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Effects of Presenting Incidental Information in Consequent Events on Future Learning

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The effects of presenting future target stimuli in the consequent event following correct responses to current target stimuli were examined in two experiments teaching eight students with moderate handicaps to name photographs. In Experiment I, progressive time delay was used to teach two sets of photographs. During instruction, correct responses to one set of stimuli resulted in praise and presentation of the printed word for the person in the photograph (future condition). In the second set, a correct response was followed by praise alone (non-future condition). After establishing criterion level performance on both sets of photographs, students were taught to read the printed word from each of the two sets. Experiment II was a systematic replication of Experiment I. Four students from a different classroom also were taught to name two sets of photographs. An adapted alternating treatments design was used in each experiment. The results indicated that (a) all students learned to name the photographs; (b) presentation of future target stimuli (words) in consequent events resulted in seven of the eight students learning to read some of the words; and (c) the total number of sessions, trials, errors, and percentage of errors

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needed to teach students four photographs and four words were lower for the future condition than the non-future condition. The results are discussed in terms of increasing the efficiency of instruction.

KEY WORDS: progressive time delay; words; photographs; alternating treatments design.

In the past 20 years, considerable research has focused on identifying effective instructional strategies for teaching students with moderate to severe mental retardation a variety of useful skills (Ault, Wolery, Doyle, & Gast, 1989; Billingsley & Romer, 1983; Doyle, Wolery, Ault, & Gast, 1988; Wolery, Ault, & Doyle, in press). Effectiveness has been defined in this research as a demonstration that students learned what was taught. A strategy is described as effective if students acquire the skills that were taught when it is used. Recently, emphasis also has been placed on assessing the efficiency of instruction (Ault et al., 1989). Efficiency is defined as effective instruction that results in learning with less effort or energy when compared to some other form of instruction. To be called efficient, a strategy must meet two criteria. First, it must be effective (i.e., result in learning), and second, it must result in "better" learning than some other instructional strategy.

Five conceptualizations of instructional efficiency have been proposed (Wolery & Gast, 1990). First and most commonly described, efficiency is conceptualized as the rapidity of learning. One strategy is said to be more efficient than another if it results in an equal amount of learning in fewer sessions, trials, and/or minutes of direct instructional time to criterion. Second, efficiency can be viewed as providing more generalized performance. For example, two strategies could result in equally rapid learning, but the strategy that resulted in greater generalization across persons, settings, and materials would be labeled as more efficient. Third, efficiency has been conceptualized as producing broader learning. Again, two strategies could result in equally rapid learning and equal generalization of the acquired skills, but one strategy may result in learning behaviors that were not directly targeted for instruction. These nontargeted behaviors could, for example, be acquired through observational or incidental learning. Fourth, efficiency has been conceptualized as the emergence of relationships that are not directly taught. This conceptualization has been investigated under the rubric of the acquired equivalence or transfer mediational paradigms. One instructional strategy would be considered more efficient if it resulted in the acquisition of relationships that were not directly taught and the second strategy did not. Fifth, efficiency has been conceptualized as instruction that positively influences later learning. For example, two instructional strategies could be used and result in equally rapid learn-

ing, but one strategy may allow students to learn future target behaviors more rapidly than the other.

The current investigations focused on the fifth conceptualization of efficiency (i.e., effects on future learning). The purpose of the studies was to determine if "current" instruction could be systematically manipulated to cause students to learn "future" behaviors more efficiently. The specific manipulation studied was the presentation of additional (future) stimuli in the consequent events for correct responses. Past research has indicated that presenting additional information in the feedback statements results in incidental learning of some of that information (Doyle, Gast, Wolery, Ault, & Farmer 1990; Gast, Wolery, Morris, Doyle, & Meyer, 1990; Gast, Doyle, Wolery, Ault, & Baklarz, in press; Wolery, Cybriwsky, Gast, & Boyle-Gast, in press). For example, Gast et al. (in press) taught students to read sight words. In the descriptive praise statements for correct responses, the teacher told students the definition of the word they had just read. All students learned to state some of the definitions. The current investigations sought to determine whether presentation of "future" target stimuli in the consequent events following correct responses would result in more efficient learning of those stimuli when they became the focus of instruction. Specifically, the research question addressed in this study was: If students are taught to name photographs and are shown a written word for the photo following each correct response, will they learn to name the photographs and read the written words more rapidly?

EXPERIMENT I

Method

Participants and Setting

Participants in Experiment I included four students (2 females and 2 males), ranging in age from 9 years 5 months to 13 years 7 months, who were enrolled in a public school classroom for students with moderate disabilities. In addition to normal visual and auditory functioning with corrective appliances when needed, each participant met the following entry criteria: (a) previous history with systematic response prompting procedures (student could wait up to 6 sec for a prompt and orally imitate an expressive model by the teacher); (b) ability to identify photographs (student could name a minimum of 3 photographs of occupations); and (c) minimal sight word reading ability (student could identify at least 3 survival words). Additional decriptions of participants are presented in Table 1.

Experimental sessions were conducted by the teacher in the students' self-contained portable classroom adjacent to a public elementary school. The classroom consisted of six rooms, including a kitchen area, a room for occupational and physical therapy, and several (2.0 m × 3.0 m) rooms for small group and individual instruction. The experimental sessions occurred in a room with a rectangular table, chairs, and classroom instructional materials on shelves. The teacher sat directly opposite the student. Students not involved in the investigation participated in their normal classroom activities with another teacher.

Materials

A total of eight colored photographs *Photo Cue Cards* (Kerr, 1985) were selected as the current target stimuli. Words selected as future target stimuli were printed in black lower case letters on white (10 cm × 15 cm) index cards. The reinforcers included small candy bars (e.g., Snickers, Milky Ways M. & M's) and a variety of inexpensive toys. The target stimuli are presented in Table 2.

Procedures

General Procedures. Conditions were implemented in the following sequence: Probes (photographs and words), photograph instruction (future and non-future), reinstate probe condition, word instruction, and a final probe condition. Progressive time delay in individual instructional sessions was used to teach eight photographs depicting occupations found in the community. The photographs were divided into two sets of four stimuli each; correct responses in one set resulted in praise and presentation of the printed word for the occupation depicted in the photograph (future condition) and correct responses in the second set resulted in praise alone (non-future condition). Photographs were assigned to the two conditions to minimize the differences between the sets. Each set contained an equal number of photographs across similar numbers of syllables, beginning and ending letters, and the students' ability to orally name the function of the occupation (e.g., when shown a picture of a veterinarian, students could say "He works with animals,"). Each student was taught the same two sets of photographs. Two students were taught Photograph Set A with the future condition (i.e., praise plus presentation of the printed word) and Photograph Set B with the non-future condition (i.e., praise alone). The other two students were taught Photograph Set A with the non-future condition (praise only) and Photograph Set B with

Table 1. Description of Participants in Experiments I and II

Student C.A.	Test score	Diagnosis	Functioning level
		Experiment	
		Experiment I	
Casey 13-7	WISC-R; IQ 45	Autism; Mental Retardat.	Reading achievement, spelling, and math scores were 46; reads grocery words; time to 5 min; l.d. days and months; relates personal info.
Ada 10-7	WISC-R; IQ 45	Microcephaly; Mental Retardat.	Reading achievement, spelling, and math scores were 46; time to 5 min; age-appropriate social skills with nonhandicapped peers; calculator to purchase groceries; counts change.
Deanna 9-5	WISC-R; IQ 45	Mental Retardat.	Identifies days of week; tells personal info; near age-appropriate gross motor and self-care skills; tell time to 5 min.
Tom 11-8	WISC-R; IQ 51	Mental Retardat.	Reading achievement 49; for spelling and math, 46; reads 1st grade; writes personal info; counts change; washes dishes, mops floor.
		Experiment II	
Chris 9-9	WISC-R; IQ 40	Mental Retardat.	Reads 10 survival signs and days of week; Identifies upper and lower case letters; writes full name and copies address; counts 1-20 items; recognizes # 1-20.
Tommy 11-1	Stanford-Binet; IQ 42	Mental Retardat.	Reads survival signs; identifies upper and lower case letters; writes full name; tells time to the hour; counts 12 items; uses calculator (enters prices and subtracts totals).
Carrie 8-5	Stanford-Binet; M.A. 4-10	Mental Retardat.	Reads 12 survival words; recognizes letters; counts 1-20 items; writes name; copies address; uses calculator (enters prices, subtracts totals).
Jarrod 6-10	Stanford-Binet; IQ 51	Mental Retardat.	Recognizes upper and lower case letters; l.d. # 1-10; counts 5 items; copies full name; uses calculator (enters prices. subtracts totals).

the future condition (praise plus word). The order of introduction of the two instructional conditions also was counterbalanced across students. Two sessions were conducted daily: one future and one non-future session.

Following acquisition of photograph naming, progressive time delay was used to teach students to read the words for each occupation depicted in the photographs. All words were divided into two sets: one set of words to which students had been exposed in the photograph naming condition and one set of words they had not seen in the photograph naming conditions.

Probe Procedures. Prior to instruction, students were assessed on naming the photographs and reading the words. Each probe condition consisted of six sessions or until the data were stable; i.e., three sessions for the photographs and three for the words. The probe sessions were randomly presented across days. Each probe session consisted of 24 trials (three trials on each of the current or future target stimuli). Prior to beginning a probe session, each student selected a prize, which was delivered noncontingent of performance at the end of a session. A probe trial consisted of the teacher holding the target stimulus in front of the student, presenting the attending cue ("*Name,* look."), ensuring an attending response, delivering the task direction ("What is this?"), and providing a 4-sec response interval. All student responses to the task direction were followed by the teacher waiting a 3-5-sec intertrial interval and presenting the next trial. Students were reinforced every six trials for attending to the target stimulus.

Photograph Instruction. A progressive time delay procedure was used to teach each student two sets of four occupation photographs. Each instructional session consisted of 24 trials (six trials on each of four stimuli in a set). Before each session, students were asked to select a prize to be delivered noncontingent of performance at the end of an instructional session. The first session for both sets of photographs was at the 0-sec delay. A 0-sec trial began with the teacher presenting a photograph, delivering an attending cue ("Name, look."), ensuring an attending response, presenting the task direction ("What is this?"), and immediately delivering the controlling prompt (a vocal model of the correct response by the teacher). In each subsequent session, the delay interval was increased by 1-sec increments (i.e., session 2, 1-sec; session 3, 2-sec; session 4, 3-sec interval) to a maximum of 6 seconds. The delay interval remained at 6 sec until the student reached criterion level responding. Instruction continued in each of the treatment conditions until a student reached criterion level responding; that is, two sessions of 100% correct unprompted responding, one session using a continuous schedule of reinforcement (CRF) and one session with approximately six reinforcers delivered for correct responding (VR4).

Table 2. Target Stimuli Across Students and Conditions for Experiments I and II

Condition stimuli	Student name	Current stimuli	Photograph set	Future target stimuli presented
		Experiment I		
Future Photographs	Casey	secretary	A	YES word
	Ada	butcher		YES word
		veterinarian		YES word
		cashier		YES word
Non-Future Photographs	Casey	mechanic	B	NO
	Ada	barber		NO
		electrician		NO
		gardener		NO
Future Photographs	Deanna	mechanic	B	YES word
	Tom	barber		YES word
		electrician		YES word
		gardener		YES word
Non-Future Photographs	Deanna	secretary	A	NO
	Tom	butcher		NO
		veterinarian		NO
		cashier		NO
		Experiment II		
Future Photographs	Chris	Little Caesars	A	YES word
	Tommy	Ritzy's		YES word
		Wendy's		YES word
Non-Future Photographs	Chris	White Castle	B	NO
	Tommy	Jerry's		NO
		Shoney's		NO
Future Photographs	Carrie	White Castle	B	YES word
	Jarrod	Jerry's		YES word
		Shoney's		YES word
Non-Future Photographs	Carrie	Little Caesars	A	NO
	Jarrod	Ritzy's		NO
		Wendy's		NO

Future Photograph Condition. Two types of correct responses could occur during an instructional session. If the student responded correctly before the prompt was delivered (unprompted correct) the teacher delivered praise (e.g., "Good, that is right.") and showed the student the printed word for the occupation depicted in the target photograph. The teacher did not say the name of the occupation when presenting the printed stimulus. If the student waited for the teacher to deliver the controlling

prompt and responded correctly after the prompt (prompted correct), the teacher also delivered praise and the printed word. If a student made an error before the prompt was delivered (unprompted error), the teacher said "No, this occupation is _____.". If the student did not respond (no response) or responded incorrectly after the prompt (prompted error), the teacher ignored the response, waited a 3-5-sec intertrial interval, and presented the next trial.

Non-future Photograph Condition. The non-future condition was identical to the future condition with the exception of the consequent event following correct responding. Correct responses (prompted and unprompted) resulted in praise alone; the teacher did not show the printed word.

Word Instruction. Following acquisition of the photographs and a second probe condition, students were taught using progressive time delay to read two sets of four words: one set of words shown by the teacher during photograph instruction (future words) and one set of words that had not been presented (non-future words). The trial sequence and criterion were identical to that used in photograph instruction. If a student had acquired a word through training on the photographs and/or through incidental presentation of the word in the consequent event, that word was still taught. This was done to equalize the two sets of target stimuli across number of trials (24), exposures per stimulus (6), and session length.

Review Trials. If a student reached criterion level responding in one condition before the second, the teacher conducted two review trials in place of the instructional session. The trial sequence for review trials was identical to a progressive time delay trial from the session where criterion was met (e.g., if 6-sec delay when criterion was reached, 6 sec was used for review trials).

Experimental Design

An adapted alternating-treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used to compare the effects of the incidental presentation of future target stimuli during instruction on current target stimuli. With this design, two treatment conditions were applied to different but equally difficult stimuli (e.g., two sets of photographs) in alternating experimental sessions. Following the initial probe condition to measure the percentages of correct responding to both the photographs and the words, students learned to name the occupations depicted in the photographs (current target stimuli); one set included praise and presentation of the printed word as the consequent event for correct responding and one set included

praise alone. After a second probe condition, students were taught to read the words (future target stimuli). A final probe was conducted to measure maintenance of photographs and words.

Reliability

Dependent Measure Reliability. Reliability observations were conducted two to three times weekly and at least once during each experimental condition. A point-by-point method (number of agreements divided by the number of agreements plus disagreements multiplied by 100) was used to calculate interobserver agreement percentages.

Independent Measure Reliability Estimates. The teacher's adherence to written descriptions of the experimental procedures also was assessed (Billingsley, White, & Munson, 1980). These measures included recording total session length, presenting the correct target stimulus, delivering the attending cue, securing an attending response, presenting the task direction, waiting the correct response interval, delivering the prompt when appropriate, delivering the correct consequent event, and waiting the correct intertrial interval. The teacher's behavior was observed and compared to a written description of the experimental procedures. Independent measure reliability estimates were calculated by dividing the number of actual teacher behaviors by the number of planned behaviors and multiplying by 100. An estimate was calculated on each behavior, for each experimental condition, across all students.

Results

Reliability

Interobserver reliability on student responding and fidelity with the written description of the procedures occurred in 22.1% of the probe sessions, and in 30.1% of the instructional sessions. The mean percentage of agreement on student responding during probe and instructional conditions was 100% across all students. In the probe conditions, the mean percentage of agreement on procedural reliability was 100% on all behaviors and students. In the photograph instructional condition, the mean percentage of agreement was 100% on all measures across students, except for delivering the correct consequent event (mean = 99.6%, range = 97.5%-100%). In the word instructional condition, the mean percentage of agreement was 100% on all variables, with the exception of waiting the correct delay interval (mean = 99.8%, range = 98.6%-100%).

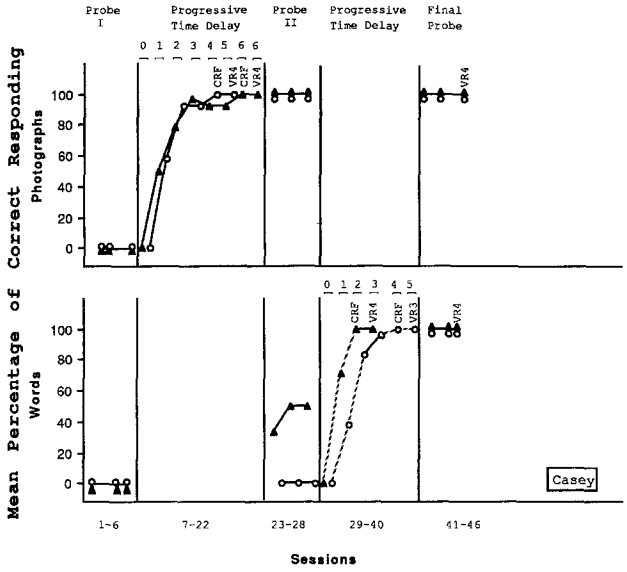

Fig. 1. The percentages of correct unprompted responding by Casey for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

Photograph Instruction

Effectiveness. The mean percentages of unprompted correct responding on photographs and words for Casey, Ada, Deanna, and Tom are shown in Figures 1, 2, 3, and 4, respectively. As shown, all students performed at 0% across untrained target stimuli in Probe I. During instruction on photographs, Casey, Ada, and Deanna increased to criterion level without any procedural modifications. However, because Tom continued to wait for the prompt, differential reinforcement was implemented in the non-future condition after 11 sessions of instruction. Unprompted correct responses were followed with praise and prompted corrects were followed by the teacher waiting the intertrial interval and presenting the next trial. This modification was effective in establishing criterion level performance for Tom. In Probe II, criterion level performance on the occupation photographs was maintained for Casey and Deanna across three probe ses-

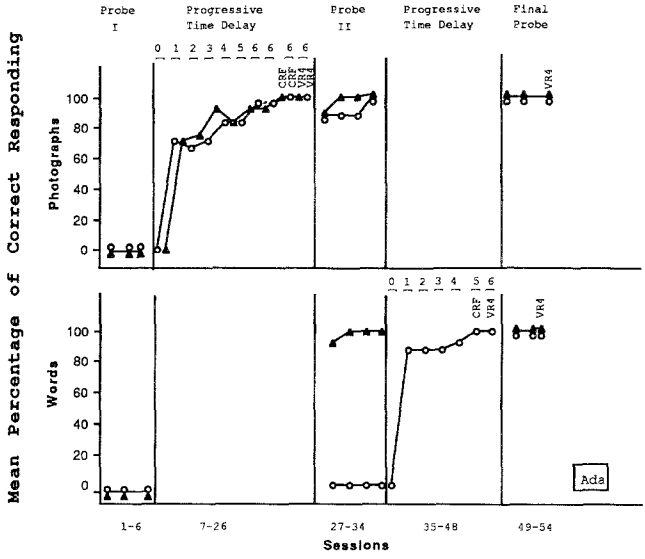

Fig. 2. The percentages of correct unprompted responding by Ada for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

sions. For Ada, one additional session was conducted, and she responded at 100% across the final three sessions on photographs from the future condition and 100% in the fourth session on non-future photographs. Tom responded at 100% across all probe sessions on the future photographs and 100% in five of the six sessions on photographs from the non-future condition.

Efficiency. The number of instructional sessions, trials, errors, percentage of errors, and amount of direct instructional time through criterion for each student are presented in Table 3. Minimal differences existed in these measures between the two conditions (future and nonfuture) for teaching photographs. Differences were seen only for Tom; he reached criterion level performance more rapidly in the future condition. Although each student made errors during photograph instruction, each of the conditions was near errorless; the mean percentage of errors across students in the future and non-future conditions was .9% and 1.3%, respectively.

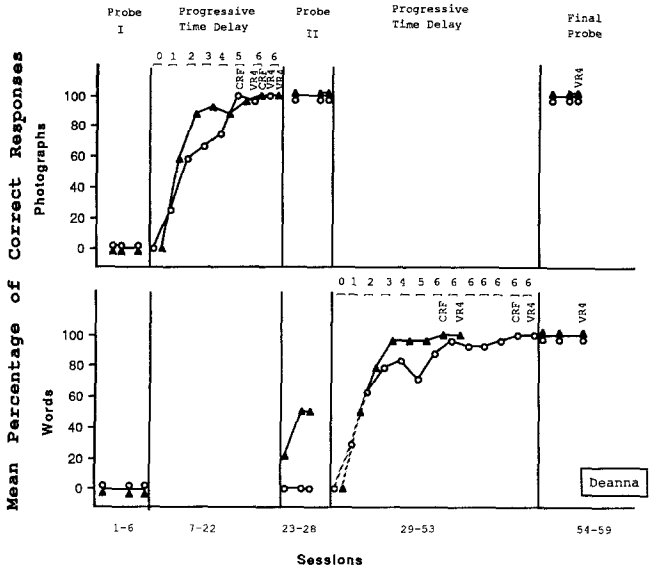

Fig. 3. The percentages of correct unprompted responding by Deanna for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

Although there were no differences between conditions across these traditional measures of efficiency, the future condition was more efficient in terms of its effect on the acquisition of future target stimuli across students. Based on data from Probe II, the use of progressive time delay in teaching photographs and the incidental presentation of words in the future condition resulted in each of the students learning some of the words; Casey and Deanna acquired two words, and Ada and Tom learned all four of the printed words presented in the future condition. Tom also learned each of the words assigned to the non-future condition.

Word Instruction

Effectiveness. The mean percentages of correct responding for the words also are presented in Figures 1, 2, 3, and 4. As with the photographs, all students performed at 0% across the untrained target words in Probe I.

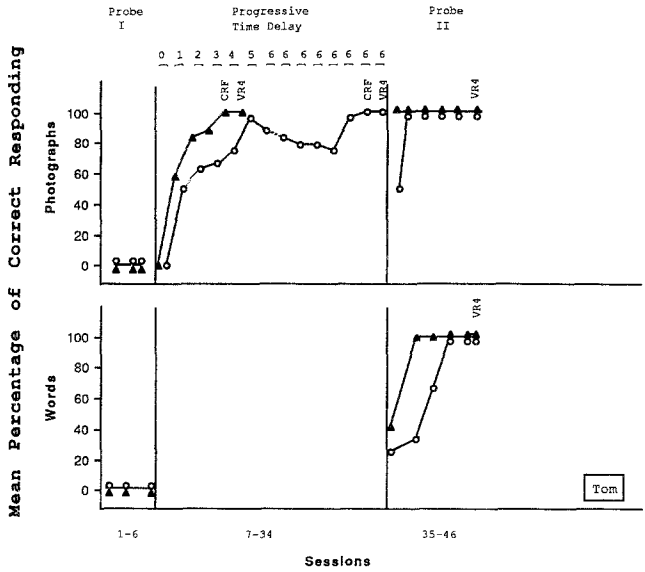

Fig. 4. The percentages of correct unprompted responding by Tom for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

Following photograph instruction, student performance on the words was measured. Based on Probe II data, Casey, Ada, and Deanna received instruction using progressive time delay on the two sets of words (future and non-future). During this instructional condition, the newly acquired words were intermixed with the unknown words. As shown in the Figures, progressive time delay was effective in teaching two words from the future condition and four words from the non-future condition to both Casey and Deanna, and also four words from the non-future condition to Ada. Because Tom's performance was at criterion level across both sets of four words in the final three sessions in Probe II, he did not receive instruction on the words. Casey, Ada, and Deanna maintained criterion level responding on the photographs and words in the final probe condition.

Efficiency. The traditional efficiency measures for students during word instruction also are presented in Table 3. Although the number of trials and exposures during instructional sessions were equal across the two sets of words, the number of unknown stimuli in each set varied. As a

Table 3. Efficiency Measures for Experiment I

Experiment	Number of sessions		Number of trials		Number of errors		Percent of errors		Minutes of direct instruction	
Student Condition:	Future	Non-future	Future	Non-future	Future	Non-future	Future	Non-future	Future	Non-future
Experiment I: Photographs										
Casey	8	6	192	144	2	0	1.0	0.0	32	19
Ada	9	10	216	240	3	7	1.4	2.9	32	31
Deanna	8	8	192	192	2	2	1.0	1.0	29	28
Tom	6	14	144	192	0	3	0.0	0.9	22	40
Experiment I: Words										
Casey	4	6	96	144	0	1	0.0	0.7	11	16
Ada	–	7	–	168	–	5	–	3.0	–	19
Deanna	8	13	192	312	2	11	1.0	3.5	20	39
Tom	–	–	–	–	–	–	–	–	–	–
Total across conditions	43	64	1,032	1,536	9	29	0.9	1.9	146	192

result, no direct comparisons across efficiency measures can be made for word instruction.

Included in this table are the total numbers for all efficiency measures summed across students for each condition, which were needed in establishing criterion level performance for both words and photographs. Although the future condition was more efficient than the non-future condition across the total numbers on all efficiency measures, the results were mixed for individual students. For Casey, there were no differences between the two conditions; he learned four photographs and four words assigned to each condition in the same number of trials and sessions, with minimal differences in errors and instruction time. For Ada and Deanna, the future condition was more efficient than the non-future condition across all measures. Although, the future condition was more efficient than the non-future condition for Tom in photograph instruction, he acquired both the future and non-future word sets.

Discussion

For Experiment I, two findings are apparent. First, presentation of future target stimuli (i.e., words) in the consequent events during photograph instruction did not interfere with the efficiency of the progressive time delay procedure. That is, the students learned both sets of photographs (i.e., those with the word plus praise presented in the consequent events, and those with praise only) in about the same number of trials, sessions, errors, and minutes of instructional time to criterion. Second, analysis of the efficiency of the future condition (i.e., photograph instruction with words presented in consequent events *and* later word instruction on those words) and the non-future condition (photograph instruction without word presentation *and* later word instruction on the words depicted in the photographs) suggests that the future condition was more efficient. That is, students learned to name the photographs and read the words in the future condition more efficiently than in the non-future conditions where words were not shown for correct photograph naming. An equal amount of learning occurred in both conditions, but the future condition required 21 fewer sessions, 504 fewer trials, and 46 fewer minutes of instructional time than the non-future condition. Further, the error percentage in the future condition was about half as high as the non-future condition. Further discussion of Tom's performance is presented in the General Discussion section. The purpose of Experiment II was to replicate Experiment I with a different teacher, students, behaviors, and setting.

EXPERIMENT II

Method

Participants and Setting

Participants in Experiment II included four students (1 female and 3 males), ranging in age from 6 years 10 months to 11 years 1 month, who were enrolled in a public school classroom for students with moderate disabilities. The entry level criteria were identical to those in Experiment I. Additional information about each student is shown in Table 1.

Experimental sessions were conducted by the teacher in the students' self-contained classroom (6.4 m × 8.9 m) in a public elementary school. Sessions were conducted at a semicircular table in a corner of the classroom separated from other activities by a (3 m × 4 m) partition. The teacher sat directly opposite the student during experimental sessions. Students not involved in the investigation engaged in their usual classroom activities with a teaching assistant.

Materials

Six 35 mm photographs of local restaurants were selected as the current target stimuli. Words were printed in black letters on white (10 cm × 15 cm) index cards. The words were printed as they appeared on the restaurant sign in the community. The reinforcers selected as prizes for students included small candies and a variety of small toys. The target stimuli are presented in Table 2.

Procedures

General Procedures. Experimental conditions were implemented as in Experiment I. Progressive time delay was used to teach photographs and words to students in two daily individual instructional sessions. The six restaurant photographs selected as current target stimuli were divided into two sets of three stimuli: one set for the future condition (praise plus word presentation) and one set for the non-future condition (praise only). The restaurant photographs were assigned to the two conditions based on the length of the printed stimulus (e.g., one or two words), and the beginning and ending letters (e.g., each condition contained a word that began with "w"). Following the second probe condition, progressive time delay also was used to teach students to read the words for restaurants depicted in

the photographs. The assignment of stimuli to the conditions and students is shown in Table 2.

Probe Procedures. Prior to instruction, students were assessed on their ability to name the photographs and read the words depicted in the photographs. Each probe condition consisted of a minimum of six sessions; i.e., three sessions across both the photographs (current target) and words (future target). As in Experiment I, the sessions were randomly presented across days. Each individual probe session consisted of 18 trials (three trials on each of the current or future target stimuli). The probe trial sequence was identical to that used in Experiment I.

Instruction. Each instructional session consisted of 18 trials (six trials on each of three stimuli in a set). All other procedures were identical to those described in Experiment I.

Experimental Design

The design was identical to that used in Experiment I.

Results

Reliability

Interobserver reliability on student responding and the teacher's adherence to the written description of the procedures occurred in 30.9% of the probe sessions and in 44.1% of the instructional sessions. The mean percentage of agreement on student responding during probe and instructional conditions was 100% across all students. In the probe conditions, the mean percentage of agreement on procedural reliability was 100% on all behaviors and students except delivery of the correct consequent event (mean = 99.8%, range = 99.1%-100%). In the progressive time delay future and non-future conditions, the mean percentage of agreement was 100% on all measures across students except for waiting the appropriate delay interval (mean = 99.6%, range = 98.4%-100% and mean = 99.6%, range = 98%-100%).

Photograph Instruction

Effectiveness. The mean percentages of unprompted correct responding on photographs and words for Chris, Tommy, Carrie, and Jarrod are shown in Figures 5, 6, 7, and 8, respectively. All students performed at 0% across

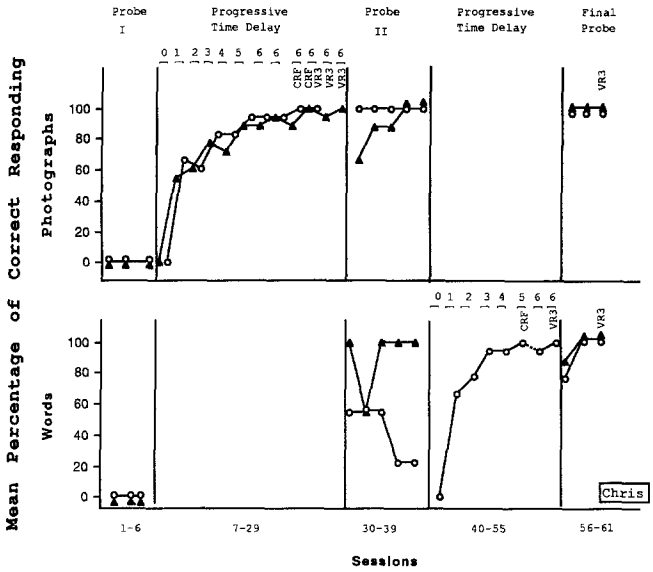

Fig. 5. The percentages of correct unprompted responding by Chris for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

photographs and words in the first probe condition. During photograph instruction, criterion level performance was met by all students without procedural modifications. Tommy, Carrie, and Jarrod maintained this performance on the restaurant photographs in Probe II. Chris needed two additional probe sessions before data were stable at 100% unprompted correct responding.

Efficiency. As in Experiment I, traditional efficiency measures were calculated for each student. This information is presented in Table 4. There were few differences between the two conditions during photograph instruction with the exception of (a) the number and percentages of errors for Chris and Jarrod; each student made 3 errors (1.4% and 2.8%, respectively) in the future condition and zero errors in the non-future condition, and (b) the minutes of direct instruction time; the future condition required 38 more minutes than the non-future condition.

As measured in Probe II, the procedures implemented during photograph instruction resulted in three of the four students learning some of the words; Chris learned 3 words, Carrie learned 2 words, and Jarrod

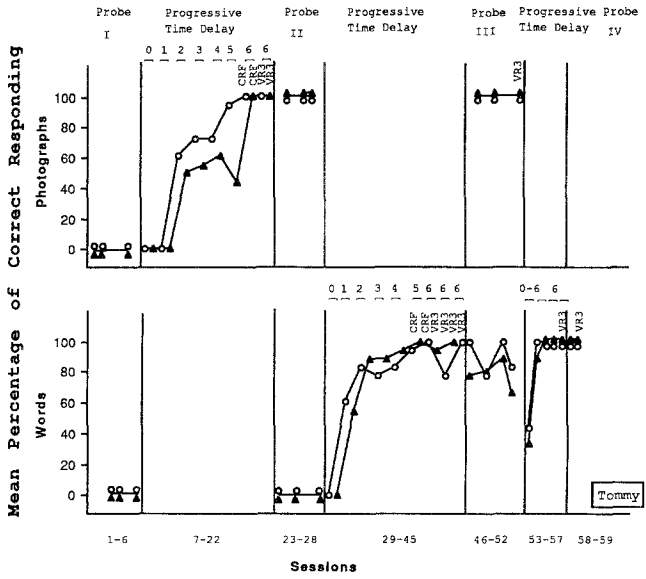

Fig. 6. The percentages of correct unprompted responding by Tommy for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

learned 1 of the words presented in the future condition. No student in Experiment II acquired words from the non-future condition.

Word Instruction

Effectiveness. Following Probe II, Tommy, Carrie, and Jarrod received instruction on both future and non-future sets of words. Because Chris's performance was at criterion level on the future words, he received instruction on the non-future set only. As in Experiment I, progressive time delay was effective in teaching each student to read the words depicted in the photographs. Although students maintained criterion level responding on the photographs in the final probe condition, the results were mixed for the two sets of words. Chris responded at 100% across the final two probe sessions on both word sets, Carrie responded at 100% in all sessions measuring non-future words and the final two sessions on future words,

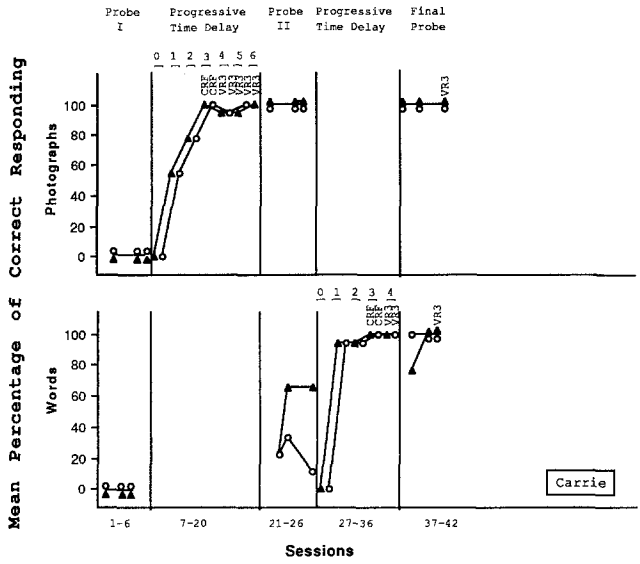

Fig. 7. The percentages of correct unprompted responding by Carrie for both photographs and words during probe and instructional conditions. The percentage of correct unprompted responses to photographs and words assigned to the future condition are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

and Jarrod maintained criterion level responding across three sessions on words from the future condition and two sessions on the non-future words. Because Tommy did not maintain criterion level on one word from each condition, booster sessions that intermixed these two words were conducted using progressive time delay. This was effective in establishing criterion level performance.

Efficiency. Although no comparisons are made, the efficiency measures for students during word instruction also are presented in Table 4. The future condition was more efficient across total numbers of sessions, trials, and errors than the non-future condition photograph and word instructional conditions for Chris, Tommy, and Jarrod, and there were no differences between the two conditions for Carrie.

Discussion

The results from Experiment II were similar to those found in the first experiment in that (a) both instructional conditions were effective in

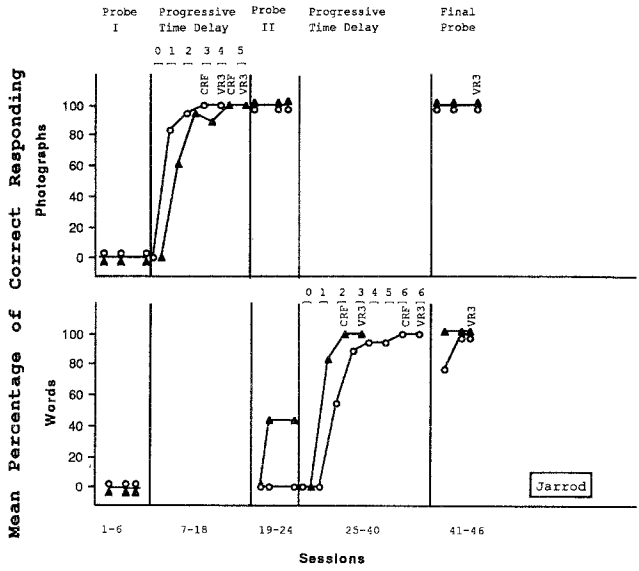

Fig. 8. The percentages of correct unprompted responding by Jarrod for both photographs and words during probe and instructional conditions. The percentages of correct unprompted responses to photographs and words assigned to the future conditon are represented by closed triangles. The percentages of correct unprompted responses to photographs and words assigned to the non-future condition are represented by open circles.

teaching four photographs to each of the students, (b) there were minimal differences between conditions across all traditional measures of efficiency, and (c) the future condition was more efficient in establishing acquisition of photographs and words combined.

GENERAL DISCUSSION

The purpose of this experiment was to determine whether presentation of words in the consequent events for photograph naming would result in more efficient acquisition of both photographs and words than when the words were not presented as part of the consequent events for photograph naming. Three findings are apparent. First, presentation of the words during the consequent events for correct responding (future condition) did not interfere with students' acquisition of the photograph names. The efficiency measures for the two photograph instructional conditions in both

Table 4. Efficiency Measures for Experiment II

Experiment	Number of sessions		Number of trials		Number of errors		Percent of errors		Minutes of direct instruction	
Student Condition:	Future	Non-future	Future	Non-future	Future	Non-future	Future	Non-future	Future	Non-future
Experiment II: Photographs										
Chris	12	10	216	180	3	0	1.4	0.0	40	24
Tommy	8	8	144	144	1	2	.7	1.4	32	23
Carrie	7	6	126	108	1	0	.8	0.0	20	14
Jarrod	6	5	108	90	3	0	2.8	0.0	18	11
Experiment II: Words										
Chris	—	8	—	144	—	3	—	2.1	—	21
Tommy	8	9	144	162	2	5	1.4	2.1	24	25
Carrie	5	5	90	90	0	2	0.0	2.2	11	12
Jarrod	4	8	72	144	0	9	0.0	6.3	9	21
Total across conditions	50	61	900	1,098	10	21	1.1	1.9	154	151

experiments are similar. This finding is of value because it sets the occasion for students to acquire additional behaviors without having to be directly taught those behaviors and it does not interfere with the behaviors "currently" receiving instruction.

Second, seven of the eight students in the two experiments learned some of the words that were presented in consequent events without direct instruction. This finding is consistent with previous research which demonstrated that students could incidentally learn "extra" behaviors inserted in consequent events (Doyle et al., 1990; Gast et al., 1990; Gast et al., in press; Wolery et al., in press). In Experiment I, two students acquired 2 of the 4 words shown in the consequent events, and two students learned all 4 words. In Experiment II, one student learned 1 of the 3 words, one learned 2 of the 3 words, and one learned all 3 words. One student, Tom, in Experiment I learned the 4 words in the non-future condition. This may have been due to the additional sessions in the non-future condition that were necessary to establish criterion level performance during photograph instruction. The combination of extensive exposure to the non-future photographs and the presentation of words in the future condition may have resulted in the discrimination that the four words were related to the four photographs. That is, Tom recognized that the task in Probe II was essentially a four-choice task. None of the other seven students in either experiment learned any of their non-future words. Thus, across the two experiments, the eight subjects learned 18 of the 25 words in the future condition and 4 of the 25 words in the non-future condition without direct instruction.

Third, the future condition was clearly more efficient than the non-future condition as measured by the number of trials, sessions, errors, percent of errors, and number of minutes of instructional time to criterion when combined for photographs and words. When these figures are summed across the two conditions, the following results are found. In the future condition, the photographs and words were learned in 32 fewer sessions, 702 fewer trials, and 43 fewer minutes of instruction. The number of errors also was less in the future condition (19 versus 50), and the error percentages were lower (0.98% versus 1.89%). It should be noted that the number of sessions and trials to criterion in the future condition may be inflated because students who had acquired some, but not all, words during photograph instruction also were taught their acquired words. For example, Casey learned 2 of his 4 words during photograph instruction in the future condition (i.e., from presentation of the word in the consequent event); however, when he participated in the word instruction, all four words were included. This was done to ensure equal session length, equal number of trials, etc., across the two conditions, future and non-future. Thus, the

combined efficiency measures are a conservative estimate of the relative differences between the two conditions.

These findings suggest that presentation of future target stimuli in the consequent events of current instruction may increase the efficiency of instruction. Given the sequential nature of many curricular content areas, this finding may hold considerable value for presenting instruction. Several possibilities for future research could be addressed. Specifically, would these benefits continue to accrue if the word instruction also contained future targets in the consequent events? For example, if during the word instruction, the teacher also spelled the words in the consequent events, would students learn to spell the words without direct instruction? Another area of useful study could focus on what types of behaviors are most appropriately taught in this manner, and whether the amount and type of information presented in the consequent event influence future learning. For example, could statements of rules in the consequent event be effective in establishing rule application for similar behaviors in later learning. Future research also should determine whether other manipulations of current instruction might influence later instruction. For example, would presentation of future stimuli in the attentional cue prior to presentation of each trial in the photograph condition result in similar effects on later learning?

Two methodological issues need attention. In this study, we chose to include all words in word instruction, regardless of whether students demonstrated acquisition of some of these words during the second probe condition (i.e., immediately after photograph instruction). An alternative would have been to teach only the words that were not learned in the future condition with an equal number of words in the non-future word instruction condition. Another alternative would be to place the acquired words in review (e.g., 1 trial per session) and thereby reduce the total number of trials in the future word instruction condition. We chose the first option for two reasons. First, we conceptualized the research question as being whether the presentation of words in the consequent event for correct responses in photograph instruction would result in more rapid learning of both the photographs and words. We were interested in the efficiency of the manipulation for all photographs and all words. This was done because we suspected that the presentation of the words in the consequent event during photograph instruction might interfere with acquisition of the photograph names. This may have occurred for Chris (Experiment II); he needed 12 sessions in the future condition, as compared to 10 in the non-future condition, and required 40 minutes of instruction in the future condition, as compared to 24 in non-future. Second, we chose to include all words in the word instruction condition because we feared that word

reading acquired during photograph instruction would not maintain in Probe III without some direct instruction. Although students demonstrated 100% correct responding during Probe II on some words, they had never been reinforced directly for reading those words.

The second methodological issue that needs to be addressed comes from Tom's results in Experiment I; he learned all words in both conditions (future and non-future) without direct instruction. It appears that he discovered that the words being assessed during Probe II were related to the pictures that had been taught in photograph instruction. To control for this, extra words that were similar to the words in both conditions could have been included during probes. This would have eliminated the possibility that students could simply match words to the pictures.

In summary, this study presents a prototype for assessing the effects of current instruction on future instruction. While the sequencing of curriculum content through task analysis and other procedures has been used for years to influence later learning, this study suggests that some manipulations of the instructional procedures may influence later learning. Clearly, this is an area that merits a considerable amount of research activity. Such research may advance what is known about how learning occurs and hold practical implications for how to make instruction more efficient.

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