COMPARISON OF PROGRESSIVE TIME DELAY WITH INSTRUCTIVE FEEDBACK AND PROGRESSIVE TIME DELAY WITHOUT INSTRUCTIVE FEEDBACK FOR CHILDREN WITH AUTISM SPECTRUM DISORDERS

By

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CHAPTER I

INTRODUCTION

Current recommended practice for the treatment of autism suggest children with autism should receive a comprehensive intervention program (a) beginning as soon as diagnosis, (b) addressing their unique deficit areas, (c) utilizing low student to teacher ratios, (d) involving children's families, (e) providing intensity of 20 to 25 hours per week, and (f) including ongoing assessment and revision of treatment goals and practices (Dawson & Osterling, 1999; Iovannone, Dunlap, Huber, & Kincaid, 2003; Lord et al., 2001, Volkmar et al., 1999). These guidelines are generally consistent with recommended practices in early intervention (Sandall, Hemmeter, Smith, & McLean, 2005).

A method used to meet these suggested guidelines are treatments based on applied behavior analytic principles. There are many different comprehensive programs based on applied behavior analysis (e.g., Lovaas, Douglas Developmental Disabilities Center, May Institute, Princeton), and these programs have been used for many years to guide interventions for children with autism. Recent survey data suggest interventions based on these methods continue to be some of the most frequently used treatments for children with autism (Green, Pituch, Itchon, Choi, O'Reilly, & Sigafoos, 2006; Stahmer, Collings, & Palinkas, 2005).

A common aspect of the comprehensive treatment programs for children with autism based on applied behavior analysis is the use of discrete trial instruction. Discrete trial instruction involves trials in which a stimulus is presented, the child responds, a contingent consequence to the response is delivered, and an inter-trial interval is provided before the next trial. Discrete trial instruction is often carried out in a massed trial format, in which multiple trials (e.g., 10, 12, 14) of one or more stimuli are provided to the learner in single sessions, and the inter-trial interval is short (e.g., 2 to 5 s). One method of discrete trial instruction using a massed trial format that has been studied with children who have autism is response prompting procedures (Wolery, Ault, & Doyle, 1992).

Response prompting procedures (Wolery et al., 1992) involve the systematic application *and* removal of teacher prompts. There are multiple types of response prompting procedures (e.g., constant time delay, progressive time delay, system of least prompts, simultaneous prompting, most-to-least prompts), which are defined by the method of presenting the prompts or the method of how the prompts are removed. Response prompting procedures have been used to teach individuals of all ages and levels of functioning (e.g., severe mental retardation to typical development), including individuals with autism.

In addition to demonstrating the effectiveness of response prompting procedures for teaching children with autism, researchers have explored methods to increase the efficiency of learning in discrete trial formats. Wolery et al. (1992) defined efficiency as, “an instructional procedure that results in learning (i.e., is effective) *and* is better than some other instructional procedure (p. 220).” Wolery et al. suggested five conceptualizations of efficiency: (a) more rapid learning, (b) greater generalization, (c) emergence of unintentional relations, (d) broader learning, and (e) promoting future learning.

Three studies have examined the fifth aspect of efficiency (i.e., promoting future learning). The first study to examine the promotion of future learning examined the presentation of stimuli targeted for future learning with eight elementary and middle-school-aged participants with moderate disabilities (Wolery, Doyle, Ault, Gast, Meyer, & Stinson, 1991). The study examined the effects of presenting future target stimuli using instructive feedback during the consequent event of correct responses by showing the participant the printed word identifying the stimulus. The future targets that were shown during the consequent event were then used as target stimuli in later conditions (i.e., future condition). Across participants, the future condition was superior (as measured by number of sessions, trials, and errors to criterion) than novel stimuli.

The second study (Holcombe, Wolery, Werts, & Hrenkevich, 1993) evaluating future learning examined the presentation of parallel future targets (i.e., targets requiring the same response) during the consequent event of correct responses in current learning trials. Four preschool-aged children with disabilities participated in the study. The findings of the study showed most participants learned the future targets and the presentation of future targets resulted in increased efficiency when the future targets became target stimuli.

The third study (Wolery, Schuster, & Collins, 2000) evaluating future learning extended the previous findings in two ways. First, the future targets were not parallel; this was the only study to use non-parallel future targets. Second, the study evaluated the presentation of the future targets in both the antecedent and the consequent events of trial sequences. The findings indicated that the three teenage participants with mental retardation required fewer instructional sessions to reach criterion levels for the future targets included in IF (as compared to the novel targets not presented previously as IF). There were small differences related to presentation of the future target in the antecedent or the consequent events; either placement resulted in similar outcomes.

While the small body of research on the use of future targets within (or associated with) instructive feedback suggests this technique can produce more efficient learning, none of the research has involved young children with autism. One study (Wolery et al., 1991) examined future learning in an adolescent with autism. Given the potentially high cost for the treatment of children with autism (e.g., Jacobson, Mulick, & Green, 1998), research on increasing the efficiency of instruction for children with autism is greatly needed.

The current study sought to extend the research on using instructive feedback to promote future learning through the inclusion of young children with autism. Specifically, the study sought to determine if the addition of future target instructive feedback into a progressive time delay (PTD) procedure would increase the efficiency (conceptualized as promoting future learning [Wolery et al., 1992]) of learning for children with autism. Five specific research questions guided this study:

1. When conducting discrete trials in a massed trial format using PTD with children with autism, are target behaviors acquired more efficiently, defined as seconds to criterion per target and sessions to criterion per target, for novel targets (e.g., new to the participant) or targets that were previously presented to the participant using instructive feedback?
2. When conducting discrete trials in a massed trial format using PTD with children with autism, are target behaviors acquired more efficiently, defined as seconds to criterion per target and sessions to criterion per target, when stimuli are presented without instructive feedback or when instructive feedback is presented during the consequent event of correct responses?
3. When conducting discrete trials in a massed trial format using PTD with children with autism, does the addition of instructive feedback during the consequent event of correct responses prevent the acquisition the target behaviors?

4. When conducting discrete trials in a massed trial format using PTD with children with autism, are target stimuli acquired with fewer errors for novel targets (e.g., new to the participant) or targets that were previously presented to the participant using instructive feedback?
5. When conducting discrete trials in a massed trial format using PTD with children with autism, are target stimuli acquired with fewer errors when stimuli are presented without instructive feedback or when instructive feedback is presented during the consequent event of correct responses?

CHAPTER II

METHOD

Participants

Five participants were selected based on the following inclusion criteria (a) 36- to 84-months-old at beginning of study, (b) an educational or medical diagnosis of an autism spectrum disorder; (c) average of at least 80% attendance during the previous school quarter, (d) demonstrated ability to imitate words, (e) identification (through teacher report) of deliverable reinforcers, and (f) no previous exposure to instructive feedback procedures. All participants attended a public school in a southern suburban school district. Four participants, Sally, Amanda, Chris, and Paul attended the same early intervention program for children with autism (e.g., self-contained special education preschool classroom), while Sanjay attended a blended preschool classroom (i.e., the class contained students with and without disabilities). All participants attended school 5 hours each day for 5 days per week.

Sally was a 41-month-old white female with a neurological diagnosis of developmental delay with characteristics of pervasive developmental disorder. She lived with her parents and an older sister who had a diagnosis of Asperger’s disorder. Her family was of lower-middle class socio-economic status. When tested at 29-months-of-age, her *Developmental Assessment of Young Children* (*DAYC*; Voress & Maddox, 1998) age equivalent scores were 6 to 14 months below her chronological age. Her expressive language consisted of 1-3 word combinations of attributes of nouns and verbs. She had limited expressive language skills, which often consisted of echoing the prompt.

Amanda was a 61-month-old Asian female with diagnoses of autism, visual impairment, and albinism. She has lived with her adopted mother and her adopted mother's mother (adopted grandparent) since being adopted from China when she was 24-months-old. She did not live with any siblings and her family was of middle class socio-economic status. Results from her diagnostic assessment showed scores in the range of autism for all domains of the *Autism Diagnostic Observation Schedule* (social domain – 11; communication domain – 8, social-communication total – 19; restrictive and repetitive domain – 6) (Lord et al., 2000; Lord, Rutter, DiLavore, & Lisi, 1999). When tested at 46-months-of-age, results of the *DAYC* showed delays of at least 22 months across subtests. The *Vineland Adaptive Behavior Scales* (2^{nd} ed.; *VABS*; Sparrow, Cicchetti, Balla, 2005) administered when she was 54-months-old showed scores at least 2 standard deviations below the mean across all subtests. Her expressive language consisted of 1-2 word requests and comments, and her teacher reported her as having "good" receptive skills. Prior to inclusion in the study, she could name 3 sight words (her name, lunch, and snack).

Chris was a 53-month-old white male with a diagnosis of autism. He lived with his parents in a family with middle class socio-economic status. Chris had one sibling, a younger sister, who also had autism. When assessed at 35-months-of-age, he had delays of at least 1 year on all subtests of the *DAYC*. His expressive language consisted of 1-2 word combinations, which typically were used to request items (e.g., few comments). When asked to complete a demand or answer a question, he often complied, demonstrating good receptive language for instruction and requests for identification. Chris had been receiving 1:1 intervention services based on applied behavior analysis in his home for 1.5 years at the beginning of the study. He was the only participant with a history of such instruction.

Paul was a 58-month-old white male with a diagnosis of autism. Paul lived with his parents. His family was of lower SES, as indicated by receipt of free and reduced lunch at school. Diagnostic assessment results showed an autism quotient of 96 on the *Gilliam Autism Rating Scale* (Gilliam, 1995), and results of a *VABS* assessment conducted when he was 34-months-old showed delays of at least 1 year on communication, social, and adaptive behavior. His expressive language consisted of 2-5 word combinations that were beginning to form complete sentences and good receptive language skills. He could read at least 100 sight words and could identify the Arabic numerals 1-15. Paul completed two separate experimental manipulations of the procedure; at the onset of the second experiment, he was 60-months-old.

Sanjay was a 55-month-old Indian male with a diagnosis of autism. He lived with his parents and his family was of upper-middle class socio-economic status. When assessed at 57-months-of-age, he had delays of 10 – 21 months on all subtests of the *DAYC*. Sanjay had good expressive and receptive language skills, and typically greeted the instructor before each session. Sanjay's math skills were mixed. He could identify Arabic numerals up to 100, but he could not perform simple addition equations (e.g., 1+1).

Setting

Sessions for all participants were conducted in a one-to-one arrangement within the children's classrooms. During the sessions, the investigator was seated next to or across a table from the child. The investigator and the child were typically the only individuals in the area of the classroom during the experimental sessions. The specific location of each session within the classroom varied across participants. Sessions for Paul, Sally, Amanda, and Chris were typically in the work area of the autism classroom. Sanjay's sessions were typically conducted at a large table in the middle of the blended classroom.

Materials

The materials used in the study included target stimuli, reinforcers, stopwatches, and data collection sheets. Each participant had 6 or 7 stimulus sets. Each set contained two stimuli, thus there were 12 to 14 stimuli assigned to each participant. All stimuli were two-dimensional and varied across participants. A list of the behaviors for each stimulus set by participant is shown in Table 1. The stimuli for Amanda, Paul, and Sanjay were printed on 21.6 by 27.9 cm Hammermill® Cover Stock-White paper (148 g/m^2 paper weight) and cut to the respective sizes by the investigator. The stimuli for Paul's first experimental manipulation were Arabic numerals with values between 20 and 39. These stimuli were created using a word processing program with 72 point Ariel Black font. The stimuli measured 8.5 by 11.2 cm and were printed in black ink on the cover stock paper. The stimuli for Paul's second experimental manipulation were Arabic numerals and colors. The stimuli had the same measurements as the first collection of stimuli. The colors were depicted using solid 2-D colored shapes printed on the cover stock using an ink jet printer. The stimuli for Amanda were written words. The words were 3 to 5 letters in length and were created using a word processing program with 100 point Century Gothic font. The stimuli were printed in black ink, and measured 9.6 by 4.6 cm after the stimuli were cut. The stimuli for Sanjay were 2-D representations using Arabic numerals of addition equations. One half of the stimuli were of one-digit plus one-digit equations with sums between 11 and 17. The other half of the stimuli were one-digit plus two-digit equations with sums between 16 and 25.

These stimuli were created using a word processing program with 72 point Ariel Black font, measured 8.5 by 11.2 cm, and were printed in black ink on the cover stock paper.

The stimuli for Sally and Chris were photographic representations of their targets. The photographs were selected from two card sets, Alphabet Sounds Photo Library and Building Language Photo Library, both manufactured by Lakeshore®. The stimuli were printed on 14.6 by 11.4 cm heavy-stock paper with a gloss finish. No printed words identifying the stimuli were on the front of the stimuli. Most stimuli were oriented horizontally (i.e., width > height), but some were oriented vertically.

Table 1. Behaviors for Each Participant by Set

	Paul I	Sally	Amanda	Chris	Sanjay	Paul II
Set 1	25	sink	rat	ticket	9 + 8	negro
	34	dress	taxi	olive	14 + 5	siete
Set 2	26	bowl	fox	magnet	7 + 6	blanco
	32	gloves	train	lobster	13 + 9	cinco
Set 3	22	glass	lion	ruler	6 + 5	azul
	38	coat	bus	pickle	12 + 4	doce
Set 4	21	range	fish	ladder	5 + 9	rojo
	36	tie	car	rooster	16 + 8	uno
Set 5	29	pot	dog	easel	8 + 7	marron
	31	yarn	ship	lettuce	15 + 3	diez
Set 6	28	fridge	cow	toolbox	3 + 9	verde
	39	belt	van	gecko	18 + 7	ocho
Set 7	---	fan	kite	compass	---	gris
		quilt	ant	garlic		cuatro

Two digital stopwatches were used during the study to record the duration of each session. Data on child responses were recorded via paper and pencil using the data collection forms shown in Appendices A and B.

The deliverable reinforcers varied across participants. Initial reinforcers were determined through teacher nomination and modified as needed by the investigator throughout the study. Each individual's preferred reinforcers were rotated throughout the study to prevent satiation. Examples of reinforcers included bubbles, balloons, stickers, and various toys that lit up while spinning. All participants received descriptive verbal praise in addition to the deliverable reinforcement.

Experimental Design

The current study used an adapted alternating treatment design with probes (Sindelar, Rosenberg, & Wilson, 1985). The use of the adapted alternating treatment design permitted the comparison between different conditions through the rapid iteration of two conditions, PTD without instructive feedback (PTD no IF) and PTD with instructive feedback (PTD with IF). Two types of conditions were used for this study; probe phases and comparison phases. There were three probe phases, which served three purposes. First, the data from the probe sessions were used to represent baseline performance. Second, the probe phases allowed the assessment of a control set of stimuli. Assessing the control stimuli allowed the detection of the threats to internal validity related to maturation and history. Third, the final probe phase provided an assessment of the maintenance of stimuli acquired during the first comparison phase. In addition to the probe phases, the design contained two comparison phases. Each comparison phase utilized different target stimuli for each of the experimental conditions. A depiction of the study design is shown in Table 2.

Table 2. Order of Experimental Conditions.

Target Stimuli	Condition				
	Probe 1	Comparison 1	Probe 2	Comparison 2	Probe 3
Set 1	X	Teach (PTD NO IF)	X		X
Set 2	X	Teach (PTD with IF)	X		X
Set 3	X	(IF for set 2)	X		X
Set 4	X	Control	X	Teach (PTD NO IF)	X
Set 5	X	Control	X	Teach (PTD with IF)	X
Set 6	X	Control	X	(IF for set 5)	X
Set 7	X	Control	X	Control	X

X – indicates set will be probed; IF – Instructive feedback

Data Collection

Data for the dependent measures were collected by the researcher through trial-by-trial event recording using specifically designed data collection sheets. Separate data collection sheets were used for the probe sessions and instructional sessions, which are shown in Appendices A and B. Interobserver agreement and procedural fidelity data were collected simultaneously by an independent second observer using the same procedure during at least 20% of the sessions for each condition for each participant.

Response Definitions

Unprompted responses. When using PTD, unprompted correct responses inform the teacher about the transfer of stimulus control (Wolery et al., 1992). Therefore, the main dependent measure for the study was unprompted correct responses. There were two possible unprompted responses, unprompted correct and unprompted error. An *unprompted correct* response was defined as the child saying the correct answer to the task direction ("What's this word?") within the delay interval provided (i.e., before the delivery of a controlling prompt). An *unprompted error* response was defined as the child saying anything other than the correct answer to the task direction during the delay interval (i.e., before the delivery of the controlling prompt).

Prompted responses. Data also were collected on student behavior after the delivery of the controlling prompt. Prompted responses are participant responses occurring after the controlling prompt, and included (a) prompted correct, (b) prompted error, and (c) no response. A *prompted correct* response was defined as a correct imitation produced by the child of an instructor model (i.e., controlling prompt) within 5 s; a *prompted error* response was defined as a child saying anything other than the instructor's model (i.e., controlling prompt) within 5 seconds. *No response* was defined as the participant saying anything within 5 s of the controlling prompt.

Criterion Levels and Termination Criteria

Criterion levels were predetermined for all participants and were assessed using the unprompted correct data from the instructional trials. The criterion level for all participants was three consecutive sessions of 100% unprompted correct responses using a continuous reinforcement schedule (CRF) and two consecutive sessions of 100% unprompted correct responses on a variable reinforcement schedule of an average of every third response (VR-3). A probe phase was conducted after each participant met the criterion level for both behavior sets within a comparison condition (e.g., set 1 and set 2).

Two experimental manipulations were terminated. The first termination occurred in Paul's first experimental manipulation. During this experiment, Paul met the criterion level for both conditions during the first comparison phase. However, the results of the second probe phase suggested the target behaviors associated with the stimuli serving as control sets (i.e., sets 4, 5, and 6) reached mastery level (i.e., 100% unprompted correct responses). Such a data pattern does not eliminate the threats to internal validity of history or maturation, thus, necessitating the need for termination.

The second termination occurred in Sanjay's experimental manipulation. Formative data analysis during the first comparison phase of Sanjay's experiment showed a decreasing trend in the data for unprompted correct responses, which suggested the transfer of stimulus control was not occurring (e.g., progress was not being made). Multiple modifications were made to the procedure in an attempt to strengthen the procedure including the addition of an attending cue, error correction, wait training, and attempting to alter the deliverable reinforcement. None of the procedural changes had the desired effect (i.e., increased unprompted correct responses). The first comparison phase was stopped after the 12th session and a probe phase of the stimuli presented to Sanjay (stimulus sets 1-3) and one control set (set 4) was conducted. The results of the probe suggested the experimental procedure under the present conditions was not an effective method of instruction. Therefore, the experiment was terminated.

Data Metrics

Data collected during the sessions of the study were converted to different metrics for formative analysis. These metrics also were used for the summative analysis.

Acquisition. For the analysis of participant acquisition of target stimuli, the *percentage of stimulus sets at criterion for each participant by method of presentation* was calculated by dividing the number of stimulus sets at which an individual met the criterion level for a given instructional presentation (i.e., PTD, PTD that included IF, IF) by the number of all stimulus sets for the given method of presentation and multiplying the quotient by 100. The *overall stimulus sets at criterion for each participant* was also calculated by dividing the number of stimulus sets at which an individual met the criterion level by the total number of stimulus sets less the control set and multiplying the quotient by 100.

Time to criterion. The amount of time between the beginning of the intervention and the last session of criterion (i.e., the 2nd session of 100% unprompted correct responses on a VR-3) was calculated using two metrics. These metrics were calculated within participants independently for each condition of each comparison phase and as a mean for each condition across phases. First, the number of *sessions to criterion per target* was calculated by counting the number of sessions until criterion was reached beginning with the first instructional session and concluding with the last instructional session (*i*) and dividing the sum by the number of target behaviors acquired during the condition (i.e., 2 for PTD no IF and 4 for PTD with IF). The number of *minutes to criterion per target* was calculated by summing the duration of the instructional sessions and dividing the sum by the number of target behaviors acquired during the condition (i.e., 2 for PTD no IF and 4 for PTD with IF).

Errors to criterion. Two metrics were calculated related to participant errors. The *mean number of instructional trial errors per target* was calculated by condition by summing the gross number of unprompted errors, prompted errors, and no responses for each comparison and dividing the sum by the number of target behaviors acquired during the condition (i.e., 2 for PTD no IF and 4 for PTD with IF). The *percentage of instructional trial errors* was calculated for each condition by dividing the number of errors for a condition by the total number of trials presented during the condition.

Procedure

Initial assessment sessions. Three to six initial assessment sessions were conducted for each participant prior to the initial probe phase (i.e., before data collection began). Each session occurred in a one-on-one arrangement within the child's classroom and was 5 to 8 min in duration. The purpose of the initial assessment sessions was twofold. First, the sessions were used to determine what type of stimuli would be appropriate for each participant (e.g., sight words, numbers, pictures). The initial assessment sessions assessed each participant's knowledge and familiarity with possible stimuli by having participants complete one or all of the following tasks: (a) matching two identical 2-D representations of a potential target, (b) receptive identification of a 2-D representation of the target, (c) expressively naming a potential target when shown a 2-D representation of the target that was not identical to the potential stimulus (e.g., identifying a picture of a cat if the target stimuli was the written word "cat"), and (d) expressively naming a potential stimulus. Criterion levels for the inclusion of the target stimulus were: (a) 100% correct matching two identical 2-D representations of the stimuli, (b) 100% correct matching verbal model to 2-D representations of the stimuli, (c) 100% correct expressive identification (i.e., naming) of other 2-D representations of the target (i.e., representations that were not the potential stimulus), and (d) 0% correct expressive identification (i.e., naming) of the potential stimulus. After the type of stimuli was determined, the sessions were used to assess each participant's prior knowledge of exemplar stimuli. These data were then used to select the target behaviors that would make up the stimulus sets. Six target stimulus sets of equal difficultly consisting of two stimuli per set were determined for each participant. The difficulty of each stimuli set was assessed through a logical analysis of the characteristics of each target behavior (e.g., number of syllables, number of letters, number and type of letter blends) and expert opinion (e.g., teacher, therapist, professor). After the target behaviors were selected, the responses were randomly assigned to stimulus sets (and thus, randomly assigned to the experimental conditions) for each participant by drawing numbers out of a hat.

Probe phase. There were three types of probe phases (initial, second, and final), which only differed in terms of their temporal relation in the study and by the number of stimulus sets that were assessed (the initial probe phase assessed six sets and later probe phases assessed seven sets). When seven sets of stimuli were assessed, 3 sessions assessed 3 sets and 3 sessions assessed 4 sets. Probe phases consisted of six sessions, in which the stimulus sets were presented in a predetermined random order. An example of the order of stimulus set presentation is shown in Table 3. During the probe phases, the target behaviors were assessed such that (a) the stimuli within a set were presented together; (b) each stimulus set was probed during three sessions, but no stimulus set was probed on three consecutive sessions; and (c) different combinations of stimulus sets were assess for each probe session. Within a session, each target behavior of a stimulus set was assessed on 3 trials. The format of probe trials is shown in Table 4. All initial probe sessions also included known stimuli, which were presented approximately every 3rd trial.

Known trials were inserted to keep the number of trials similar across sessions that had different number of sets being assessed and to provide opportunities for the child to be reinforced and thereby minimize deflated probe performance.

Table 3. Number of Trials Per Stimulus Set Ordered by Probe Session for Six Stimulus Sets and Seven Stimulus Sets

	Probe 1						Probe 2						Probe 3					
session	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Set 1	6			6	6			6		6		6						
Set 2	6	6				6	6		6		6							
Set 3		6	6		6		6			6	6							
Set 4			6	6		6	6	6				6						
Set 5	6		6		6			6	6		6							
Set 6		6		6		6			6	6		6						
Set 1	6			6		6			6		6	6	6			6	6	
Set 2		6		6	6		6	6				6			6	6		6
Set 3	6		6		6		6		6	6				6	6		6	
Set 4		6	6			6		6		6	6		6	6				6
Set 5	6		6	6					6	6		6		6		6	6	
Set 6		6			6	6	6	6			6		6		6			6
Set 7	6				6	6	6		6		6		6		6		6	

Table 4. Probe Trial Sequence

Step	Behavior
1	Deliver attending cue • e.g., "Touch my hand."
2	Secure attending response • e.g., child touches researcher's hand
3	Present target stimulus • e.g., researcher shows child flash card with sight word
4	Provide task direction • e.g., "what is this?"
5	Provide 5-s response interval • e.g., researcher waits 5 s
6	Deliver response contingency • correct response (unprompted correct) – deliver positive reinforcement • errant response (unprompted error) – ignore • no response – ignore
7	Record response and provide 2- to 5-s inter-trial interval and proceed to next trial

Comparison phase. Two instructional arrangements, PTD no IF and PTD with IF, were used in the comparison phase. As shown in Table 2, there were two planned comparison phases for each experimental manipulation. Table 2 also shows which stimulus sets were used for each experimental condition. The comparison phases consisted of multiple instructional sessions per day that were separated by at least 1 hour. The arrangement of sessions within a day followed this pattern: If the participant had not reached the criterion level, there were an equal number of PTD no IF and PTD with IF sessions; if the participant had reached criterion level in one, but only one condition, multiple sessions (2 – 4) of the condition not at criterion were conducted. Sessions consisted of 12 trials (6 trials of each target stimulus per set).

Table 5. Instructional trial sequences.

Step	Instructional Trial with IF	Instructional trial without IF	Behavior
1	Deliver attending cue	Deliver attending cue	• e.g., researcher says, “Ready?”
2	Secure attending response	Secure attending response	• e.g., child says, “Okay.”
3	Present target stimulus	Present target stimulus	• Researcher shows child flash card with sight word
4	Provide task direction	Provide task direction	• e.g., researcher says, “What is this?”
5	Provide response interval	Provide response interval	• e.g., 0 s, 1 s, 2 s, 3 s, 4 s • for 0 s response interval, go to step 6 immediately after providing task direction • if the child provides an unprompted error or does not respond, go to step 6 • if the child provides an unprompted correct response before the delivery of the controlling prompt, go to step 8
6	Deliver controlling prompt	Deliver controlling prompt	• e.g., verbal model (researcher says, “This is [*stimulus*].)
7	Provide 5-s response interval	Provide 5-s response interval	• e.g., researcher waits 5 s
8	Deliver response contingency	Deliver response contingency	• correct response (prompted correct) – deliver SR+ • errant response (prompted error) – ignore, go to step 9 • no response – ignore, go to step 9
8a	If response was unprompted correct or prompted correct, deliver IF after the conclusion of the positive reinforcement		• e.g., wait for bubbles to pop, then show child stimulus and say, “this is [*stimulus*]” • if child does not respond, go to step 9 • if child responds, ignore and go to step 9
9	Provide 2- to 5-s inter-trial interval and proceed to next trial	Provide 2- to 5-s inter-trial interval and proceed to next trial	• e.g., researcher records response on data sheet and waits 2- to 5-s before delivering attentional cue for next trial

IF – instructive feedback; SR+ - positive reinforcement

Both experimental conditions used the PTD response prompting procedure. The procedures for the instructional trials using this procedure are presented by condition in Table 5. Note that the trial format is identical except for the presentation of the IF in the PTD with IF condition. The PTD instructional procedure involved five different lengths of delay: 0 s, 1 s, 2 s, 3 s, and 4 seconds. The 0-s delay interval remained in operation until the participant had 2 consecutive sessions of 100% prompted correct responses. Thereafter, each delay interval was in place for 2 sessions until reaching the 4-s delay, which remained in effect until the criterion level was met. If the participant had met the criterion level in one condition but not the other, 4 review trials (2 trials per stimulus of a set) were conducted every other session.

Experimental Modifications

Unexpectedly, the participants responded at 100% correct to the stimulus set presented as instructive feedback (set 3). Therefore, it was decided not to use the instructive feedback stimuli as the target stimuli for the PTD with IF condition in the second comparison phase. Instead, stimulus set 4 was used as the stimuli for the PTD no IF condition, stimulus set 5 was used as the target stimuli for the PTD with IF condition and stimulus set 6 was used for the stimuli of the instructive feedback. With this arrangement, all six stimulus sets (i.e., all stimuli) were scheduled to be presented to each participant, leaving the second comparison phase without a control set. Thus, a new stimulus set (set 7) was created and probed for each participant, and this set served as the control stimuli for the second comparison phase.

Paul participated in two separate tests of the experimental procedures. The procedures and contingencies of the first experiment were those described above. However, some of the procedures of the second experiment were modified to reflect the unexpected outcomes. The changes were as follows. First, seven (not six) sets of stimuli were developed prior to beginning of the initial probe sessions. With this increased number of sets, the arrangement of presenting the stimulus sets during all probe phases followed the seven set arrangement outlined in Table 3. Second, four experimental sessions were typically conducted in one day; the requirement of separation of sessions by at least one hour was met.

Interobserver Agreement and Procedural Fidelity

Data for interobserver agreement (IOA) and procedural fidelity were collected simultaneously and independently for at least 20% of sessions for each participant in each condition. The second observer was a graduate student in special education. He used the same data collection method and forms for each respective session type (see Appendixes A, and B). Interobserver agreement was assessed on the participant's response to each trial, and was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100 (Kennedy, 2005). The range of IOA across participants was 99.2 – 100% with a mean agreement of 99.7%. Agreement data are shown by participant by condition in Table 6.

Procedural fidelity provides an assessment of the adherence of experimental procedures (Billingsley, White, & Munson, 1980) and was assessed by event recording for each trial on 8 researcher behaviors: (a) securing the child's attention, (b) using the correct stimulus, (c) delivering the task direction, (d) providing the appropriate delay interval, (e) delivering the controlling prompt, (f) providing contingent positive reinforcement on the correct schedule, (g) delivering the instructive feedback, and (h) maintaining a 2- to 5-s inter-trial interval. The percentage of correct implementation was calculated by dividing the number of actual researcher behaviors by the number of planned researcher behaviors and multiplying the quotient by 100 (Billingsley et al.). The average ranges of procedural fidelity across behaviors and participants was 99.7 to 100% for probe sessions, 99.6 to 100% for instructional sessions using PTD without IF and 99.4 to 100% for instructional sessions using PTD with instructive feedback. The mean percentage of correct implementation (i.e., procedural fidelity) across participants and session format was 99.9%. Procedural fidelity data of researcher behavior are presented for each participant by instructional session format in Tables 7, 8, and 9, for probe sessions, instructional sessions using PTD without IF, and instructional sessions using PTD with IF, respectively.

Table 6. *Mean and Range for Percentage of Interobserver Agreement on Child Response for Each Participant by Condition*

Participant	Sally		Amanda		Chris		Paul I		Paul II		Sanjay	
Condition	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Initial probe	100		100		100		100		98.2	96.4-100	100	
First comparison PTD	98.6	91.7-100	100		100		100		100		100	
First comparison PTD with IF	100		100		100		100		100		100	
Second probe D	97.8	95.5-100	100		97.2	94.4-100	100		100		100	
Second comparison PTD	100		95.6	91.7-100	100		--	--	100		--	--
Second comparison PTD with IF	100		100		100		--	--	100		--	--
Final probe	97.9	95.8-100	100		100		--	--	98	96-100	--	--
Overall	99.2	97.8-100	99.6	95.6-100	99.7	97.2-100	100		99.5	98-100	100	

Table 7. *Mean and Range of Procedural Fidelity Data by Percentage of Planned Teacher Behaviors for Probe Sessions*

Participant	Sally		Amanda		Chris		Paul I		Paul II		Sanjay	
Behavior	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Secured attention	100		100		100		100		100		100	
Presented correct stimulus	100		100		100		100		100		100	
Delivered task direction	100		100		100		100		100		100	
Correct delay interval	100		100		100		100		100		100	
Delivered controlling prompt	100		100		100		100		100		100	
Sr+ / ignore	100		100		100		100		100		100	
Showed correct IF	100		100		100		100		100		100	
2-5 s ITI	98.5	90.9-100	99.3	95.8-100	99.3	99.5-100	100		100		100	
Overall for condition	99.7	98.5-100	99.9	99.3-100	99.9	99.3-100	100		100		100	

Table 8. *Mean and Range of Procedural Fidelity Data by Percentage of Planned Teacher Behaviors for PTD NO IF Instructional Sessions*

Participant	Sally		Amanda		Chris		Paul I		Paul II		Sanjay	
Behavior	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Secured attention	100		100		100		100		100		100	
Presented correct stimulus	100		100		100		100		100		100	
Delivered task direction	100		100		100		100		100		100	
Correct delay interval	100		100		100		100		98.4	91.7-100	100	
Delivered controlling prompt	100		100		100		100		98.4	91.7-100	100	
Sr+ / ignore	100		100		100		100		100		100	
Did not show IF	100		100		100		100		100		100	
2-5 s ITI	100		100		100		100		100		100	
Overall for condition	100		100		100		100		99.6	98.4-100	100	

Table 9. *Mean and Range of Procedural Fidelity Data by Percentage of Planned Teacher Behaviors for PTD with IF Instructional Sessions*

Participant	Sally		Amanda		Chris		Paul I		Paul II		Sanjay	
Behavior	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Secured attention	100		100		100		100		98.4	91.7-100	100	
Presented correct stimulus	100		100		100		100		100		100	
Delivered task direction	100		100		100		100		98.4	91.7-100	100	
Correct delay interval	100		100		100		98.4	91.7-100	100		98.4	91.7-100
Delivered controlling prompt	100		100		100		100		100		100	
Sr+ / ignore	100		100		100		100		100		100	
Showed correct IF	100		100		100		100		98.4	91.7-100	100	
2-5 s ITI	100		100		100		100		100		100	
Overall for condition	100		100		100		99.8	98.4-100	99.4	98.4-100	99.8	98.4-100

CHAPTER III

RESULTS

Visual Analysis

Sally. The results for Sally are shown in Figure 1. Initial probe data showed no changes in level, trend, or variability across all six stimulus sets. Data for unprompted correct responses for the target behaviors associated with all stimulus sets were 0% correct for all probe sessions.

During the first comparison phase, Sally demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 10 and 11 for the target behaviors associated with the stimuli of the PTD no IF condition (set 1) and sessions 2 and 3 for the target behaviors associated with the stimuli of the PTD with IF condition (set 2). After the delay procedure began, the data for unprompted correct responses showed an increasing trend in both conditions. The data for unprompted correct responses for the PTD no IF condition reached 100% for the first time at the 15th session, and the criterion level was achieved after the 27th session. The data for unprompted correct responses for the PTD with IF condition reached 100% unprompted correct responses for the first time at the 10th session, and the criterion level was met after the 22nd session. Review trials were conducted for the PTD with IF condition, during which the participant had 100% unprompted correct responses on all review trials.

The second probe phase showed 100% unprompted correct responding for the target behaviors associated with the stimulus sets of the PTD no IF and PTD with IF conditions, sets 1 and 2, respectively. Additionally, the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase (set 3) showed 100% unprompted correct

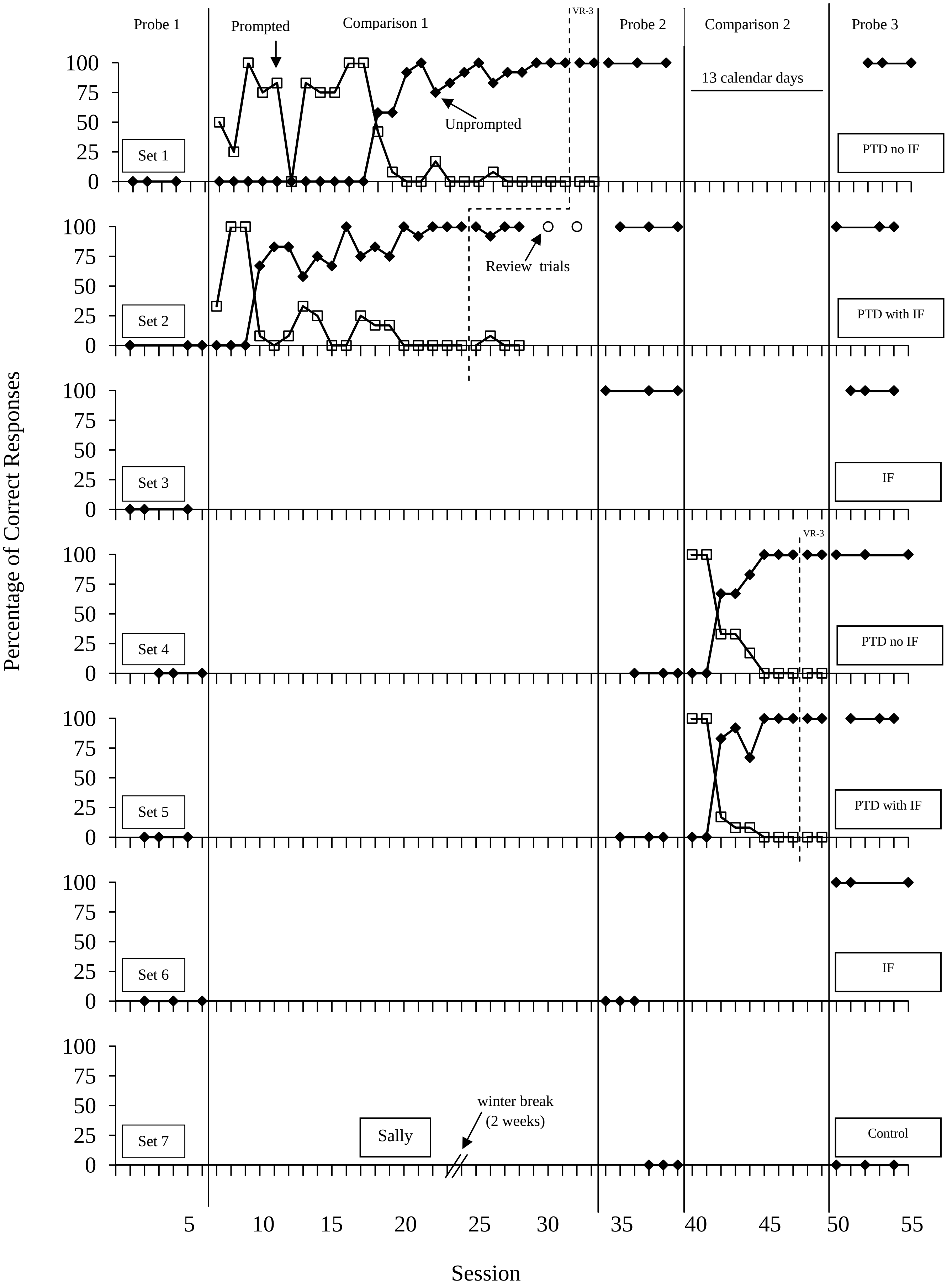

Figure 1. *Percentage of unprompted correct (filled diamond) and prompted correct (unfilled square) responses for Sally presented by stimuli set and session.*

responding across all probe sessions. These data suggest the behaviors associated with stimulus sets 1, 2, and 3 were acquired during the first comparison phase. Probe data for the target behaviors associated with the stimulus sets not yet presented (sets 4-6) and the additional stimulus set (set 7) showed no changes in level, trend, or variability; data for unprompted correct responses were 0% for all probe sessions. The acquisition of the behaviors associated with the stimulus sets presented during the first comparison phase and the lack of acquisition of the behaviors associated with the stimulus sets not presented during the first comparison phase suggest the instructional procedure was responsible for the change in behavior, thus demonstrating experimental control.

In the second comparison phase, Sally demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 1 and 2 for the target behaviors associated with the stimuli of the PTD no IF and PTD with IF conditions, sets 4 and 5, respectively. After the delay procedure began, the data for unprompted correct responses showed an increasing trend in both conditions. The PTD no IF condition reached 100% unprompted correct responses for the first time at the 6th session and the criterion level was achieved after 10th session. The same pattern was shown for the PTD with IF condition; 100% unprompted correct responses was demonstrated for the first time at the 6th session and the criterion level was achieved after 10th session.

The final probe phase showed 100% unprompted correct responding for the target behaviors associated with the stimulus sets presented in the second comparison phase for the PTD no IF and PTD with IF conditions, sets 4 and 5, respectively. As with the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase, the target behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the second comparison phase (set 6) showed 100% unprompted correct responding across all probe sessions. The level of unprompted correct responses for the target behaviors associated with the stimuli serving as a control set (set 7) was 0% across all probe sessions. As with the data from the first comparison phase, the results of the second comparison phase suggest experimental control was demonstrated. Additionally, the final probe phase served as a maintenance check for the stimulus sets presented in the first comparison phase. All three stimulus sets (sets 1-3) showed 100% unprompted correct responses, thus, the behaviors associated with the stimulus sets that were acquired during the first comparison phase were maintained across the second comparison phase.

Amanda. The results for Amanda are shown in Figure 2. Initial probe data showed no changes in level, trend, or variability across all six stimulus sets. Data for unprompted correct responses for the target behaviors associated with all stimulus sets were 0% correct for all probe sessions.

During the first comparison phase, Amanda demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 6 and 7 for the target behaviors associated with the stimuli of the PTD no IF condition (set 1) and sessions 4 and 5 for the target behaviors associated with the stimuli of the PTD with IF condition (set 2). After the delay procedure began, the data for unprompted correct responses showed an increasing trend in both conditions and a change in level in the PTD with IF condition. The data for unprompted correct responses for the PTD no IF condition reached 100% for the first time at the 15th session, and the criterion level was achieved after the 22nd session. The data for unprompted correct responses for the PTD with IF condition reached 100% unprompted correct responses for the first time at the 9th session, and the criterion level was met after the 15th session. Review trials were conducted for the PTD with IF condition, during which the participant had 100% unprompted correct responses on all review trials.

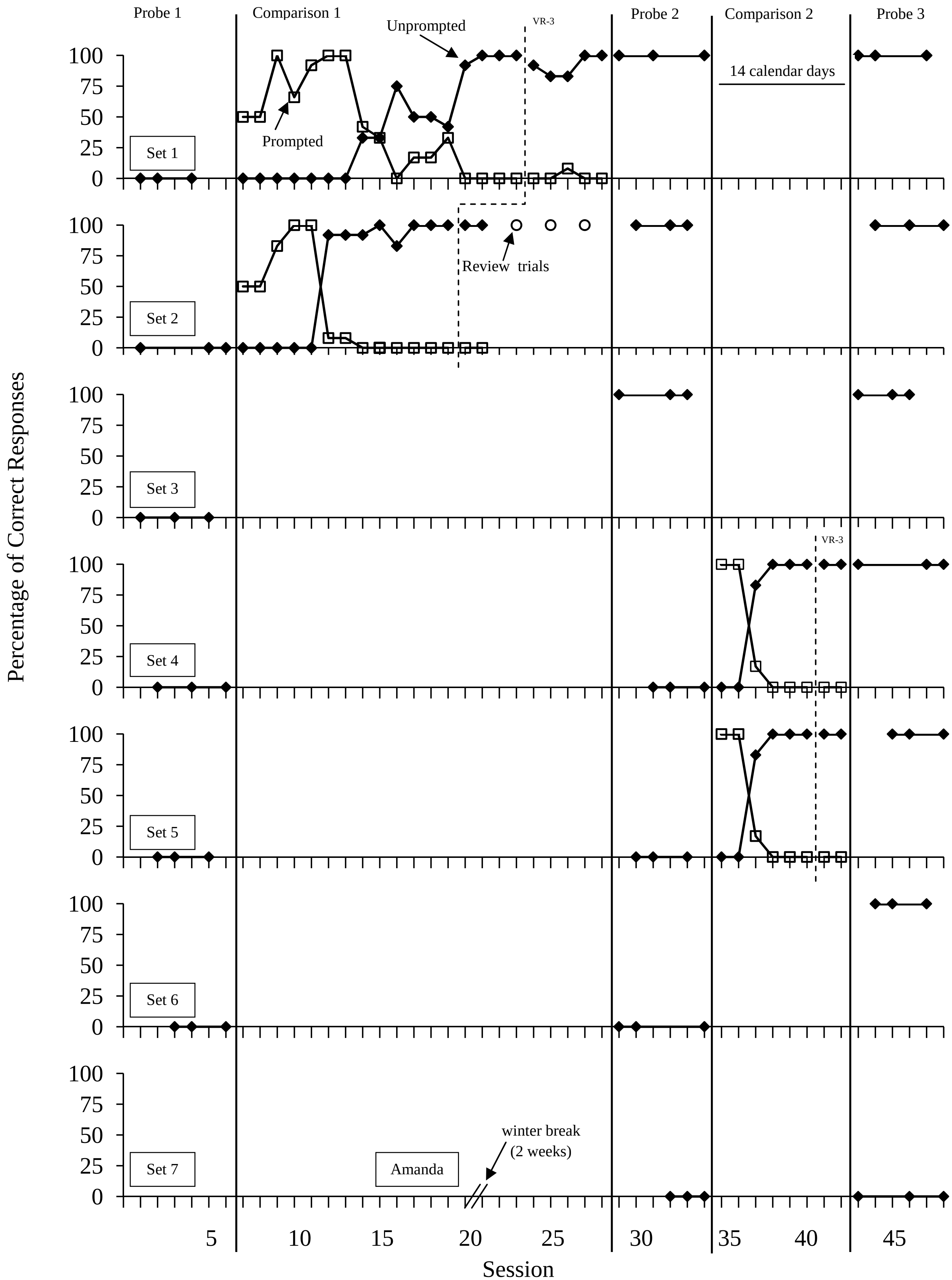

Figure 2. *Percentage of unprompted correct (filled diamond) and prompted correct (unfilled square) responses for Amanda presented by stimuli set and session.*

The second probe phase showed 100% unprompted correct responding for the target behaviors associated with the stimulus sets of the PTD no IF and PTD with IF conditions, sets 1 and 2, respectively. Additionally, the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase (set 3) showed 100% unprompted correct responding across all probe sessions. These data suggest the behaviors associated with stimulus sets 1, 2, and 3 were acquired during the first comparison phase. Probe data for the behaviors associated with the stimulus sets not yet presented (sets 4-6) and the additional stimulus set (set 7) showed no changes in level, trend, or variability; data for unprompted correct responses were 0% for all probe sessions. The acquisition of the behaviors associated with the stimulus sets presented during the first comparison phase and the lack of acquisition of the behaviors associated with the stimulus sets not presented during the first comparison phase suggest the instructional procedures were responsible for the changes in behavior, thus demonstrating experimental control.

In the second comparison phase, Amanda demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 1 and 2 for the target behaviors associated with the stimuli of the PTD no IF and PTD with IF conditions, sets 4 and 5, respectively. After the delay procedure began, the data for unprompted correct responses showed an increasing trend in both conditions. The PTD no IF condition reached 100% unprompted correct responses for the first time at the 4th session and the criterion level was achieved after 8th session. The same pattern was shown for the PTD with IF condition; 100% unprompted correct responses was demonstrated for the first time at the 4th session and the criterion level was achieved after 8th session.

The final probe phase showed 100% unprompted correct responding for the target behaviors associated with the stimulus sets presented in the second comparison phase for the PTD no IF and PTD with IF conditions, sets 4 and 5, respectively. As with the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase, the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the second comparison phase (set 6) showed 100% unprompted correct responding across all probe sessions. The level of unprompted correct responses for the behaviors associated with the stimuli serving as a control set (set 7) was 0% across all probe sessions. As with the data from the first comparison phase, the results of the second comparison phase suggest experimental control was demonstrated. Additionally, the final probe phase served as a maintenance check for the stimulus sets presented in the first comparison phase. All three stimulus sets (sets 1-3) showed 100% unprompted correct responses, thus, the behaviors associated with the stimulus sets that were acquired during the first comparison phase were maintained across the second comparison phase.

Chris. The results for Chris are shown in Figure 3. With the exception of the target behaviors for stimuli associated with set 4, initial probe data showed no changes in level, trend, or variability across all stimulus sets. Data for unprompted correct responses for stimulus sets 1, 2, 3, 5, and 6 were 0% correct across all probe sessions. The data for the target behaviors associated with stimulus set 4 suggested one of the stimuli chosen from the initial assessment sessions (i.e., gator) was known (evidenced by unprompted correct responses during probe session 2). The known stimulus was removed and replaced with a different stimulus that was unknown during the initial assessment sessions (gecko). The replacement stimulus was used for the final three sessions of the initial probe phase and all subsequent conditions.

During the first comparison phase, Chris demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 2 and 3 for the target behaviors associated with the stimuli of the PTD no IF and the PTD with IF conditions, sets 1 and 2, respectively. After the delay procedure began, the data for unprompted correct responses showed an

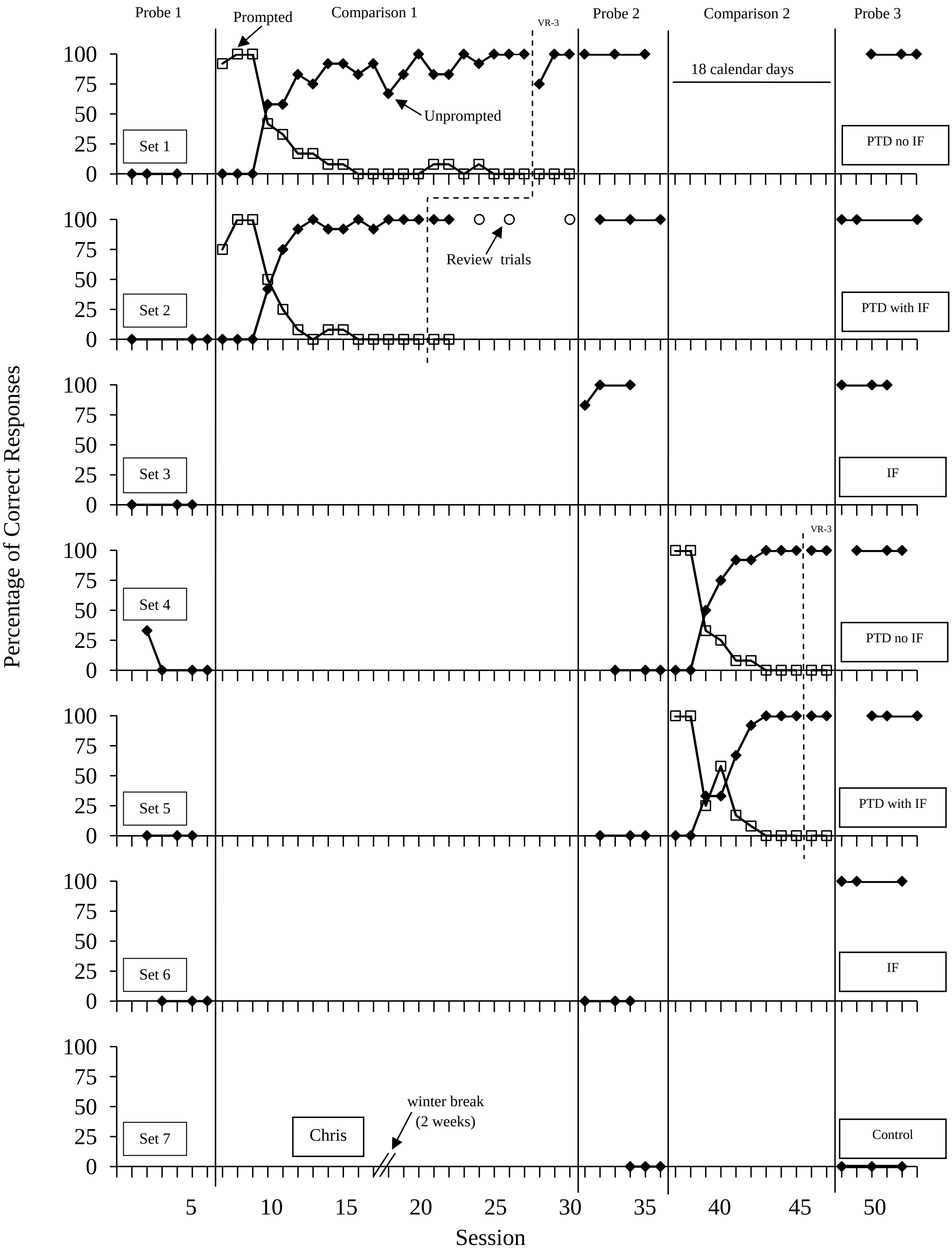

Figure 3. *Percentage of unprompted correct (filled diamond) and prompted correct (unfilled square) responses for Chris presented by stimuli set and session.*

increasing trend in both conditions. The data for unprompted correct responses for the PTD no IF condition reached 100% for the first time at the 14th session, and the criterion level was achieved after the 24th session. The data for unprompted correct responses for the PTD with IF condition reached 100% unprompted correct responses for the first time at the 7th session, and the criterion level was met after the 16th session. Review trials were conducted for the PTD with IF condition, during which the participant had 100% unprompted correct responses on all review trials.

The second probe phase showed 100% unprompted correct responding for the target behaviors associated with the stimulus sets of the PTD no IF and PTD with IF conditions, sets 1 and 2, respectively. Additionally, the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase (set 3) showed 100% unprompted correct responding for 2 of 3 probe sessions. These data suggest the behaviors associated with stimulus sets 1, 2, and 3 were acquired during the first comparison phase. Probe data for the behaviors associated with the stimulus sets not yet presented (sets 4-6) and the additional stimulus set (set 7) showed no changes in level, trend, or variability; data for unprompted correct responses were 0% for all probe sessions. The acquisition of the behaviors associated with the stimulus sets presented during the first comparison phase and the lack of acquisition of the behaviors associated with the stimulus sets not presented during the first comparison phase suggest the instructional procedures were responsible for the changes in behavior, thus demonstrating experimental control.

In the second comparison phase, Chris demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 1 and 2 for the target behaviors associated with the stimuli of the PTD no IF and PTD with IF conditions, sets 4 and 5, respectively. After the delay procedure began, the data for unprompted correct responses showed an increasing trend in both conditions. The PTD no IF condition reached 100% unprompted correct responses for the first time at the 7th session and the criterion level was achieved after 11th session. The same pattern was shown for the PTD with IF condition; 100% unprompted correct responses was demonstrated for the first time at the 7th session and the criterion level was achieved after 11th session.

The final probe phase showed 100% unprompted correct responding for the target behaviors associated with the stimulus sets presented in the second comparison phase for the PTD no IF and PTD with IF conditions, sets 4 and 5, respectively. As with the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase, the behaviors associated with the stimuli set presented as IF for the PTD with IF condition during the second comparison phase (set 6) showed 100% unprompted correct responding across all probe sessions. The level of unprompted correct responses for the behaviors associated with the stimuli serving as a control set (set 7) was 0% across all probe sessions. As with the data from the first comparison phase, the results of the second comparison phase suggest experimental control was demonstrated. Additionally, the final probe phase served as a maintenance check for the stimulus sets presented in the first comparison phase. All three stimulus sets (sets 1-3) showed 100% unprompted correct responses, thus, the behaviors associated with the stimulus sets acquired during the first comparison phase were maintained across the second comparison phase.

Paul (first experimental manipulation). The results for Paul's first experimental manipulation are shown in Figure 4. Initial probe data showed no changes in level, trend, or variability across all six stimulus sets. Data for unprompted correct responses for the target behaviors associated with all stimulus sets were 0% correct for all probe sessions.

During the first comparison phase, Paul demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 6 and 7 for the target behaviors

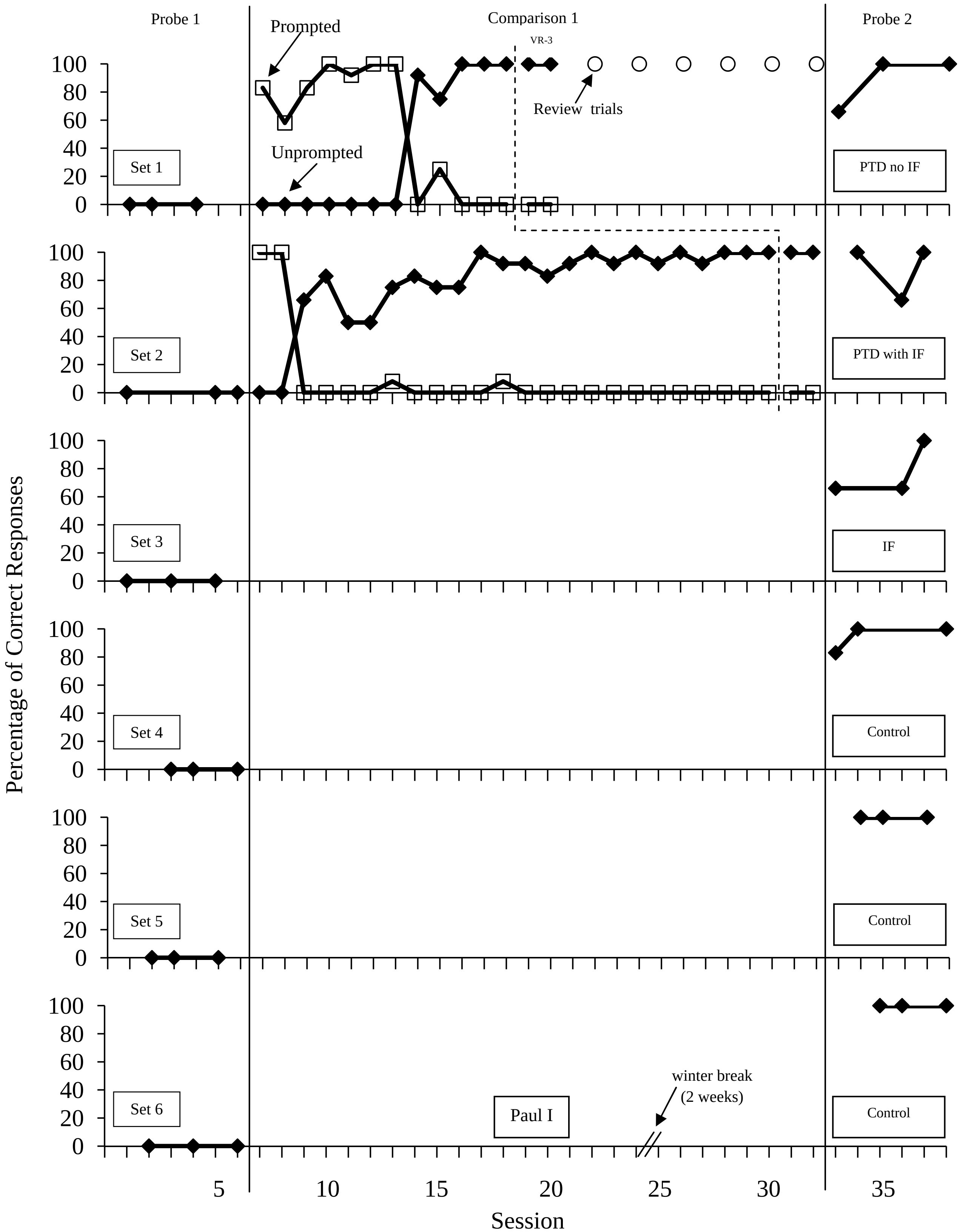

Figure 4. *Percentage of unprompted correct (filled diamond) and prompted correct (unfilled square) responses for Paul's first experimental manipulation presented by stimuli set and session.*

associated with stimuli of the PTD no IF condition (set 1) and sessions 1 and 2 for the target behaviors associated with stimuli of the PTD with IF condition (set 2). After the delay procedure began, the data for unprompted correct responses showed an increasing trend and change in level in both conditions. The data for unprompted correct responses for the PTD no IF condition reached 100% for the first time at the 10th session, and the criterion level was achieved after the 14th session. The data for unprompted correct responses for the PTD with IF condition reached 100% unprompted correct responses for the first time at the 11th session, and the criterion level was after the 26th session. Review trials were conducted for the PTD no IF stimuli; the participant had 100% unprompted correct responses on all review trials.

The second probe phase showed 100% unprompted correct responding on 2 of 3 sessions for stimuli associated with the PTD no IF and PTD with IF conditions, sets 1 and 2, respectively. Additionally, the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase (set 3) showed 67% unprompted correct responding for 2 of 3 probe sessions and 100% unprompted correct responding for the third probe session. These data suggest the behaviors associated with stimulus sets 1 – 3 were acquired during the first comparison phase. However, the data for behaviors associated with the stimulus sets that were not presented during the first comparison phase (sets 4, 5, and 6) also showed high to perfect levels of unprompted correct responses; collectively, 8 of 9 probe sessions had 100% unprompted correct responding. Because the data suggest the behaviors associated with stimulus sets that were not presented were acquired without presentation during the instructional sessions, the threats to internal validity of history and maturation cannot be ruled out. Because these threats to internal validity could not be ruled out, the experimental manipulation was terminated.

Paul (second experimental manipulation). The results for Paul's second experimental manipulation are shown in Figure 5. Initial probe data showed no changes in level, trend, or variability across all seven stimulus sets. Data for unprompted correct responses were 0% for all probe sessions.

During the first comparison phase, Paul demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 1 and 2 for the target behaviors associated with the stimuli of the PTD no IF and PTD with IF conditions, sets 1 and 2, respectively. After the delay procedure began, the data for unprompted correct responses showed an increasing trend in both conditions. The data for unprompted correct responses for the PTD no IF condition reached 100% for the first time at the 8th session, and the criterion level was achieved after the 12th session. The data for unprompted correct responses for the PTD with IF condition reached 100% unprompted correct responses for the first time at the 6th session, and the criterion level was met after the 12th session.

The second probe phase showed 100% unprompted correct responding for the target behaviors associated with the stimulus sets of the PTD no IF and PTD with IF conditions, sets 1 and 2, respectively. Additionally, the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase (set 3) showed 100% unprompted correct responding across all probe sessions. These data suggest the behaviors associated with stimulus sets 1, 2, and 3 were acquired during the first comparison phase. Probe data for the behaviors associated with the stimulus sets not yet presented (sets 4-7) showed no changes in level, trend, or variability; data for unprompted correct responses were 0% for all probe sessions. The acquisition of the behaviors associated with the stimulus sets presented during the first comparison phase and the lack of acquisition of the behaviors associated with the stimulus sets not presented during the first

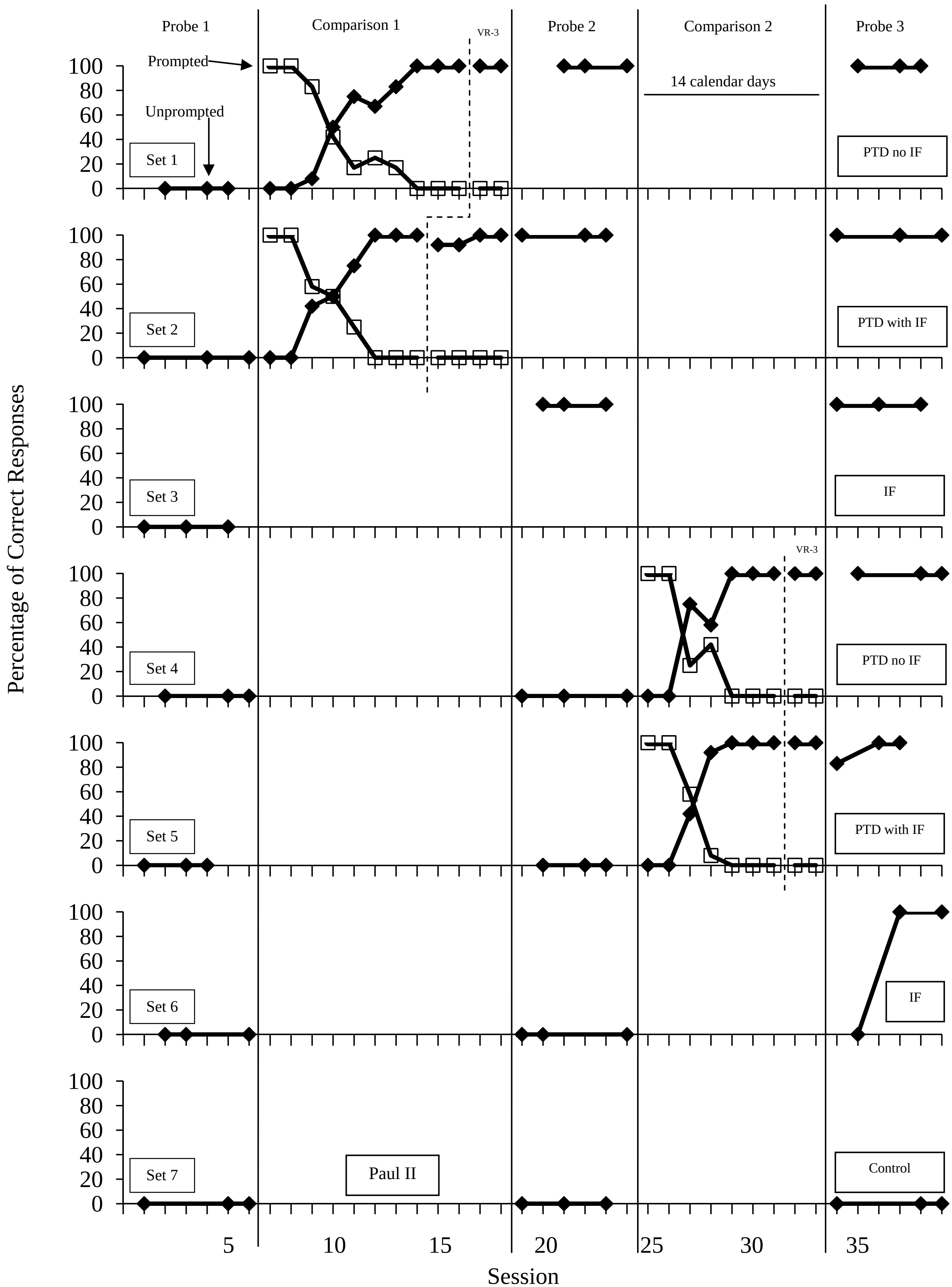

Figure 5. *Percentage of unprompted correct (filled diamond) and prompted correct (unfilled square) responses for Paul's second experimental manipulation presented by stimuli set and session.*

comparison phase suggest the instructional procedure was responsible for the change in behavior, thus demonstrating experimental control.

In the second comparison phase, Paul demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 1 and 2 for the target behaviors associated with the stimuli of the PTD no IF and PTD with IF conditions, sets 4 and 5, respectively. After the delay procedure began, the data for unprompted correct responses showed an increasing trend in both conditions. The PTD no IF condition reached 100% unprompted correct responses for the first time at the 5th session and the criterion level was achieved after 9th session. The same pattern was shown for the PTD with IF condition; 100% unprompted correct responses was demonstrated for the first time at the 5th session and the criterion level was achieved after 9th session.

The final probe phase showed 100% unprompted correct responding for the target behaviors associated with the stimulus sets presented in the second comparison phase for the PTD no IF and PTD with IF conditions, sets 4 and 5, respectively. As with the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase, the target behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the second comparison phase (set 6) showed 100% unprompted correct responding for 2 of 3 probe sessions. The level of unprompted correct responses for the behaviors associated with the stimuli serving as a control set (set 7) was 0% across all probe sessions. As with the data from the first comparison phase, the results of the second comparison condition suggest experimental control was demonstrated. Additionally, the final probe phase served as a maintenance check for the stimulus sets presented in the first comparison phase. All three stimulus sets (sets 1-3) showed 100% unprompted correct responses, thus, the behaviors associated with the stimulus sets that were acquired during the first comparison phase were maintained across the second comparison phase.

Sanjay. The results for Sanjay are shown in Figure 6. Initial probe data showed no changes in level, trend, or variability across all six stimulus sets. Data for unprompted correct responses for the behaviors associated with all stimulus sets were 0% correct for all probe sessions.

During the first comparison phase, Sanjay demonstrated 2 consecutive sessions of 100% prompted correct responses in the 0-s delay arrangement on sessions 1 and 2 for the target behaviors associated with the stimuli of the PTD no IF and PTD with IF conditions, sets 1 and 2, respectively. After the delay procedure began, the data for unprompted correct responses were variable in both conditions. Both data patterns had an increasing trend over the first 5 sessions, followed by a decreasing trend. Neither condition reached 100% unprompted correct responses. The first comparison phase was stopped after the 12th session with no condition having achieved the criterion level.

The second probe phase confirmed the behaviors associated with the stimuli of the PTD no IF and PTD with IF conditions, sets 1 and 2, respectively, were not acquired. The three probe sessions for the target behaviors associated with the PTD no IF condition had 0% unprompted correct responses and target behaviors associated with the stimuli of the PTD with IF condition had 0% unprompted correct responses on 2 of 3 probe sessions. The data for the behaviors associated with the stimulus sets not presented during the first comparison phase (sets 4-6) also showed the responses were not acquired; probe sessions across the sets showed 0% unprompted correct responses. However, the data for the behaviors associated with the stimulus set presented as IF for the PTD with IF condition during the first comparison phase (set 3) showed 100% unprompted correct responding across all probe sessions. The lack of acquisition of the behaviors associated with the stimulus sets presented in the PTD no IF and PTD with IF conditions suggests the procedure was ineffective and did not result in the desired change in behavior, thus no experimental control was demonstrated.

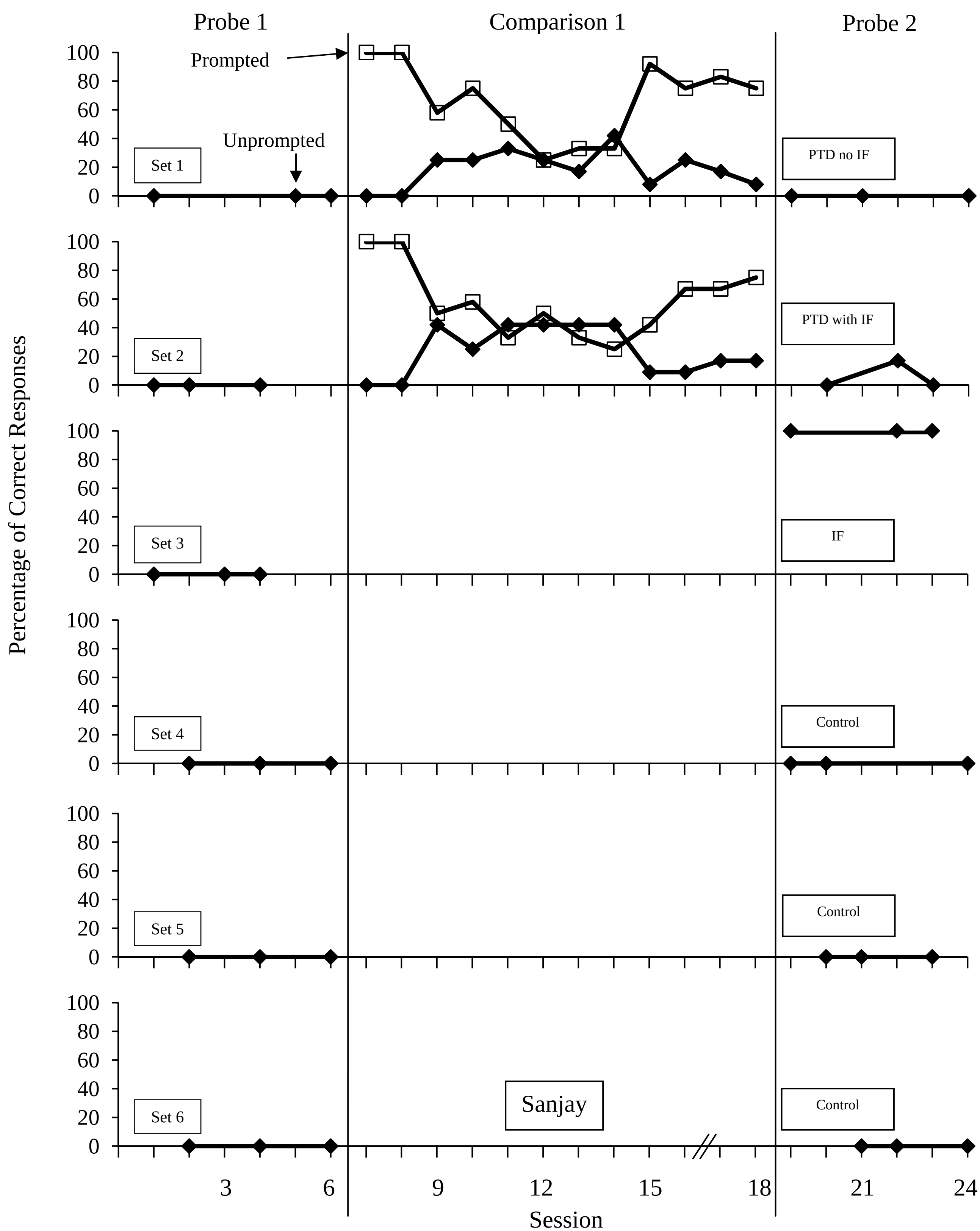

Figure 6. *Percentage of unprompted correct (filled diamond) and prompted correct (unfilled square) responses for Sanjay presented by stimuli set and session.*

Descriptive Analysis

Acquisition. Descriptive statistics were used to calculate the number of stimulus sets demonstrating mastery for each participant at each probe phase by method of instruction (i.e., PTD, PTD in which IF was included, and IF). The data for acquisition of stimulus sets are presented in Table 10. Sally, Amanda, Chris, and Paul II acquired all target behaviors presented to them and no control stimuli. Paul I acquired all target behaviors associated with the stimulus sets presented, but also acquired the behaviors associated with all control stimulus sets. Sanjay acquired no target behaviors associated with the stimulus sets used as the target stimuli for the two experimental conditions or control stimuli, however, he did demonstrate acquisition of the behaviors associated with the stimulus set presented as IF.

Table 10. Percentage of Stimulus Sets Acquired by Participants by Method of Stimulus Presentation

	PTD alone	PTD followed by IF	IF	Control
Sally	100	100	100	0
Amanda	100	100	100	0
Chris	100	100	100	0
Paul I	100	100	100	100
Paul II	100	100	100	0
Sanjay	0	0	100	0

Efficiency. Descriptive statistics also were used to examine the efficiency of learning, which are presented for each participant by condition for the first and second comparison phases in Tables 11 and 12, respectively. The statistics were calculated on the data for the participants demonstrating a functional relation (i.e., Sally, Amanda, Chris, and Paul's second experimental manipulation). Collectively, the PTD with IF condition was more efficient across all measures of efficiency for the first and second comparison phases.

In the first comparison phase, the shortest number of sessions per condition occurred in Paul's second experimental manipulation, which was 12 sessions in length for both conditions. The greatest number of sessions occurred in the PTD no IF condition for Chris, which had a length of 27 sessions. For all participants, criterion was reached in the same or fewer sessions for the PTD with IF condition. During the first comparison phase, all participants acquired the behaviors associated with the PTD with IF condition on average in fewer minutes as well.

For the second comparison phase, all participants reached the criterion level in the same number of sessions for each condition (range 8-11). The shortest number of sessions to criterion was Amanda, and the greatest number of sessions to criterion occurred with Sally and Chris (11). During the second comparison phase, all participants acquired the behaviors associated with the PTD with IF condition on average in fewer minutes per target.

For the participants with whom experimental control was demonstrated (Sally, Amanda, Chris, Paul II), four opportunities existed with sets 1-3 to evaluate the consistency of the efficiency data. PTD with IF was more efficient in all 4 comparisons for average sessions per behavior to criterion, and for average minutes per behavior to criterion. PTD with IF resulted in lower error percentages for 3 of 4 comparisons-Paul II had a higher error percentage per behavior with PTD with IF than PTD no instructive feedback. In terms of magnitude of the differences across these participants, the PTD no IF averaged 10.4 sessions per acquired behavior and the PTD with IF averaged 4.1 sessions. Similar patterns were seen with respect to average minutes per behavior to criterion and percentage of errors per behavior. The PTD no IF averaged 39.5 minutes per behavior and the PTD with IF averaged 17.9 minutes per behavior, and the PTD no IF averaged 1.0 errors per session and the PTD with IF averaged .5 errors per session. Thus, the PTD with IF required, on average, less than half the sessions, minutes, and errors than the PTD no IF per behavior learned.

Instructional Trial Errors

The data for instructional trial errors for the first and second comparison condition are also presented in Tables 11 and 12, respectively. The data show on average, participants made fewer errors in the PTD with IF than the PTD no IF condition during the first comparison phase, 4.2% to 8.5% of trials, respectively. During the second comparison phase, more errors were seen in the PTD with IF condition. However, few errors occurred for both conditions and the average percentage of error trials was less than .1% for both conditions. Collectively, very few errors were made by participants during the instructional sessions.

Table 11. Descriptive Statistics for First Comparison Phase for Each Participant by Condition

	Sally		Amanda		Chris		Paul I		Paul II		Sanjay		Average	
	NOIF	IF	NOIF	IF	NOIF	IF	NOIF	IF	NOIF	IF	NOIF	IF	NOIF	IF
Behaviors Acquired	2	4	2	4	2	4	2[a]	4[a]	2	4	0[a]	2[a]	2	4
Sessions														
total per condition	24	16	22	15	27	22	14	26	12	12	12	12	21.3	16.3
average per target	12	4	11	3.8	13.5	5.5	n/c	n/c	6	3	n/c	n/c	10.6	4.1
Minutes														
total per condition	108	96.4	71.2	54.8	80.4	77.6	49.1	100.8	46.6	57.2	48.5	53.8	76.6	71.5
average per session	4.5	6.0	3.2	3.7	3.0	3.5	3.5	3.9	2.9	4.8	4.0	4.5	3.4	4.5
average per target	59.0	24.1	35.6	13.7	40.2	19.4	n/c	n/c	23.3	14.3	n/c	n/c	39.5	17.9
Errors[b]														
total per condition	29	6	33	13	19	5	11	36	6	9	22	22	21.8	8.3
average per session	1.2	.4	1.5	.9	.7	.2	.8	1.4	.5	.8	1.8	1.8	1.0	.5
percentage of trials	10.1%	3.1%	12.5%	7.2%	5.9%	1.9%	6.5%	11.5%	4.2%	6.3%	15.3%	15.3%	8.5%	4.2%

n/c – not calculated because experimental control was not demonstrated

[a] – experimental control not demonstrated

[b] – unprompted errors, prompted errors, and no response

Table 12. Descriptive Statistics for Second Comparison Phase for Each Participant by Condition

	Sally		Amanda		Chris		Paul II		Average	
	NOIF	IF	NOIF	IF	NOIF	IF	NOIF	IF	NOIF	IF
Behaviors Acquired	2	4	2	4	2	4	2	4	2	4
Sessions										
total per condition	11	11	8	8	11	11	9	9	9.8	9.8
average per target	5.5	2.8	4	2	5.5	2.8	4.5	2.3	4.9	2.5
Minutes										
total per condition	42.6	51.6	33	30	26.4	29.2	32.4	37.2	33.6	37
average per session	3.9	4.7	4.1	3.8	2.4	2.7	3.6	4.1	3.5	3.8
average per target	21.3	12.9	11.5	7.5	13.2	7.3	16.2	9.3	15.6	9.3
Errors[a]										
total per condition	1	3	0	0	2	7	0	0	.8	2.5
average per session	.1	.3	0	0	.2	.6	0	0	.1	.3
percentage of trials	.8%	2.3%	0%	0%	1.5%	5.3%	0%	0%	.7%	2.1%

[a] – unprompted errors, prompted errors, and no response

CHAPTER IV

DISCUSSION

General Findings

The present study was conceptualized as an examination of future target IF. In this conceptualization, the IF stimuli presented in the PTD with IF condition in the first comparison phase were to become the target stimuli of the PTD with IF condition of the second comparison phase. Previous research on future target IF (Holcombe et al., 1993; Wolery et al., 1991; Wolery et al., 2000) suggested the target behaviors presented as instructive feedback would have a range of 40 – 80% unprompted correct responses after being presented as instructive feedback. The most current review of IF suggested the rate would be 58.2% (Werts et al., 1995). Based on these estimates, it was anticipated that the target behaviors of the stimulus set presented as IF would not be acquired during the first comparison phase, thus allowing the use of the target behaviors as the target stimulus set for the PTD with IF condition during the second comparison phase. However, all participants demonstrated mastery of the IF presented during the first comparison phase when the stimuli were assessed in the second probe phase. Therefore, the second comparison phase contained stimulus sets and instructive feedback that had not previously presented. Because of this procedural modification, the results do not illustrate the performance of target stimuli previously presented as IF in subsequent instructional sessions. Thus, the research questions focused on the examination of future target IF (e.g., questions 1 and 4) cannot not be addressed.

While the utility of PTD has been well documented for individuals with autism (Walker, 2008), the use of IF in instructional trials with children with autism has not been frequently examined (Werts et al., 1995). The present study provides (a) an evaluation of the effectiveness of the PTD procedure, (b) an evaluation of the effectiveness of IF, and (c) a comparison of PTD without IF and PTD with IF with young children with autism. For the analysis and interpretation of the results, the data were considered separately for the experimental manipulations demonstrating a functional relation and for the experimental manipulations for which experimental control was not achieved. While the inability to demonstrate experimental control precludes the elimination of alternative explanations, a functional relation was demonstrated on eight separate occasions, thus providing strong evidence of the procedure's effects.

Given the limited study of using IF with children with autism, the initial evaluation of this study was whether young children with autism could learn target behaviors when additional information unrelated to the target behaviors (i.e., IF) was included in instructional trials. The study bore 8 tests of the acquisition of target behaviors when IF was presented during the consequent event of correct responses (i.e., the PTD with IF condition). In all 8 evaluations, the target behaviors associated with the stimulus set presented during the PTD procedure (i.e., sets 2 and 5) reached the criterion level by the conclusion of the comparison phase. Thus, the participants learned the target behaviors when additional information after the consequent event was provided. Furthermore, the target behaviors of the stimulus sets associated with the PTD with IF condition reached criterion levels in the same or fewer sessions than the target behaviors associated with the stimulus sets in the PTD no IF condition. An additional consideration on the effectiveness IF is the acquisition of the behaviors presented as IF. In the present study, all behaviors presented as IF were acquired through their presentation as IF; these behaviors were not acquired through direct instruction. Collectively, the results support the conclusion that PTD and IF are effective instructional practices when educating young children with autism.

The efficiency of using IF was examined by comparing the acquisition of target behaviors when IF was not presented (PTD no IF) and when IF was presented during the consequent event of correct responses (PTD with IF). Because the behaviors associated with the stimuli presented as IF (sets 3 and 6) demonstrated mastery during the subsequent probe phases, the behaviors were likely acquired through their presentation during the preceding comparison phase. Thus, there was a potential to acquire 4 behaviors in the PTD with IF condition and 2 behaviors in the PTD no IF condition. Support of the increased efficiency of using IF is illustrated when examining the difference in performance of the two experimental conditions during the second comparison. When examining the mean data for the second comparison phase, which is most likely the closest estimation of results for repeated use of the procedure, the PTD with IF condition was more efficient than the PTD no IF condition. This efficiency is shown by the fewer average sessions to criterion per behavior and shorter average minutes to criterion per behavior needed in the PTD with IF condition.

These data can be extrapolated with reference to the two measures to illustrate how this increased efficiency might affect learning in other situations. With reference to the average number of sessions needed to acquire target behaviors, 10 sessions (1 session a day for 2 school weeks) would be needed to acquire 2 behaviors using PTD without IF while the same number of behaviors could be acquired in 5 sessions (1 session a day for 1 school week) when IF was utilized. With reference to the amount of instructional time needed to teach 2 behaviors, approximately 35 minutes would be required when using PTD without IF while less approximately 19 minutes would be necessary when using the same procedure with instructive feedback. If the goal was to teach the 2 behaviors in one school week, it is a difference of approximately 3 min per day (7 min v. 4 min, respectively).

Experimental Manipulations Not Demonstrating Functional Relations

Paul I. The visual analysis of the data from Paul's first experimental manipulation suggests the threats to internal validity of history and/or maturation could have been present. That is, Paul might have learned the target behaviors through means other than the experiment or, Paul learned the target behaviors through the natural progress of learning. With respect to the possibility of a history effect, Paul was excluded from classroom activities in which the target behaviors were present (e.g., calendar, time), but no assurances can be made for his exclusion from the stimuli outside of school. In regard to maturation, the initial probe assessment and informal assessments after intervention showed mastery of the numerals 1-15 but not 16-19. Thus, the typical progression of identifying numerals (e.g., sequentially) was not shown, which renders the possibility of a maturation effect less likely.

While these alternative explanations cannot be ruled out, a third possibility exists–Paul learned to generalize responses across behaviors. All of the target responses for Paul's first experimental manipulation had a similar pattern (i.e., "twenty" for stimuli with the numeral 2 on the left and "thirty" for stimuli with the numeral 3 on the left, followed by the name of the numeral on the right). The repeated trials inherent in a massed trial format using a response prompting procedure provided Paul with multiple opportunities to be exposed to and demonstrate the pattern. In the second probe, it is possible that when Paul was faced with an unknown stimulus (e.g., control stimulus), he might have applied the pattern, thus demonstrating generalization across stimuli. The application of a pattern also was seen during the second and final probes of Paul’s second experimental manipulation. During this second experimental manipulation, one half of the targets behaviors were the names of Spanish numerals. Three of six targets during the first comparison phase ended with an –o (i.e., negro, blanco, cinco). During the subsequent probe conditions, Paul would often add an –o to the English name of the stimuli that had not been previously taught (e.g., “fouro,” “eighto,” “redo”), thus applying a pattern of adding an –o to words when speaking Spanish. Although the alternative explanation of generalization across patterned stimuli is hypothetical, it is consistent with rule-governed behavior (Baldwin & Baldwin, 2000) and is an issue deserving of future study.

Sanjay. The results of Sanjay’s experiment are peculiar and inconsistent with behavioral conceptualizations of learning (e.g., positive reinforcement increases behavior). Only one result occurred as expected: The target behaviors for the control sets (sets 4-6) were not acquired. The remaining results are contrary to what was expected; the target behaviors for which teacher delivered contingent positive reinforcement was provided were not acquired (i.e., sets 1 and 2), while the target behaviors presented as instructive feedback (set 3) were acquired in the absence of teacher delivered reinforcement. This is a peculiar result with no theoretical basis. Transfer of stimulus control with the PTD procedure is dependent on reinforcement, thus all interpretations are hypothetical.

As mentioned in the method section, procedural modifications were made for Sanjay during the first comparison phase. These modifications were made to increase his attention to the target stimuli and the frequency with which he provided the desired behavior. However, the procedural modifications did not result in the desired result (i.e., acquisition of the target behaviors). There are four possible explanations of why the target behaviors presented using the PTD procedure were not acquired. First, it is possible that the researcher was not able to identify a stimulus that functioned as a reinforcer for Sanjay (i.e., there was no teacher delivered reinforcement). During the initial assessment sessions, the teacher indicated praise was a reinforcer, but praise did not appear to function as a reinforcer during the experimental procedure. The teacher and researcher met to identify tangible reinforcers that could be delivered by the researcher during the sessions, but no reinforcers were identified. Second, the times in which the teacher allowed as opportunities for the researcher to conduct sessions were during Sanjay's preferred activities. Thus, Sanjay often shifted attention between the instructional session and the classroom activity. Third, direct instructional procedures were not frequently used for learning in the classroom. Most of the instruction was given to students using a large group instructional format, and reinforcement was received after the completion of an activity contingent on being present during the activity (i.e., not contingent on performance). Thus, Sanjay was not familiar with the contingencies present during the instructional sessions. Finally, it is possible that the task selected, 1+1 and 2+1 digit addition with sums greater than 16, was too difficult. When selecting a target response class, the classroom teacher stated Sanjay did not know addition, which was a skill she felt he should know. However, simple addition equations (e.g., 2+3, 1+4), which are typically the initial equations given to an individual learning to add, could not be included because the participant was exposed to these facts daily during the circle-time activity. Collectively, these scenarios suggest the researcher had little control over study conditions.

Two possibilities can be hypothesized with respect to how the stimuli presented as IF were acquired. First, the instructional arrangement of the instructive feedback, presenting the stimuli without requiring a response and no teacher delivered consequences, might have been the instructional arrangement with which the participant was most accustomed. Informal observation of 1:1 instruction between Sanjay and his teacher revealed teacher delivered consequences (assumed reinforcers) was typically given at the conclusion of a session, not contingent on correct responding. The second possible explanation for how the IF targets were acquired is that the experimental procedure took on reinforcing properties. In the PTD with IF condition, the consequent event to the presentation of the IF was the inter-trial interval. The inter-trial interval signaled the completion of a trial, and provided Sanjay an opportunity to look away, assumedly at the ongoing classroom activity, which was typically a preferred activity. Both of these functions could have been reinforcing for Sanjay, thus illustrating how the experimental procedure could have taken on reinforcing properties.

Future Research

As stated in the purpose of the current study, additional evaluations of future target IF are needed. Because this study was the first to experience the "problem" of the future targets being mastered when presented through IF, modifications from the original study design might not be necessary. Future studies might consider examining this instructional format using a standardized curriculum to identify the target behaviors. The curriculum would allow the researcher to better identify the response classes and the relations between response classes, and experimentally manipulate the relations to examine the conditions under which the procedure is effective.

A second line of research should examine the phenomena of the participants reaching criterion faster in the comparison phases following their initial exposure to the procedure. For the participants receiving two comparison phases, everyone reached the criterion levels in fewer sessions during the second comparison phase. Additionally, Paul reached criterion more quickly in the first comparison phase of the second experimental manipulation compared to the first comparison phase of the first experimental manipulation. The pattern of learning demonstrated is consistent with the theory of learning sets proposed by Harlow (1949), and should be further examined to determine if there might be priming events or other pre-intervention techniques that can be used to provide similar results.

Research should also continue to examine the efficiency of instructive feedback. As with the present study, most previous studies examining the technique have used extrapolation from a comparison of directly teaching 2 behaviors and directly teaching 2 behaviors while providing instructive feedback for an additional 2 behaviors to estimate efficiency (Werts et al., 1995). Future studies should directly compare efficiency by examining the relation between directly teaching 4 behaviors and directly teaching 2 behaviors while providing IF for an additional 2 behaviors. Research should also compare the increased efficiency of IF compared to difference in efficiency of directly teaching 4 behaviors when compared to directly teaching 2 behaviors.

Seeing that individuals with autism often have difficulty generalizing responses, the PTD procedure with instructive feedback might be an instructional procedure that might help individuals with autism generalize responses. Further research is needed before such conclusions can be drawn. Thus, it is possible that individuals with autism could increase the efficiency of learning conceptualized as greater generalization (Wolery et al., 1992) in addition to more rapid learning when using PTD with IF when the target behaviors have similar patterns. However, further research examining the utility of this instructional arrangement are needed before conclusions can be made.

The premise that experimental procedures and/or routines might be reinforcing for individuals with autism has occasionally been speculated (Mesibov, Shea, & Schopler, 2005). However, no study has examined the phenomena by experimentally manipulating study procedures. Research on the reinforcing properties of different instructional techniques (e.g., discrete trial teaching, structured teaching, incidental teaching) would provide knowledge that could be used to strengthen and refine instruction for individuals with autism. Such strengthening and refinement would likely lead to greater efficiency, as was the main finding in the present study.

Qualifications and Limitations of Findings

Although the results from the present study are robust, the study was not without limitations, which must be taken into consideration in interpretation of the findings. First, the procedure was not successful with all participants. Although the data for the four experimental manipulations demonstrating functional relations appear to rule out threats to internal validity, such threats can never be ruled out entirely. Although the present study had many replications within participants, further replication is needed for increased confidence in its findings.

Research often attempts to identify participant characteristics and environmental conditions necessary for treatment efficacy. This study was conducted under one set of conditions using a small sample of a population with great heterogeneity. These factors limit the generality of the findings, and it is unclear if replication would be achieved under different circumstances (e.g., group instructional format, older children, children with severe autism). Future research should examine and manipulate participant and/or environmental conditions to determine the necessary elements for the greatest probability of success and to whom and what conditions generalizations can be made.

Appendix A: Probe Session Data Collection Form

Participant: ___________________ Date: ________________________ Session: _________________

Target Stimulus sets: 1 2 3 4 5 6 Time: ______________________ Length: ___________

Trial	TS	Attending cue	Task direction	Delay interval	CP	Child response			Reinforces correct	IF	Ignore	ITI
						Correct	Error	None				
Probe												
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												

Appendix B: Instructional Session Data Collection Form

Participant: ___________________ Date: ________________________ Time: __________ Session: ___________________

Target Stimulus Set: __________ Instructive Feedback Set: ______ Delay Interval: ____sec Length: ___________________

Trial	TS	Atnd Cue	Task direction	Delay interval	CP	Child response					Reinforces correct	IF	Ignore	ITI
						UP Correct	UP Error	P Correct	P Error	No Resp				
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														

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