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Embedding Instructive Feedback into Teacher-Student Interactions During Independent Seat Work

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The effects of embedding a constant time delay procedure into an independent seat work activity and using instructive feedback were evaluated in this study. Seven students with mild disabilities participated in the study that occurred in their special education classroom. A multiple probe design across sets of target behaviors was used, and students' responses to instructive feedback stimuli were evaluated during each probe condition. The procedures were implemented with a high degree of fidelity, and the results indicate that (a) the students acquired the target behaviors taught with the constant time delay procedure that was embedded into independent seat work, and (b) the students acquired some but not all of the responses to the instructive feedback stimuli. These findings are discussed in terms of using instructive feedback in classrooms and future research on instructive feedback.

KEY WORDS: instructive feedback; constant time delay; independent seat work.

A substantial literature has emerged documenting the effects of systematic instruction when teaching students with disabilities, including those who have learning and behavior disorders (Mercer & Mercer, 1989) and

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moderate or severe disabilities (Westling & Fox, 1995). Systematic instruction involves presenting tasks clearly, providing opportunities for students to respond, presenting and fading prompts and other teacher assistance, and delivering reinforcers and corrective feedback—particularly during initial instruction. Several strategies for presenting and fading teacher prompts have been studied, such as constant and progressive time delay, system of least prompts, most-to-least prompts, and graduated guidance (Wolery, Ault, & Doyle, 1992). Direct comparisons of these and other strategies often indicate that the compared procedures are effective, but one may be more efficient than the other(s) (Ault, Wolery, Doyle, & Gast, 1989).

Instructional efficiency can be conceptualized in a number of ways; for example, the rapidity with which students achieve criterion level responding, the amount of teacher time required to deliver the instruction, and the number of behaviors learned in the same amount of instructional time (Wolery et al., 1992). A procedure for increasing the number of behaviors learned while maintaining essentially the same amount of instructional time is instructive feedback. Instructive feedback involves presenting students with extra, non-target stimuli during the consequent events of instructional trials (Werts, Wolery, Holcombe, & Gast, 1995). The extra stimuli are presented while the teacher delivers consequent events such as praise or other reinforcers, students are not asked nor required to respond to the extra stimuli, and students are not reinforced if they do. When instructive feedback is used, students with a variety of disabilities acquire a majority of the behaviors for the instructive feedback stimuli (see Werts et al., 1995, for a review).

Of the 28 studies evaluating instructive feedback, 23 occurred in teacher-directed small-group or one-on-one instructional arrangements (Werts et al., 1995). Two studies involved peers using instructive feedback while tutoring their classmates (Anthony, Wolery, Werts, Heckathorn, & Caldwell, 1995; Collins, Branson, & Hall, 1995); one study involved computer presentation (Edwards, 1989); and two other studies used transition-based teaching (Werts, Wolery, Holcombe, Vassilaros, & Billings, 1992; Werts, Wolery, Venn, Demblowski, & Doren, in press)—transition-based teaching involves the teacher presenting a single instructional trial during each in-class transition throughout the day.

In addition to these arrangements, systematic instruction, but not instructive feedback, has been embedded into other ongoing activities. In preschool classrooms, for example, Fox and Hanline (1993) embedded the use of the system of least prompts in free play; Venn et al. (1993) embedded the use of progressive time delay in art activities; and Chiara, Schuster, Bell, and Wolery (1995) embedded the use of constant time delay into free

play activities. Also, Wolery, Anthony, Snyder, Werts, and Heckathorn (in press) embedded the constant time delay procedure into teacher-lead lessons in inclusive elementary classrooms.

While systematic instruction can occur in such contexts, many students spend some of their school day in other arrangements such as in cooperative learning activities or in independent work at their desks. When students are engaged with independent work at their desks, their teachers may walk among the students, respond to students' requests, monitor students' progress, and interact briefly with individual students—providing instruction or clarifying requirements. No instructive feedback study has occurred in such an arrangement, and embedding constant time delay has not been evaluated in this arrangement.

The purpose of this study was to evaluate the effects of embedding constant time delay and instructive feedback into an independent seat work activity. Specifically, as children were engaged in independent written work at their desks, the teacher approached them, used the constant time delay procedure to teach a target behavior, and delivered the instructive feedback stimulus while praising their performance on the target response. The effects of this instruction were evaluated on students' acquisition of responses to the target and to the instructive feedback stimuli.

METHODS

Participants

Seven students (8-12 years of age) with diagnosed disabilities from a special education classroom in an urban school district participated in the study. They were enrolled for a majority of the day in the special education class, but received some instruction in general education classrooms. Four were males, 3 were females; 4 were African American, 3 were caucasian; 5 were from single-parent homes, 2 were from two-parent families; and 6 were from low-income families, 1 was from a middle-income family. All students possessed adequate auditory and visual acuity for the experimental tasks, were responsive to verbal requests, and displayed expressive language. None had received instruction with the constant time delay procedure or with the instructive feedback procedure.

Richard (10-yr-3-mo old, caucasian male) was diagnosed with a learning disability. He was the fourth of five children and lived with his siblings and mother who was unemployed and received some public assistance. He saw his father regularly. He was evaluated at 8 yr 6 mo, and received the following scores: On the *Wechsler Intelligence Scale for Children-Revised*

(WISC-R) (Wechsler, 1974) his full scale IQ was 85 (VIQ = 90, PIQ = 82); on the *Wide Range Achievement Test-Revised* (WRAT-R) (Jastak & Wilkinson, 1984) his grade equivalents were pre-first grade for reading (SS = 47, %ile= <1), pre-first grade for spelling (SS = 47, %ile = <1), and end of first grade for math (SS = 69, %ile = 2); and on the *Basic Achievement Skills Individual Screener* (BASIS) (Psychological Corporation, 1983) his grade equivalent for reading was 1:3 (SS = 69, AE = 6-6) and for math was 1:4 (SS = 74, AE = 6-8). He received Chapter I and pre-referral services before being enrolled in special education at grade three. He received speech and language therapy.

Jamal (11-yr-8-mo old, African American male) was diagnosed with a learning disability. He was the youngest of 3 children and had lived since infancy with his maternal grandmother who was retired. He spent time with his mother frequently. He was evaluated at 9 yr 4 mo, and received the following scores: on the *WISC-R* his full scale IQ was 82 (VIQ = 80, PIQ = 87); on the *WRAT-R* his grade equivalent for reading was beginning first grade (SS <46, %ile = <1) and for math was ending second grade (SS = 81); on the *BASIS* his reading and spelling grade equivalents were 1:2 (SS = 65, %ile = 1); and on the *Developmental Test of Visual-Motor Integration-Revised* (VMI-R) (Beery, 1982) his standard score was 99 (%ile = 47). Jamal was enrolled in special education since first grade.

Phillip (9-yr-1-mo old, caucasian male) was diagnosed with a learning disability. He was the youngest of four children. He had lived with his aunt, whom he considered his mother, and 3 siblings since infancy. He was evaluated at 7 yr 1 mo, and received the following scores: on the *WISC-R* his full scale IQ was 81 (VIQ = 75, PIQ = 90); on the *WRAT* his grade equivalent was pre-first grade for reading (SS = 64, %ile = 1) and for math (SS = 62, %ile = 1); and on the *BASIS* his age equivalent for reading and math was 6:0 (SS = 65, %ile = 1). Phillip was enrolled in an inclusion model classroom from kindergarten through grade two.

Shaunice (11-yr old, African American female) was diagnosed with mild mental retardation. She lived with 2 younger brothers and her mother who was unemployed and received some public assistance. She was evaluated at 8 yr 8 mo and received the following scores: On the *WISC-R* her full scale IQ was 71 (VIQ = 81, PIQ = 64); on the *WRAT* her grade equivalent was pre-first grade (SS = 46, %ile <1) for reading, spelling, and arithmetic; on the *BASIS* her age equivalent was 6:2 for reading (SS = 65, %ile = 1) and 6:0 for math (SS = 65, %ile = 1); and on the *VMI-R* her age equivalent was 4:7. Shaunice had repeated kindergarten and first grade, and received special education services since third grade.

Faith (8-yr-5-mo old, African American female) was diagnosed with mild mental retardation. She had lived with two older brothers and both

parents since she was adopted at age 2. Her father was a respiratory therapist and her mother was a social worker. She was evaluated at 6 yr 6 mo, and received the following scores: On the *WISC-R* her full scale IQ was 78 (VIQ = 73, PIQ = 86); on the *WRAT-R* her grade equivalents were pre-first grade for reading (SS = 80, %ile = 9), spelling (SS = 84, %ile = 14), and math (SS = 78, %ile = 7); and on the *BASIS* her age equivalents were 6:0 for reading (SS = 84) and math (SS = 89). Faith received pre-referral services in first and second grades and began receiving special education in third grade.

Carmen (10-yr-7-mo old, caucasian female) was diagnosed at 4 yr 9 mo with an emotional impairment and at 10 yr 2 mo with a learning disability. She also was diagnosed as having attention-deficit hyperactivity disorder at 4 yr 7 mo, and she was prescribed Ritalin from that time until she was 10 yr 5 months. She was an only child and lived with her mother who was unemployed. She was evaluated at 4 yr 9 mo, and received the following scores: On the *Wechsler Preschool and Primary Scale of Intelligence* (WPPSI) (Wechsler, 1974) her full scale IQ was 96 (VIQ = 91, PIQ = 101); on the *WRAT* her standard scores were 61 in reading, 75 in math, and 79 in spelling; and on the *VMI-R* her age equivalent was 4:4 (%ile = 9). Carmen's social assessment concluded that there were substantial social and emotional concerns. She had received support services since kindergarten.

Trevor (12-yr-6-mo old, African American male) was diagnosed with mild mental retardation. He lived with both parents and a brother and sister. He was evaluated at 10 yr 11 mo, and received the following scores: on the *Wechsler Intelligence Scale for Children-III* (WISC-III) (Wechsler, 1993) his full scale IQ was 69 (VIQ = 69, PIQ = 73); on the *Wechsler Individual Achievement Test* (WIAT) (Psychological Corporation, 1992) his standard scores were 82 in reading, 81 in math reasoning, and 78 in spelling; and on the *VMI-R* his age equivalent ranged from 6:0 to 6:5. He was retained in kindergarten and first grade. In the fourth grade he received Chapter I support.

Setting

The experimental sessions occurred in a self-contained special education classroom with a special education teacher, full-time teaching assistant, and 14 children (grades 3-5). Probe sessions occurred at a table (1 m × 3 m) at the right side of the room between the entrance and the teacher's desk. Instructional sessions usually occurred at the students' desks, however, some sessions occurred at other areas such as the listening

center or library area. During experimental sessions, the remainder of the class worked with the teaching assistant or on independent activities.

Materials

Each student was taught three sets of target behaviors with each set containing two target behaviors; each target behavior had a corresponding instructive feedback stimulus. Two students were taught to name state outlines, and the instructive feedback was the corresponding state motto. Five students were taught to read words depicting various vocations, and the instructive feedback was a brief description of the work done by persons in that vocation. The target and instructive feedback stimuli are listed in Table 1.

For probe conditions, target stimuli (state outlines and vocation words) were printed on white index cards (10 cm × 15 cm). State outlines were printed in black ink using graphics generated by Charisma software (Micrografx, 1990). Vocation words were printed using Universal font black

Table 1. Target and Instructive Feedback Stimuli

Students	Set	Target Stimuli	Instructive Feedback
Carmen	Set 1	Alaska	The Last Frontier
Trevor		Texas	The Lone Star State
	Set 2	Louisiana	The Pelican State
		Ohio	The Buckeye State
	Set 3	Virginia	The Old Dominion State
		Illinois	The Land of Lincoln
		Connecticut	The Constitution State
		Delaware	The First State
Richard	Set 1	dietician	A dietician plans meals
Jamal		teller	A teller counts money at a bank
Faith		curator[a]	A curator is in charge of a museum
Phillip			
Shaunice	Set 2	architect	An architect designs buildings
		physician	A physician is a doctor
	Set 3	senator	A senator makes laws
		professor	A professor teaches at a college
		meteorologist[b]	A meteorologist predicts the weather
		orthodontist	An orthodontist is a dentist
		cosmetologist	A cosmetologist cuts and styles hair

[a]Curator was used instead of teller for Richard and Jamal.
[b]Meteorologist was used instead of senator for Richard and Shaunice.

type, 48 point, in lower case letters. Probes for instructive feedback were verbal and required no visual stimuli or materials.

For the instructional conditions with students learning to name state outlines, four work sheets were prepared for each set of behaviors. Each work sheet contained eight items, four for each of the two behaviors being taught. The directions for these work sheets were: (a) draw a line from the state name to the correct state outline; (b) write the correct state name under the state outline; (c) given the state outline, fill in the missing letters of the state name below; and (d) given three state outlines, circle the correct outline. Four work sheets also were prepared for each set of behaviors taught to students learning to read vocation words. The directions for these work sheets were: (a) draw a line from the vocation in column A to the same vocation in column B, (b) unscramble the letters in the left column and write the correct vocation on the line in the right column, (c) fill in the missing letters of the vocation, and (d) write the vocation in the left column on the line in the right column. The work sheets were prepared using Charisma and Wordperfect software.

Response Definitions and Data Collection

The investigator collected the data using trial-by-trial recording. Responses during full probe conditions and daily probe sessions were scored as *correct*, the student said the name for the state outline or vocation (target probes) or said the state motto or job description (instructive feedback probes) within 3 s of the task direction; or *incorrect*, the student did not say anything, said the response was unknown, or said an incorrect state name, vocation word, state motto, or job description within 3 s of the task direction. The probe data served as the dependent variable. Data also were collected during instruction to obtain information for making instructional adjustments. During instruction, five responses were possible: *correct anticipation*, the student correctly named the state outline or vocation within 3 s of the delivery of the task direction; *correct wait*, the student correctly imitated the instructor's model; *non-wait error*, the student erroneously named the state outline or vocation within 3 s of the task direction; *wait error*, the student did not imitate the model correctly; and *no response*, the student did not speak within 3 s of the instructor's model.

Experimental Design

A multiple probe design across behaviors replicated across participants (Tawney & Gast, 1984) was used to evaluate the effectiveness of the in-

struction. The students were screened to identify target and instructive feedback stimuli that were unknown. The initial full probe condition, conducted individually with each student, was implemented to assess students' performance on target and instructive feedback stimuli. The instructional procedures were then implemented on the first set of behaviors. Individual daily probes were used to measure students' performance on the behaviors being taught and were conducted by the investigator before daily instruction. Instruction included the constant time delay procedure, work sheets, and instructive feedback. It was delivered by the teacher or by the investigator when the teacher was unavailable.

When criterion level performance on target behaviors was evident from daily probe data, the full probe condition was reinstated to assess students' performance on all target and instructive feedback behaviors. When all students who were learning a particular type of behavior (state outlines or vocational words) had achieved criterion level responding on behavior Set I and had completed the second full probe condition, instruction was implemented on the second set of target behaviors. This pattern continued until all three sets of behaviors were taught to all students. Criterion was 3 of 4 days at 100% correct responses during daily probe sessions with praise for each response followed by 2 days of 100% correct with praise only at the completion of daily probe sessions.

Full Probe Condition Procedures

Before instruction, the investigator assessed each student individually to ensure that the target and the instructive feedback stimuli were unknown. Target stimuli and instructive feedback stimuli were assessed in separate sessions using the same procedures. All stimuli of the same type (target or instructive feedback) were intermixed during probe sessions. For the state outline/motto probes, each probe consisted of 24 trials (3 trials $\times$ 8 stimuli). For the vocation/job description probes, each probe consisted of 30 trials (3 trials $\times$ 10 stimuli). Three probe sessions for target stimuli and three probe sessions for instructive feedback stimuli occurred over a minimum of two days with at least 45-mins between sessions. Probe conditions were repeated when a student reached criterion on a target behavior set.

Probe trials were conducted in the following manner: The investigator placed a card in front of the student (target probes only), presented an attentional cue (i.e., "Look."), secured the student's attention, delivered the task direction (i.e., "What state/word is this?" for target stimuli, and "What state is [the] *motto*?" or "What does a[n] *vocation* do?" for instruc-

tive feedback stimuli), provided a response interval of 3 s (counting silently "1001, 1002, 1003"), and recorded the student's response. Correct responses during full probe conditions were praised ("Good job."), and incorrect answers or no responses were ignored.

Daily Probes

Daily probes consisted of 4 trials (2 trials × 2 stimuli). They were conducted prior to instruction each day using the same trial sequence as the full probe condition. Only the target stimuli that were currently being taught were assessed in the daily probe sessions. The investigator assessed each student individually.

Instructional Procedures

After the daily probe session, students were given a work sheet to complete. They were instructed to leave the work sheet on top of their desks. The teacher approached the student when appropriate and provided instructional trials using the work sheet. A minimum of 1 trial and a maximum of 3 instructional trials were given at any one time, and a 1- to 10-min interval was allowed between blocks of trials. Each instructional day consisted of 8 trials (2 stimuli × 4 trials) for all sets of behaviors.

A constant time delay procedure was used (Wolery et al., 1992). For each set of behaviors, the first day consisted of 0-s trials and all subsequent days used 3-s delay trials. A trial consisted of the instructor providing an attending cue (i.e., "Look, *child's name.*"), pointing to either a state outline or vocation word on the student's work sheet, delivering the task direction (i.e., "What state/word is this?"). For the 0-s trials, a verbal model was immediately delivered followed by a 3-s response interval (teacher silently counted, "1001, 1002, 1003"). For 3-s delay trials, a response interval was provided after the task direction; and if no response occurred, the verbal model was delivered followed by another 3-s response interval. Prompted and unprompted correct responses for both types of trials (0-s and 3-s delay trials) resulted in praise and delivery of the instructive feedback (i.e., "Good, *state name* is (the) *motto,*" or "Good, a *vocation job description.*"). Error responses were ignored and instructive feedback was not delivered. A 1- to 2-s intertrial interval was given between trials in a block, and a 1- to 10-min interval occurred between blocks.

The investigator recorded students' responses for each trial and recorded the teacher's implementation of the trial procedures periodically. Instructional sessions continued for each student until he or she reached

criterion, after which, he or she was removed from instruction and placed in the full probe condition. Instruction for subsequent sets of behaviors did not begin until all students being taught the same stimuli type (state outline or vocations) had completed the full probe condition for the previous set.

Review Sessions

If a student did not maintain correct performance on target behaviors during full probe conditions, review sessions were conducted. Review sessions consisted of 8 trials (4 trials × 2 stimuli or 2 trials × 4 stimuli). Review session procedures were identical to instructional procedures. Daily probes for the review sessions consisted of either 4 trials (2 trials × 2 stimuli) or 8 trials (2 trials x 4 stimuli), and the procedures were identical to the daily probes used during original instruction.

Reliability

Interobserver agreement assessments occurred for students' responses during full probe and daily probe sessions. Interobserver agreement percentages were calculated by dividing the number of exact agreements by the number of agreements plus the number of disagreements and multiplying the quotient by 100. Overall, 34.8% of the daily probe sessions (range, 25.0% to 45.0% per student) were scored by two observers, and interobserver agreement was 99.4% (range, 98.4% to 100% across students). The percentage of full probe sessions scored by two observers was 42.3 (range, 26.7% to 45.8% per student). Interobserver agreement was 99.5% (range of 98.0% to 100%).

Procedural reliability checks for instructional and probe trials were conducted to measure the consistency of the investigator's and teacher's implementation of the procedures (Billingsley, White, & Munson, 1980). The percentage of compliance was calculated by dividing the number of actual behaviors by the number of planned behaviors with the quotient multiplied by 100. The following behaviors were assessed: ensuring student attention, showing the correct stimuli, delivering the task direction, waiting the appropriate response interval, providing a model when needed (instruction only), providing the appropriate consequences, delivering the instructive feedback (instruction only), ignoring responses to the instructive feedback (instruction only), and waiting the correct intertrial interval. Procedural reliability was assessed on 85.9% of the instructional trials (range of 80.5% to 90.4% across students), 34.8% of the daily probe trials (range

of 25.0% to 45.0%), and 42.3% of the full probe trials (range of 26.7% to 45.8%). For instructional trials, procedural reliability on the assessed behaviors was: 100% for ensuring student attention, 99.3% for showing the correct stimuli, 99.6% for delivering the task direction, 99.3% for waiting the appropriate response interval, 97.4% for providing a model, 96.6% for providing the appropriate consequences, 97.4% for delivering the instructive feedback, 99.7% for ignoring responses to the instructive feedback, and 99.9% for waiting the correct intertrial interval. Procedural reliability for daily probe trials was 100% for all investigator behaviors except waiting the appropriate response interval which was 99.1% (range of 96.7% to 100%) and providing the appropriate consequences which was 99.2% (range of 97.7% to 100%). Procedural reliability for full probe trials was 100% for all investigator behaviors except waiting the appropriate response interval which was 99.8% (range of 99.3% to 100%) and providing the appropriate consequences which was 99.8% (range of 99.2% to 100%).

RESULTS

Acquisition of Target Behaviors

The effects of embedding constant time delay with work sheets into the independent seat work activities were evaluated through the daily probe data. These data are presented for Richard and Jamal in Figure 1, Phillip and Faith in Figure 2, Shaunice in Figure 3, and Carmen and Trevor in Figure 4. As is evident, performance on the target behaviors prior to instruction was low and only increased after instruction was implemented. Each student achieved criterion level performance on each of the three sets of behaviors that were taught. In most cases, students maintained criterion level responding in subsequent probes; however, Phillip on Set 2, Faith on Sets 2 and 3, and Carmen on Sets 2 and 3 did not maintain high levels of correct responding on subsequent probes. Review sessions were implemented and produced criterion level responding.

The number of days of instruction, the minutes of instruction, the number of daily probes, and the number of minutes of probing for each behavior set and review sessions are shown in Table 2. The minutes of instruction involved the time required to deliver the embedded trials, and 95.5% of the trials were timed. The mean number of seconds per day per student to embed the constant time delay trials was 63.1 (range across students: 57 to 70.5 seconds). Thus, the instruction involved slightly more than 1 minute per day for each student. A total of 97.5% of the daily probes were timed. The average number of seconds per daily probe was 23.2

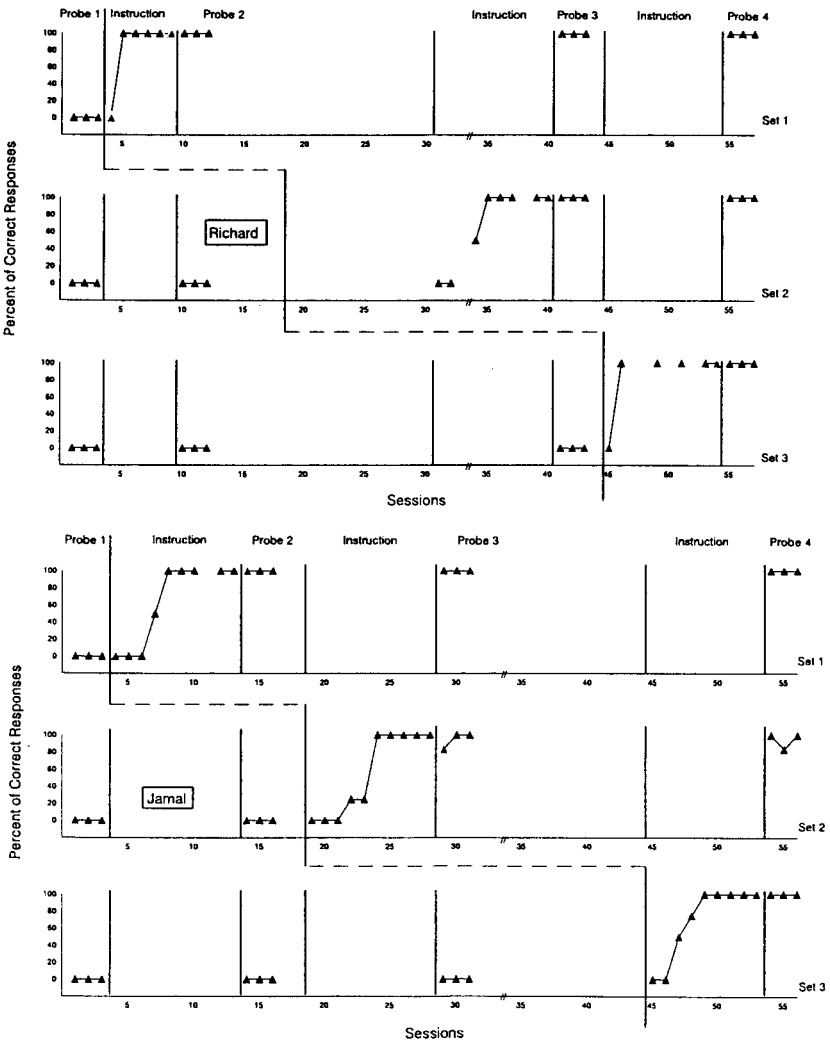

Fig. 1. Percentage of correct responses on target behaviors during probe conditions and daily probe sessions for three sets of behavior for Richard (top graph) and Jamal (lower graph). The scale break lines on the abscissa represent an interruption of data collection due to school holidays.

(range across students, 19.8 to 30.5 seconds). Thus, each students' involvement with the daily probes and the embedded constant time delay trials averaged less than 1.5 min per day.

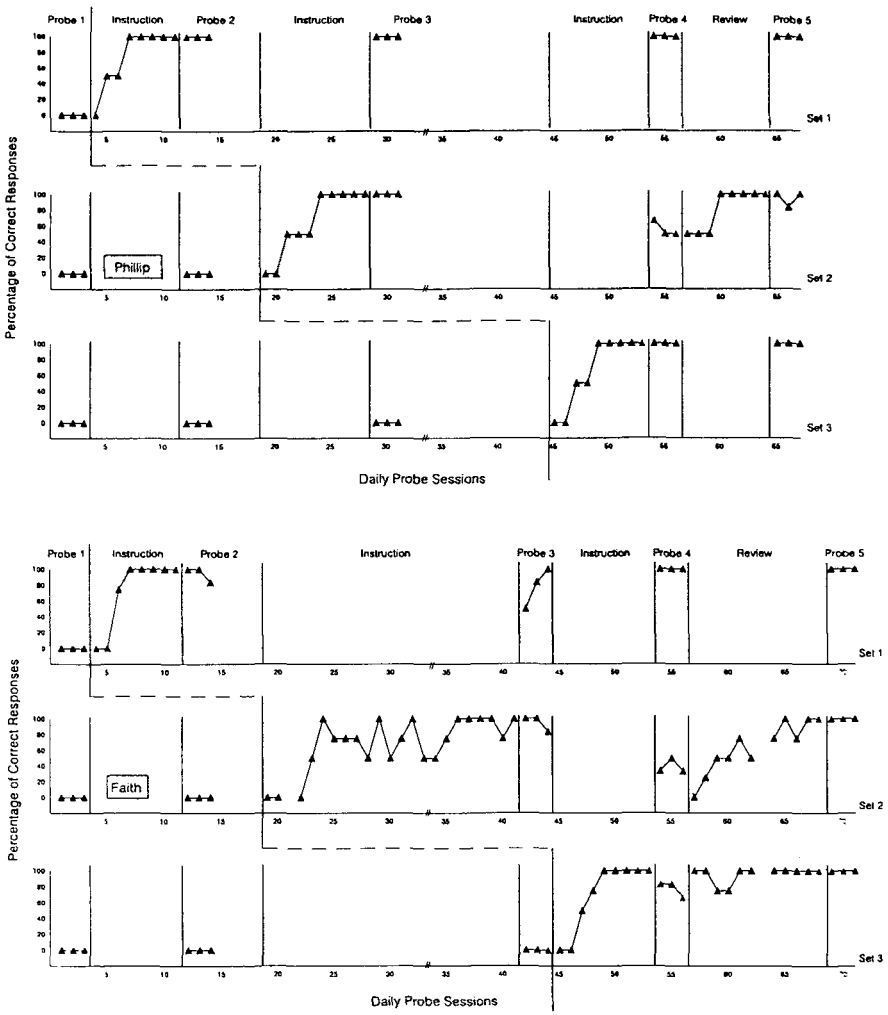

Fig. 2. Percentage of correct responses on target behaviors during probe conditions and daily probe sessions for three sets of behavior for Phillip (top graph) and Faith (lower graph). The scale break lines on the abscissa represent an interruption of data collection due to school holidays.

Acquisition of Instructive Feedback

The students' responses to instructive feedback stimuli were assessed during the full probe conditions (3 sessions per condition). Their percent-

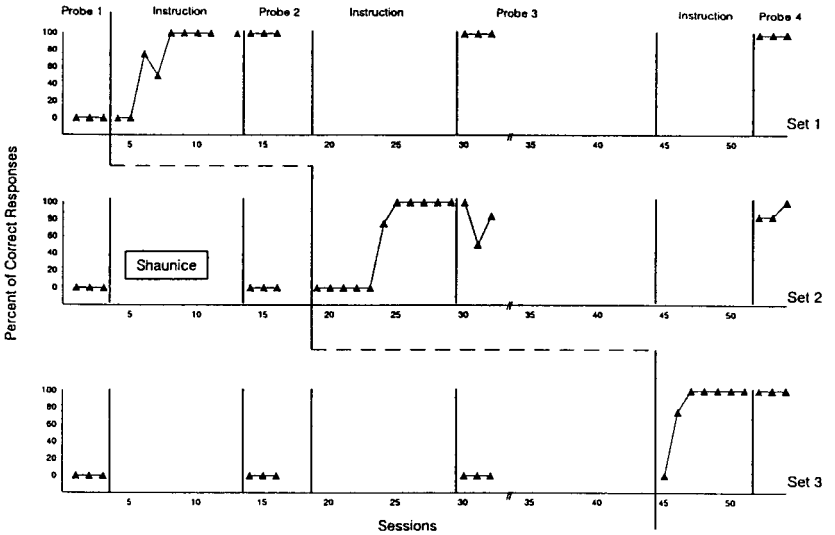

Fig. 3. Percentage of correct responses on target behaviors during probe conditions and daily probe sessions for three sets of behavior for Shaunice. The scale break lines on the abscissa represent an interruption of data collection due to school holidays.

age of correct responses for each condition are shown in Table 3. In the probe conditions prior to instruction, none of the students responded correctly to any of the instructive feedback stimuli. In probe conditions immediately following instruction, all students responded correctly to the instructive feedback stimuli for at least one set of target behaviors. Four of the students (Faith, Shaunice, Carmen, and Trevor) responded correctly to the instructive feedback stimuli for each of the three sets of behaviors. Two students (Jamal and Phillip) responded correctly on two sets of behaviors, and one student (Richard) responded correctly to one set. After instruction on Set 1 behaviors, Richard was absent for approximately 4 weeks. When he returned, he received instruction on Set 2 target behaviors; however, he never again responded correctly during the instructive feedback probes.

With the exception of Richard after instruction on the first set of behaviors, none of the students responded at 100% correct on all probe sessions for any set of instructive feedback behaviors after instruction. Two students, Richard and Faith, demonstrated little maintenance of the responses for the instructive feedback stimuli in subsequent probe conditions. Carmen and Trevor, who were taught to name state outlines and were presented with state mottos through instructive feedback, had higher levels of

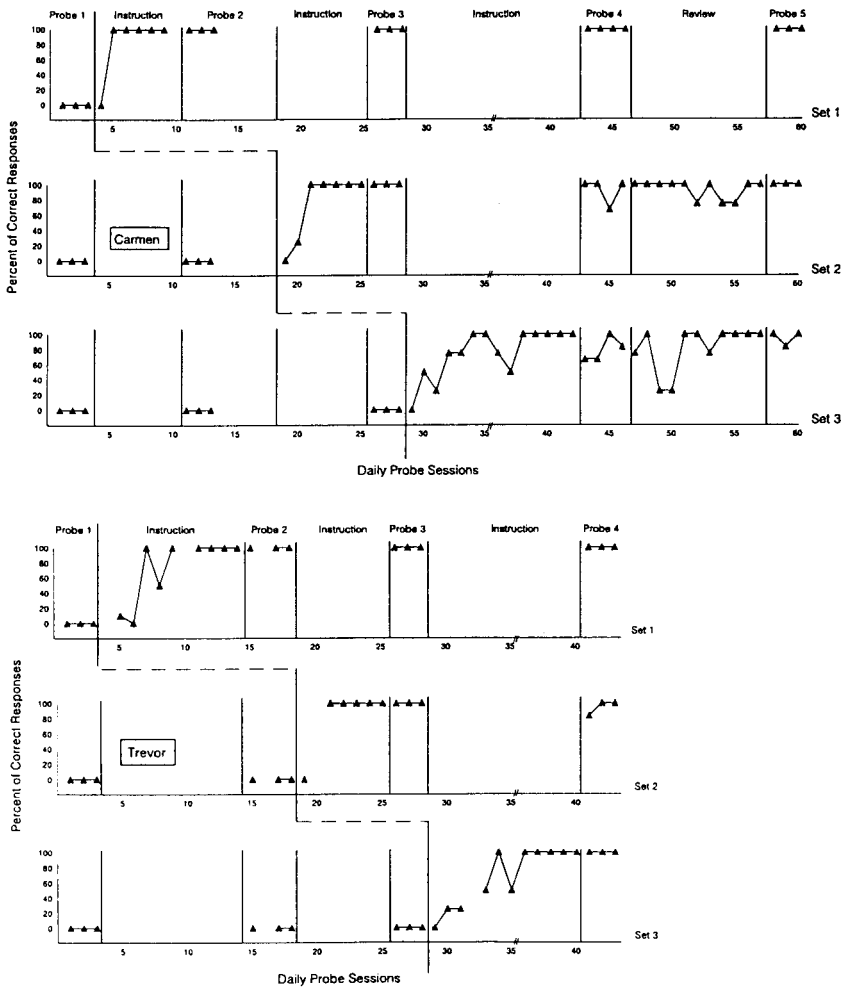

Fig. 4. Percentage of correct responses on target behaviors during probe conditions and daily probe sessions for three sets of behavior for Carmen (top graph) and Trevor (lower graph). The scale break lines on the abscissa represent an interruption of data collection due to school holidays.

correct responses and greater maintenance of the instructive feedback behaviors than did the students who were taught to read names of vocations and were presented with a statement describing the work of persons in those vocations.

Table 2. Number of Sessions, Daily Probes, and Minutes of Instruction and Assessment

Student Stimulus Set	# of Instruc. Sessions	# Min:Sec of Instruction[a]	# Daily Probes	# Min:Sec of Probing[a]
Richard				
Set 1	5	5:31 (95.0)	6	2:25
Set 2	7	6:55	8	2:31 (87.5)
Set 3	5	5:11	6	1:40
Total	17	17.37 (98.5)	20	6:36 (95.0)
Jamal				
Set 1	8	8:03 (96.9)	9	4:23
Set 2	9	9:06	10	2:51
Set 3	8	7:20	9	2:39
Total	25	24:29 (99.0)	28	9:53
Phillip				
Set 1	7	6:38 (80.4)	8	3:10
Set 2	9	10:04	10	3:01
Set 3	8	7:19 (87.5)	9	2:21
Rev. Set 2	7	5:55	8	4:12
Total	31	29:26 (92.3)	35	12:44
Faith				
Set 1	7	7:14 (92.9)	8	3:25
Set 2	21	26:35 (94.0)	22	8:27 (90.1)
Set 3	8	9:40 (93.8)	9	2:35 (88.9)
Rev. Sets 2 & 3	10	9:47	11	10:56
Total	45	53:16 (95.1)	50	25:23 (94.0)
Shaunice				
Set 1	8	8:02 (92.2)	9	4:02
Set 2	10	13:48	11	3:55
Set 3	6	6:23 (83.3)	7	1:52
Total	24	28:13 (93.2)	27	9:49
Carmen				
Set 1	5	5:38 (87.5)	6	2:57
Set 2	6	7:25 (95.8)	7	2:00 (85.7)
Set 3	13	11:57	14	4:21
Rev. Sets 2 & 3	10	9:11 (90.0)	1	6:46
Total	34	34:11 (94.5)	38	16:04 (97.4)
Trevor				
Set 1	8	8:45 (92.2)	9	3:39
Set 2	5	5:46	6	1:55
Set 3	10	9:59 (97.5)	11	3:52 (90.9)
Total	23	24:30 (96.2)	26	9:26 (95.2)

[a]Numbers in parenthesis are the percentages of trials and probes that were timed; times were then extrapolated.

DISCUSSION

In this study, instruction was provided for target behaviors by embedding constant time delay with work sheets into independent seat work activities, and additional stimuli (instructive feedback) to which students were

Table 3. Percentage of Correct Responses in Instructive Feedback Probes

Student Stimulus Set	Probes I	II	III	IV	V
Richard					
Set 1	0.0	100	0.0	0.0	
Set 2	0.0	0.0	0.0	0.0	
Set 3	0.0	0.0	0.0	0.0	
Jamal					
Set 1	0.0	94.4 (83.3-100)	88.9 (83.3-100)	88.9 (66.7-100)	
Set 2	0.0	0.0	0.0	0.0	
Set 3	0.0	0.0	0.0	38.9 (33.3-50.0)	
Phillip					
Set 1	0.0	0.0	16.7 (0.0-50.0)	33.3 (0.0-50.0)	50.0
Set 2	0.0	0.0	11.1 (0.0-33.3)	11.1 (0.0-33.3)	5.6 (0.0-16.7)
Set 3	0.0	0.0	0.0	0.0	0.0
Faith					
Set 1	0.0	44.4 (33.3-50.0)	0.0	0.0	0.0
Set 2	0.0	0.0	77.8 (66.7-83.3)	5.6 (0.0-16.7)	0.0
Set 3	0.0	0.0	0.0	33.3 (0.0-50.0)	50.0
Shaunice					
Set 1	0.0	50.0	55.6 (53.0-66.7)	55.6 (33.3-83.3)	
Set 2	0.0	0.0	16.7 (0.0-50.0)	0.0	
Set 3	0.0	0.0	0.0	33.3 (16.7-50.0)	
Carmen					
Set 1	0.0	77.8 (66.7-83.3)	77.8 (66.7-83.3)	54.2 (33.3-66.7)	61.1 (50.0-66.7)
Set 2	0.0	0.0	94.4 (83.3-100)	50.0	83.3 (66.7-100)
Set 3	0.0	0.0	0.0	79.2 (50.0-100)	88.9 (66.7-100)
Trevor					
Set 1	0.0	33.3 (0.0-66.7)	55.6 (50.0-66.7)	77.8 (66.7-83.3)	
Set 2	0.0	0.0	38.9 (33.3-50.0)	44.4 (33.3-66.7)	
Set 3	0.0	0.0	0.0	50.0 (33.3-66.7)	

[a]Lines indicate when training occurred; numbers in parenthesis indicate ranges across sessions.

not asked to respond were presented during praise statements for correct responses to target behaviors. All of the students acquired their target behaviors, and performance during probes of instructive feedback stimuli increased only after students had received instruction.

This study extends both the constant time delay and the instructive feedback research. Although constant time delay has been embedded into free play activities (Chiara et al., 1995) in preschool classrooms and into teacher-directed lessons in general elementary education classrooms (Wolery et al., in press), it had not been embedded into independent seat work activities. It should be noted, however, that in this study students also completed work sheets independent of the teacher's use of the constant time delay procedure. Thus, students' acquisition of the target behaviors may have been facilitated by both the work sheets and the constant time delay procedure. The primary rationale for embedding instruction in ongoing activities is threefold: Instruction can be (a) individualized for selected students, (b) implemented without making modifications to schedule of classroom activities, and (c) accomplished without additional personnel.

None of the previous instructive feedback studies had used embedded instruction (Werts et al., 1995); thus, this study extends that literature. The findings of this study indicate that some students with mild disabilities will acquire responses to instructive feedback stimuli when those stimuli are presented after embedded instructional trials. Of the 28 previous studies, 26 had used massed trial arrangements with a teacher, peer, or computer delivering the instruction; the two other studies had used transition-based teaching arrangements (Werts et al., 1992, in press). The findings from the current study suggest that when teachers are embedding instruction, then additional learning may occur if they also use instructive feedback.

Despite the fact that all students responded correctly in instructive feedback probes on at least one set of behaviors, variability occurred across students and across sets of behaviors within students in terms of the amount of learning that occurred. For example, Richard initially demonstrated 100% correct responding to the instructive feedback stimuli for Set 1, but did not have any correct responses to the instructive feedback stimuli for Sets 2 and 3. Similarly, Jamal had correct responses to Set 1 and 3 instructive feedback stimuli, but none for Set 2. Faith, Shaunice, Carmen, and Trevor had correct responses in the probe condition immediately following each behavior set, although the percentages of correct responses were higher and greater maintenance occurred for Carmen and Trevor. In the previous instructive feedback studies, 135 students participated and 131 learned some of the responses to the instructive feedback stimuli (Caldwell et al., 1995). However, across studies, different levels of correct responding

occurred. Most students responded correctly on a majority of the instructive feedback probe trials after instruction (Werts et al., 1995).

Future research should replicate embedding instructive feedback stimuli across different behaviors, across different activities in which instruction is embedded, across different types of students, and across different types of classrooms (e.g., inclusive classrooms). More importantly, however, the instructive feedback research should focus on factors that can predict and control for the variability that occurs in the learning of the instructive feedback responses.

A factor that appears to deserve particular attention in such research is the difficulty of the target and instructive feedback responses (Wolery, Werts, & Holcombe, 1993). The difficulty of behaviors undoubtedly occurs on a continuum; and to some degree, the placement of behaviors on that continuum may vary from one student to the next. Individual differences may be reduced or eliminated, however, by conceptualizing the continuum as having a small number of levels. For example, four levels of difficulty could be identified: behaviors that are extremely difficult, those that are moderately difficult, those that are moderately easy, and those that are extremely easy. Behaviors, of course, would need to be placed empirically on the continuum of difficulty (i.e., into a few levels) (Romer, Billingsley, & White, 1988). This could be done by identifying the average number of trials a large number of students needed to achieve a specific criterion on each of many different behaviors. Given that behaviors were categorized into three or four levels of difficulty, two broad research questions could be studied: (a) does the difficulty of the target behavior influence the amount and variability of learning of the instructive feedback behaviors, and (b) does the relative difficulty of the target to the instructive feedback behaviors influence the amount and variability of learning of the instructive feedback behaviors.

For the first question, the difficulty of the target behaviors would vary (i.e., be the independent variable) and the difficulty of the instructive feedback would be held constant across conditions. In such experiments, an inverted u-shaped function may be predicted for depicting the amount of learning of the instructive feedback behaviors. When the target behaviors are extremely easy, students will have little exposure to the instructive feedback stimuli, which in turn, may produce little learning of the instructive feedback responses. When the target behaviors are extremely difficult, students may devote all of their attention to the target stimuli to the exclusion of the instructive feedback stimuli, which in turn, may produce little learning of the instructive feedback responses. The second broad research question focuses on the relative difficulty of the target to the instructive feedback behaviors. For these studies, the independent variable is the rela-

tive classification of the difficulty of both the target and instructive feedback behaviors rather than focusing exclusively on the difficulty of one type of behavior. In such studies, the prediction is that more learning and less variable learning of the instructive feedback responses will occur when the target behaviors are more difficult than the instructive feedback behaviors are. With both of these broad questions, several studies will be required to explicate the role of behavior difficulty in the learning of the instructive feedback responses.

Another factor that may influence the variability in learning is the manner in which the instructive feedback stimuli are presented. Fairly consistent procedures were used in much of the previous research (Werts et al., 1995). For example, each target behavior has a corresponding instructive feedback stimulus, the instructive feedback stimuli are presented in an identical topography across trials and sessions, the instructive feedback is presented during the consequent events for each trial on which students respond correctly, and students' performance on the instructive feedback stimuli is assessed prior to instruction and following criterion level responding on target behaviors. Variations in these procedures may produce more predictable performance in the instructive feedback probes.

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REFERENCES

Anthony, L., Wolery, M., Werts, M. G., Heckathorn, J., & Caldwell, N. K. (1995). *Peer tutoring with constant time delay and instructive feedback.* Unpublished manuscript, Allegheny-Singer Research Institute, Pittsburgh, PA.

Ault, M. J., Wolery, M., Doyle, P. M., & Gast, D. L. (1989). Review of comparative studies in instruction of students with moderate and severe handicaps. *Exceptional Children, 55,* 346-356.

Beery, K. (1982). *Revised Developmental Test of Visual-Motor Integration.* Cleveland: Modern Curriculum Press.

Billingsley, F. F., White, O. R., & Munson, R. (1980). Procedural reliability: A rationale and an example. *Behavioral Assessment, 2,* 229-241.

Caldwell, N. K., Wolery, M., Werts, M. G., Anthony, L., Snyder, E., & Heckathorn, J. (1995). *Instructive feedback: Learning made more efficient.* Pittsburgh, PA: Allegheny-Singer Research Institute.

Chiara, L., Schuster, J. W., Bell, J., & Wolery, M. (1995). Small-group massed-trial and individually distributed-trial instruction with preschoolers. *Journal of Early Intervention, 19,* 203-217.

Collins, B. C., Branson, T. A., & Hall, M. (1995). Teaching generalized reading of cooking product labels to adolescents with mental disabilities through the use of key words taught by peer tutors. *Education and Training in Mental Retardation and Developmental Disabilities, 30,* 65-75.

Edwards, B. J. (1989). *The effects of a computer-assisted instruction program using the constant time delay procedure to teach spelling of abbreviations to adolescents with mild learning handicaps.* Unpublished doctoral dissertation. University of Kentucky. Lexington.

Fox, L., & Hanline, M. F. (1993). A preliminary evaluation of learning within developmentally appropriate early childhood settings. *Topics in Early Childhood Special Education, 13,* 308-327.

Jastak, S. & Wilkinson, J. (1984). *Wide Range Achievement Test-Revised.* Wilmington, DE: Jastak Associates.

Mercer, C. D., & Mercer, A. R. (1989). *Teaching students with learning problems* (3rd ed.). Columbus, OH: Merrill.

Micrografx Charisma [Computer software]. (1990). Richardson, TX: Micrografx.

Psychological Corporation. (1983). *Basic Achievement Skills Individual Screener.* San Antonio: Psychological Corporation.

Psychological Corporation. (1992). *Wechsler Individual Achievement Test.* San Antonio: Psychological Corporation.

Romer, L. T., Billingsley, F. F., & White, O. R. (1988). The behavior equivalence problem in within-subject treatment comparisons. *Research in Developmental Disabilities, 9,* 305-315.

Tawney, J. W., & Gast, D. L. (1984). *Single subject research in basic education.* Columbus, OH: Merrill.

Venn, M. L., Wolery, M., Werts, M. G., Morris, A., DeCesare, L. D., & Cuffs, M. S. (1993). Embedding instruction in art activities to teach preschoolers with disabilities to imitate their peers. *Early Childhood Research Quarterly, 8,* 277-294.

Wechsler, D. (1974). *Manual for the Wechsler Preschool and Primary Scale of Intelligence - Revised.* New York: The Psychological Corporation.

Wechsler, D. (1974). *Wechsler Intelligence Scale for Children - Revised.* New York: The Psychological Corporation.

Wechsler, D. (1993). *Wechsler Intelligence Scale for Children - III.* New York: The Psychological Corporation.

Werts, M. G., Wolery, M., Holcombe, A., & Gast, D. L. (1995). Instructive feedback: Review of parameters and effects. *Journal of Behavioral Education, 5,* 55-75.

Werts, M. G., Wolery, M., Holcombe, A., Vassilaros, M. A., Billings, S. S. (1992). Efficacy of transition-based teaching with instructive feedback. *Education and Treatment of Children, 15,* 320-334.

Werts, M. G., Wolery, M., Venn, M. L., Demblowski, D., & Doren, H. (in press). Effects of transition-based teaching with instructive feedback on the acquisition of skills by children with and without disabilities. *Journal of Educational Research.*

Westling, D. L., & Fox, L. (1995). *Teaching students with severe disabilities.* Columbus, OH: Prentice Hall/Merrill.

Wolery, M., Ault, M. J., & Doyle, P. M. (1992). *Teaching students with moderate and severe disabilities: Use of response prompting strategies.* White Plains, NY: Longman.

Wolery, M., Anthony, L., Snyder, E. D., Werts, M. G., & Heckathorn, J. (in press). Training elementary teachers to embed instruction during classroom activities. *Education and Treatment of Children.*

Wolery, M., Werts, M. G., & Holcombe, A. (1993). Reflections on effects of instructive feedback related and unrelated to the target behavior. *Exceptionality, 4,* 117-123.