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Following the Child's Lead When Teaching Nouns to Preschoolers With Mental Retardation

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The current study tested the effects of following the child's attentional lead on the efficiency of object-label teaching. Three preschoolers with mental retardation participated. An alternating-treatments design was used to test relative treatment effects. An elicited-production method of teaching object labels was used to present the words under two conditions. Two sets of 32 nonsense words and unfamiliar objects were randomly assigned to the two teaching conditions to create equivalent goal sets and to control for prior exposure to the words and objects. Under the "following-the-child's-lead" condition, teaching episodes occurred only when the child had sustained attention to a target object or intentionally communicated about the target object. Under the "recruiting-the-child's-attention" condition, the child's attention was recruited intrusively away from his or her object of interest and toward the target object before each teaching episode began. The number of teaching trials per item and per session was carefully controlled. Results indicated that object-label teaching was more efficient under the following-the-child's-lead condition for all three participants.

KEY WORDS: language intervention, noun acquisition, mental retardation, child-centered intervention

This study tested the hypothesis that following the child's attentional lead improves the efficiency of object-vocabulary teaching to young children with mental retardation. Following the child's lead refers to teaching about the child's current object of interest, rather than recruiting attention to an object and then teaching.

Object-vocabulary is an appropriate language intervention goal for young children with mental retardation. Object-labels comprise the largest class of words in children's early vocabularies (Nelson, 1973).

Children with mental retardation may have particular problems in learning new vocabulary—problems that are not explained by their lower mental age. Some studies suggest that children with mental retardation tend to have smaller vocabularies than mental age-matched normally developing children (Mervis, 1990; Strominger, Winkler, & Cohen, 1984). The period of rapid vocabulary acquisition, usually experienced by normally developing children between the ages of 20 to 22 months, has recently been called the "naming spurt" because the rapid increases in vocabulary during this period are primarily due to rapid acquisition of object-labels (Goldfield & Reznick, 1990). Miller (personal communication, October 1989) found that the naming spurt occurs at a substantially later mental age for children with mental retardation than is generally found in normally developing children. Mervis (1990) has suggested that children with mental retardation have smaller vocabularies than normally developing children of the same mental age because many children with mental retardation have more difficulty with memory storage (McDade & Adler, 1980), memory retrieval (Dodd, 1975; McDade & Adler, 1980), and verbal encoding and decoding (Bilovsky & Share, 1975).

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The timing and context of linguistic input to the child probably affects the degree to which such input facilitates object-vocabulary development, particularly in young children (Snow & Gilbreath, 1983). Joint-attention episodes (i.e., periods in which the adult and child attend to the same referent) are an example of a context that may maximize the effect of linguistic input. Tomasello and Farrar (1986) have suggested that children are probably most attentive to and best able to determine the meaning of adult speech during joint-attention episodes. Snow and Gilbreath (1983) posited that young children may find it difficult to switch topics and still have sufficient information processing capacity to analyze adult language input. Observations of high-risk infants indicate that these babies respond to their mothers' attempts to get them to maintain or establish joint attention best when the mothers' attentional bids are about the object with which the child is already engaged (Landry & Chapieski, 1989). One of the most effective ways to establish joint-attention episodes may be for the adult to focus on the object of the child's attention (i.e., follow the child's lead).

In the current study, we hypothesized that teaching noun vocabulary would be most efficient when the teaching episode focuses on objects to which the child is already attending. Empirical support for this hypothesis comes from research with normally developing children by Tomasello and colleagues (Tomasello & Todd, 1983; Tomasello, Mannle, & Kruger, 1986; Tomasello & Farrar, 1986). A positive longitudinal relation between the amount of time spent in joint-attention episodes and later child vocabulary development has been demonstrated and replicated (Tomasello & Todd, 1983; Tomasello et al., 1986). In a well-controlled experiment, 17-month-old children who were developing normally comprehended more unfamiliar words taught under follow-the-child's-lead conditions than under conditions where the child's attention was recruited to the referent before teaching (Tomasello & Farrar, 1986). No differences in production of trained words were found. Generalization of word comprehension to untaught exemplars of the target vocabulary was not tested.

Following the child's lead may be even more important with children with mental retardation than with children who are developing normally. Landry and Chapieski (1990) found that infants who were mentally retarded were less likely to follow parental bids to redirect their attention than were mental age-matched, high-risk, preterm infants. These results suggest that such recruited attention shifts may be particularly difficult for children with mental retardation. Yoder, Kaiser, and Alpert (1991) found that an intervention approach based on following the child's lead was more effective in facilitating general language development in children with developmental delays who had vocabulary goals than was an intervention that followed the teacher's agenda. The Yoder et al. (1991) study did not test directly the importance of following the child's lead on vocabulary learning because there were several differences between compared treatments and because vocabulary level was not one of the affected dependent variables. However, theory and studies with normally developing and mentally retarded children suggest that young children with mental retardation have more difficulty learning from teaching methods that require them to change the focus of their attention than from those that follow their attentional lead.

It is particularly important to examine the potentially facilitating effects of teaching while following the child's lead with children who have mental retardation for two reasons. First, these children's delayed productive vocabulary acquisition makes finding contexts that enable efficient language learning critical to improving early language intervention outcomes. Second, following the child's lead is a central principle in most "naturalistic language interventions" (Fey, 1986; Warren & Kaiser, 1986; Weistuch & Lewis, 1985). Because these interventions have been partly derived from mother-child literature with normally developing children, it is important that the validity of the underlying principles of naturalistic teaching be tested on the populations experiencing these interventions.

In summary, the purpose of the present study was to test whether it is more efficient to teach object-label vocabulary to children with mental retardation under follow-the-child's-lead conditions than under recruiting-the-child's-attention conditions. In the present study, we used one instructional method and manipulated the timing of the teaching episodes relative to the child's attentional focus to test this question.

Methods

Participants

Three children participated in the study. They were recruited from a university-based preschool for children with mental retardation. To be included in the study, the children had to show evidence of a 25% delay in language and cognitive development. In addition, they had to display a vocabulary of at least 50 words as indicated on Rescorla's (1989) vocabulary checklist.

Table 1 presents the selected descriptive information about the participants. On the average, the children were 43 months old (*SD* = 3.8). The children's mean length of utterance (MLU) in morphemes was estimated from two 1/2 hour language samples obtained during interactions between an examiner and the child. The average MLU was 1.94 (*SD* = .71), suggesting that their level of linguistic development was in Brown's (1973) late stage I. One child (Child B) had an MLU above stage I. However, this child's expressive and receptive age equivalency scores were substantially lower than one would expect for her MLU. This pattern suggests that the child may have used longer utterances than she really understood. We could not test Child C's language using standardized tests because she would not attend to the test materials, even after repeated trials. However, her MLU of 1.54 placed her productive language within Brown's stage I. For the children with standardized test scores, their comprehension and productive levels were equal. The language-age equivalency scores were established using estimates from the *Sequenced Inventory of Communication Development* (SICD) (Hedrick, Prather, & Tobin, 1984). The children's mean mental age was 23 months (*SD* = 9.8). Mental ages were established by having a licensed examiner administer intelligence tests that were judged as most appropriate

TABLE 1. Subjects' chronological and mental ages, language age equivalence, mean length of utterance, and IQ.

Subjects	Chronological age (mos)	Mental age (mos)	Language age: Receptive (mos)	Language age: Expressive (mos)	MLU	IQ
A	47	31	28	28	1.52	68
B	40	27	28	28	2.77	68
C	46	12	nt	nt	1.54	<50
Mean	43	23			1.94	62
SD	3.8	10			.71	11

Note. MLU = mean length of utterance; IQ = intelligence quotient; nt = not testable.

for each child's estimated mental age and actual chronological age. The intelligence tests used were the Bayley Scales of Infant Development (Bayley, 1969), Merrill-Palmer Scale of Mental Ages (Stutsman, 1948), and Stanford Binet Intelligence Scale, 4th edition (Thorndike, Hagen, & Sattler, 1986). The children's deviation intelligence quotients were in the mentally retarded range. The diagnosis for Child A was developmental delay due to unknown etiology. The etiology of Child B's mental retardation was hypoplasia of the corpus collosum. Child C had a primary diagnosis of cerebral palsy, although her motor impairments were relatively mild. Children with different etiologies and diagnoses were studied because we expected superior efficiency of noun-label learning in the following-the-child's-lead condition regardless of such differences between children.

Teachers

The language session teachers were two members of our staff. Both teachers were experienced with the milieu teaching procedure. In addition, both received between 20 and 40 hours of training in implementing the teaching episodes with the prescribed timing. Finally, teachers received daily feedback on (a) the degree to which they implemented the milieu teaching procedures correctly and (b) the degree to which they adhered to the prescribed timing for teaching episodes.

Teaching Procedure

We selected a modified version of the Milieu Language Teaching method (Kaiser, Hendrickson, & Alpert, 1991) to present the object-labels to the children. The milieu method has two advantages over other intervention methods. It can be used in a play context, and it has been found to be efficacious in facilitating language development in children with mental retardation at the developmental period of interest (Yoder et al., 1991). We wanted to use a teaching method in a play context because such is the context of most naturalistic language teaching methods.

In this application of the Milieu Language Teaching method, we did not use the time-delay procedure because child access to materials was not controlled. Controlling materials would have reduced the number of toys that the child played with during the session, thus reducing the diversity of targets that we could teach to in any one session. Therefore, we chose to use the mand-model and the model procedures (Kaiser et al., 1991). The model procedure involves asking the child to imitate the object-label and is used at the beginning of training. After the child successfully imitates the adult model of the object-label consistently, the mand-model procedure is used. The mand-model method involves asking a question or giving a mand that requests an object-label. If the child does not answer or answers incorrectly, a prompt to elicit imitation of the desired response may be used. If the child still does not answer or answers incorrectly, the adult provides the correct object-label and toy play is continued. Correct responses are consequated with either expansions of the child utterance or continuing the child's topic and with access to the named object.

Timing Conditions

The model and mand-model procedures were implemented under two different timing conditions: following the child's lead (FCL) and recruiting the child's attention (RCA). Under the FCL condition, the teaching episode began (a) when the child intentionally communicated about the target referent or (b) after 10 sec of sustained play with the target referent. "Intentional communication" was defined as (a) the use of a conventional gesture (e.g., a point or nod), (b) the use of a symbolic word, or (c) the use of sequential or simultaneous attention to the adult listener and the object of attention. During the RCA condition, teaching episodes began only when the child was engaged with a nontarget referent for at least 30 sec prior to teaching. The adult called the child's attention to the target referent and began the teaching episode when the child turned his or her attention to either the adult or the target referent.

Design

The study used an alternating treatments design (Barlow & Hersen, 1984) in which equivalent sets of noun-labels were used under the two teaching conditions. Object-sets were counterbalanced across conditions.

Selection of objects and words. To ensure that children did not have prior knowledge of the words we taught, we used nonsense names for objects that the children were not likely to have played with before; hence it was unlikely they would have English label for them. To test prior knowledge of

English labels for the objects, we pretested the children's comprehension and production of the English labels for the objects. In the pretreatment comprehension test, children were show four objects and was asked to point to "x." In the production test, children were asked, "What is this?" while the experimenter held up the target object. If the children understood or used the label for the object, that object was not used during training. To reduce the probability that the children had prior experience with the objects, we selected esoteric toys or objects (see Appendix). To increase the probability that children could say the nonsense words, we selected CVCV or CVC syllables. The syllables were composed of phonemes seen in the children's responses to the stimuli in the Goldman-Fristoe Test of Articulation (Goldman & Fristoe, 1972). The 64 nonsense words were randomly assigned to objects.

Creation of equivalent goal-sets. To create the set of objects and corresponding target words that were equivalent between timing conditions, the 64 object-word pairs were assigned randomly to conditions with two constraints. To increase the probability that the nature of the play that the object-sets afforded was not grossly different, random assignment was followed after stratifying for objects that could be used as agents and for object-sets that are usually used to build structures (e.g., blocks). Object-set assignments were counterbalanced across children.

Controlled variables. Several variables were constant across teaching conditions. To control for clinician-effect, a particular child received language instruction in both conditions from the same clinician. To control for the amount of exposure to target words between conditions, four design elements were implemented. First, the length of the session was equal in both conditions (i.e., 15 min). Second, the number of sessions was equal in both conditions (i.e., 64 sessions). Third, language teachers were instructed to give 10 teaching trials per session in each condition. Fourth, the number of teaching episodes per item was constant across conditions. This was achieved by pairing objects across condition so that the teacher could give the same number of teaching episodes for the paired object in the RCA condition as its match received in the FCL condition.

Uncontrolled variable. Although we attempted to control the number of completed trials across sessions and conditions, the number of incomplete trials in which the child lost interest varied between conditions. In other words, it was sometimes necessary for the teacher to attempt more trials in one condition than the other to achieve equivalence in number of completed trials in the two conditions.

Intervention Sessions

The intervention sessions lasted for 15 min per day and occurred on 4 days per week. Sixty-four sessions were conducted during each condition. The sessions were given in a therapy room, which was located down the hall from the children's classrooms. During a session the child was exposed to five target words that had been randomly selected from the condition's set of 32 word/object pairs. At least three exemplars of each target word were made available during each session to encourage teaching a generalized concept of the word's meaning. For example, if a group of suction cup toys was the target-word category, we had three suction cup toys of varying sizes and colors. During the intervention sessions, coders recorded teacher and child behaviors. The independent and dependent variable scores were derived from this *in vivo* coding.

Generalization Probes

Twice each week, the subjects were tested for comprehension of the words being taught in both conditions using a discrimination task. Three distractor stimuli and an untrained exemplar of the target object/word category were presented. The child was instructed to point to the correct object (i.e., "Point to the *x*"). The probe was conducted by a staff member who was not the child's language teacher. This procedure represented an across-person, across-exemplar, and across-interaction style generalization test. The score on this test served as the source for the comprehension component of the mastery criteria.

Mastery Criteria

Mastery criteria were (a) correct responses to the target word on two out of three consecutive comprehension probes and (b) three nonimitative, spontaneous, referential uses of the target word in one week in the intervention setting. When a word was mastered, it was replaced with an object/word pair that was randomly selected from the pool of 32 object/words that were originally assigned to the condition.

Dependent Measures

Two dependent measures were recorded in each session. First, we measured the number of attempted trials in which the child looked away from the object or adult and did not say the target word sometime during the teaching episode. We called these the number of times the child lost interest. These were counted to determine whether the timing of the teaching episode relative to the child's current focus affected whether the child attended during the teaching episodes. Second, we measured the number of words meeting the mastery criteria to determine the effect of the timing of teaching episodes on child learning of the target vocabulary. Because the mastery criteria had production and comprehension components, two other measures were derived to determine when a word had been mastered. The number of unique words used spontaneously and referentially during the training sessions was used as the basis for the production component of the mastery criteria. The number of unique words to which the child correctly responded during generalization comprehension probes was used as the basis for the comprehension component of the mastery criteria. We used cumulative frequency graphs of the dependent variables to examine learning trends between the two teaching conditions. Cumulative frequency was used because this method aids interpretation when data are highly variable and learning is slow (Barlow & Hersen, 1984).

Independent Measures

We measured four independent variables to monitor treatment fidelity and comparability. To determine whether the treatment was implemented as prescribed, we measured (a) the percentage of teaching episodes in which the prescribed timing was followed and (b) the percentage of teaching episodes that followed the correct milieu teaching procedure. To determine whether the treatments were implemented in a way that controlled for the amount of exposure to the target words across conditions, we measured (a) the number of teaching episodes per session and (b) the total number of times a target word was modeled during the session.

Reliability

During an average of 5.5 sessions per child for the RCA condition and an average of 6.5 sessions per child for the FCL condition, two staff members independently and simultaneously recorded the dependent and independent variables. Using a point-by-point comparison, the percentage agreement [i.e., (agreements/agreements + disagreements) × 100] was computed on all variables. The average percentage agreement was 90%, with a range of 99% to 87%.

Results

Treatment Fidelity

Treatment implementation data from each session indicated that an average of 99.2% of the teaching episodes were implemented according to the prescribed Milieu Language Teaching method. It should be noted that the language teachers were experienced in implementing Milieu Language Teaching prior to the study. Data indicated that every teaching episode followed the prescribed timing. It should be noted that the data regarding the extent to which teaching episodes followed prescribed timing could be inflated because it was not possible to keep observers blind to the prescribed timing for teaching episodes in any particular session.

Comparability of Implementation

Although 10 episodes per session were planned, in actuality, an average of 9.3 episodes (SD = .27) was given in the following-the-child's-lead (FCL) condition and an average of 9.0 per session (SD = .48) was given in the recruiting-the-child's-attention (RCA) condition across all three children. Summing across instances within and outside teaching episodes, target words were modeled an average of 12 times per session (SD = 6.5) in the FCL condition and an average of 12 times per session (SD = 5) in the RCA condition.

Effects of Different Timing of Teaching Episodes on Children

Cumulative number of words mastered by session. Figure 1 indicates the rate at which children mastered target words in the two conditions. Three types of results are illustrated here: (a) the absolute amount and rate of learning within each teaching condition, (b) the relative amount of learning between teaching conditions, and (c) the relative rate of learning between teaching conditions.

Child A showed the most learning in either condition, with 26 words mastered in the FCL condition and 22 mastered in the RCA condition (total mastered = 48). Child B showed the second most learning in either condition, with 12 and 4 words mastered in the FCL and RCA conditions, respectively (total mastered = 16). Child C mastered 9 and 6 words in the FCL and RCA conditions, respectively (total mastered = 15).

To aid the reader in deciding whether the relative effects on the amount of learning are clinically important, we computed the percentage of the total number of words mastered across conditions that were learned more efficiently in the superior condition. That is, the denominator of this proportion was the total number of words mastered across conditions; the numerator was the difference in the number of words mastered between conditions. The difference in the number of words learned in the FCL condition over the RCA condition was

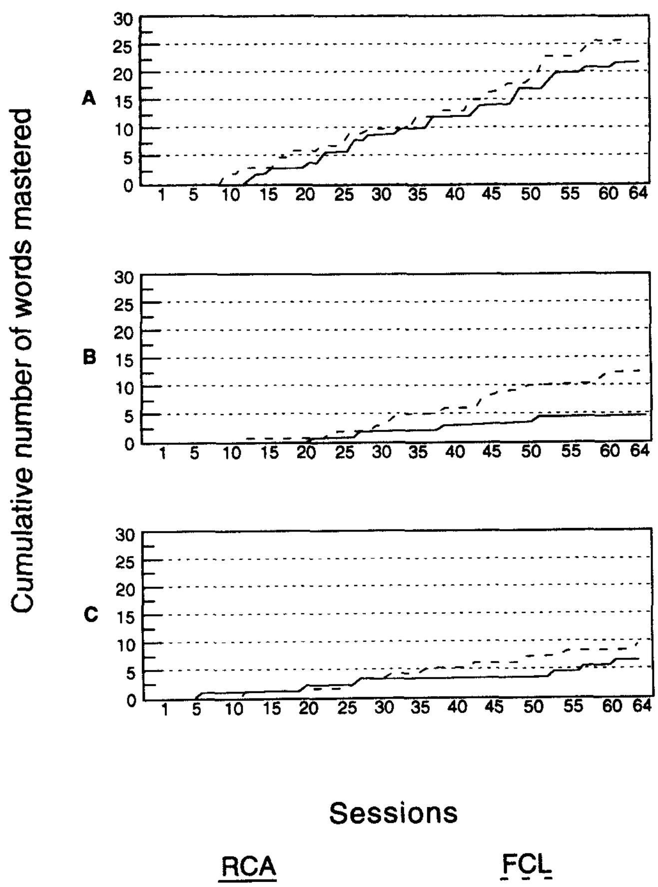

FIGURE 1. Cumulative number of words mastered by sessions.

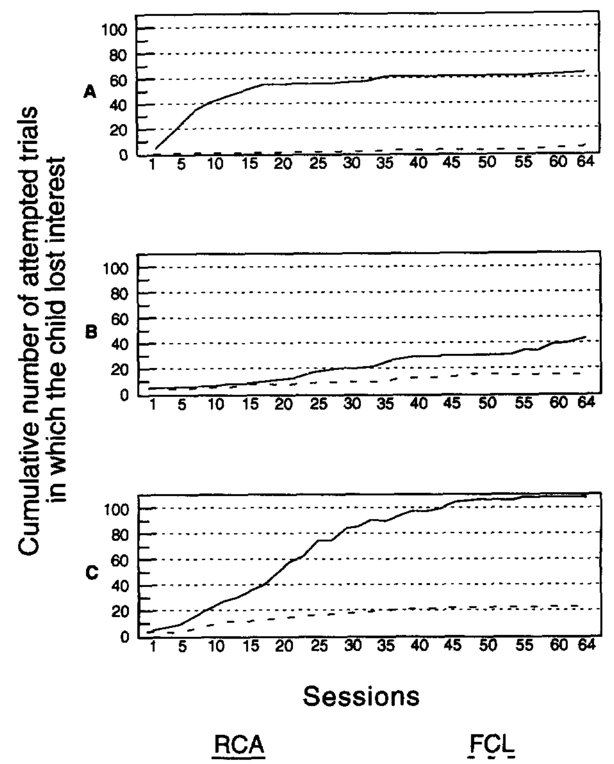

FIGURE 2. Cumulative number of attempted trials in which the child lost interest by sessions.

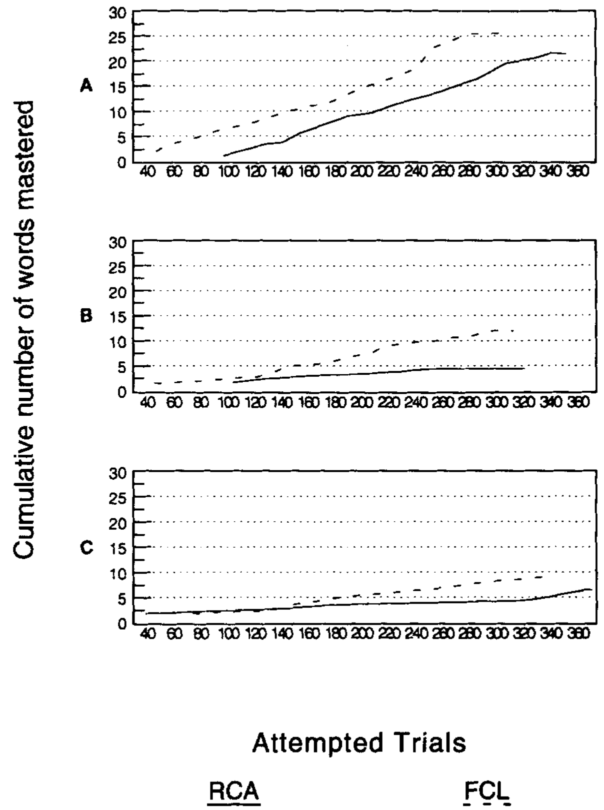

FIGURE 3. Cumulative number of words mastered by attempted trials.

50%, 20%, and 8% of child B's, C's, and A's total words learned during the study, respectively.

Looking at the difference between the slopes for the cumulative learning rate in Figure 1, it appeared that one of the three children (i.e., Child B) clearly mastered new nouns faster in the FCL condition than in the RCA condition. Children A and C showed a weaker effect, but still performed better in the FCL condition. The children's response to the different teaching conditions became clearer when we examined the number of trials the teachers had to attempt to teach in order to accomplish their goal of 10 completed teaching trials.

Cumulative number of attempted trials in which children lost interest by session. Figure 2 indicates that teachers attempted more trials during the RCA condition than during the FCL condition in order to achieve the prescribed 10 trials per session. Children lost interest in the RCA trials more often. The cumulative number of attempted trials in which children lost interest was low in the FCL condition for all three children.

On an individual basis, Child A lost interest more often during RCA trials than FCL trials in only the first 20 sessions in each condition. Child B lost interest more often in the RCA trials than in the FCL trials periodically throughout the intervention phase (between sessions 23-25, 35-37, 55-64). Child C lost interest more often during RCA trials than FCL trials during the first 30 sessions in each condition. It is noteworthy that although Child C learned only a little faster per session in the FCL condition (see Figure 1), the teacher had to work much harder to retain this child's attention during teaching episodes in the RCA condition during the first 30 intervention sessions (see Figure 2).

Cumulative number of words mastered by attempted trials. Figure 3 shows the number of attempted trials required to facilitate the children's noun learning. More nouns were mastered per attempted trial in the FCL condition than in the RCA condition.

To aid the reader in judging whether these differences are clinically important, the number of words mastered given the same number of attempted trials is reported below. The maximum number of trials for the inferior condition was selected as the point for comparing relative efficiency of learning under the two conditions. Because different subjects had different numbers of maximum attempted trials in the inferior condition, the exact session number from which the data are reported varies across subjects.

Child B mastered 12 words in 307 attempted trials in the FCL condition and 4 words in the same number of attempted trials in the RCA condition. This difference between conditions (8 words) is 50% of total number of words Child B learned at that point in the study. Child C mastered 9 words in 329 attempted trials in the FCL condition and 4 words in the same number of attempted trials in the RCA condition (i.e., a 38% difference). Child A mastered 26 words in 299 attempted trials in the FCL condition and 20 words in the same number of attempted trials in the RCA condition (i.e., a 13% difference).

Discussion

We predicted that teaching nouns would be more efficient when the teacher followed the child's attentional lead than when she intrusively recruited the child's attention and then taught. The results support this hypothesis for all three children. It should be remembered that all these children were mentally retarded. In addition, all were in Brown's late stage I, with the exception of the child whose receptive SICD score suggests that her MLU may overestimate her language ability. It should also be noted that the vocabulary taught in this study was a set of nouns.

Finally, it should be noted that all three children learned some of the words, even in the intrusive teaching condition: RCA. Therefore, the current study's results do not imply that developmentally young children cannot learn under intrusive teaching conditions. It indicates that they learn more efficiently under FCL conditions. Relative to the total number of words learned for the same number of attempted trials, the difference in the efficiency between the two teaching conditions exceeded 10% in all three children. Criteria for clinical significance will vary across readers. Our judgment is that the differential effects are clinically important for two of the three subjects (Child B and Child C). It is noteworthy that Child A had the highest mental age (i.e., 31 months).

It may be that as children's mental age increased the difference between noun-learning in the FCL as opposed to the RCA conditions lessens. Interestingly, when Milieu Language Teaching (an FCL teaching method) was compared with a direct-instruction method of language teaching (not an FCL teaching method), the Milieu Language Teaching approach was more effective than the direct instruction approach only for developmentally younger children (Yoder et al., 1991). It should be noted, however, that the RCA condition in the present study differs from the direct instruction in the Yoder et al. (1991) study. In direct instruction, the teacher does not necessarily intrude upon the child's focus of attention to teach. Instead, the child is expected to attend to the teacher throughout the teaching session.

We predicted that FCL teaching would be more efficient than RCA teaching because children are assumed to be most attentive to, motivated to learn from, and best able to understand adult speech during joint-attention episodes (Tomasello & Farrar, 1986). Better attention to linguistic input during FCL conditions has been posited in both motivational (Warren & Kaiser, 1986) and information processing (Snow & Gilbreath, 1983) models of children's language learning. Children may simply be more interested in knowing the labels for objects that interest them. Additionally, young children may find it difficult to switch topics and still have sufficient information processing capacity to analyze adult language input. Finally, making the association between word and referent is a simpler task if the child is already attending to the referent when the label is given (Hoff-Ginsberg & Shatz, 1982). The memory and verbal encoding disabilities that many young children with mental retardation experience may be particularly aided by the reduction in information processing load and facilitated associative learning during FCL teaching episodes.

The current results corroborate those of Tomasello and Farrar (1986). However, there are some important differences between the Tomasello and Farrar study and the current study. First, the subject populations differ. The current study selected children with identified language and cognitive delays; the Tomasello and Farrar (1986) study selected normally developing 17-month-olds. That is, the current study extends the data supporting the importance of following the child's lead to children with language and cognitive impairments who are in Brown's stage I.

Second, there were important differences in the dependent variables between the two studies. Tomasello and Farrar did not find any differences in the children's use, either elicited or spontaneous, of the target words taught in the two conditions. Although a more stringent definition of "spontaneous production" was used in the current study than was used in the Tomasello and Farrar study, our results indicated that more words taught in the FCL condition passed the productive components of the mastery criteria than those taught in the RCA condition. While it is possible that differences in the number of events that stimulate spontaneous use of the target words between conditions could explain the current findings, this is unlikely. The mastery criteria used in the current study required that the children show comprehension of the words as well as spontaneously produce the words. The number of opportunities for correct responding in the comprehension probe was controlled. Thus, variation in the number of opportunities for spontaneous use alone could not explain the finding that the three children in the current study mastered more words per attempted trial in the FCL condition than in the RCA condition.

Finally, Tomasello and Farrar did not test for across-person or across-material generalization; the current study did test for these types of generalization during the comprehension probe. Using a relatively stringent test of comprehension of the target items, the current study found that a greater number of items were mastered per attempted trial during FCL teaching. One explanation for the generalization observed is that we programmed for generalization by providing several exemplars of each vocabulary class. Hupp and Mervis (1981) found that using three exemplars of a noun category resulted in better generalization in students with severe mental retardation than did using one exemplar. Because this procedure was used in both FCL and RCA conditions, it does not account for the differential effects found, but may account for why we found across-material generalization.

A brief discussion is warranted concerning how the current study differs from investigations of fast mapping in children with disabilities. The current study's subjects showed relatively slow mastery of the target words. Other studies have demonstrated evidence of fast mapping in children with specific language impairment (Dollaghan, 1987) and mental retardation (Chapman, Kay-Raining Bird, & Schwartz, 1990). However, the measures used to infer "learning" of the new word in the fast mapping studies are different from those used in the present study in important ways. Dollaghan (1987) and Chapman et al. (1990) inferred learning from evidence that the subjects could discriminate the same novel object that was named in the exposure condition from other objects when named. There was much less evidence that the children in either the Dollaghan (1987) or Chapman et al. (1990) studies could produce the new word to be learned after only a few exposures, even when production testing was with the same object as that used in the exposure condition. In the current study, comprehension was tested using unfamiliar members of the target word class (thus requiring generalization) and spontaneous production of the target word was used to infer that learning occurred. It seems that many more exposures to the word and to multiple exemplars of the referent are needed to learn the underlying concept of a word and to produce such a word spontaneously than is usually available in fast mapping studies.

There are several methodological issues in the current study that warrant discussion. Alternating-treatment designs, such as that used in the present study, allow for inferences about relative treatment effects on dependent variables that do not change quickly or abruptly after the treatment has begun (Barlow & Hayes, 1979). The multiple-baseline-across subjects design is among the most common in the language intervention literature. If strong inferences about treatment effects are to be made from studies using multiple-baselines-across-subjects, the slope or intercept of the trend line for the dependent variable must shift with the onset of the treatment phase (Barlow & Hersen, 1984). The types of dependent variables that are of most interest to language intervention researchers (e.g., generalization of newly learned language targets) typically do not change abruptly, particularly when the subjects have mental retardation. Alternating-treatment designs only require separation of the learning curves of the targets in the two conditions during the treatment phase to allow interpretation of differential treatment effects (Barlow & Hayes, 1979). Therefore, alternating-treatment designs are particularly well suited to investigating treatment effects on newly learned language skills in people who learn slowly. When used for such purposes, alternating-treatment designs require that the investigator select two sets of different language targets that, when learned, do not affect the use or understanding of the other set of language targets. Vocabulary may be one of the only language targets in which a set of targets may be learned without affecting the learning of other targets. For example, government binding theory suggests that the learning of one aspect of grammar enables the learning of other aspects of grammar (Leonard & Loeb, 1988). Additionally, alternating-treatment designs require that equivalent language targets be selected. These targets must be equivalent in terms of their "learnability" by the particular subjects studied.

The current study used nonsense syllables to increase the probability that the sets of vocabulary words to be taught in the two conditions would have equal learnability for our participants. Using nonsense syllables allows more confidence that sets are equivalent than does using English words for two main reasons. First, the practice of using the literature on the sequence of acquisition in children who are developing normally to construct equivalent sets of vocabulary words for studies with children who are disabled is problematic. The normative language-acquisition literature is based on several studies that usually have small samples and yield somewhat conflicting results regarding the relative order of acquisition of specific language structures. Additionally, it is not clear whether the sequence of acquisition of very specific language structures is the same in impaired populations as it is in children who are normally developing. Second, to determine whether vocabulary sets have equivalent learnability for a particular child, we must establish that the child understands the words to the same extent across vocabulary sets. We cannot rely only on production data to equate sets of language targets because children will probably learn to say words they understand before they will learn to say words they do not understand or say. Currently available methods for determining whether a particular child understands a particular word have questionable validity when the child is functioning on a 24-months level or under (Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987).

The use of nonsense words may be controversial because some readers may question whether studies using nonsense words can be generalized to the learning of naturally occurring languages. Other studies that compare a method of teaching English that uses following-the-child's-lead to one that does not have findings similar to the findings of the current study for developmentally young children with (Giumento, 1990; Yoder et al., 1991) and without disabilities (Tomasello & Farrar, 1986). The corroboration of studies that vary on whether they use nonsense words (the current study) or not (Giumento, 1990; Tomasello & Farrar, 1986; Yoder et al., 1991) supports the generalizability of the current study to the acquisition of naturally occurring languages.

In summary, the current study extends the support for following the child's lead during early noun-vocabulary teaching by (a) showing the effect with three children who were cognitively impaired and (b) using both spontaneous production and comprehension of target words in response to materials not used in the training sessions as the mastery criteria. Future research is needed to examine the source for individual differences in children's responses to efforts to teach nouns by following the child's lead versus efforts that do not.

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References

Barlow, D. H., & Hayes, S. C. (1979). Alternating treatments design: One strategy for comparing the effects of two treatments in a single subject. *Journal of Applied Behavior Analysis, 12,* 199–210.

Barlow, D., & Hersen, M. (1984). *Single case experimental designs.* New York, Pergamon Press.

Bayley, N. (1969). *Bayley Scales of Infant Development.* New York. The Psychological Corporation.

Bilovsky, D., & Share, J. (1975). The ITPA and Down's syndrome: An exploratory study. *American Journal of Mental Deficiency, 70,* 78–82.

Brown, R. (1973). *First language: The early stages.* Cambridge: Harvard University Press.

Chapman, R., Kay-Raining Bird, E., & Schwartz, S. E. (1990). Fast mapping of works in event contexts by children with Down syndrome. *Journal of Speech and Hearing Disorders, 55,* 761–770.

Dodd, B. J. (1975). Recognition and reproduction of words by Down's syndrome and non-Down's syndrome mentally retarded children. *American Journal of Mental Deficiency, 80,* 306–311.

Dollaghan, C. (1987). Fast mapping in normal and language-impaired children. *Journal of Speech and Hearing Disorders, 52,* 218–222.

Fey, M. (1986). *Language intervention with young children.* San Diego: College-Hill Press.

Giumento, A. (1990). *The effectiveness of two intervention procedures on the acquisition and generalization of object labels by young children who are at-risk or who have developmental delays.* Unpublished dissertation. Graduate School of the University of Oregon.

Goldfield, B. A., & Reznick, S. (1990). Early lexical acquisition: Rate, content, and the vocabulary spurt. *Journal of Child Language, 17,* 171–183.

Goldman, R., & Fristoe, M. (1972). *Goldman-Fristoe Test of Articulation.* Circle Pines, MN: American Guidance Service.

Golinkoff, R. M., Hirsh-Pasek, K., Cauley, K. M., & Gordon, L. (1987). The eyes have it: Lexical and syntactic comprehension in a new paradigm. *Journal of Child Language, 14,* 23–45.

Hedrick, D. L., Prather, E. M., & Tobin, A. R. (1984). *Sequenced Inventory of Communication Development. Test manual.* Seattle: University of Washington Press.

Hoff-Ginsberg, E., & Shatz, M. (1982). Linguistic input and the child's acquisition of language. *Psychological Bulletin, 92,* 3–26.

Hupp, S. C., & Mervis, C. B. (1981). Development of generalized concepts by severely handicapped students. *The Journal for the Association for Persons with Severe Handicaps, 6,* 14–21.

Kaiser, A. P., Hendrickson, J. M., & Alpert, C. L. (1991). Milieu language teaching: A second look. In R. G. Gable (Ed.), *Advances in mental retardation and developmental disabilities* (Vol. 4, pp. 63–92). London: Jessica Kingsley Publishing.

Landry, S. H., & Chapieski, M. L. (1989). Joint attention and infant toy exploration: Effects of Down syndrome and prematurity. *Child Development, 60,* 103–118.

Landry, S. H., & Chapieski, M. L. (1990). Joint attention of six-month-old Down syndrome and preterm infants; I. Attention to toys and mother. *American Journal of Mental Retardation, 94,* 488–498.

Leonard, L. B., & Loeb, D. F. (1988). Government binding theory and some of its applications; A tutorial. *Journal of Speech and Hearing Research, 31,* 515–524.

McDade, H. L., & Adler, S. (1980). Down syndrome and short-term memory impairment: A storage or retrieval deficit. *American Journal of Mental Deficiency, 84,* 561–567.

Mervis, C. B. (1990). Early conceptual development of children with Down syndrome. In D. Cicchetti & M. Beeghly (Eds.), *Children with Down syndrome: A developmental perspective* (pp. 252–301). Cambridge: Cambridge University Press.

Nelson, K. (1973). Structure and strategy in learning to talk. *Monographs of the Society for Research in Child Development, 39,* (1–2, Serial No. 149).

Rescorla, L. (1989). The language development survey: A screening tool for delayed language in toddlers, *Journal of Speech and Hearing Research, 54,* 587–599.

Snow, C. E., & Gilbreath, B. J. (1983). Explaining transitions. In R. Golinkoff (Ed.), *The transition from prelinguistic to linguistic communication* (pp. 281–296). Hillsdale, NJ: Erlbaum.

Strominger, A. Z., Winkler, M. R., & Cohen, L. T. (1984). Speech and language evaluation. In S. M. Pueschel (Ed.), *The young child with Down syndrome* (pp. 253–261). New York: Human Sciences Press.

Stutsman, R. (1948). *Merrill-Palmer Scale of Mental Tests.* Chicago: C. H. Stoelting.

Thorndike, R. L., Hagen, E. P., & Sattler, J. M. (1986). *Stanford Binet Intelligence Scale, 4th edition.* Chicago: Riverside Publishing.

Tomasello, M., & Farrar, M. J. (1986). Joint attention and early language. *Child Development, 57,* 1454–1463.

Tomasello, M., Mannle, S., & Kruger, A. (1986). The linguistic environment of one to two year old twins. *Developmental Psychology, 22,* 169–176.

Tomasello, M., & Todd, J. (1983). Joint attention and lexical acquisition style. *First Language, 4,* 197–212.

Warren, S. F., & Kaiser, A. P. (1986). Incidental language teaching: A critical review. *Journal of Speech and Hearing Disorders, 55,* 291–299.

Weistuch, L., & Lewis, M. (1985). The language interaction intervention project. *Analysis and Intervention in Developmental Disabilities, 5,* 97–106.

Yoder, P. J., Kaiser, A. P., & Alpert, C. (1991). An exploration study of the interaction between language teaching methods and child characteristics. *Journal of Speech and Hearing Research, 34,* 155–167.

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Appendix

Nonsense Words and List of Objects Used

Madday: marbles
Nahba: army ants
Hegguh; kiddie links
Bomma: elephant stack
Koonah: hair clips
Pownee: laces
Mynow: musclemen
Hebboe: "H" blocks
Dymay: wacky whippers
Keydoo: kaleidoscope
Naggoo: puzzle post
Howdah: ribbons
Behtah: keys of learning blocks
Boeday: fish bait
Doytoy: sparklers
Penae: pencil grips
Diiga: road signs
Hoedoo: bottle caps
Dammow: puppet faces
Tukah: transformer
Bahdee: blocks
Keemah: finger puppet
Gappo: lense
Poppoo: popper
Haymau: wall walker
Hobah: funform
Neckii: chain
Parnoy: parachutist
Deenay: dinosaur
Digga: loader
Meddoy: stick-a-roo
Giddau: egg
Petty: tin pans
Dabboo: domino blocks
Niddae: weird faces
Boogow: suckers
Nimmii: sea creatures
Puhgoo: pencil rops
Boytah: bath bugs
Pinnoe: squarbles
Baytoo: battle beasts
Deedoy: shape dominoes
Nootoe: golf tees
Himmoy: hair holders
Kuhnee: key chains
Noemow: space machines
Koyty: fish
Bannoy: thread
Hoymah: tops #2
Ninnoo: parquay blocks
Boinka: boink
Meemoo: mythical creature
Dopy: uglyball
Dobo: cutter
Toppoy: top
Kaggoo: bendable animal
Baggii: creeper
Taunae: popbeads
Hummy: slinkie
Natty: robot
Leetoe: lizard
Hupay: lifter
Boopee: barrel
Neemoe: disc