study must be replicated before they are expected to occur in other similar samples. We could have confidence in the replicability of patterns of results seen in the present study if a future study demonstrated that a group of children, all of whom fall in

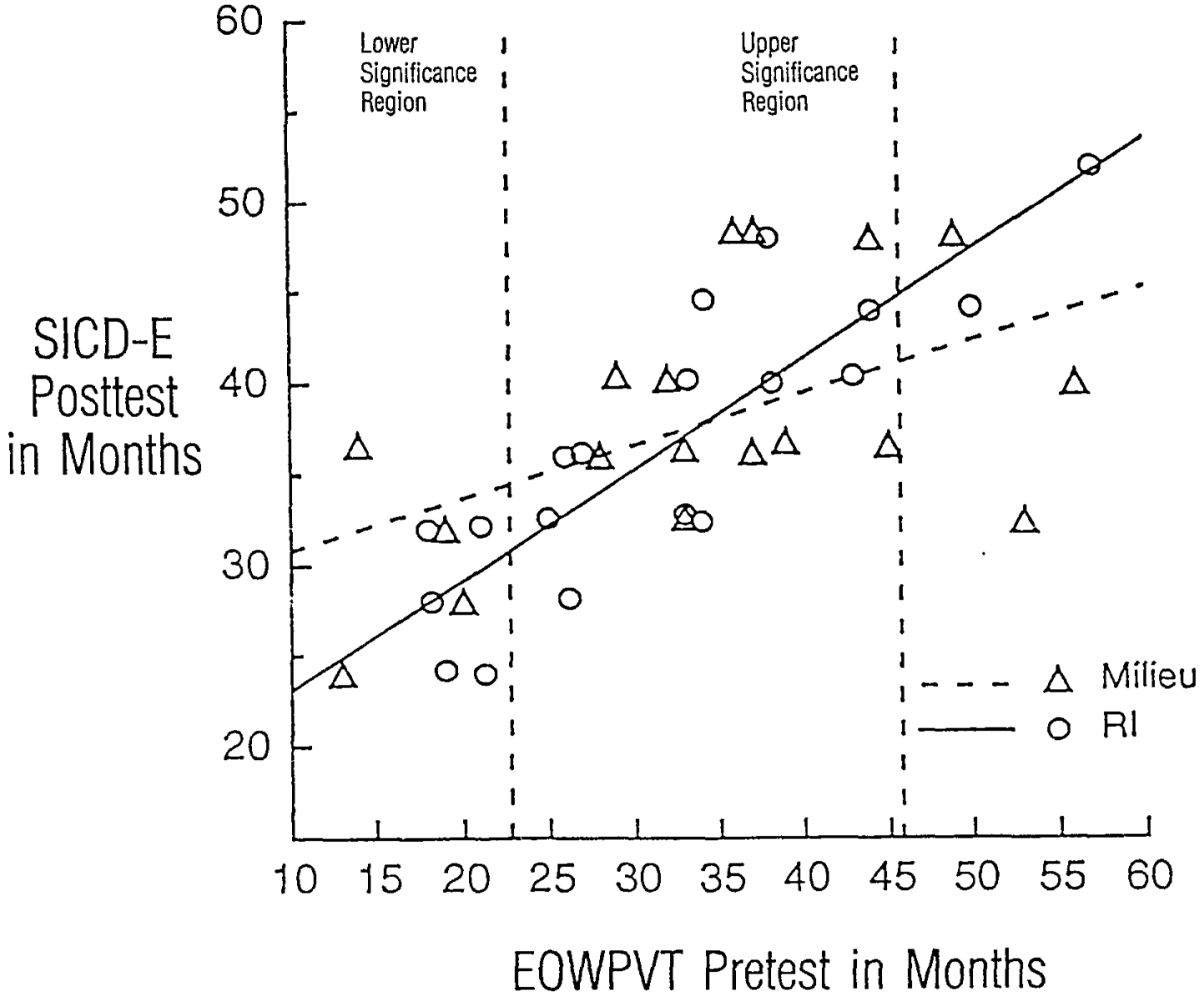
FIGURE 6.
Interaction between EOWPVT pretest and group predicting SICD-R posttest.



the lower region of significance, benefitted more from milieu teaching than from responsive interaction in the context of a well-controlled experiment. A similar study for children in the upper region of significance would lend support to the external validity of the finding that responsive interaction benefitted children in the upper region of significance more than did milieu teaching.

In the present study, the aspect of language that the children were learning was correlated with the developmental level of the children. This happened for two reasons. First, we selected developmentally appropriate language goals for each child within a developmentally diverse sample. Second, regardless of what goals we select, children will learn the aspect of language that is most functional for them at that particular period of development. One consequence of the fact that children at different developmental levels were learning different aspects of language in the intervention sessions is that we cannot know whether it was the developmental level of the children or the language aspect being learned that predicted the relative efficacy of the teaching methods. Future research should attempt to determine which of these factors best pre-

FIGURE 7.
Interaction between EOWPVT pretest and group predicting SICD-E posttest.



dicts the relative efficiency of the two teaching methods.

Finally, the lack of very specific treatment fidelity and the use of a treatment package prevents us from knowing exactly what aspect of the treatment was responsible for the results. Future studies should have more specific descriptions of the treatments, which would allow statistical comparison of the two treatments as they were actually implemented. For example, future studies could measure the frequency of opportunities for expansions and the frequency of expansions in a representative sample of the treatment sessions. Doing so would document whether the treatments were different on such important aspects of the interventions. Additionally, future studies would document more specifically and more systematically whether the treatments were implemented differently across sites.

One of the conceptual challenges in studies comparing treatments is the generation of a common metric for comparing the intensity and the correctness of the implementation of the treatment. For example, milieu teaching episodes often required four or five teacher utterances related to the child's goal in order

to teach the goal correctly. In the responsive interaction intervention, a single child utterance followed by a specific adult behavior could be counted as an episode of teaching towards a goal. Thus, the length of episodes and the opportunities for errors are quite different for the two interventions. It is also the case that very little empirical evidence is available to suggest what ideal levels of frequency or correctness of the implementation would be. Therefore, the fidelity of treatment data in the present research is best used to describe the treatments, not to compare them.

Possible Explanations for the Results

The posttest performance of the two groups did not differ significantly for any of the outcome measures. The pretest by group interactions suggest that pretest group means did not differ because different children benefitted from different treatments.

Analyses of the interactions between pretreatment child characteristics and the intervention approaches revealed a consistent pattern of results. Within the range of language abilities represented by the children with developmental disabilities in these early intervention classrooms, children with more advanced language skills seemed to benefit more from the responsive interaction treatment and children with less sophisticated language skills tended to benefit more from the milieu treatment. The results give us moderate confidence in claiming that children whose receptive language level was less than 22–26 months learned more receptive language and expressive vocabulary through the milieu teaching intervention than through the responsive interaction treatment.

The results of the current study are consistent with our previous research finding that the milieu method was particularly effective for children in the first stage (Brown, 1973) of language learning, in which vocabulary learning and early semantic relations are the primary aspect of language acquired (Yoder et al., 1991). Milieu language teaching may be particularly powerful at facilitating vocabulary development and early semantic relations because it uses elicited production methods. Others have found that both children with specific language impairments (Connell, 1987) and children with mental retardation (Ezell & Goldstein, 1989) learn a language target more efficiently if the children are asked to say the language target than if the children are just asked to listen to the language model.

Alternatively or additionally, it may be more difficult to implement the responsive interaction method than the milieu teaching method in an effective manner when children are at the single-word stage of development. Expansion of child utterances may be particularly effective if they accurately encode the child's intended message (Nelson, 1989). It may be more difficult to identify the child's intended message from single-word or prelinguistic messages (Snow, Perlmann, & Nathan, 1987), without the context of adult question-child reply sequences (Scollon, 1976). Alternatively, the relatively infrequent talking of the child with developmental delays, in the first stage of language learning, may prevent the responsive interaction teacher from using the primary intervention technique, expansions, very frequently (Yoder & Davies, 1990). The use of mands in the milieu teaching procedure may, however, increase the frequency of child utterances and thus increase opportunities for adult responses. Yoder and Davies (1990) found that children who are developmentally delayed in the first stage of language learning use multiword replies to continue the established conversational topic more frequently after nonyes/no questions that continue the established topic than after any other type of adult utterance. Multiword utterances may be more likely to precede expansions because the communicative intent of the utterance may be easier to identify than

are single word utterances. Additionally, the communicative intent of responses to mands may be more accurately interpreted because mands provide the adult with contextual support helpful in interpreting ambiguous child utterances (Yoder & Davies, 1992).

Perhaps the more intriguing results occurred at the higher developmental level. Yoder et al. (1991) indicated that the more teacher-directed didactic approach was superior to milieu for teaching developmentally more advanced children who were learning syntactic aspects of language. In the present research, the less teacher-directed responsive interaction approach was superior to milieu teaching for teaching developmentally more advanced children who were assigned syntactic goals. With regards to predicting which intervention is more efficient for facilitating developmentally delayed children's syntactic development, it appears that the degree of teacher directedness is not the aspect of the intervention that explains the results. Once again, the results may be explained by (a) the match of the intervention method with the aspect of language the children are learning or (b) the relative difficulty of implementing the intervention methods with children at this developmentally advanced period.

In the present study and the Yoder et al. (1991) study, the dependent variables involved in the interactions did not measure syntactic level directly; however, performance on these measures may have covaried with syntactic level. Syntax is the set of organizational rules underlying language (Owens, 1984). It may be that both the didactic and responsive interaction models are superior to milieu teaching for facilitating syntactic development in preschoolers who are developmentally delayed because the first two interventions provide more opportunities than the last for making the meaningful comparisons between the child's and the adult's utterance for the same meaning. The careful selection, in didactic teaching, of positive exemplars presented in massed trials may help children notice the aspect of the underlying rule being taught that makes the exemplars similar. The deliberate pairing of nonexamples and examples in didactic teaching may help the child learn to understand the linguistic aspect of the teaching stimuli, thus improving the possibility that the child will understand the meaning of the examples used in training. The use of expansions in responsive interaction may help children notice the syntactic or semantic information that the adults add to the child's utterance.

In contrast, milieu teachers ask the child to imitate the answers to or answer questions about child-selected objects or activities. Because teaching episodes tend to be more temporally separated than in the didactic approach, the comparison between different exemplars of an underlying rule may be difficult due to memory constraints in children with developmental delays. Although milieu teaching allows expansions as one option to consequate child production (Kaiser & Alpert, 1994), the expansion option may be used less frequently in milieu teaching than in the responsive interaction method, where expansions are a central feature of the teaching method. This possibility was confirmed in our replication study (Kaiser et al., 1994.).

It may be difficult to implement effective milieu teaching for complex, syntactic structures with developmentally more advanced children. For example, verbal and nonverbal prompts that specify several components of the expected response (e.g, complex sentences with conjunctions) are difficult to generate spontaneously while conversing. Therefore, it may be difficult to elicit production of example sentences of target syntactic structures during ongoing conversation. In contrast, the teacher-directed nature of and presession planning in the didactic approach makes eliciting target sentences more feasi-

ble. The responsive interaction intervention does not depend on eliciting child production of language targets. In contrast to the single-word developmental period, simple- and complex-sentence users have facile conversational abilities, thus providing adults with frequent opportunities to expand their utterances accurately.

Milieu teaching may facilitate semantic or even early syntactic development, just not as efficiently as some other interventions. Although not providing definitive evidence, Warren and Gazdag (1990) and Warren and Bambara (1989) found increases in diversity in examples of the target semantic relations (e.g., action-object) during training sessions and generalization probes after applying a slightly different version of milieu teaching than was used in the present study. It was not clear whether this increase was due to more frequent use of semantic categories the child already used in other contexts or whether the intervention resulted in the children's learning to use new semantic relations (Kaiser et al., 1992).

Much future research is needed to untangle the myriad of possible explanations for the results in comparing early language interventions. In addition to testing the explanations just given, future research is needed to determine whether responsive interaction or didactic methods are more efficient for teaching generalized syntactic skills to developmentally more advanced children with disabilities. On the one hand, responsive interaction might be expected to be superior for such purposes. Warren and Rogers-Warren (1983) found that children with severe mental retardation only generalized about 50% of the language targets they were taught through a didactic language intervention (Guess, Sailor, & Baer, 1976). One reason given for the lack of generalization was the obvious differences in the social demands of the therapy context when compared to the conversational context (Stremel- Campbell & Campbell, 1985). A more naturalistic intervention context, such as in responsive interaction, may aid generalization to a greater extent because of its similarity to the conversational context (Hart, 1985). On the other hand, for generalization of the rule to occur, there has to be initial learning of the syntactic rule. The didactic method may provide more efficient contexts for facilitating rule acquisition than responsive interaction. Thus, another research question to be addressed is whether responsive interaction is superior to using didactic intervention for initial acquisition of rules and milieu for generalization of newly acquired rules to conversational use for facilitating syntactic development in children with disabilities.

The current study corroborates that of Cole et al. (1990) in suggesting that throughout the day, teacher- implemented language teaching can be effective in facilitating the language development of preschoolers with developmental delays above that expected by maturation alone. This study provides support for the potential importance of the role of classroom teachers and instructional assistants as primary language interventionists. For most classroom teachers to implement a day-long language intervention program, speech and language clinicians or other language intervention professionals will need to provide consultation on language goal selection, implementation, and child progress. Future research should address the relative efficacy of pull-out by clinicians versus day-long language intervention by teachers with clinician consultation to determine which model produces the most generalized language use. No single language teaching method may be superior for all children and all language goals. The current study presented exploratory data suggesting that milieu teaching may be best suited to developmen-

tally young children with vocabulary goals and that responsive interaction may be best suited to developmentally older children with syntactic goals. Replication of these results is necessary before generalization to other samples of similar children is warranted. Finally, a longitudinal study will be needed to confirm whether it is really the developmental level of children, not individual differences in children that covary with developmental level, that accounts for the present pretreatment characteristic by treatment interactions. Exploratory studies such as the one presented here are necessary for theory building, for guiding future studies, and for developing a research basis for selecting the most efficient teaching method on the basis of the child's particular language goal and learning characteristics.

Appendix: ID Number and Goal of Participants

Milieu	Responsive-Interaction
308 actions; attributes; possessive	312 nouns; actions; attributes
301 attributes + noun; plurals, interclausal "and"	136 action + object
115 action + attribute; action + object	106 action + attribute; action + location
113 action + attribute; action + object	118 relational + noun (that ball); action + object
303 possessive + noun; attribute + noun; location + state verb [3 words]	313 attribute + noun
300 location + state verb; intraclausal "and"	314 possessive + noun; intraclausal "and"; action + attribute + noun
126 acton + attribute; action + location + intent	122 action + attribute; attribute + noun
124 action + attribute; action + location	107 action + attribute; location + action
128 action + attribute; action + location	318 irregular past-tense verb;
112 action + attribute; noun + verb + complement	100 action + "ing"
127 action + attribute; action + location + intent	103 action + attribute
114 action + attribute; action + location + intent	121 object + action; location + action; noun + verb + complement
123 action + location + intent; intraclausal "and"	315 state verb + attribute; "because"; irregular past-tense verb
129 action + attribute; action + location + intent	135 action + location + intent
130 action + location + intent; intraclausal "and"	316 "because"; if-then
309 state verb + attribute	319 propositional complex sentence; "because"; irregular past-tense verb
111 "because"; "so"; relative clause	119 action + attribute; propositional complex sentence; "because"
310 "because"	317 propositional complex sentence; comparative

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