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THE FACILITATIVE EFFECTS OF INCIDENTAL TEACHING ON PREPOSITION USE BY AUTISTIC CHILDREN

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In a comparison of incidental teaching and traditional training procedures, three language-delayed autistic children were taught expressive use of prepositions to describe the location of preferred edibles and toys. Traditional highly structured training and incidental teaching procedures were used in a classroom setting, and generalization was assessed during free-play sessions. Results clearly indicate that incidental teaching promoted greater generalization and more spontaneous use of prepositions. These findings have important implications for language programming and teacher training, suggesting that incidental teaching should be included as a standard component of language development curricula for autistic and other developmentally delayed children.

DESCRIPTORS: autistic children, incidental teaching, generalization, prepositions, language

An extensive body of research has documented the effectiveness of traditional operant training procedures in promoting speech acquisition by autistic children (Koegel, Rincover, & Egel, 1982; Lovaas, 1977; Lovaas & Newsom, 1976; Risley & Wolf, 1967; Wolf, Risley, & Mees, 1964). Hart and Risley (1968, 1974, 1975) adapted operant procedures for use in the course of children's ongoing play activities, and they demonstrated that incidental teaching enhanced generalization of descriptive language by disadvantaged preschoolers. Similar generalization benefits resulted in extensions of incidental teaching procedures to autistic children (Carr & Kologinsky, 1983; McGee, Krantz, Mason, & McClannahan, 1983).

Although there have been modifications of both procedures, the major distinctions between traditional and incidental teaching procedures appear to be as follows: (a) traditional training is controlled and paced by the teacher, who presents opportunities to respond that are separated by specified intertrial intervals; incidental teaching episodes are child-initiated, usually by requests or gestures for preferred items; (b) traditional training usually occurs in sit-down sessions, where the setting has been arranged to minimize distractions; incidental teaching takes place in the context of other activities, where the environment includes items of interest among other naturally occurring stimuli; and (c) in traditional formats, teaching stimuli are typically teacher-selected items, and consequent stimuli are often unrelated to teaching stimuli; stimuli used in incidental teaching are child-selected items, and contingent access to these items is used as reinforcement. An additional distinction may be made in prompt strategies, with traditional language training curricula making use of standard prompts until the child has achieved a criterion level of correct responding, whereas incidental teachers' prompts for elaborated language are varied according to the child's initiating responses.

Other in-context language training strategies have also been found to be effective with developmentally disabled children. Substantial generalization resulted from use of (a) a "mand-model" technique with language-deficient preschool children (Rogers-Warren & Warren, 1980), (b) a "delay procedure" with severely language-delayed retarded children (Halle, Baer, & Spradlin, 1981),

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(c) "loose training" with moderately retarded children (Campbell & Stremel-Campbell, 1982), (d) "natural language training" with nonverbal autistic children (Koegel & O'Dell, 1982), and (e) "embedded instruction" with developmentally delayed, severely language-disordered children (Neef, Walters, & Egel, 1984). Although various components of these procedures differed from standard incidental teaching formats, each application involved prompting language in the context of naturally occurring stimuli.

It has frequently been suggested that incidental teaching is more efficacious than traditional training in facilitating generalized language use, but there has been little comparative research on these procedures or on variations of the two approaches. Williams, Koegel, and Egel (1981) showed that the use of functional response-reinforcer relations increased teaching efficiency relative to the use of arbitrary reinforcers, and in other studies (Koegel & O'Dell, 1982; Neef et al., 1984), language training in a more natural setting produced acquisition and generalization of expressive speech by children who had made minimal progress in traditional training conditions. Given the characteristic generalization deficits displayed by autistic children (Koegel & Rincover, 1974; Lovaas, Koegel, Simmons, & Long, 1973), well-controlled comparative information on strategies to remediate such deficits appears to be central to effective language programming.

Our study was a direct comparison of traditional and incidental teaching procedures for language-delayed autistic children. The two instructional strategies were assessed in the context of teaching expressive use of prepositions—language concepts that have typically been difficult for autistic children to acquire. Incidental teaching and traditional paradigms were compared in terms of children's patterns of acquisition and in terms of teaching effficiency. Generalization of preposition use across teachers, settings, and stimulus positions was assessed in free-play sessions; levels of spontaneous (unprompted) preposition use associated with each teaching method were also compared in generalization sessions.

METHOD

Participants

Three autistic boys who were enrolled in the day educational and treatment program of the Princeton Child Development Institute participated. Children 1 and 2 had attended for less than 6 months; Child 3, who was awaiting placement in one of the Institute's group homes, had attended the day program for 7½ years. All three children had functional, but severely delayed, expressive language, which was frequently echolalic and perseverative. The three boys were often ritualistic, becoming inappropriate or disruptive when there were changes in their daily routines.

Criteria for selecting participants were verbal imitation skills and inability to use target prepositions correctly, as determined by scores on a 25-item screening test derived from the *Boehm Kit Concept Cards* (Boehm, 1976).

Child 1 was 8 years old at the time of the study. In a recent evaluation he achieved a Peabody Picture Vocabulary Test (PPVT) Mental Age Score of 3.5 and a Vineland Age Equivalent Score of 2.2. His inappropriate behaviors included noncontextual laughing, tantrums, and self-stimulatory behaviors such as hair twirling and fingerplay. His expressive speech consisted primarily of brief requests ("water toy"), prompted statements, and echolalic responses ("Say I do"). Child 1's verbalizations were characterized by severe articulation problems.

Child 2 was 6 years old. He scored 3.0 on the PPVT, and obtained a Vineland Age Equivalent of 3.8. This child was receiving individualized treatment for self-injurious behavior (head and chest hitting), which had decreased to relatively low levels by the onset of the study. However, fingerplay and vocal noisemaking were frequently displayed. Child 2 had clear articulation; he was able to request preferred items in sentences ("I want the Tom and Jerry book."); and he typically engaged in high rates of verbal behavior. However, his speech was often noncontextual or perseverative.

Child 3 was 11 years old when the study began. He scored 5.7 on the PPVT, and had a Vineland

Age Equivalent of 5.3. He received individualized treatment designed to decrease headbanging, physical aggression, and destructive behavior. His verbalizations were usually requests ("I want ____ please.") and brief replies to familiar questions ("I'm fine, thank you."). His speech was often extremely low in volume, particularly when he was acquiring new responses.

Setting

All teaching sessions took place in a classroom subdivided into three activity areas that were reserved for: (a) assessment probes, (b) traditional training, and (c) incidental teaching. During assessment probes, a participant was seated at a desk facing the teacher, and stimulus items were presented on the desk top. A similar arrangement was used for traditional training. For incidental teaching, stimulus items were arranged on three small (0.3 m × 0.4 m × 0.6 m), yellow, triangular-shaped corner shelves; participants sat or stood (their preference) approximately 0.3 m from the shelves; and the teacher sat beside the child. An observer, seated on the perimeter of these activities, had full view of the participant and the teaching materials but could not see the teacher's data sheet. Stopwatches were used to time the duration of teaching sessions.

Generalization probes were held in a different classroom, where a participant was seated 0.9 m in front of a large (1.2 m × 1.3 m), brown bookcase with five shelves. The child could see the stimulus items arranged on the shelves, and the teacher stood near the child. Observers were situated behind room dividers (1.5 m tall) that were located in back of the participant; this arrangement ensured that data collection activities did not interfere with the play environment. A physical barrier prevented observers from seeing one another's data sheets, but both observers could see and hear the child, teacher, and stimuli. A portable cassette tape recorder and earphones were used to synchronize the timing of observation intervals.

The stimulus items were clear plastic shoeboxes and play materials and edibles; plastic shoeboxes were commonly used to store instructional and play materials in all of the children's classrooms. Twelve toys/edibles that would fit on or in the boxes were identified by each child, who selected his most preferred items from a menu of 30 foods and toys prior to baseline. The first six items selected by a child were randomly paired with the last six items he chose, to arrange six pairs of stimuli of approximately equal value for each participant. Tokens were used to mediate delays in reinforcement during acquisition probes.

Experimental Design

Traditional and incidental teaching procedures were compared in terms of their effects on acquisition, teaching efficiency, and generalization, by simultaneous teaching (Kazdin, 1977) of pairs of prepositions. The results were replicated within and across participants, using a multiple baseline (Baer, Wolf, & Risley, 1968) across three pairs of prepositions nested within a multiple baseline across three participants. Acquisition and generalization were evaluated using two probe procedures that remained standard across conditions. Generalization across teachers, settings, and positions of stimulus items was assessed in each experimental condition, and differential effects on the spontaneous use of expressive language were also examined.

Three pairs of prepositions were taught: (a) on-under, (b) inside-next to, and (c) in front of-in back of. For Children 1 and 3, the members of each pair were randomly assigned to traditional and incidental teaching procedures. For Child 2, the assignment of prepositions to teaching procedures was exactly the reverse of Child 1's assignments; this was done to achieve added control for difficulty of prepositions. Next, pairs of stimulus items were randomly assigned to each target preposition. The random assignment of prepositions to procedures, as well as training stimuli assignments, is displayed in Table 1.

Teaching Session Procedures

Each child received 1:1 instruction from the teacher during daily sessions (approx. 45 min long), which began with an acquisition probe, followed by traditional and incidental teaching procedures.

Table 1
Random Assignment of Target Prepositions and Stimulus Items to Traditional and Incidental Teaching Procedures

Child	Procedure	Prepositions	Stimulus items
1	Traditional training	1. under	turtle—candy
		2. next to	TV Guide—roulette
		3. in back of	ball—cracker
	Incidental teaching	1. on	comic strip—bells
		2. inside	Viewmaster—water toy
		3. in front of	clown—Spiderman book
2	Traditional training	1. on	Viewmaster—Spiderman book
		2. inside	Play-doh—roulette
		3. in front of	bubbles—turtle
	Incidental teaching	1. under	clown—gum
		2. next to	Tom & Jerry book—water toy
		3. in back of	Dataman—ball
3	Traditional training	1. on	chips—bubbles
		2. next to	ball—Viewmaster
		3. in back of	Spiderman book—water toy
	Incidental teaching	1. under	roulette—car
		2. inside	coloring book—bells
		3. in front of	fish—Dataman

The order of teaching procedures was randomly determined for each child on the first day of teaching and alternated thereafter.

Traditional training. The child was seated at a desk in a distraction-free area of the room, and the teacher presented stimulus materials on the desk top. A training stimulus was placed in relation to the plastic shoebox to demonstrate a target preposition. The teacher then asked, "Where is the ____?"

Errors were followed by prompts (e.g., "Say, 'The bubbles are *on* the box.'"). Descriptive praise (e.g., "Super, you said the bubbles are *on* the box!") and reinforcement followed every correct response, whether unprompted or prompted. Reinforcement consisted of approximately 5-sec access to the member of the stimulus pair *not* used as a training stimulus; that is, the consequent stimulus was never the training stimulus for that trial. On the next trial, the consequent stimulus used in the preceding trial became the training stimulus, and the other member of the pair was now used as a reinforcer. Thus, to control reinforcer value, training and consequent stimuli were child-selected items, both of which were visible throughout; however, unrelated training and consequent stimuli were used so that the reinforcement techniques would approximate traditional procedures used for teaching prepositions. The members of the stimulus pair continued to be alternated in this fashion across trials, with trials separated by 5-sec intervals.

Incidental teaching. Training stimuli were displayed on small corner shelves, together with plastic shoeboxes, to demonstrate the target preposition(s). When the child initiated an incidental teaching episode by naming or requesting an item, the teacher asked, "Where is the ____?" If it was unclear exactly which of two items the child was selecting, the teacher asked, "What do you want?" before inquiring, "Where is the ____?" If the child responded to the teacher's location inquiry by pointing or gesturing toward the item, his hands were gently held at his sides, and he was instructed, "Tell me where."

Errors were followed by prompts (e.g., "Say, 'The car is *under* the box.'"), with the level of prompts varying according to the child's initial response. For example "Say, 'The car is *under* the

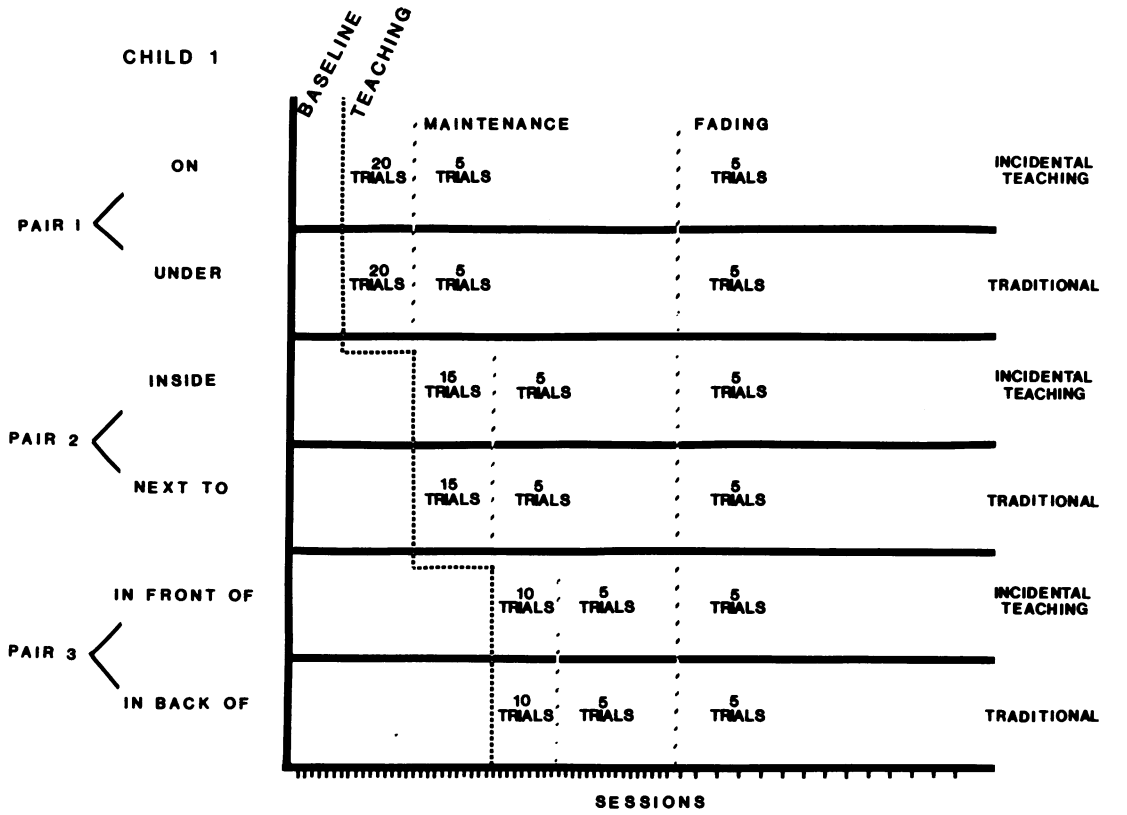

Figure 1. Sequence of conditions and corresponding number of teaching trials during each session for incidental teaching and traditional procedures.

box.'" might be used early in teaching, but as the child began to use labels and prepositions spontaneously, more complex responses were prompted (i.e., "Say, 'I want (with pause).'" or "Say, 'I (with pause).'"). Access to requested items was always contingent on an elaborated response about the item, which is consistent with the description of incidental teaching provided by Hart and Risley (1982).

The reinforcement procedure consisted of descriptive praise (e.g., "Terrific, you said the car is *under* the box!") and approximately 5-sec access to the training stimulus following each correct response, prompted or unprompted. Because child initiations determined the order of teaching trials, training stimuli were removed from the shelves when the specified number of trials for each stimulus had been completed.

Criteria. Initially, 20 traditional trials and 20 incidental teaching trials were completed daily for the first pair of prepositions. When an acquisition probe showed that a child had achieved 80% correct or better on prepositions taught with both procedures, the next pair of prepositions was introduced. Maintenance teaching (five trials per preposition per session) continued for previously acquired pairs. When two or more prepositions were taught with both procedures during a single session, the order of presentation of trials was randomly alternated. The sequence of conditions and the corresponding numbers of trials provided for each teaching procedure are illustrated in Figure 1. In summary, 20 trials for each teaching procedure were provided in every session, until a child met criterion of 80% correct on the third pair of prepositions on an acquisition probe. Subsequently, 15 maintenance trials on each procedure were provided.

When 100% correct responding on both teaching procedures was achieved on an acquisition

Table 2
Arrangement of Stimulus Items for Generalization Probes

	Arrangement 2 for child 1			
Shelf location	Stimulus item	Preposition displayed	Teaching procedure	Item position
1	turtle	on	incidental teaching	novel
2	Viewmaster	in back of	traditional	novel
3	candy	under	traditional	training
4	ball	in front of	incidental teaching	novel
5	roulette	inside	incidental teaching	novel
6	TV Guide	next to	traditional	training
7	water toy	inside	incidental teaching	training
8	bells	under	traditional	novel
9	cracker	in back of	traditional	training
10	comic strip	on	incidental teaching	training
11	Spiderman book	next to	traditional	novel
12	clown	in front of	incidental teaching	training

probe, fading was introduced. That is, maintenance teaching for all three pairs with both procedures continued during each session, but sessions were conducted only every other school day. When 100% accuracy was again achieved, acquisition probes and teaching sessions were thinned to every third day. Teaching was discontinued when all three participants' response rates on acquisition probes had stabilized in fading conditions.

Generalization Assessment Procedures

One-to-one, 10-min, free-play sessions were conducted by one of two different teachers in a different room, to assess generalization across people and settings. The measurement system also assessed children's use of prepositions to describe novel positions of teaching items, as well as spontaneous preposition use.

All 12 stimulus items (the toys and edibles and the plastic boxes used in teaching with both procedures) were arranged on a large bookcase prior to each session. To assess generalization of preposition use across stimulus positions, one member of the pair of stimuli used in teaching each target preposition appeared in its original teaching position, and the other member of that pair was randomly assigned to a new position. Two such arrangements of stimuli for each participant were alternated across generalization probes; in both displays, the location of the stimuli on the shelves was randomized, as shown in Table 2. The child was seated 0.9 m in front of the bookcase on which play materials, edibles, and boxes were displayed. The teacher was at one side, between the child and the play materials/edibles. This provided the child a good view but prevented direct access to items on the shelves.

The two teachers who participated in the generalization probes were selected because of their good contingency management skills. Both had received training in the implementation of traditional highly structured training procedures, and neither had experienced any systematic exposure to incidental teaching formats. They alternated in the role of teacher on an arbitrary basis, and both teachers were blind regarding the teaching procedures and experimental conditions. In general, teachers were instructed to use the free-play session to prompt and praise children's appropriate verbalizations. Additionally, they were instructed in the following procedures to ensure that no inadvertent teaching of prepositions occurred during the free-play session.

Requests for a toy/edible that spontaneously included a preposition correctly describing the location of the item (e.g., "gum under box" or "I want the gum under the box.") were followed by immediate access to the requested item. When the

child's request did not include a spontaneous prepositional description of the item, the teacher prompted, "Where is the ____?" Correct preposition use in response to the teacher's prompt was also followed by access to the item. If the child gestured toward the bookcase, the teacher asked, "What do you want?" before proceeding with the prompt ("Where is the ____?"); this step was necessary for the teacher to identify the item that was being gestured for (the child was 0.9 m from a large array of items) and to judge the accuracy of any prepositions used by the child.

Following errors of omission or commission, the child was instructed: (a) "Show me where it is," *and* (b) "Say, 'I want the (gum, ball, car, etc.).'" The child received the item he touched or pointed to as soon as he imitated the teacher's request. Teachers did not model use of prepositions, and provided no feedback, teaching, or practice for incorrect responses.

In summary, the child received the desired item immediately after correctly using a preposition, whether the preposition was used spontaneously or was prompted by the teacher's question, "Where is the ____?" Children were also able to obtain the edibles and play materials without correct preposition use; access was gained simply by following the teacher's instruction to gesture toward and to request the item. When requested items were toys, approximately 5 sec of play was permitted; when food items were requested, small pieces were provided. The teacher replaced all items in their original positions after each use.

At least three generalization sessions were conducted during baseline for each child. The participants were yoked once teaching was initiated for the first child, with all three children participating in generalization probes whenever any child met the 80% acquisition criterion on a pair of prepositions. Five final generalization probes were conducted when all children had met criterion on all three pairs of prepositions on acquisition probes.

Response Definitions

Preposition use was scored correct when the child used a preposition to accurately describe the location of a stimulus (play material or edible) in relation to a plastic box. Both sentences and phrases were scored correct, and verb tense was not considered relevant to scoring. For example, correct preposition uses included (a) "The ball is on the box."; (b) "I want the ball on box."; and (c) "on box" (in response to the teacher's question, "Where is the ball?").

Errors of omission and errors of commission were scored separately. Errors of omission included no child response and responses that occurred more than 5 sec after the teacher's prompts. Errors of commission (incorrect preposition use) included (a) inaccurate descriptions of the spatial relationships between stimulus items and boxes; (b) ambiguous descriptions of the location of stimuli (e.g., "The bells are around the box."); and (c) self-corrected responses.

During generalization probes, phrases containing prepositions were scored as correct or incorrect *and* as spontaneous or prompted. Prompted statements were those preceded by the teacher's cue, "Where is the ____?" Spontaneous preposition use was scored for any statement or request that contained a preposition, and that was not preceded by the teacher's prompt, "Where is the ____?"

Measurement Procedures

Acquisition probes. An acquisition probe was administered at the beginning of each teaching session; these probes consisted of five presentations of the three target prepositions for each teaching procedure. On probe trials, one member of the pair of training stimuli randomly assigned to a preposition was arranged with a plastic box to demonstrate that preposition, and the teacher asked, "Where is the ____?" The order of presentation of prepositions varied across five randomized blocks of the six prepositions, yielding a total of 30 trials per probe. The two training stimuli assigned to each preposition were presented in alternating blocks of trials, so that both training items were presented on every probe. Participants earned tokens and descriptive praise for visual attending and direction following on a variable ratio 3 schedule. No feedback was provided for correctness of re-

sponding during acquisition probes. Tokens were exchangeable for brief access to a child-selected toy or edible at the end of each probe.

The data sheet for acquisition probes indicated the order for presentation of prepositions, as well as the stimuli that were used to demonstrate the preposition. Additional randomization of stimulus presentation was achieved by rotating three versions of the data sheet across sessions. The teacher and an independent observer scored each trial for the presence or absence of preposition use, as well as for correct or incorrect preposition use. Two independent observers, uninformed about the purposes and procedures of the study, alternated across sessions in assessing interobserver agreement with the teacher.

Teaching sessions. The same observers collected data on acquisition probes, duration of teaching procedures, and number of teaching trials. The duration of each teaching procedure was recorded to the nearest minute. Stopwatches were started at the end of a standard teacher statement; for incidental teaching the cue was, "It's time to play with these toys now."; for traditional procedures the cue was, "It's time to answer some questions now." Stopwatches were stopped when the item earned by the child on his last trial left the teacher's hand. An independent observer also recorded the number of teaching trials, as a measure of teacher accuracy in delivering the correct number of trials per procedure.

Generalization probes. Preposition use was assessed during 1:1, 10-min, free-play sessions that were conducted during baseline and teaching by one of two different teachers in a different classroom. Frequency of occurrence of preposition use was scored within 10-sec intervals; a time-sampling data collection procedure was used to facilitate assessment of interobserver agreement. Each preposition use was scored in the interval in which it ended, regardless of the degree of overlap across intervals, and an audiotape signaled the end of each 10-sec interval. As an additional control, different observers were used during teaching sessions and generalization sessions. The two generalization observers were trained in data collection procedures prior to the study, and were kept blind regarding experimental conditions throughout.

A coded data sheet provided for scoring up to two occurrences/nonoccurrences of preposition uses per interval, the maximum number possible within a 10-sec interval because preposition uses were separated by toy play (or eating) and teacher interactions. Each preposition use was scored in the following categories: (a) use of one of the six target prepositions or "other" prepositions, (b) correct or incorrect preposition use, and (c) spontaneous or prompted preposition use. Observers also recorded the stimulus items requested, so that it could later be determined whether the preposition had been used to describe a stimulus located in the teaching position or in a novel position (see Table 2). Generalization data were summarized for use of prepositions assigned to traditional procedures, and for use of incidental teaching prepositions, in the following ways: (a) the frequency of occurrence of correct preposition use, (b) the frequency of correct use of prepositions to describe stimulus items in novel positions, and (c) the percentage of preposition uses scored spontaneous and correct.

Interobserver Agreement

Acquisition probes. Interobserver agreement was assessed in 21% of the acquisition probes, for each child in each condition, and was calculated using the formula: total number of agreements divided by total number of agreements plus disagreements. Mean interobserver agreement on acquisition probes was 99% for Child 1 (range 97% to 100%), 99% for Child 2 (range 87% to 100%), and 99% for Child 3 (range 93% to 100%).

Teaching sessions. Interobserver agreement was assessed for each child in both traditional and incidental teaching conditions, in 18% of the teaching sessions. Agreement for procedure duration was calculated by dividing the smaller duration by the larger duration. Mean interobserver agreement on duration of teaching procedures for Child 1 was 98% (range 89% to 100%), for Child 2 mean duration agreement was 99% (range 89% to 100%), and for Child 3 mean agreement for the duration of teaching procedures was 98% (range

83% to 100%). For all children, with both procedures, interobserver agreement was 100% for number of teaching trials (calculated by dividing the smaller frequency by the larger frequency).

Generalization probes. Interobserver agreement was assessed in 60% of the generalization probes, for each child in every condition, and was computed for occurrences as well as for occurrences and nonoccurrences. The formula used to calculate interobserver agreement was: number of agreements divided by total number of agreements plus disagreements, with an agreement counted only for statements scored the same across categories (e.g., the same preposition circled, correct versus incorrect, spontaneous versus prompted, and identical stimulus items recorded). For Child 1 mean agreement on occurrence of preposition use was 85% (range 70% to 100%), and mean occurrence/nonoccurrence agreement was 94% (range 80% to 100%). Mean occurrence agreement for Child 2 was 95% (range 75% to 100%), and occurrence/nonoccurrence agreement was 98% (range 95% to 100%). Mean interobserver agreement for Child 3's occurrence data was 80% (range 50% to 100%), and mean agreement for occurrence/nonoccurrence data was 94% (range 90% to 100%). Mean levels of interobserver agreement for each condition across all three children were 80% for occurrences during baseline and 95% for occurrence/nonoccurrence data during baseline; mean interobserver agreement during teaching was 87% for occurrence data and 94% for occurrence/nonoccurrence. The few occasions when interobserver agreement was less than 80% were primarily due to a low number of occurrences of preposition uses during baseline; however, articulation clarity improved considerably during teaching, also contributing to increased levels of interobserver agreement.

RESULTS

Comparative acquisition data are displayed in Figure 2. The mean of the last three data points in baseline was 0% correct for Child 1 for prepositions assigned to incidental teaching, and baseline means of 0% correct were obtained by Children 2 and 3 for prepositions assigned to both procedures. Child 1's perseverative responding (i.e., he answered "under the box" on every trial) yielded a baseline mean of 33% correct for his last three data points on traditional prepositions. The means of the last three data points in teaching conditions for Child 1 were 87% correct for traditional procedures and 95% correct for incidental teaching procedures. For Child 2, the mean of his last three traditional training sessions was 98% correct, and the mean of his last three incidental teaching sessions was 100% correct. Child 3's mean percent correct in the last three teaching sessions was 98% for traditional training and 89% for incidental teaching. Similar results were displayed in single-subject representations of these data. In summary, there were no significant differences in acquisition or retention of prepositions taught with traditional or incidental teaching procedures.

Procedural efficiency data, or relative durations of teaching sessions, are shown in Table 3. Across the three children, the mean duration of traditional sessions was 9 min (range 5 min to 23 min), and the mean duration of incidental teaching sessions was 12 min (range 5 min to 30 min). Traditional sessions were completed slightly faster than incidental teaching sessions; differences were negligible for Children 2 and 3, and these differences tended to decrease as sessions proceeded.

The effects of traditional and incidental teaching procedures on the generalization of prepositions from teaching sessions to a different setting and different teachers are shown in Figure 3. In the free-play setting, there was no correct preposition use during baseline, with the exception that Child 1 perseveratively used the preposition "under." The mean frequencies for correct use of prepositions acquired through traditional (incidental) training for Children 1, 2, and 3 were 1 (4), 2 (7), and 6 (9), respectively. Across participants, mean correct use of traditional prepositions in the free-play setting was 1 during baseline, increasing to a mean of 3 correct following acquisition in traditional training sessions. There was no correct use of prepositions assigned to incidental teaching procedures during baseline, and a mean of 7 correct preposi-

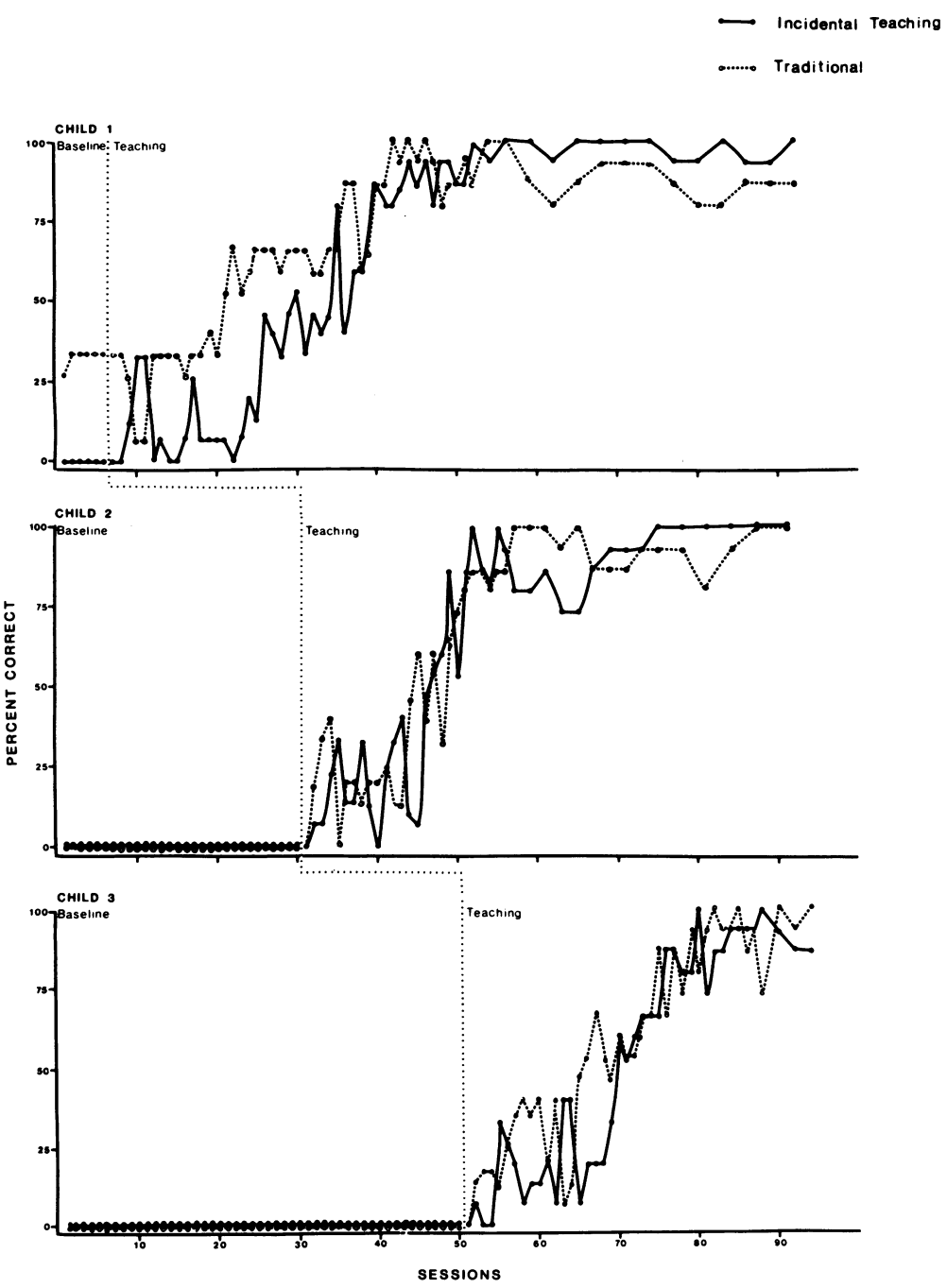

Figure 2. Percent correct responses on acquisition probes during incidental teaching and traditional training.

tion uses occurred per free-play session following acquisition in incidental teaching sessions. For all participants, differential generalization effects occurred after all three pairs of prepositions has been mastered during teaching sessions, and generalization to a different setting and different teachers was greater with incidental teaching procedures.

Generalization of preposition use to describe

Table 3
Duration of Traditional and Incidental Teaching Sessions with Equivalent Number of Trials

Child	Means (and ranges) of each procedure in minutes	
	Traditional training	Incidental teaching
1	10 (6–23)	17 (8–30)
2	8 (5–13)	9 (5–14)
3	8 (6–11)	10 (7–13)

novel arrangements of training stimuli was also evaluated in the free-play setting, by locating half the training stimuli in positions other than the positions in which they were taught (see Figure 3). As with other generalization measures, virtually no correct preposition uses occurred during baseline (with the exception of Child 1's perseverative use of "under"). Following acquisition in teaching conditions, Child 1 correctly used a traditional preposition to describe novel stimuli arrangements only once in 11 sessions: he correctly used a mean of 2 incidental teaching prepositions per free-play session to request items in novel positions. Child 2 was largely unable to generalize preposition use across stimulus positions, demonstrating no such generalization with prepositions taught with traditional training procedures, and only two instances of generalization across stimulus positions occurred with prepositions acquired through incidental teaching. Child 3 correctly described novel arrangements of stimuli a mean of 3 times per free-play session using prepositions acquired in traditional training, and he used a mean of 6 incidental teaching prepositions per probe. Therefore, incidental teaching procedures also yielded higher levels of preposition use when the children encountered arrangements of stimuli that had not been used in teaching.

Spontaneous, correct uses of prepositions in the generalization setting are displayed in Figure 4. During baseline there was no spontaneous preposition use by any of the three participants. During teaching, mean percent (and range) of preposition uses scored spontaneous and correct in the free-play setting were: for Child 1, traditional, 3% (0% to 22%); incidental teaching, 19% (0% to 44%); for Child 2, traditional, 9% (0% to 20%); incidental, 36% (0% to 83%); and for Child 3, traditional, 25% (0% to 33%); incidental, 36% (0% to 54%). In summary, the participants showed some spontaneous use of both sets of prepositions in generalization sessions, but the highest levels of spontaneous use were of prepositions taught with incidental teaching procedures.

DISCUSSION

In a controlled comparison of incidental teaching and traditional teaching procedures, autistic children's acquisition and use of prepositions was investigated. The results demonstrate that incidental teaching produced greater generalization of preposition use across settings, teachers, and positions of training stimuli. Importantly, the findings also demonstrate that incidental teaching fostered more spontaneous use of speech by severely language-delayed autistic children. There were no significant procedural differences in acquisition, retention, or time efficiency.

An unbiased assessment of procedural differences was ensured by controlling for difficulty of prepositions, number of teaching trials, reinforcer value, and reinforcement schedule. Generalization sessions were conducted in an entirely different environment by uninformed teachers (with traditional training histories). There was potential for differential stimulus control favoring incidental teaching in the teacher's question, "What do you want?", which was necessary to identify desired items when unclear gestures occurred during incidental teaching or generalization sessions. However, this question was seldom used during incidental teaching because children were close to stimulus items and high rates of verbal requests occurred throughout. Although in generalization sessions children were a greater distance from a large array of items, the question, "What do you want?" was primarily used early in baseline because children quickly learned that verbal requests were necessary. It is also noteworthy that during the free-play sessions, the children requested stimuli from both teaching conditions with similar frequencies. The possibility remains that, despite an

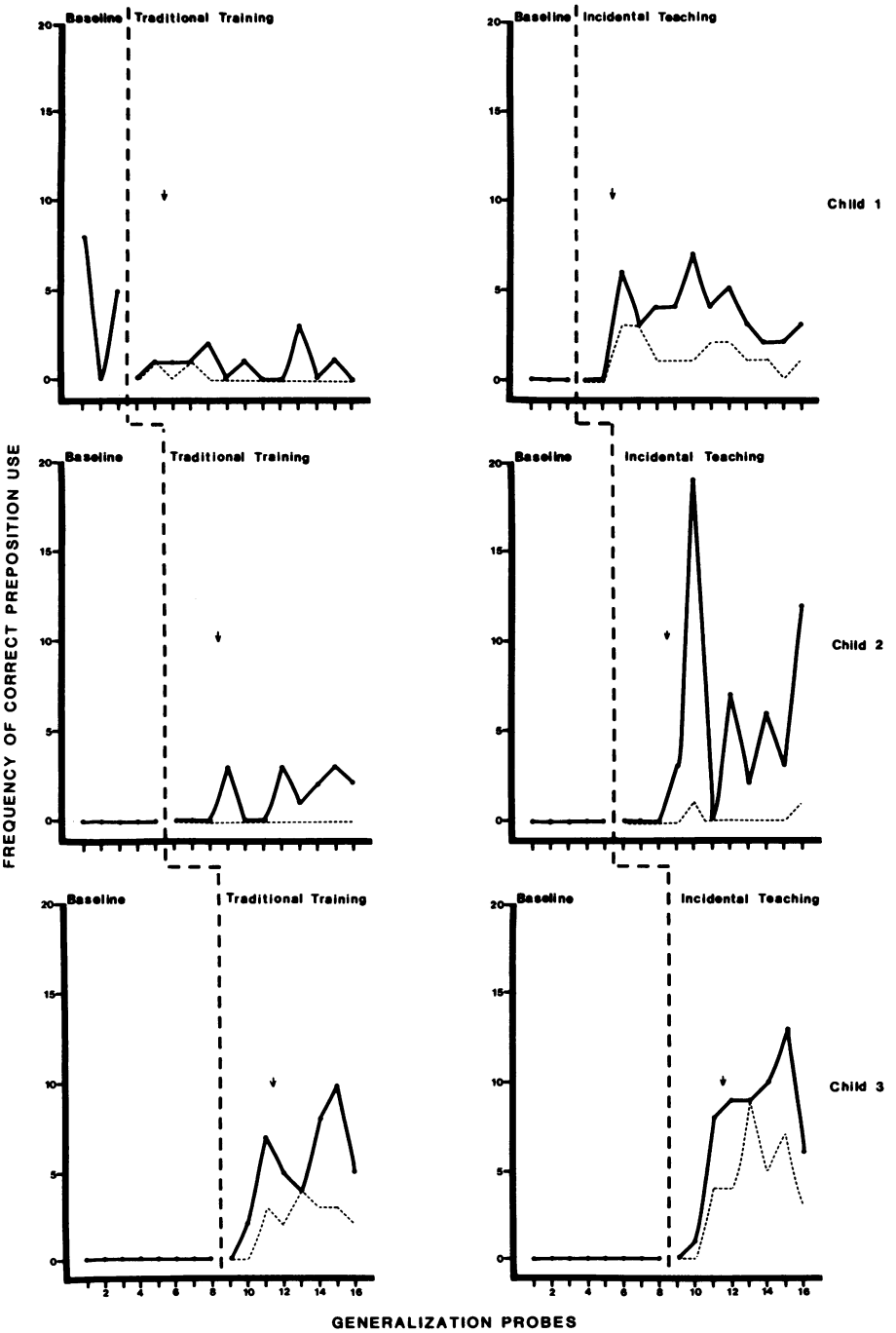

Figure 3. Frequency of correct preposition uses during free-play generalization probes (solid lines), and portion of correct responses in which prepositions were used to describe novel positions of training stimuli (dashed lines). Arrows indicate the point at which each child met criterion on three pairs of prepositions during acquisition probes.

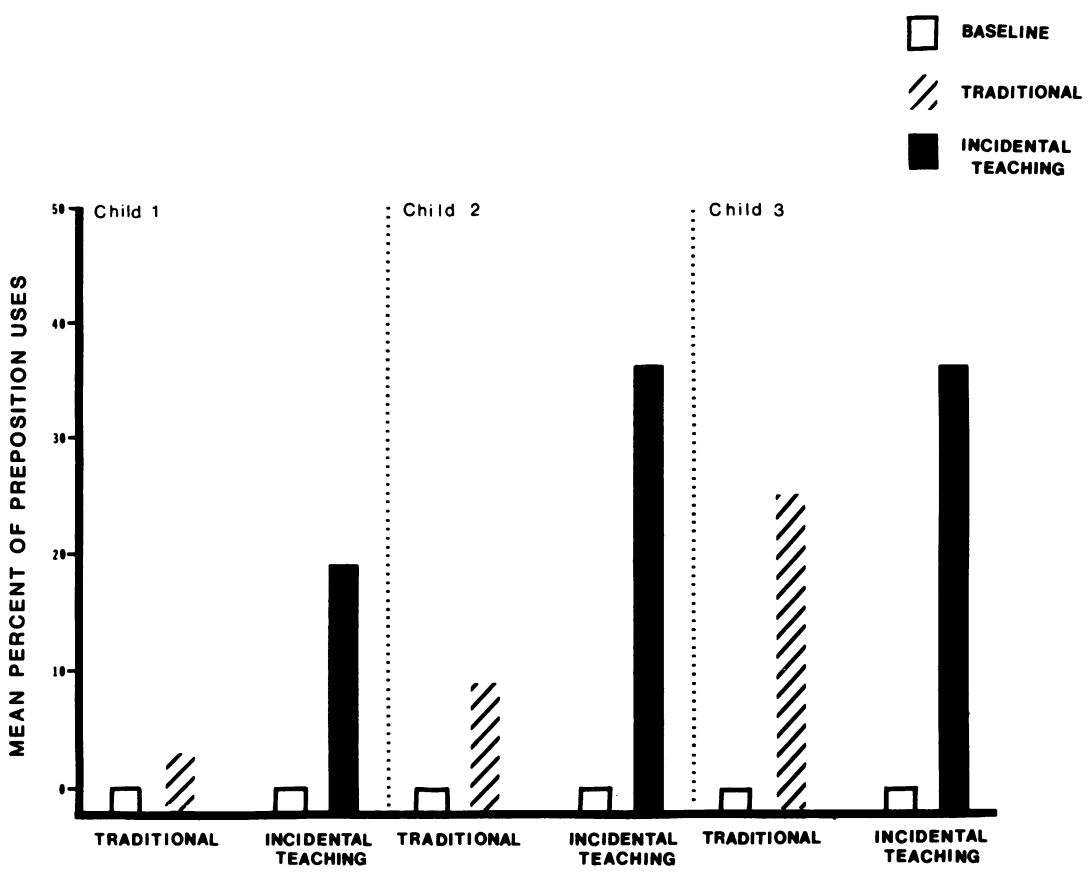

Figure 4. Mean percentage of prepositions used during free-play generalization probes that were scored as spontaneous and correct responses.

extensive set of controls, the incidental teaching and generalization settings may have shared some common controlling stimuli intrinsic to the process of obtaining toys from a shelf or bookcase. Of course, this situation exists to some extent in all generalization assessments of incidental teaching procedures because a characteristic strength of such language training is teaching in the context of naturally occurring controlling stimuli.

Findings that incidental teaching resulted in greater generalization of preposition use across settings, persons, and positions of training materials, although promising, do not imply that the problems of programming generalization for autistic children are solved. During a special probe at the end of this study, Children 1 and 2 showed virtually no generalization of prepositions to describe the locations of novel stimuli. Child 3 displayed limited, but equal, levels of generalization of both incidental teaching and traditional prepositions to describe novel stimuli (which could be a learning history effect because he had received traditional language training at the Institute for several years). It is likely that more generalization can be achieved by using more than two exemplars of training stimuli (Stokes & Baer, 1977).

As described by Hart and Risley (1982), the essential elements of incidental teaching appear to be child initiations, response-produced reinforcement, and instruction in natural settings. Our study demonstrates that autistic children who have simple expressive language can participate in "standard" incidental teaching procedures, given a curriculum for teachers and students to follow.

However, the incidental teaching procedure in our study is less natural than Hart and Risley's (1982) format, in that children receive consecutive teaching episodes on specific target responses. More natural interactions between language-delayed children and their teachers have been arranged through task variation (Koegel & O'Dell, 1982) and through distribution of teaching trials throughout the course of other activities (Neef et al., 1984); and in both of those studies, in-context language training produced improved acquisition and generalization of expressive speech. Our results showed similar comparative generalization effects, but differential acquisition did not occur; however, the variables relevant to acquisition are unclear due to differences in the traditional and in the more natural teaching procedures used in these three studies.

As with other components of incidental teaching procedures, the relative contributions of child initiations are yet to be fully evaluated. We do know that the procedures can be modified for children who are unable to engage in conventional initiations, while preserving the benefits of generalization (McGee et al., 1983). Although children initiated incidental teaching episodes in the study reported here, they all engaged to some degree in ritualistic behavior, choosing items in a repetitive sequence across and down the shelves. These rituals (which occurred during both incidental teaching and generalization sessions) did not appear to be related to reinforcer satiation. Ritualistic initiations were not interrupted when newly selected edibles and play materials were used in a probe at the end of the study, and the incidental teaching procedure seemed to be an enjoyable activity based on one of the boy's frequent requests to participate. Additional analyses are needed to determine whether child initiations increase the reinforcement value of the task and whether initiations maximize the spontaneous use of speech. Findings that child-initiated teaching produces positive effects on task engagement or on spontaneous language use would highlight the importance of identifying ways to teach natural, unprompted initiations.

In summary, incidental teaching can be used to teach new language responses (prepositions) to autistic children, while simultaneously programming generalization across multiple dimensions. Incidental teaching formats are called for in language development curricula for autistic children; application of these procedures will also require training programs that prepare teachers to make use of naturally occurring teaching opportunities (Halle et al., 1981). Perhaps conclusions should come as no surprise: Autistic children can best acquire functional and spontaneous use of prepositions through carefully programmed instruction that emulates normal language development.

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