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An Evaluation of The Effects of Spaced Trial Fading on Skill Acquisition: An Analysis of Transfer of Stimulus Control

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AN EVALUATION OF THE EFFECTS OF SPACED TRIAL FADING ON SKILL ACQUISITION: AN ANALYSIS OF TRANSFER OF STIMULUS CONTROL

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This manuscript represents a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Psychology (in School Psychology)

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The purpose of this study was to assess efficacy of spaced trial fading procedures on skill acquisition and transfer of stimulus control. Specifically, 3 participants were each taught a set of skills identified from the ABLLS or VB-MAPP. Each set of skills was randomly assigned to a no spaced-trial treatment group or spaced trial fading treatment group. In addition, maintenance and generalization probes were conducted following mastery to assess skill acquisition and transfer of stimulus control 1 week following treatment.

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LITERATURE REVIEW

The Diagnostic and Statistical Manual of Mental Disorders–Fourth Edition, a text revision (DSM-IV-TR; American Psychiatric Association, 2000) describes autism as a delay or collection of deficits in social interaction (e.g., social or emotional reciprocity) and communication (e.g., verbal or nonverbal receptive and expressive language), as well as restricted and repetitive interests, behaviors, and activities. Previous research has described various approaches for addressing behavioral deficits and excesses (e.g., steroid treatments, auditory integration training, immunotherapy, gluten avoidance; Green, 1996); however, few have demonstrated clinical effects. By contrast, a substantial body of research has recognized behavioral approaches, such as applied behavior analysis, as effective treatments for children with autism (Carr & Firth, 2005; Chong & Carr, 2005; Dunlap & Koegel, 1980; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Lovaas et al., 1981; Sautter & LeBlanc, 2006; Smith, 2001, Sundberg & Michael, 2001; Sundberg & Partington, 1998). Behavioral approaches to the treatment of autism have been prevalent in the literature since the early 1960's (Carr & Firth, 2005) and have driven the development of comprehensive treatment programs aimed at early and intensive behavioral intervention (EIBI).

The work of Lovaas and colleagues has contributed significantly to the evidence base for EIBI in the treatment of autism. Lovaas (1987) evaluated the effectiveness of applied behavior analysis, and specifically Discrete Trial Instruction (DTI), as an instructional method for teaching targeted skills. DTI is a restricted-operant procedure characterized by five distinct characteristics. First, a discriminative stimulus (S^D), or instructional cue (e.g., "Do this"), is provided. Second, depending on the instructional needs of the child, a prompt stimulus may be included to evoke the correct response (i.e., providing a model). Third, the response is made. If the correct response is made, a reinforcer is provided to increase the future likelihood of correct responding. Fourth, in the event of incorrect responding the stimuli may be presented and re-presented using a more intrusive prompt stimulus to evoke the correct response. Finally, the beginning of the inter-trial interval (ITI) is signaled by the completion of the task and is terminated by the presentation of the next S^D (Chong & Carr, 2005; Delprato, 2001; Lovaas, et al., 1981; Smith, 2001). This process is often repeated until mastery is achieved (e.g., three consecutive sessions with correct responding at or above 80%) and can be used to teach multiple skill sets (e.g., receptive and expressive language). Traditionally, the DTI approach to teaching language focuses on the acquisition of receptive and expressive language skills, following a psycholinguistic view of language development (LeBlanc, Esch, Sidener, & Firth, 2006).

A large-scale, clinical demonstration of the DTI methodology was evaluated by Lovaas et al. (1987) in the Young Autism Project. In this evaluation, 19 children were exposed to an average of 40 hours of intensive behavioral treatment in the form of DTI. Ten children were exposed to 10 hours of DTI. Additionally, twenty-one children participated in other forms of DTI outside of the Young Autism Project and served as a control group. All participants had a diagnosis of autism and were of comparable levels of development, play and language skills, and stereotypic behavior. Participants were included in the program for a minimum of 2 years and were under 4 years old prior to treatment. Results showed that 9 of the 19 children who received 40 hours of DTI demonstrated significant gains in IQ, adaptive skills, and emotional functioning. In addition, they appeared indistinguishable from their typically developing peers and regular-education first grade. Eight of the 19 participants were placed in special education or language-delayed classrooms. The remaining 2 children who received 40 hours of instruction scored in the profound/mentally retarded range and were placed in classrooms designed for those diagnosed with autism and/or mental retardation. In comparison, only one child from the control groups made significant gains in IQ, adaptive skills, and emotional functioning and completed regular-education first grade. Of the remaining participants, 45% and 53% were placed in classrooms for children with language and learning delays and classrooms designed for those diagnosed with autism and/or mental retardation, respectively. Thus, results indicated that 40 hours of intensive behavioral treatment in the form of DTI was effective in increasing skills in areas where children with autism were experiencing delays or deficits.

The instructional procedures evaluated by Lovaas have significantly impacted service delivery for children with autism, with many programs including key features of Lovaas' methods (e.g., DTI, frequent and intensive intervention, use of reinforcement, sequential introduction of target stimuli; Carr & Firth, 2005; Sundberg & Michael, 2001). However, many variations to the methodology described by Lovaas have been evaluated, leading to advances in treatment. Some of these variations include manipulations of ITI length (Koegel, Dunlap, & Dyer, 1980), interspersal of mastered and non-mastered tasks (Dunlap & Koegel, 1980; Koegel & Koegel, 1986; Koegel, Dunlap, & Dyer, 1980; Neef, Iwata, & Page, 1980; Noell, Whitmarsh, VanDerHayden, Gatti, & Slider, 2003; Panyan & Hall, 1978; Williams, Koegel, & Egel, 1981; Winterling, Dunlap, & O'Neill, 1987), and reinforcement contingencies (Charlop, Kurtz, & Milstein, 1992).

Building on the methodology described by Lovaas et al., the applied verbal behavior, or verbal behavior (VB), approach has emerged in recent years as a technology for teaching children with autism, specifically in the area of language development (Carr & Firth, 2005). The VB approach to teaching language shares many similarities to the method described by Lovaas (e.g., utilizes a trial format, frequent, daily exposure to teaching environments, progressive curriculum, use of reinforcement, focus on teaching language). However, there are some distinct differences.

First, DTI and VB differ in regards to the composition of the learning environment. In traditional DTI procedures teaching occurs in structured, analog environments under tightly controlled stimulus conditions. After mastery occurs, with specific S^Ds, generalization and maintenance are often assessed and trained under similar structured, tightly controlled stimulus conditions. By contrast, VB teaching occurs in a blend of discrete trial and natural teaching environments (also called natural environment teaching; NET). This approach focuses on teaching skills in the presence of the various S^Ds *and* motivating operations that naturally control the verbal behavior of the learner (Carr & Firth, 2005).

This focus on the variables that control the verbal behavior of the learner leads to the second, and perhaps the most significant, difference between the two methods. While the psycholinguistic view focuses on receptive and expressive aspects of language, the VB approach utilizes the technical framework proposed by Skinner (1957) to account for the various S^Ds and motivating operations that control verbal behavior (LeBlanc, Esch, Sidener, & Firth, 2006). Skinner's analysis of verbal behavior identified 7 verbal operants (e.g., mand, tact, echoic, intraverbal, textual, transcriptive, and copying a text), each with its own functional relation within language and with specific controlling variables that are specific to the function of the operant. The VB approach incorporates Skinner's framework into curriculum development and assessment of skills (e.g., Sundberg & Partington, 1998).

One common teaching method used within programs aimed at teaching language is errorless prompting. Errorless prompting is similar to the strategies used in DTI prompting. However, where DTI uses a least to most prompting sequence, errorless prompting, uses a most to least prompting sequence. This strategy is ideal for teaching as it allows few opportunities for errors in the presence of the S^D. Errorless strategies have been prevalent since the 1960's in both basic and applied preparations (Terrace, 1966; Touchette & Howard, 1984).

In errorless prompting procedures, a S^D (e.g., "Do this" while clapping hands), is provided. Second, a prompt stimulus, also known as a controlling prompt, is immediately provided (e.g., physical guidance to clap hands), following the S^D. The controlling prompt is the specific prompt level required to evoke a correct response. Third, the transfer trial is provided (e.g., a second exposure to the S^D). If the correct response is made, a reinforcer may be provided to increase the future likelihood of correct responding. Fourth, in the event of incorrect responding the S^D and the controlling prompt or a more intrusive controlling prompt may be represented to evoke the correct response. Finally, the beginning of the ITI is signaled by the completion of the task and is terminated by the presentation of the next S^D.

A main concern that arises when using prompts to evoke the correct response is the transfer of stimulus control from the controlling prompt to the S^D that is functionally related to the response. Generally speaking, when a controlling prompt reliably controls a response and reinforcement occurs in the presence of the controlling prompt it is said to have stimulus control. When the controlling prompt is paired with another stimulus (ideally the stimulus that is functionally related to the response; i.e., the S^D), and the controlling prompt is removed, transfer of stimulus control occurs when the new stimulus (i.e., the S^D) reliably controls the response (Touchette & Howard, 1984).

A procedure for assessing transfer of stimulus control, also referred to as a transfer trial, involves providing the S^D, (i.e., an independent opportunity for a correct response) immediately following a trial where the S^D is presented with a controlling prompt (Kelley, Shillingsburg, Castro, Addison, & LaRue, 2007). A second exposure the S^D may also be provided to further "test" the transfer of stimulus control. In this example, if the S^D reliably controls the response on the transfer trial or transfer test when the controlling prompt is removed, transfer of stimulus control is said to have occurred. One potential limitation to this procedure is the possibility that a participant will continue to emit the response that had previously contacted reinforcement on the transfer trial regardless of the next S^D that is presented (e.g., behavioral momentum; Nevin, 1996). In order to address this limitation, a spaced trial (e.g., mastered task) may be inserted between the transfer trial and transfer test to "disrupt" the potential that behavioral momentum effects control the response and ensure that the S^D reliably controls responding.

Past research has contributed important information in regards to transfer of stimulus control, response maintenance, and generalization. However, few studies to date have evaluated the effects of using spaced trials, on rate of transfer of stimulus control (i.e., number of sessions until the point of transfer), as well as skill maintenance and generalization following termination of treatment.

Therefore the purpose of this study was to assess the efficacy of a spaced trial fading procedure on the transfer of stimulus control from the controlling prompt to the S^D specific to the function of the specific verbal operant being taught. In addition, a secondary aim of the study was to evaluate the maintenance of generalization of transfer of stimulus control at 1week following mastery.

METHOD

Participants and Setting

Participants included two children that had been referred to a day treatment program for the assessment and treatment of language delays. Both participants had completed either the Assessment of Basic Language and Learning Skills (ABLLS) or Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) within 6 months prior to enrollment in the study and had a diagnosis of autism. Consent was attained from parents or legal guardians for both participants. All sessions were conducted in clinic classrooms containing tables, chairs, and teaching materials.

Bea was a 9-year-old female with a diagnosis of autism. Bea communicated using 1-word signs. Javier was a 5-year-old male with a diagnosis of autism. Javier communicated using 1-word signs and gestures.

Response Measurement and Reliability

Trained observers recorded data using a pencil and a data sheet (see data sheets, Appendix A and Appendix B) and were seated in unobtrusive positions within the classroom. During sessions, the observers collected trial by trial data on the number of correct or incorrect responses following the presentation of the S^D or controlling prompt. A correct response was scored if the participant engaged in the correct response within 3 s of the S^D.

In baseline probes, treatment probes, maintenance probes, and generalization probes, percentage of correct responses for each target was calculated by dividing the total number of trials with correct responses by the total number of trials in each session. This number was multiplied by 100% to yield the percentage of trials with correct independent responses.

In the treatment no spaced trial condition and spaced trial fading condition, the percentage of correct responses was calculated for the transfer trial and for the transfer test. For the transfer trial, percentage of correct responses for each target was calculated by dividing the total number of transfer trials with correct responses by the total number of transfer trials in each session. This number was multiplied by 100% to yield the percentage of transfer trials with correct responses. For the transfer test, percentage of correct responses for each target was calculated by dividing the total number of transfer test trials with correct responses by the total number of transfer test trials in each session. This number was multiplied by 100% to yield the percentage of transfer test trials with correct responding.

A second observer independently and simultaneously collected data on 43% and 45% of sessions for Bea and Javier, respectively. Interobserver agreement for the number of correct responses was calculated by dividing the total number of agreements by the total number of agreements plus disagreements in each session and then multiplying by 100%. Agreement was defined as both observers scoring the same response (e.g., “C” for correct or “I” for incorrect) on a given trial. Disagreement was defined as observers scoring different responses on a given trial. Agreement averaged 98% for Bea (range, 90% to 100%) and 97% for Javier (range, 81% to 100%).

Treatment integrity data was collected to insure that the procedures were implemented correctly on 43% and 45% of sessions for Bea and Javier, respectively. Treatment integrity was calculated by dividing the number of procedural steps implemented correctly for 5 trials in the session by the total number of possible steps per trial in the session. This number was multiplied by 100% to yield the percentage of procedural steps implemented correctly per trial. Data collectors recorded whether each of the procedural steps was implemented correctly for each trial observed in the session by marking “y” for correct implementation, “n” for incorrect implementation or “N/A” if the specific step was not applicable. (see attached data sheet, Appendix C). Treatment integrity averaged 100% for Bea and 100% for Javier.

Data were also collected for social validity by delivering a questionnaire to the primary therapist working with the participant during the investigation. The questionnaire was delivered immediately following the completion of the investigation. The questionnaire asked 4 questions using a 5-point likert scale (see attached questionnaire, Appendix D) with scores ranging from strongly disagree (e.g., score of 1) to strongly agree (e.g., score of 5). Questions were aimed at assessing satisfaction with the information gained from the analysis, effectiveness of the procedures, and the likelihood to utilize the procedures to teach skills in the future. Overall social validity scores were calculated by adding the score reported on each item and then dividing by the number if items answered.

Experimental Design

Sessions were conducted in a multiple baseline design and multiple probe design across groups A, B, and C for each participant. For each group, procedures consisted of baseline, treatment, and post-treatment phases.

Procedures

All sessions were 18 trials in length. Approximately 4-6 sessions were conducted daily, 4 -5 days each week. No more than 6 sessions were conducted in one 24-hour period. Therapists included post-baccalaureate trainees, Master's level trainees, and pre-doctoral interns. All therapists completed Collaborative Institutional Training Initiative (CITI) training prior to involvement with this study.

One skill set was selected for instruction for each participant. Skill sets included goals and tasks that were identified as unmastered according to the ABLLS or VB-MAPP. Six stimuli were selected for intervention from the identified skill area. For Bea, the skill set targeted for intervention was 2-D tacts of common items using signs. For Javier, targets selected for instruction included receptive identification of 2-D pictures by feature, function, and class.

For each participant, each target was randomly assigned to either group A, B, or C so that each group contained 2 targets. In each group, targets were randomly assigned to the no spaced trials condition or the spaced trials fading condition. Table 1 depicts the target, group assignment, and condition assignment for each participant. In addition, previously mastered targets were identified for each participant and included targets from a variety of skill areas (e.g., tacts, motor imitation, and receptive instructions).

Table 1

Target Assignments for Each Participant

		Condition	
Participant	Group	Spaced Trial	No Spaced Trial
Bea	A	Chair	Knife
	B	Plate	Shoe
	C	Fork	Sock
Javier	A	Wings (bug)	Hand (glove)
	B	Handle (wagon)	Head (hat)
	C	Legs (cow)	Feet (shoe)

Prior to the start of all sessions, the therapist conducted a multiple stimulus without replacement (MSWO) assessment similar to methods used by DeLeon and Iwata (1996) with 3-5 items to determine preferred items to be used as reinforcers for correct responding. The items ranked 1^{st} and 2^{nd} were included as reinforcers for correct responding and were randomly alternated. Sessions began with the therapist sitting either directly across from or next to the participant.

Baseline: The purpose of baseline was to determine if the skill set selected for instruction was unmastered (i.e., participants did not provide the correct response following presentation of the S^D). Baseline sessions randomly alternated between groups A, B, and C. In each session, the no spaced trial and spaced trial fading targets were randomly presented 9 times each, totaling 18 trials.

At the start of each session, the therapist presented the S^D for the target (e.g., "What is it?" along with the picture of a cow). Contingent upon an incorrect or correct answer within 3 s of the S^D, the therapist provided no feedback. The therapist marked "I" for incorrect or "C" for correct on the data sheet. Immediately following the participant's response the therapist presented the next trial (e.g., either the next baseline trial or a mastered task). Trials were counter balanced so that no more than two baseline trials or two mastered targets occurred in a row. For mastered targets, contingent upon a correct answer within 3 s of the S^D, the therapist provided verbal praise and a tangible item (identified in the MSWO) on a fixed ratio 2 (FR 2) schedule and contingent on an incorrect answer the therapist utilized an error correction procedure (i.e., providing the least intrusive controlling prompt) to evoke the correct response.

Baseline was terminated and treatment was initiated for one of the groups when stable responding was observed at or below 33% across 3 sessions. If the participant responded correctly on 33% or more trials during the first 3 sessions for any of the targets included in the baselines for group A, B, or C, the target(s) were removed from the array and were replaced with a novel target(s) from the target skill area. The new targets were reassigned to groups and conditions, and baseline was reimplemented using the procedures described above. In addition, if three consecutive sessions were observed with correct responding at or above 78%, the target was considered mastered, baseline was discontinued, and treatment was not initiated.

Treatment: The purpose of treatment was to determine which teaching procedure (e.g., no spaced trials or spaced trials fading) produced more efficient transfer of stimulus control. Each day one treatment probe was conducted for the group selected for treatment, followed by one or two teaching sessions, and a baseline probe for one of the remaining groups. For example, sessions on the first day may have included a treatment probe for group A, two teaching sessions for group A, and a baseline probe for group C. Sessions on the second day may have included a treatment probe for group A, two teaching sessions for group A, and a baseline probe for group B. Each session contained 9 trials of the no spaced trials target and 9 trials of the spaced trials fading target, totaling 18 trials. Trials were randomly alternated within each session.

No spaced trials condition: The no spaced trials target was presented 9 times within a session randomly alternating with the target from the spaced trials fading condition. At the start of each trial, the therapist provided the S^D and immediately provided the controlling prompt (e.g., "What is it? Cow"). Contingent upon an incorrect answer within 3 s of the S^D the therapist provided either a second controlling prompt or a more intrusive controlling prompt until the controlling prompt evoked the correct response and proceeded to the transfer trial. Contingent upon a correct answer within 3 s of the S^D the therapist provided positive verbal feedback and proceeded to the transfer trial. The therapist marked “I” for incorrect or “C” for correct on the data sheet. To implement the transfer trial the therapist provided the S^D without the additional controlling prompt (e.g., “What is it?” while holding a picture of a cow). Contingent upon an incorrect answer within 3 s of the S^D, the therapist immediately proceeded to the transfer test. Contingent upon a correct answer within 3 s of the S^D the therapist provided positive verbal feedback, a preferred tangible item, and proceeded onto the transfer test. The therapist marked “I” for incorrect or “C” for correct on the data sheet. To implement the transfer test the therapist represented the S^D (e.g., “What is it?” while holding a picture of a cow). Contingent upon an incorrect answer within 3 s of the S^D the therapist provided no feedback, immediately discontinued the trial, and recorded an “I” for an incorrect response. Contingent upon a correct answer within 3 s of the S^D the therapist provided positive verbal feedback and a preferred tangible item, immediately discontinued the trial, and recorded a “C” for correct response.

Spaced trials fading condition: The spaced trials fading target was presented 9 times within a session randomly alternating with targets from the no spaced trials condition. At the start of each trial, the therapist provided the S^D and immediately provided the controlling prompt (e.g., “What is it? Cow”). Contingent upon an incorrect answer within 3 s of the S^D the therapist provided either a second controlling prompt or a more intrusive controlling prompt until the controlling prompt evoked the correct response and proceeded to the transfer trial. Contingent upon a correct answer within 3 s of the S^D the therapist provided positive verbal feedback and proceeded to the transfer trial. The therapist marked “I” for incorrect or “C” for correct on the data sheet. To implement the transfer trial the therapist provided the S^D (e.g., “What is it?” while holding a picture of a cow). Contingent upon an incorrect answer within 3 s of the S^D, the therapist immediately proceeded to the spaced trial. Contingent upon a correct answer within 3 s of the S^D the therapist provided positive verbal feedback, a preferred tangible item, and proceeded to the spaced trial. The number of mastered tasks included in the spaced trial(s) was determined according to the fading criterion listed below.

Contingent upon a correct answer within 3 s of the S^D on the spaced trial(s), the therapist provided verbal praise and a tangible item (identified in the MSWO) and proceeded to the transfer test. Contingent upon an incorrect answer within 3 s of the S^D, the therapist provided no feedback and proceeded to the transfer test.

To implement the transfer test the therapist represented the S^D (e.g., “What is it?” while holding a picture of a cow). Contingent upon an incorrect answer within 3 s of the S^D the therapist provided no feedback, immediately discontinued the trial, and recorded an incorrect response. Contingent upon a correct answer within 3 s of the S^D the therapist provided positive verbal feedback and a preferred tangible item, immediately discontinued the trial, and recorded a correct response.

Fading criteria: The spaced trial fading condition initially included 1 spaced trial between the transfer trial and the transfer test. Each day transfer of stimulus control was assessed following administration of the treatment probe and prior to initiating the teaching sessions. One additional mastered task was inserted following the transfer trial and prior to proceeding to the transfer test if one of the following criteria were met. First, if the percentage of correct responses for the spaced trials fading condition in the treatment probe, completed that day, was at or below 33% and the percentage of correct responses on the transfer test for the spaced trials fading condition in all teaching sessions, completed the day prior, was at or above 78% one additional mastered task was added. Second, if the percentage of correct responses for the spaced trials fading condition treatment probe was above 33%, but a decreasing trend in correct responses was observed over the last 3 treatment probes and the percentage of correct responses on the transfer test for the spaced trials fading condition in all teaching sessions, completed the day prior, was at or above 78% one additional mastered task was added. Spaced trials were added, using the fading criterion described above, until a maximum of 4 mastered tasks were presented between the transfer trial and the transfer test or 3 consecutive sessions at or above 78% were observed on the treatment probes (i.e., mastery criteria were met).

Treatment Probes: Treatment probes were conducted for the group in treatment at the teaching table in 18 trial sessions. Each target from the no spaced trials and spaced trial fading condition was presented 9 times each in a randomized order totaling 18 trials. Treatment probes were conducted each day prior to the initiation of teaching trials.

At the start of each session, the therapist presented the S^D for the target (e.g., “What is it?”). Contingent upon an incorrect or correct answer within 3 s of the S^D, the therapist provided no feedback. The therapist recorded “C” for correct or “I” for incorrect on the data sheet. Immediately following the participant’s response the therapist presented two mastered instructions on a fixed-ratio 2 (e.g., FR2) schedule. Contingent on an incorrect or correct answer the therapist provided no feedback. The therapist recorded “C” for correct or “I” for incorrect on the data sheet.

Treatment was terminated when correct responding was observed at or above 78% on three consecutive treatment probes in both the no spaced trials or spaced trial fading conditions or once 100 sessions were completed without an increasing trend observed in the treatment probes. Once sessions were terminated, maintenance and generalization probes were implemented.

Treatment sessions were initiated with one of the remaining groups once both targets in the first group reached mastery criteria and were placed in the post-treatment phase.

Post-treatment:

Maintenance Probes: Maintenance probes were conducted at 1 week following termination of treatment. Maintenance probe sessions were conducted at the teaching table in 18 trial sessions. Each target (no spaced trials or spaced trial fading) was presented 9 times in a randomized order. Sessions were identical to the treatment probes.

Generalization Probes: Generalization probes were conducted at 1 week following termination of treatment. Generalization probe sessions were conducted in the natural learning environment in 18 trial sessions. Each target (no spaced trials and spaced trial fading) was presented 9 times in a randomized order using stimuli that were not used in the teaching environment (e.g., using a children's book with pictures rather than a 2-D card) in a location other than the teaching table (e.g., playroom). Sessions were identical to the treatment probes.

RESULTS

Figure 1 depicts the percentage of correct responding for Bea across groups A, B, and C for baseline probes, treatment probes, maintenance probes, and generalization probes. Figure 2 depicts the percentage of correct responding for Bea across groups A, B, and C for teaching sessions. In addition, table 2 depicts the mean percentage of correct responding for Bea during the transfer trial, transfer test, and treatment probes for all targets during teaching.

Figure 1. *Percentage of correct responses for Bea on treatment probes for groups A, B, and C across baseline, treatment, and post treatment sessions.*

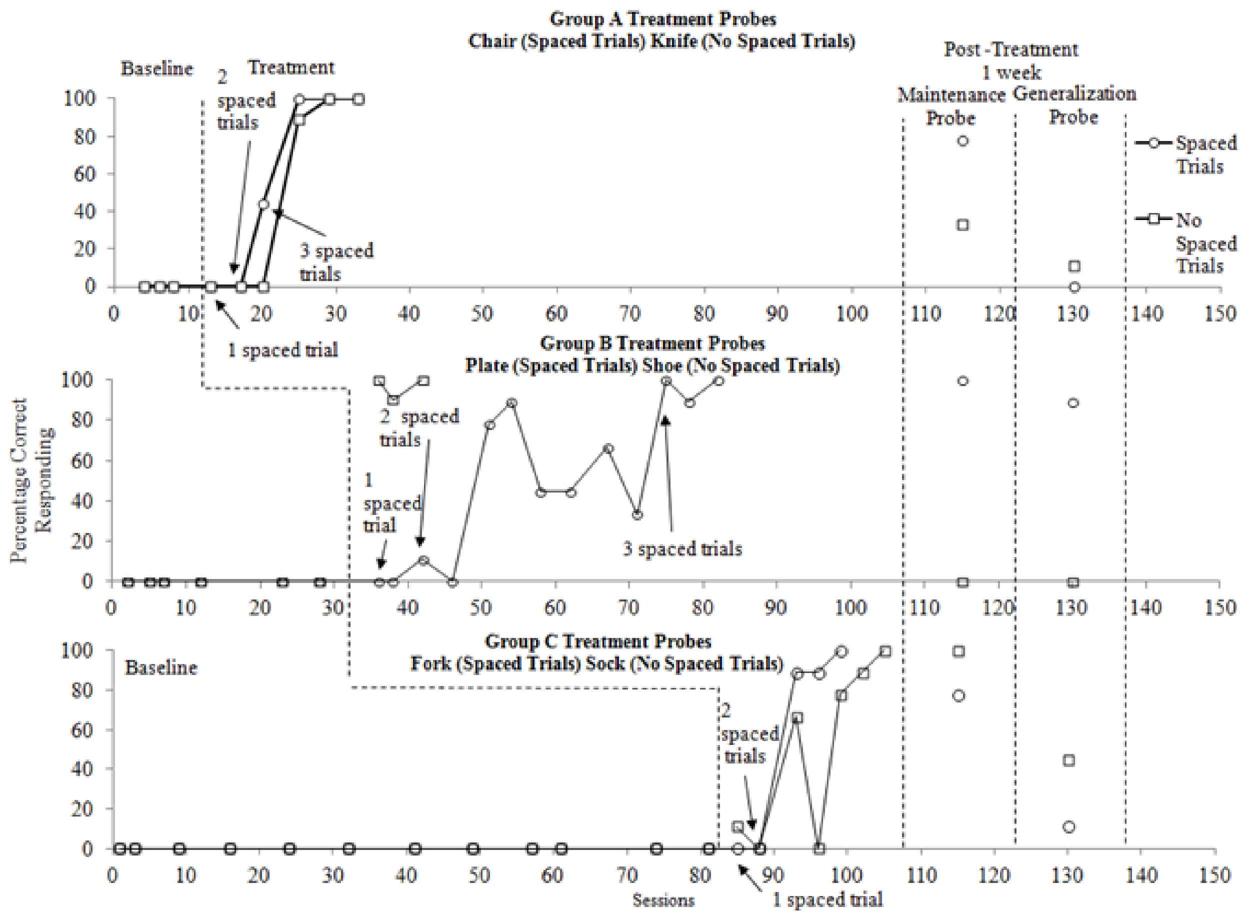

Figure 2. *Percentage of correct responses on teaching sessions for Bea across groups A, B, and C.*

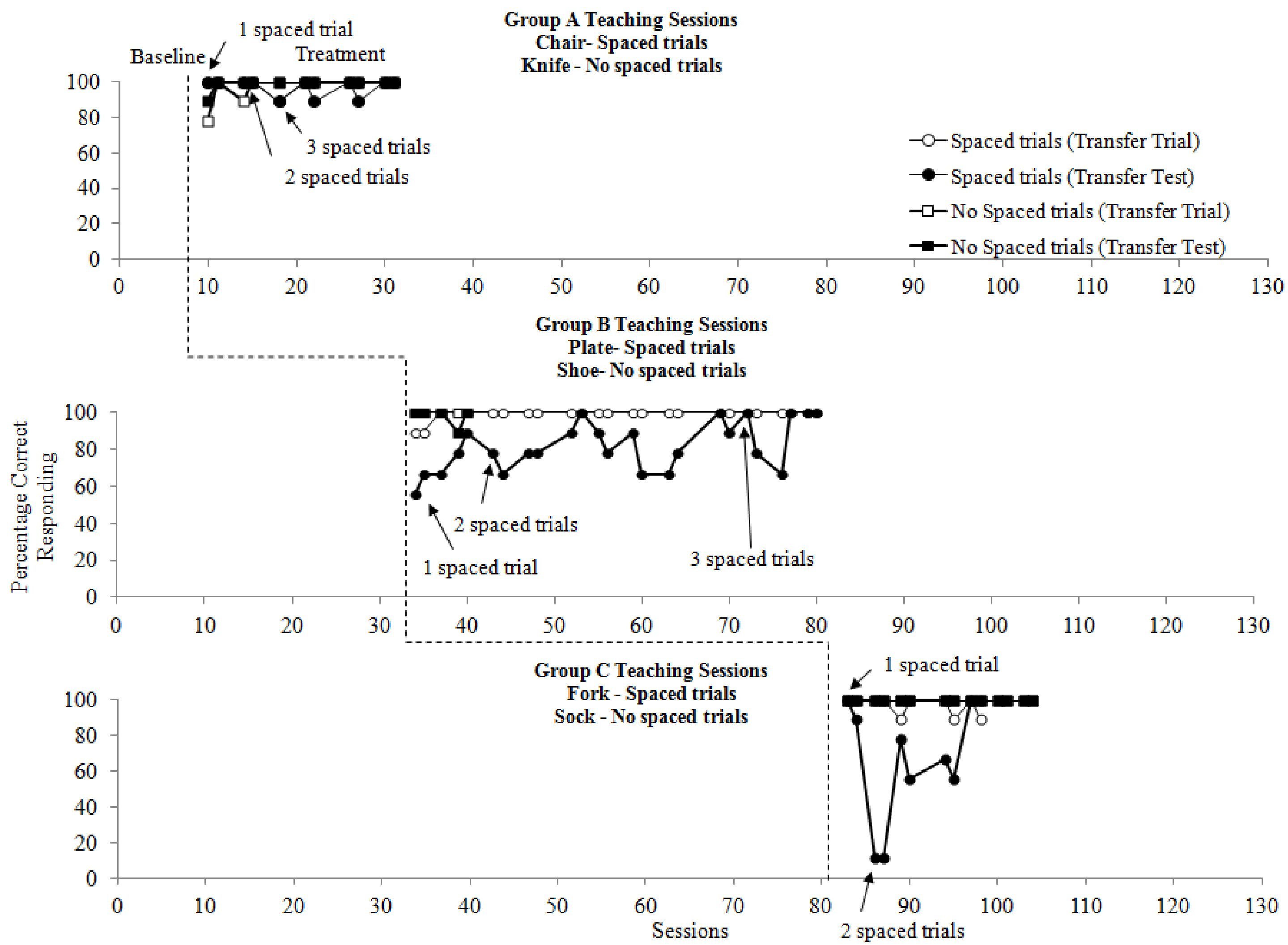

Table 2
Mean percentage of correct responding for Bea during the transfer trial, transfer test, and treatment probes for all targets.

Group	Number of Spaced Trials In Spaced Trial Fading Procedure	Mean Percentage of Correct Responding (Transfer Trial)		Mean Percentage of Correct Responding (Transfer Test)		Mean Percentage of Correct Responding (Treatment Probe)	
		Spaced Trial Fading	No Spaced Trials	Spaced Trial Fading	No Spaced Trials	Spaced Trial Fading	No Spaced Trials
A	1	100% (n=2)	88.9% (n=2)	100% (n=2)	94.4% (n=2)	0% (n=1)	0% (n=1)
	2	100% (n=2)	94.4% (n=2)	100% (n=2)	100% (n=2)	0% (n=1)	0% (n=1)
	3	98.4% (n=7)	100% (n=7)	95.2% (n=7)	100% (n=7)	86.1% (n=4)	72.2% (n=4)
B	1	92.6% (n=3)	100% (n=3)	63.0% (n=3)	100% (n=3)	0% (n=2)	95.0% (n=2)
	2	100% (n=16)	100% (n=1)	81.9% (n=16)	94.4% (n=1)	45.8% (n=8)	100% (n=1)
	3	100% (n=6)	-	90.7 (n=6)	-	80.6% (n=3)	-
C	1	100% (n=2)	100% (n=2)	94.4% (n=2)	100% (n=2)	0% (n=1)	11.1% (n=1)
	2	95.8% (n=8)	100% (n=12)	59.7% (n=8)	100% (n=12)	69.5% (n=4)	55.6% (n=5)
	3	-	-	-	-	-	-

Initially, no correct responding was observed in the baseline probes for groups A, B, and C. Treatment was initiated in group A with 1 spaced trial included in the spaced trial fading condition. During the first teaching sessions, the mean percentage of correct responding for the transfer trial was 100% and 88.9% for the spaced trial fading and no spaced trial conditions, respectively. In addition, the mean percentage of correct responding for the transfer test was 100% and 94.4% for the spaced trial fading and no spaced trial conditions, respectively. Two teaching trials were implemented in each condition before responding in the spaced trials fading condition met the criteria for the addition of a second spaced trial. Mean percentage of correct responding in the treatment probe was 0% for the spaced trial fading and no spaced trial conditions.

During the comparison between 2 spaced trials and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 100% and 94.4% for the spaced trial fading and no spaced trial conditions, respectively. In addition, mean percentage of correct responding for the transfer test was 100% for the spaced trial fading and no spaced trial conditions. Two teaching trials were implemented in each condition before responding in the spaced trials fading condition met the criteria for the addition of a third spaced trial. Mean percentage of correct responding in the treatment probes was 0% for the spaced trial fading and no spaced trial conditions.

During the comparison between 3 spaced trials and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 98.4% and 100% for the spaced trial fading and no spaced trial conditions, respectively. In addition, the mean percentage of correct responding for the transfer test was 95.2% and 100% for the spaced trial fading and no spaced trial conditions, respectively. Seven teaching trials were implemented in each condition before responding in the spaced trials fading condition and no spaced trials condition met mastery criterion. The mean percentage of correct responding in the treatment probe was 86.1% and 72.2% for the spaced trial fading and no spaced trial conditions, respectively.

One week following mastery, maintenance and generalization probes were initiated. For the spaced trials fading group, percentage of correct responding was 78% and 0% on the maintenance probe and generalization probe, respectively. For the no spaced trials group, the percentage of correct responding was 33% and 11% on the maintenance probe and generalization probe, respectively.

Following mastery of the targets in group A, treatment was initiated in group B with 1 spaced trial included in the spaced trial fading condition. During the comparison between 1 spaced trial and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 92.6% and 100% for the spaced trial fading and no spaced trial conditions, respectively. In addition, the mean percentage of correct responding for the transfer test was 63.0% and 100% for the spaced trial fading and no spaced trial conditions, respectively. Five teaching trials were implemented in each condition before responding in the spaced trials fading condition met the criteria for the addition of a second spaced trial. The mean percentage of correct responding in the treatment probes was 0% and 95% for the spaced trial fading and no spaced trial conditions, respectively.

During the comparison between 2 spaced trials and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 100% for the spaced trial fading and no spaced trial conditions. In addition, the mean percentage of correct responding for the transfer test was 81.9% and 94.4% for the spaced trial fading and no spaced trial conditions, respectively. Fourteen teaching trials were implemented before responding in the spaced trials fading condition met the criteria for the addition of a third spaced trial. Two teaching trials were implemented in the no spaced trials condition before responding met the mastery criteria. The mean percentage of correct responding in the treatment probes was 45.8% and 100% for the spaced trial fading and no spaced trial conditions, respectively.

Teaching was continued for the target in the spaced trials fading condition with 3 spaced trials. The mean percentage of correct responding for the transfer trial was 100%. In addition, the mean percentage of correct responding for the transfer test was 90.7%. Six teaching trials were implemented before responding in the spaced trials fading condition met the criteria for mastery. The mean percentage of correct responding in the treatment probes was 80.6%.

One week following mastery, maintenance and generalization probes were initiated. For the spaced trials fading condition the percentage of correct responding was 100% and 89% on the maintenance probe and generalization probe, respectively. For the no spaced trials condition percentage of correct responding was 0% on both the maintenance probe and generalization probe.

Following mastery of the targets in group B, treatment was initiated in group C with 1 spaced trial included in the spaced trial fading condition. During the comparison between 1 spaced trial and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 100% for both the spaced trial fading and no spaced trial conditions. In addition, the mean percentage of correct responding for the transfer test was 94.4% and 100% for the spaced trial fading and no spaced trial conditions, respectively. Two teaching trials were implemented in each condition before responding in the spaced trials fading condition met the criteria for the addition of a second spaced trial. The mean percentage of correct responding in the treatment probe was 0% and 11.1% for the spaced trial fading and no spaced trial conditions, respectively.

During the comparison between 2 spaced trials and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 96.7% and 100% for the spaced trial fading and no spaced trial conditions, respectively. In addition, mean percentage of correct responding for the transfer test was 59.7% and 100% for the spaced trial fading and no spaced trial conditions, respectively. Eight teaching trials were implemented in the spaced trials fading condition before the target reached mastery. Twelve teaching trials were implemented in the no spaced trials condition before the target reached mastery. Mean percentage of correct responding in the treatment probes was 69.5% and 55.6% for the spaced trial fading and no spaced trial conditions, respectively.

One week following mastery, maintenance and generalization probes were initiated. For the spaced trials fading target the percentage of correct responding was 77.8% and 11.1% on the maintenance probe and generalization probe, respectively. For the no spaced trials target the percentage of correct responding was 100% and 44.4% on the maintenance probe and generalization probe, respectively.

Results of the social validity questionnaire were collected following completion of the teaching sessions for all targets. The primary therapist scored 5 (e.g., strongly agree) on all items of the social validity questionnaire. In general, the primary therapist reported that the information gained from the analysis was useful to the treatment team and the information gained, as well as the procedures used, would be useful for teaching skills in the future.

Figure 3 depicts the percentage of correct responding for Javier across groups A, B, and C for baseline probes, treatment probes, maintenance probes, and generalization probes. Figure 4 depicts the percentage of correct responding for Javier across groups A, B, and C for teaching sessions. In addition, table 3 depicts the mean percentage of correct responding for Javier during the transfer trial, transfer test, and treatment probes for all targets. Initially, low levels of correct responding were observed in the baseline probes for groups A, B, and C. Treatment was initiated in group A with 1 spaced trial included in the spaced trial fading condition. During the comparison between 1 spaced trial and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 82.4% and 74.1% for the spaced trial fading and no spaced trial conditions, respectively. In addition, the mean percentage of correct responding for the transfer test was 74.1% and 68.5% for the spaced trial fading and no spaced trial conditions, respectively. Twelve teaching trials were implemented in each condition before responding in the spaced trials fading condition met the criteria for the addition of a second spaced trial. In this instance, decreases in correct responding were observed in the treatment probes, thus meeting the criteria for the addition of an additional spaced trial. The mean percentage of correct responding in the treatment probes was 68.5% and 42.6% for the spaced trial fading and no spaced trial conditions, respectively.

Figure 3. *Percentage of correct responses for Javier on treatment probes for groups A, B, and C across baseline, treatment, and post treatment sessions.*

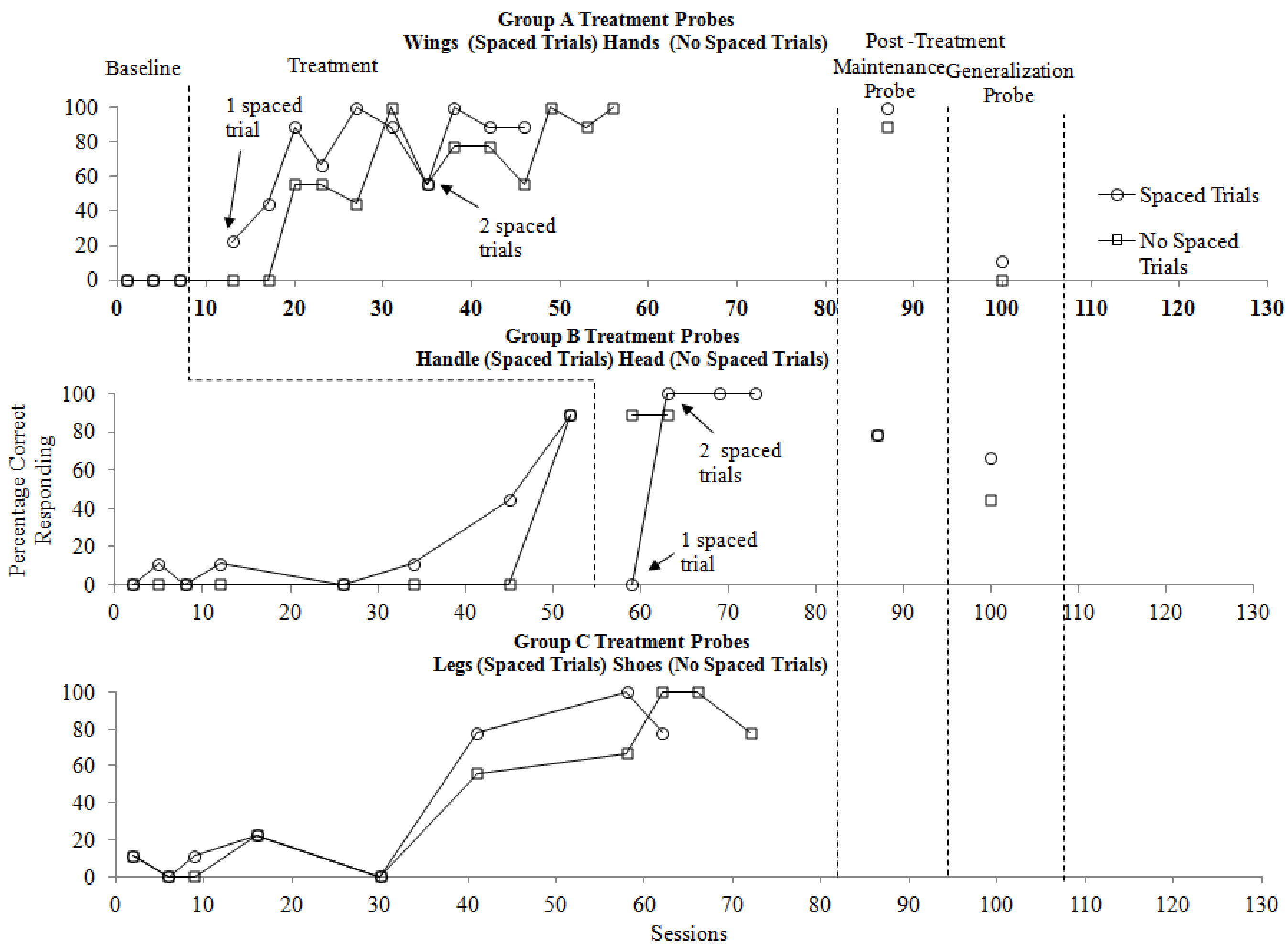

Figure 4. Percentage of correct responses on teaching sessions for Javier across groups A, B, and C.

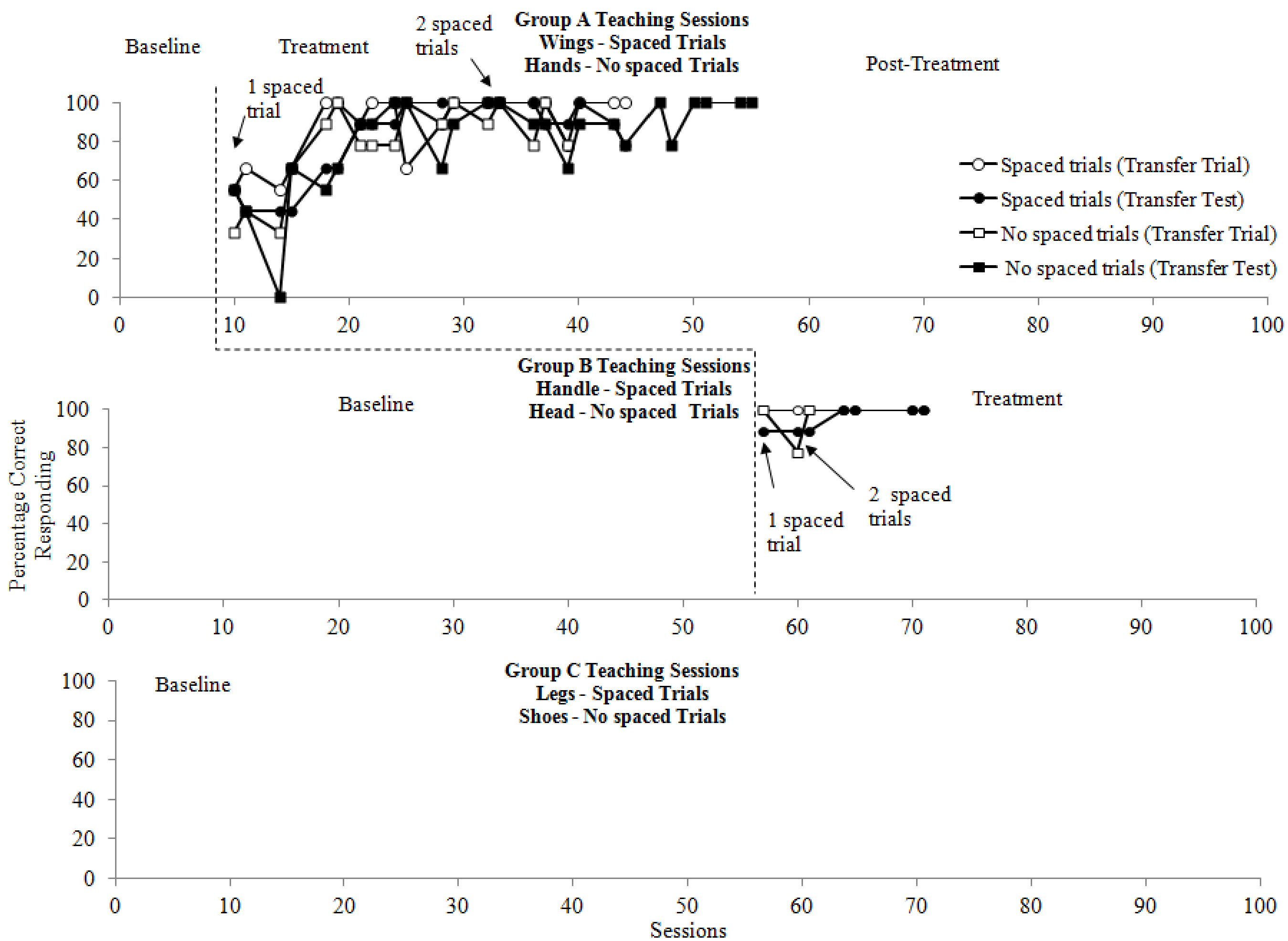

Table 3

Mean percentage of correct responding for Javier during the transfer trial, transfer test, and treatment probes for all targets.

Group	Number of Spaced Trials In Spaced Trial Fading Procedure	Mean Percentage of Correct Responding (Transfer Trial)		Mean Percentage of Correct Responding (Transfer Test)		Mean Percentage of Correct Responding (Treatment Probe)	
		Spaced Trial Fading	No Spaced Trials	Spaced Trial Fading	No Spaced Trials	Spaced Trial Fading	No Spaced Trials
A	1	82.4% (n=12)	74.1% (n=12)	74.1% (n=12)	68.5% (n=12)	68.5% (n=6)	42.6% (n=6)
	2	97.2% (n=8)	95.2% (n=14)	93.1% (n=8)	91.3% (n=14)	83% (n=4)	79.0% (n=7)
	3	-	-	-	-	-	-
B	1	100% (n=1)	100% (n=1)	88% (n=1)	100% (n=1)	0% (n=1)	88% (n=1)
	2	100% (n=6)	88.9% (n=2)	96.3% (n=6)	100% (n=2)	100% (n=1)	88% (n=1)
	3	-	-	-	-	-	-
C	1	-	-	-	-	-	-
	2	-	-	-	-	-	-
	3	-	-	-	-	-	-

During the comparison between 2 spaced trials and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 97.2% and 95.2% for the spaced trial fading and no spaced trial conditions, respectively. In addition, the mean percentage of correct responding for the transfer test was 93.1% and 91.3% for the spaced trial fading and no spaced trial conditions, respectively. Eight teaching trials were implemented before responding met mastery criteria in the spaced trials fading condition and 14 teaching trials were implemented before responding met mastery criteria in the no spaced trials condition. The mean percentage of correct responding in the treatment probes was 83.0% and 79.0% for the spaced trial fading and no spaced trial conditions, respectively. One week following mastery, maintenance and generalization probes were initiated. For the spaced trials fading target percentage of correct responding was 100% and 11% on the maintenance probe and generalization probe, respectively. For the no spaced trials target, percentage of correct responding was 88% and 0% on the maintenance probe and generalization probe, respectively.

Following mastery of the targets in group A, treatment was initiated in group B with 1 spaced trial included in the spaced trial fading condition. During the comparison between 1 spaced trial and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 100% for the spaced trial fading and no spaced trial conditions. In addition, mean percentage of correct responding for the transfer test was 88% and 100% for the spaced trial fading and no spaced trial conditions, respectively. One teaching trial was implemented in each condition before responding in the spaced trials fading condition met the criteria for the addition of a second spaced trial. Mean percentage of correct responding in the treatment probes was 0% and 88% for the spaced trial fading and no spaced trial conditions, respectively.

During the comparison between 2 spaced trials and no spaced trials conditions, the mean percentage of correct responding for the transfer trial was 100% and 88.9% for the spaced trial fading and no spaced trial conditions, respectively. In addition, mean percentage of correct responding for the transfer test was 96.3% and 100% for the spaced trial fading and no spaced trial conditions, respectively. Six teaching trials were implemented before responding met mastery criteria in the spaced trials fading condition and 2 teaching trials were implemented before responding met mastery criteria in the no spaced trials condition. Mean percentage of correct responding in the treatment probes was 88% and 100% for the spaced trial fading and no spaced trial conditions, respectively. One week following mastery, maintenance and generalization probes were initiated. For the spaced trials fading group, percentage of correct responding was 78% and 67% on the maintenance probe and generalization probe, respectively. For the no spaced trials group, percentage of correct responding was 78% and 44% on the maintenance probe and generalization probe, respectively.

For group C, gradual increases in correct responding were observed in baseline, particularly following mastery of targets in group A. The target in the spaced trial fading condition reached mastery criterion following 8 baseline sessions. The target in the no spaced trial condition reached mastery criterion following 10 baseline sessions. Treatment was never initiated for group C.

Results of the social validity questionnaire were collected following completion of the teaching sessions for all targets. The primary therapist scored 5 (e.g., strongly agree) on all items of the social validity questionnaire. In general, the primary therapist reported that the information gained from the analysis was useful to the treatment team and the information gained, as well as the procedures used, would be useful for teaching skills in the future.

DISCUSSION

The current study evaluated the effects of two teaching procedures, one with spaced trials fading and one with no spaced trials, on skill acquisition. Specifically, this study was designed to identify which procedure produced faster transfer of stimulus control from the prompt stimulus used during teaching to the S^D that functionally controlled the response. In addition, the study evaluated the effects of each teaching procedure on skill maintenance and generalization one week following mastery.

For Bea, the two teaching methods produced mastery following equal numbers of exposures to teaching trials in group A. Further analysis indicated that the mean percentage of correct responding for the spaced trials fading target was greater or equal to the mean percentage of correct responding for the no spaced trials target on the transfer trials, treatment tests, and treatment probes in the 1 spaced trials and 2 spaced trials comparisons. In the 3 spaced trials comparison, the mean percentage of correct responding for the no spaced trials target was greater than the mean percentage of correct responding for the spaced trials fading target on the transfer trials and treatment tests, but not the treatment probes. For Bea, transfer of stimulus control occurred in the treatment probes following the addition of the third spaced trial. Similar increases in correct responding were observed in the no spaced trials fading condition, however higher mean percentages of correct responding were observed in the spaced trial fading condition. Higher percentages of correct responding were observed in the maintenance probes for the spaced trials fading group compared to the no spaced trials group and similar decreases were observed in the generalization probe for both groups. For group A, the spaced trials fading and no spaced trials procedures produced transfer of stimulus control at the same rate (i.e., following the same number of teaching sessions). However, the highest mean percentage of correct responding was observed in the treatment probes and maintenance probe for the spaced trial fading target suggesting that the spaced trials fading procedure may offer additional benefits compared to the no spaced trials teaching method.

For group B, the no spaced trials teaching method produced mastery following fewer teaching trials (n=4) compared to the spaced trials fading teaching (n=25) procedure. Further analysis indicated that the mean percentage of correct responding for the no spaced trials target was greater than or equal to the mean percentage of correct responding for the spaced trials fading target on the transfer trials, treatment tests, and treatment probes in the 1 spaced trials and 2 spaced trials comparisons. For Bea, transfer of stimulus control occurred in the treatment probes following the addition of the third spaced trial. Higher mean percentages of correct responding were observed in the maintenance probe and generalization probe for the spaced trials fading group compared to the no spaced trials group. For group B, the no spaced trials method produced the most efficient transfer of stimulus control in that transfer of stimulus control occurred following significantly fewer teaching sessions. However, the spaced trials fading procedure produced the highest percentages of correct responding in the maintenance probe and generalization probe compared to the no spaced trials procedure. These results suggest that the no spaced trials method offered significant benefits the efficient transfer of stimulus control. However, the spaced trials fading method produced significantly higher percentages of correct responding on the maintenance probe and generalization probes suggesting that the spaced trials fading procedure may offer additional benefits compared to the no spaced trials procedure in terms of maintenance of the skill taught.

For group C, the spaced trials fading teaching method produced mastery following fewer teaching trials compared to the no spaced trials teaching method. Further analysis indicated that the mean percentage of correct responding for the no spaced trials target was greater than the mean percentage of correct responding for the spaced trials fading target on the transfer trials, treatment tests, and treatment probes in the 1 spaced trial comparison and 2 spaced trials comparison, with the exception of the treatment probe in the 2 spaced trial comparison. Higher percentages of correct responding were observed in the maintenance probe and generalization probe for the no spaced trials group compared to the spaced trials fading group. For group C, the spaced trial fading teaching procedure produced the most efficient transfer of stimulus control. However, the no spaced trials procedure produced the highest percentages of correct responding on the maintenance and generalization probes.

In summary, it is unclear which method produced the most efficient transfer of stimulus control during teaching considering group A targets reached mastery simultaneously, and the no spaced trial target and spaced trial fading target reached mastery criterion first in group B and C, respectively. However, it is important to note that high percentages of correct responding were observed for the spaced trials fading method for 2 of the 3 groups one week following mastery (e.g., maintenance probes) compared to the no spaced trials method. It is possible that the addition of spaced trials may have facilitated the conditions under which stimulus control developed and was transferred to the S^D that functionally maintained the response which resulted in maintenance of the response over time.

For Javier, the spaced trials fading teaching procedure produced mastery following fewer teaching trials (n=20) compared to the no spaced trials teaching procedure (n=26) for group A. Further analysis indicated that the mean percentage of correct responding for the spaced trials fading target was higher than the mean percentage of correct responding for the no spaced trials target on the transfer trials, treatment tests, and treatment probes in the 1 spaced trials and 2 spaced trials comparisons. Higher mean percentages of correct responding were observed in the maintenance probe and generalization probe for the spaced trials fading group compared to the no spaced trials group, although levels of correct responding at mastery levels were observed for both groups. For group A, the spaced trial fading teaching procedure resulted in the most efficient transfer of stimulus control and highest percentages of correct responding during the maintenance and generalization probes. The results suggest that for group A the spaced trials fading procedure was most beneficial in terms of efficient transfer of stimulus control, maintenance, and generalization.

For group B, the no spaced trials target reached mastery following fewer teaching trials compared to the spaced trials fading target, although high levels of correct responding (at mastery levels) were observed for targets across both teaching procedures. Further analysis indicated that the mean percentage of correct responding for the no spaced trials target was equal to the mean percentage of correct responding for the spaced trials fading target in the transfer trials, however the mean percentage of correct responding was higher in the treatment tests and treatment probes in the 1 spaced trials comparison.

In the 2 spaced trials comparison, higher mean percentages of correct responding were observed in the transfer trials and treatment probes for the spaced trials fading target, however higher mean percentages of correct responding were observed in the transfer tests for the no spaced trials target. Equal percentages of correct responding were observed between the spaced trial fading and no spaced trial groups for the maintenance probes. Decreases in correct responding were observed across both teaching methods in the generalization probe, with higher percentages of correct responding observed in the spaced trials fading group. In group B the no spaced trials teaching procedure produced the most efficient transfer of stimulus control compared to the spaced trials fading teaching method. Both procedures produced equal percentages of correct responding on the maintenance probes and the spaced trial fading method produced higher percentages of correct responding in the generalization probe.

For group C, increases in correct responding were observed during baseline conditions. Therefore, a comparison between the two teaching procedures was not conducted. Additionally, maintenance and generalization probes were not conducted. It is important to note that increases in correct responding in group B and group C corresponded with the mastery of targets in group A. The mechanisms responsible for the increases in correct responding, and subsequent mastery, of the targets in groups B and C are unclear. In clinic practices generalization of stimulus control may be considered a positive outcome as stimulus control was achieved without intensive teaching. These findings should be interpreted with caution. It is possible that stimulus control occurred, although it appeared that Javier learned to discriminate which card in the visual field was the target card when presented against a variety of distracter cards, versus identifying the card that matched the S^D according the specific feature, function, or class. Attention to some other salient feature of the stimulus could have resulted in faulty stimulus control (Fisher, Piazza, & Roane, 2011), resulting in high levels of correct responding.

In summary, it was unclear which procedure produced most efficient transfer of stimulus control during teaching as different results were observed in each group. In addition, the implementation of treatment in group B followed high percentages of correct responding in baseline and it is unclear if the teaching procedures alone were responsible for the high percentages of correct responding in treatment. Similar high percentages of correct responding were observed in the maintenance probes for group A and B for both teaching procedures. Similar percentages of correct responding were also observed in the generalization probe, although percentages of correct responding were slightly higher for the spaced trial fading procedure.

There are some limitations to the methodology employed in this analysis. First, in instances in which the targets did not meet mastery simultaneously, one of the targets remained in treatment, thus having additional exposure to teaching. Ultimately, in these cases additional exposures to reinforcement in the presence of the S^D occurred for one target, but not the other. Therefore it is unclear the extent to which additional exposure to treatment may have contributed to correct responding in the maintenance probes and generalization probes.

Second, the specific items selected for instruction may have influenced the speed with which transfer of stimulus control occurred. For Bea, the sign taught for “plate” was topographically similar to the sign for “ball,” which was a sign that Bea had previously mastered as a mand. It is unclear if the similarity in the topography of the sign impacted the transfer of stimulus control. Future studies may consider selecting stimuli that are dissimilar from previously mastered targets when possible. For Javier, the verbal operant selected for instruction, receptive identification by feature, function, and class, may have influenced percentages of correct responding. In Javier’s case, (as mentioned above) the 2-D stimuli were presented in a visual field of 4 and it is hypothesized that Javier may have learned to discriminate which 2-D stimuli were target cards and which 2-D stimuli were distracter cards. It is possible that each stimulus had salient features that occasioned the correct response (e.g., a card touch) rather than the specific feature, function, or class provided as an S^D. This was evidenced by occasions where Javier would attempt to make a card touch response prior to the therapist providing the S^D. This may account for the increases in correct responses for targets in group B and group C once Javier’s correct responding contacted reinforcement and transfer of stimulus control was occurring at mastery levels in the treatment probes in group A. These idiosyncratic variables should be taken into consideration when selecting targets for instruction in future analyses and when assessing the S^Ds that are controlling a response.

In addition, there are two key differences between the methods employed in the present study and typical clinic practice. First, in typical clinic practice one cold probe is conducted prior to initiating teaching to determine if the S^D alone will evoke the correct response following a period of time without exposure to teaching (i.e., the presentation of the S^D in the absence of the prompt stimulus). This procedure allows for the assessment of transfer of stimulus control, but minimizes the number of presentations of the S^D that are not followed by the correct response and reinforcement. This evaluation conducted one treatment probe (cold probe) prior to initiating teaching, however during the treatment probe each target was presented 9 times. The number of exposures to the S^D without exposure to teaching was significantly greater in this analysis. Future analyses may consider minimizing the number of presentations of the S^D in the absence of the prompt stimulus (e.g., cold probes, treatment probes) for the purposes of assessing transfer of stimulus control and maximizing the conditions under which stimulus control may occur.

Second, in clinic practices, correct responses following the presentation of a S^D contact reinforcement on cold probes. In this evaluation no feedback was provided for correct or incorrect answers following presentation of the S^D. The proportion of correct responses following presentations of the S^D while not contacting reinforcement may have been significantly higher compared to the proportion of correct responses following presentations of the S^D while contacting reinforcement. This has significant implications when considering the optimal conditions under which transfer of stimulus control occurs. Future evaluations should consider decreasing the possible number of times a correct response could occur in the presence of the S^D, but not contact reinforcement in order to maximize the potential for development of stimulus control.

It is also possible that the exposure to treatment probes where reinforcement was withheld for the target responses, specifically following periods of reinforcement during the teaching sessions, may have exposed responses, and particularly correct responses in the presence of the S^D, to extinction. It is likely that side effects of extinction were not observe due to access to reinforcement following the completion of mastered tasks (i.e., reinforcement was still available). Future evaluations may consider the addition of reinforcement for correct responses during treatment probes.

While limitations to the methodology do exist there are significant implications for practitioners, particularly when selecting teaching procedures for learners. Specific patterns of responding were apparent for each of the participants included in this analysis. For example, in the no spaced trials condition it was observed that Bea initially formed the sign that corresponded with the target following the transfer trial and prior to the therapist presenting the S^D on the transfer test despite Bea's hands being placed in a neutral, ready position between presentations of the S^D. While the persistence of the response that was reinforced on the previous trial suggests behavioral momentum (Nevin, 1996) data collection on this pattern of responding did not occur, therefore it is unclear if behavioral momentum is responsible for correct responding or if the S^D evoked the correct response. For learners that fit this pattern of responding, utilizing a spaced trials fading procedure programs for rapid exposure to varying S^Ds, thus resulting in conditions that increase the likelihood that the S^D evokes the correct response. It is likely that the high percentages of correct responding in the spaced trial fading condition for group A and group B in the maintenance probes was a result of efficient transfer of stimulus control.

For Javier, similar patterns of responding were observed for the stimuli in group B and C. It was observed that Javier attempted to engage in a card touch response prior to the therapist presenting the S^D. In this case the presentation of the 2-D stimuli may have been a signal that reinforcement was available for card touching, thus evoking a card touch response. In addition, it appeared as if Javier had discriminated which cards were distractor cards and selected the target stimulus independent of an S^D being provided. It is likely that faulty stimulus control occurred in that the presence of the 2-D stimuli controlled the response as opposed to the S^D provided by the therapist. Data collection on this pattern of responding did not occur, therefore it is unclear which S^D (e.g., the 2-D stimuli or the therapists instruction) evoked the correct response. For learners that fit this pattern of responding, utilizing a spaced trials fading procedure may be useful to address the potential that the 2-D stimuli may have been a signal that reinforcement was available for card touching, specifically when utilized with the 2-D stimuli present. For example, practitioners may present an array of 2-D stimuli, but program spaced trials that are incompatible with a card touch response (e.g., "touch your nose"), thus resulting in conditions that increase the likelihood that the S^D evokes the correct response, not extraneous features of the environment. For situations where learners adhere to other salient features of stimuli, practitioners may employ other strategies for training the skill such as increasing the size of the array or training multiple exemplars.

Future research should evaluate ways to determine the optimal conditions under which learners will maximize transfer of stimulus control during teaching. Results of this analysis indicated that the rate at which participants learn most efficiently was specific to the individual learner and varied between groups of stimuli presented. However, utilizing a systematic procedure to increase the number of spaced trials to facilitate transfer of stimulus control on the transfer trial and the transfer test may be beneficial for expediting the rate at which transfer of stimulus control occurs and may be a useful procedure when a no spaced trials teaching procedure does not facilitate transfer of stimulus control efficiently. This is of specific importance in situations where transfer of stimulus control is not occurring from the controlling prompt to the functional S^D or when transfer of stimulus control is occurring from the controlling prompt to some other S^D. This was the case for both participants, where the addition of spaced trials facilitated the transfer of stimulus control following periods of teaching where correct responding was not observed in the transfer trial and transfer test, as well as the treatment probe. In addition, there may be added benefit for the use of spaced trial fading procedures on maintenance and generalization of stimulus control following the termination of treatment.

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Appendix A

Baseline, Treatment Probe, Maintenance Probe, and Generalization Data Sheets

Client: Primary

Date: IOA

Session #

GROUP: A B C

1 2 3 4 SPACED

1	CP	C	I
2	CP	C	I
3	CP	C	I
4	CP	C	I
5	CP	C	I
6	CP	C	I
7	CP	C	I
8	CP	C	I
9	CP	C	I

TARGET:

CONDITION:

NO SPACED

1	CP	C	I
2	CP	C	I
3	CP	C	I
4	CP	C	I
5	CP	C	I
6	CP	C	I
7	CP	C	I
8	CP	C	I
9	CP	C	I

TARGET:

Appendix B

Treatment Data Sheets

Client:
Date:
Session #

Primary
IOA

GROUP: A B C
1 2 3 4 SPACED

1	CP	C	I
	TT	C	I
	TEST	C	I
2	CP	C	I
	TT	C	I
	TEST	C	I
3	CP	C	I
	TT	C	I
	TEST	C	I
4	CP	C	I
	TT	C	I
	TEST	C	I
5	CP	C	I
	TT	C	I
	TEST	C	I
6	CP	C	I
	TT	C	I
	TEST	C	I
7	CP	C	I
	TT	C	I
	TEST	C	I
8	CP	C	I
	TT	C	I
	TEST	C	I
9	CP	C	I
	TT	C	I
	TEST	C	I

CONDITION:
NO SPACED

1	CP	C	I
	TT	C	I
	TEST	C	I
2	CP	C	I
	TT	C	I
	TEST	C	I
3	CP	C	I
	TT	C	I
	TEST	C	I
4	CP	C	I
	TT	C	I
	TEST	C	I
5	CP	C	I
	TT	C	I
	TEST	C	I
6	CP	C	I
	TT	C	I
	TEST	C	I
7	CP	C	I
	TT	C	I
	TEST	C	I
8	CP	C	I
	TT	C	I
	TEST	C	I
9	CP	C	I
	TT	C	I
	TEST	C	I

Appendix C

Treatment Integrity Data Sheets

TREATMENT INTEGRITY

Name:_______________ Primary Therapist: ____________________

Date: _____________________

	Session #				
Step Observed	**Y/N/NA**	**Y/N/NA**	**Y/N/NA**	**Y/N/NA**	**Y/N/NA**
1. Correct target presented					
2. Correct Sd presented					
3. Correct consequence presented (i.e., no praise in BL or SR + is TX)					
4. Mastered target interspersed					
5. SR+ for mastered targets on FR 2					

Appendix D

Satisfaction Questionnaire

Participant's Initials:___________ Person Completing Questionnaire:___________
Date:________

1. In an overall, general sense, I am very satisfied with the information on __________'s skill acquisition that I received?

1	2	3	4	5
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

2. The instructional method that had fastest skill acquisition will be effective to teach other skills.

1	2	3	4	5
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

3. The information I learned from the analysis will be valuable to ___________'s team of therapists.

1	2	3	4	5
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

4. I would use these procedures in the future with other clients to determine the most effective instructional method.

1	2	3	4	5
Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree

Comments

BIOGRAPHY OF AUTHOR

Amanda Nicole Zangrillo was born in Pullman, Washington. She obtained her high school diploma from Blue Valley High School in Stilwell, Kansas in 1999 and a Bachelor of Arts degree with a major in Human Development and Family Life from the University of Kansas in 2003.

Following graduation Ms. Zangrillo pursued further training in assessment and intervention for children with severe developmental disabilities at the Marcus Autism Center in Atlanta, GA. During this opportunity she gained experience employing behavior analytic principles in the treatment behavior disorders. In addition, Ms. Zangrillo participated in research projects and presented research at national conferences. While working at the Marcus Autism Center Ms. Zangrillo also completed a Master's of Science degree in Educational Psychology from Georgia State University in 2008.

In September of 2007, Ms. Zangrillo began a doctoral program in school psychology at the University of Southern Maine. During studies at University of Southern Maine she focused extensively on research and applied behavior analysis, but also gained a diverse background in curriculum development, Response to Intervention methodologies, and academic and cognitive assessment. While pursuing coursework at University of Southern Maine, Ms. Zangrillo also worked as the chief Clinical specialist for Providence Service Corporation's ACHIEVE program.

As part of her experience at the Marcus Autism Center and University of Southern Maine, Ms. Zangrillo had the opportunity to participate in several research projects, serve as a guest reviewer for The Journal of Applied Behavior Analysis, and has also been given the opportunity to present research projects at the annual meetings of the Association for Behavior Analysis. In addition, she had had opportunities to serve as a graduate teaching assistant at the

University of Southern Maine under the mentorship of F. Charles Mace and have provided courses in Behavior Analysis as part of staff training.

During her pre-doctoral internship year from 2011 to 2012, she had to opportunity to complete an additional year of intensive training at the Marcus Autism Center. Areas of focus included the application of behavior analytic principles to the assessment and treatment of severe behavior disorders and pediatric feeding disorders, as well as training in verbal behavior techniques.

Following the completion of degree requirements, Ms. Zangrillo began a post-doctoral fellowship at The May Institute in Randolph, MA in July 2012. In this position she serves as the Clinical Director for the Early Learning Core in the day treatment program. *Ms. Zangrillo* currently holds Board Certified Behavior Analyst credentials and is a member of the Applied Behavior Analysis International organization. She plans to work toward licensure as a psychologist in Massachusetts over the coming year.