

## Establishment of Conditioned Reinforcement for Visual Observing and the Emergence of Generalized Visual-Identity Matching

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A nonconcurrent multiple-probe design was used to test effects of establishment of conditioned reinforcement for observing 2-dimensional (2D) print on the emergence of generalized match-to-sample (MTS) for 77 print stimuli and book preference in free time by 3 kindergarteners with autism spectrum disorders. The analysis showed functional relations between establishment of reinforcement for observing pages of print on (a) emergence of generalized MTS and (b) preference (i.e., conditioned reinforcement) for looking at books in free play. Consistent with other recent research, the findings suggest (a) the importance of establishing conditioned reinforcement for observing responses as a prerequisite for the emergence, or acceleration, of discrimination learning; and (b) affirmation of this as a behavioral developmental cusp.

*Keywords:* conditioned reinforcement, operant-observing responses, generalized visual-identity matching, behavior developmental cusps, capabilities for language

Generalized visual match-to-sample (MTS) is a key repertoire for all children. For example, it may be a prerequisite for learning visual discriminations and hence learning the names of things in the visual world. When visual discrimination is present, children immediately recognize the sameness of stimuli without instruction. It is a prerequisite for learning visual discriminations because before discriminating between stimuli, one must first recognize the sameness of stimuli (Engelmann & Carnine, 1991). It then follows that one needs to recognize that stimuli are the same before one can learn the names of things. While this repertoire apparently emerges incidentally in typically developing children, for some young children with an ASD, MTS for print such as Arabic numbers, pictures, shapes, or colors often needs to be taught separately. When generalized visual-identity matching is

present, children may require little or no instruction in matching novel stimuli. Generalized visual-identity matching meets the criteria for a behavioral developmental cusp identified by Rosales-Ruiz and Baer (1996, 1997) because its onset either allows children to emit new responses to stimuli (which, prior to its emergence, they could not) or accelerates the learning of visual MTS.

Experiments and demonstration studies have identified response observation as a class of operant behavior that is selected out by the consequences of the observation (Greer, Dorow, Wachhaus, & White, 1973; Holland, 1958; Lovitt, 1968; Lovitt, 1965; Morgan & Lindsley, 1966). Therefore, the control of print stimuli for looking is a case of conditioned reinforcement of those stimuli for observing responses (Dinsmoor, 1983; Greer, 2008). The reinforcer for observing selects out attention as identified first by Holland (1958). The processes for establishing stimuli as conditioned reinforcers has traditionally been attributed to Pavlovian second-order conditioning using stimulus-stimulus (S-S) pairing procedures (Greer, Pistoljevic, Cahill, & Du, 2011; Keohane, Pereira-Delgado, & Greer, 2009; Sundberg, Michael, Partington, & Sundberg, 1996; Williams, 1994; Williams & Dunn, 1991a, 1991b). Current evidence affirms that the conditioning phenomenon involves either the S-S pairing or con-

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textual operant contingencies (Donahoe & Palmer, 2004; Fantino, 2008). That is, either Pavlovian, operant, or implicit respondent–operant interlocking histories may establish conditioned reinforcers.

Instrumentation and measurement procedures have been developed to assess free-operant observing preference and reinforcement value in the 1960s (Lovitt, 1968; Morgan & Lindsley, 1966). Using this instrumentation to measure reinforcement value, the effectiveness of the S-S pairing process has been tested in numerous laboratory studies with children demonstrating that the participants spent more free time with previously nonpreferred auditory stimuli (i.e., initially nonpreferred music) in free-operant laboratory conditions as a result of using the S-S pairing procedures (Greer, Dorow, & Hanser, 1973; Greer, Dorow, & Randall, 1974; Greer, Dorow, Wachhaus, et al., 1973). In these studies that used experimental- and control-group designs, the DV comprised conditioned reinforcement for selection of previously nonpreferred auditory stimuli. Later on, in an experimental- and control-group study by Greer, Dorow, and Wolpert (1980), the DV comprised the rate of learning MTS auditory discriminations. The pre- and posttest discrimination-learning tasks involved matching arbitrary colored index cards to auditory examples, when the examples were the initially nonpreferred auditory stimuli. The IV was the establishment of conditioned reinforcement for the previously nonpreferred auditory stimuli made possible by S-S pairings. Based on the data, the authors surmised that the establishment of conditioned reinforcement for the stimuli led to acceleration of discrimination learning. Moreover, the degree of reinforcement value for the stimuli in free-operant laboratory conditions, measured as time spent choosing the stimuli, and the number of instructional trials needed to master related discriminations were significantly and negatively correlated with instructional trials to criterion on related discrimination learning (Pearson  $R = -.99$ ). More selection of the stimuli resulted in fewer instructional trials to mastery of related discriminations. This showed a high degree of concomitant relations between the selection of the stimuli and fewer instructional trials to mastery of related discriminations.

Not unlike the auditory stimuli in the study described above, other discrimination learning

also involves observing responses. Listener responding in vocal verbal behavior, (e.g., phonemic awareness, which in turn makes instructional control possible; visual discriminations of shapes and objects; and even gustatory discriminations require observing responses). Incorporation of the role of the listener in Skinner's (1957) theory of verbal behavior (Greer & Ross, 2008; Hayes, Barnes-Homes, & Roche, 2001; Horne & Lowe, 1996) would appear also to implicate operant-observing responses in the role of the listener. In the verbal behavioral development theory (Greer & Keohane, 2005; Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009; Keohane, Luke, & Greer, 2008), verbal developmental cusps and the reinforcement control for the related observing responses have been experimentally identified and used to clarify different types of verbal developmental phenomena, as well as the foundational cusps for verbal development (e.g., generalized visual-identity matching). Thus, many of the foundational cusps in the latter theory are observational responses that appear to be selected out by the reinforcement control of the stimuli observed. See Greer and Longano (2010) and Greer and Speckman (2009) for a review of that literature.

When individuals reach a behavioral developmental cusp, they can learn from coming in contact with the aspects of their environment, which they could not do before (Rosales-Ruiz & Baer, 1996, 1997; Tsai & Greer, 2006). Rosales-Ruiz and Baer (1996) stated that the attainment of a cusp results in new or accelerated learning or new contact with contingencies that were inaccessible before the attainment of the cusp. Therefore, when a major developmental advancement or cusp requires observing responses, the reinforcement control for the stimuli would seem to be a prominent part of the process.

Although the cusps were identified as developmentally seminal behaviors (e.g., first walking steps) in the Rosales-Ruiz and Baer (1996) paper, recent researchers have identified several cusps as newly established conditioned reinforcers that then accelerate or make new discrimination learning possible. In support of this, the attainment of new conditioned reinforcers has been shown to result in accelerated and rapid-discrimination learning in young children (Greer, 2008; Greer et al., 2011; Greer & Speckman, 2009; Keohane et al., 2009) and the

acceleration of learning in pigeons (Dinsmoor, 1983; Dinsmoor, Bowe, et al., 1983). Dinsmoor, Bowe et al. (1983) summarized the revision of the role of conditioned reinforcement in discrimination learning suggested by their findings:

It is not the discriminative performance that is necessary for observing, but the observing that is necessary for the discriminative performance. Perhaps Keller and Schoenfeld's (1950) dictum should be revised to read: "In order to act as a discriminative stimulus for any subject, a stimulus must be observed by that subject." (p. 263)

The establishment of reinforcement for observing responses has led to accelerated learning of (a) responding as a listener, greater general awareness, and preference for listening to stories (i.e., speech recordings as conditioned reinforcers for choosing; Greer et al., 2011); (b) visual discriminations (i.e., print stimuli as conditioned reinforcement for looking; Pereira-Delgado, Greer, Speckman, & Goswamy, 2008); (c) acquiring Naming or the incidental learning of new vocabulary (i.e., establishment of voices and visual stimuli as conditioned reinforcers; Longano, 2008); and (d) textually responding (i.e., books as conditioned reinforcers for choosing and prolonged looking; Tsai & Greer, 2006). We capitalize Naming in this study, and several earlier published papers, to distinguish the layperson usage from the special usage in the study of verbal behavior. Although generalized visual-identity matching, or MTS itself, is not a verbal developmental cusp or capability per se (Greer & Keohane, 2005; Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009; Skinner, 1957), in the verbal behavioral development theory, it is regarded as a prerequisite, or verbal foundational, cusp.

Tsai and Greer (2006) found that, when books and toys were available in free time, the establishment of conditioned reinforcement for observing books and preference for looking at books led to significant acceleration in children's learning to textually respond to words (i.e., see text and say word). Typically developing 2-year-olds, who were native Mandarin speakers, were taught to textually respond to English sight words before and after they acquired conditioned reinforcement for looking at books and preference for books over toys in free-play settings. In the intervention, primary

reinforcers were paired with looking at books, using an S-S pairing procedure described herein, until the children chose to look at books for 75% of 5-min free-play sessions in which choices of toys and books were available. After the books became preferred, hence were established as conditioned reinforcers for observing responses, the children learned sight words significantly faster than they did prior to the establishment of books as conditioned reinforcers for looking at books and as a preferred activity in free play. The conditioning of the print stimuli as reinforcers for observing responses led to accelerated learning.

Greer et al. (2011) found that the establishment of voices as conditioned reinforcement for listening to recordings of voices resulted in acceleration of learning from vocal instruction, increased general awareness of individuals in the environment, choosing to listen to stories in free time, and decreases in stereotypy in three preschoolers with ASD. The same S-S pairing procedure that was used in the Tsai and Greer (2006) study was used in this study, although the stimuli were auditory in the latter study rather than visual in the study presented herein. The participants were chosen because they did not learn from vocal instruction, did not attend to voices, did not choose to listen to stories read by adults, and were generally unaware of adults entering the room or speaking, as shown by pre-intervention probes and thorough classroom assessments. They received S-S pairings of primary reinforcers with listening to recordings of voices (i.e., initially primary reinforcers of edibles with voices that were not conditioned stimuli) until they chose to listen to recordings of voices for 90% of 5-min free-play sessions. After this intervention, all three subjects accelerated their rates of learning instruction involving vocal directions, two chose to listen to stories in free play, and two demonstrated greater general awareness of the presence of novel adults and adult voices. General awareness was tested by probes for the participants' orientation toward and observation of adults and adult voices when they entered the room at various distances from the participants.

Longano (2008), in an unpublished dissertation, found that conditioning voices and visual stimuli for observing responses (either visual-conditioned reinforcer stimuli with speech that was not a conditioned reinforcer, or nonrein-

forcer stimuli with a visual-conditioned reinforcer) using the S-S procedure resulted in the emergence of Naming (i.e., the ability to acquire the names of things incidentally). Several experiments have shown that Naming, or the ability to learn the names for things as both speaker and listener incidentally, can result from multiple-exemplar training across speaking and listening with training sets (Fiorile & Greer, 2007; Gilic & Greer, 2011; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005; Greer, Stolfi, & Pistoljevic, 2007). In a series of three recent experiments, Longano (2008) found that when young children did not acquire Naming from multiple-exemplar instruction (MEI) across speaking and listening, 3 of the 4 children acquired Naming when they were required to echo as they matched and pointed to stimuli during training: The fourth child did not acquire Naming. With the fourth child, conditioned reinforcement for listening and looking at visual stimuli was established through S-S pairings, as described above, and Naming emerged. In the final experiment, three children without ability to Name acquired Naming as a function of S-S pairings for voices and visual stimuli with no other intervention. This suggested that conditioned reinforcement for both visual stimuli and voices might be the reinforcement cusps that allow MEI to result in Naming.

One directly related study (Pereira-Delgado et al., 2008) indicated that children accelerated their rate of visual MTS learning (i.e., decreased instructional trials to criterion) following the establishment of two-dimensional (2D) stimuli as conditioned reinforcement for prolonged observing responses. However, no study has tested the effect of conditioning 2D print stimuli as reinforcers for observing responses on the emergence of generalized or untaught visual 2D MTS responding. In the present experiment, we tested if the establishment of conditioned reinforcement for 2D print stimuli would result in the emergence of MTS responding without instruction (i.e., generalized visual-identity responding).

## Method

### Participants

Three 5-year-old boys diagnosed with ASD participated in the experiment. Participants A,

B, and C were recruited from a combined kindergarten–third grade self-contained special education classroom in which the CABAS (Comprehensive Application of Behavior Analysis to Schooling) model of instruction and curricula (which included the prerequisites to and components of the *New York State Educational Standards for Kindergarten to Third Grade*; Greer, 1994) and the *CABAS International Curriculum and Inventory of Repertoires for Children from Preschool through Kindergarten* (C-PIRK; Greer & McCorkle, 2009; Reed, Osborne, & Corness, 2007; Waddington & Reed, 2009).

At the onset of the experiment, Participant A functioned at the beginning listener and pre-speaker levels for nonvocal verbal behavior (Greer & Keohane, 2005; Greer & Ross, 2008). He could maintain eye contact for up to 5 s. Prior to coming to the current classroom, he had been taught to use some basic sign language to emit a few sign mands (e.g., open, eat, more) and he emitted few vocal sounds that had no speech mand or tact functions (e.g., /h/, /k/, /th/). The participant was not toilet trained.

Participant B functioned at the beginning listener and speaker levels of vocal verbal behavior at the onset of the experiment. He maintained eye contact for up to 10 s and emitted mands and tacts using autoclitics (e.g., “I want juice, please,” “That’s Thomas the Train!” while pointing at a picture of the train). He was toilet trained and independently emitted a mand for the toilet using a full sentence (e.g., “I need toilet, please!”).

Participant C was functioning at the beginning listener and speaker levels of vocal verbal behavior at the onset of the experiment. He maintained eye contact for up to 160 cumulative seconds over 20 trials while being spoken to as a function of a protocol to teach conditioned reinforcement for looking at the faces of adults as they emitted facial and spoken words and sounds. He emitted mands with autoclitics (e.g., “I want cookie, please;” “No;” “Up, please;” “That’s Thomas the train”). Also, he followed vocal directions for one-step directions (e.g., touch nose, clap hands, stand up). At the onset of the study, he had been toilet trained, and emitted spoken mands for the toilet using spoken verbal phrases (e.g., “I want toilet, please;” “Toilet, please”).

The participants were selected for this study because they did not attend to instructional print stimuli materials, including alphabet letters, Arabic numbers, colors, shapes, and identical pictures on flashcards in visual MTS curricular objective assessments. The curricular objectives taught to the students before and after the conditioning intervention are shown in Table 3. During the intervention, all instruction was ceased except for the basic listener programs (e.g., sit, sit still), mand programs (e.g., “I want \_\_\_\_, please”), and one-step direction-following programs. These programs did not interfere with the test for the MTS responses and were regarded as essential instruction that needed to be maintained for ethical reasons. Once the experiment was concluded, the instruction on curricular objectives was reintroduced or new curricular objectives were introduced (e.g., sort, point to, match, and/or emit tact responses to 2D print stimuli). Research-based tactics (e.g., time-delay procedures, stimulus prompts) were implemented using blocks of 20 instructional trials meeting the criteria for

learn-unit presentations; however, the participants did not respond accurately to the MTS curricular assessment. See Tables 1, 2, and 3 for full descriptions of the participants.

All participants received individualized one-on-one or small-group instruction (i.e., consisting of two to three students) in all subject areas throughout the school day and attended some instruction outside of the classroom two to three times a week before and after the interventions (i.e., speech therapy, occupational therapy, physical therapy, physical education). Before the onset of the experiment, Participants A and B did not have histories of instruction that consisted of instructional trials that met the criterion of the learn unit (Albers & Greer, 1991; Emurian, 2004; Emurian, Hu, Wang, & Durham, 2000; Greer, 1994; Greer, 2002; Greer & McDonough, 1999; Ingham & Greer, 1992). Learn units were used in teaching the curricular objectives in the C-PIRK (Greer & McCorkle, 2009).

The participants' existing verbal repertoires (see Table 1) were assessed using C-PIRK

Table 1  
*Participant Descriptions*

Participant	A	B	C
Age	5.5	5.3	5.7
Gender	Male	Male	Male
Diagnosis	Autism	Autism	Autism
Grade level	Kindergarten	Kindergarten	Kindergarten
Levels of verbal behavior	Prelistener Prespeaker Prereader Prewriter	Emergent listener Speaker Prereader Prewriter	Prelistener Speaker Prereader Prewriter
Developmental verbal cusps and capabilities	Conditioned reinforcement for voices, and objects visual stimuli on desktop; capacity for sameness across senses	Teacher presence results in instructional control over child; conditioned reinforcement for voices, and 3d objects visual stimuli on desktop; capacity for sameness across senses; generalized imitation; echoic-to-mand; echoic-to-tact; independent mands; transformation of establishing operations	Teacher presence results in instructional control over child; conditioned reinforcement for voices, and 3d objects visual stimuli on desktop; echoic-to-mand; echoic-to-tact; independent mands; transformation of establishing operations
Repertoire	Emitted two mands using sign language; emitted eye contact; followed vocal directions; was not toilet trained	Emitted mands and tacts with autoclitics; emitted eye contact; followed vocal directions; was toilet trained	Emitted mands with autoclitics; Emitted eye contact; followed vocal directions; was toilet trained

Table 2  
*Participants' Standardized Test Scores*

Participant		
A	B	C
Test scores were not available.	<i>Stanford–Binet Intelligence Scale</i> (5 <sup>th</sup> ed.): Visual–Spatial Processing; SS = 56; Working Memory; SS = 54; Fluid Reasoning; SS = 53; Knowledge; SS = 57; Nonverbal IQ; SS = 52; Verbal IQ; SS = 57; <i>Vineland Adaptive Behavior Scales–Adaptive Behavior Composite</i> ; SS = 65; Communication Domain; SS = 59; Socialization Domain; SS = 65; <i>BASC-PRS–Behavioral Skills Composite</i> ; <i>t</i> score = 73; <i>CELF–Preschool</i> : Total Language; SS = 48	<i>Stanford–Binet Intelligence Scale</i> (5 <sup>th</sup> ed.): Full-Scale IQ; SS = 51; Nonverbal IQ; SS = 60; Verbal IQ; SS = 47; <i>Vineland Adaptive Behavior Scales–Adaptive Behavior Composite</i> ; SS = 65; <i>Preschool Language Scales–4–Auditory Comprehension</i> ; SS = 69; Expressive Communication; SS = 55; total language score; SS = 58; <i>Learning Accomplishment Profile–Diagnostic–Cognitive Counting, Matching, Writing</i> : –2.33, –2.33, –2.33 <i>SD</i> below mean

*Note.* SS = standard score; CELF = Clinical Evaluation of Language Fundamentals; BASC-PRS = Behavior Assessment System for Children–Parent Rating Scales.

(Greer & McCorkle, 2009; Reed, et al., 2007; Waddington & Reed, 2009), which is a curriculum-based assessment with which assessors are calibrated before use and continuously monitored for accuracy in presenting learn units (the teacher measure) and recording data on the students' responses to learn units. The C-PIRK includes assessments of children's existing repertoires, including 302 objectives across academic literacy and language use (173 objectives), children's community of reinforcers (16), self-management (57), and physical development (56). In addition, the children's verbal developmental cusps and capabilities, as identified in Greer and Ross (2008) and Greer and Speckman (2009), are assessed according to procedures outlined in Greer and Ross (2008). The standardized tests reported in Table 2 for Participants B and C were conducted by professionals within an agency in the participants' previous school district (i.e., not done at the school by the experimenters) and obtained from their files. Test scores for Participant A were not available. Table 2 summarizes the test scores.

### Setting

All sessions in the study took place in the self-contained classroom. The classroom consisted of three large horseshoe-shaped tables for independent or small-group instruction. It also contained two computer stations on one side of the classroom, and on the other side of the

classroom was a large carpeted area used for quiet reading or free play that included bookshelves, various educational games, blocks, puzzles, and books.

The pre- and postassessments and the intervention sessions took place at one of the large horseshoe-shaped instructional tables, and the participants sat in child-sized chairs and the experimenter sat next to the participant in an adult- or a child-sized chair (Figures 1 and 2). During the probe and experimental sessions, the other students in the classroom were engaged in one-on-one instruction, free time in the play area, or a small group instruction with a teacher or teacher assistant where the components of the instructional model were implemented for all instruction, i.e., presenting learn units, doing C-PIRK assessments (Greer & McCorkle, 2009), recording data, delivering positive reinforcement contingent on the emission of appropriate social behavior, and receiving unsequenced test and S-S pairing trials.

### Materials

Materials used during this study included a black-ink pen, a clipboard, and preconstructed data forms (see Figure 3). During conditioning, 2D print-stimuli intervention and pre- and post-conditioning probe sessions that confirmed the implementation of the IV, several sets of 20.32 cm × 27.94 cm size sheets of pages containing 15 small pictures (i.e., 5 columns and 3 rows)

**Table 3**  
*Participants Programs Implemented Prior to and Following the Acquisition of the Conditioned Reinforcement for Two-Dimensional (2D) Visual Print Stimuli on Desktop*

Participant	Programs	
	Prior to	Post
A	Basic listener programs (e.g., sit still)	Point to/give me 2D visual print stimuli of classmates, himself, and family members
	Yes/No mand program using a single vocal sound with a gesture (i.e., shake or nod head)	Sort 2D visual print stimuli by categories
	Echoic-to-mand using a single vocal sound	Echoic-to-tact Independent mand Block conditioning protocol
B	Count 3D objects vocally up to 5	Visually match 2D stimuli across irrelevant dimensions
	Intraverbally count from 1 to 10	Textually respond to phonics and sight words
	Identify more/less than with 3D objects (0–10)	Point to 2D stimuli located on printed page (i.e. letters, words, numbers, shapes)
		Match 2D numbers to 3D (i.e., quantities of objects 1–10)
		Respond with quantity of objects for vocal antecedent (1–10)
		Vocally count 2D or 3D visual stimuli or object up to 10
C	Follow one-step directions (e.g., touch head, blow kiss, etc.)	Trace letters and numbers Point to numbers up to 20
	Tact 2D stimuli (e.g., vegetable, instrument, household, clothing)	Tact numbers up to 20 Tact classmates Tell time by hour Transcribe shapes (e.g., circle, diamond, triangle)

were used with multiple exemplars across different colors, sizes, fonts, and shapes that were not preferred (i.e., they were not reinforcing for the participants to look at). All target stimuli used during this procedure were tested prior to the onset of the study to ensure that they were not preferred stimuli (see [Figure 4](#) for set stimuli used during probe sessions). [Figure 5](#) shows examples of the stimuli sets that were used during the first phase of the intervention sessions that contained only nonpreferred stimuli. [Figure 6](#) shows an example of the set stimuli used during the second phase of the intervention sessions that contained combined stimuli (i.e., nonpreferred and preferred) to provide another pairing of preferred with nonpreferred visual stimuli to enhance the effectiveness of the establishment of the 2D print stimuli as a reinforcement for the observing responses for Participants A and B. The preferred stimuli included pictures of participants' favorite cartoon characters, toys, food, and drinks.

During the MTS probe sessions, to determine the presence or absence of MTS responding, the

77 identical visual MTS repertoires and the same 77 stimuli requiring abstraction were used from the C-PIRK assessment ([Greer & McCorkle, 2009](#)). We used 7.62 cm × 12.70 cm white index cards containing single target stimuli in their centers (i.e., letters and pictures of five common animals, five shapes, and five colors). Additionally, multiple exemplars across different colors, sizes, fonts, and shapes were used for abstraction MTS probes, for example, matching Schnauzer to Beagle or another breed of dog with nondog exemplars as incorrect matches; matching red-letter H to blue-letter H with different sizes and fonts). [Table 4](#) shows a set of stimuli used and [Figures 7A, 7B, and 7C](#) show examples of identical and abstraction MTS probe sessions. Abstraction identity-matching stimuli were stimuli that varied in irrelevant characteristics (i.e., color, size, font, or different breed of the same animal), while preserving the essential component of the stimulus (i.e., hue, shape, or common characteristics across breeds of animals; see [Figures 7A, 7B, and 7C](#)).



Figure 1. The use of a visual and physical prompt used only during pairing trials to help the participants attend to the print stimuli. No prompts were used during test trials or the page probes for the establishment of the stimuli as reinforcers for observing responses.

For the tests of the reinforcement of books for observing responses, we used age-appropriate children’s books. Numerous books were available in the free-play areas, as were toys and games.

**Experimental Design**

The design was a nonconcurrent multiple probe design across three participants to control for maturation and instruction (Johnston & Pennypacker, 1993). The pre-experimental probes were staggered across each participant



Figure 2. The fading of prompts (i.e., from physical and visual to visual alone, and then to no prompts). As soon as prompts were not needed, the stimuli were placed on top of the desk for the participant to look at during the intervention sessions.

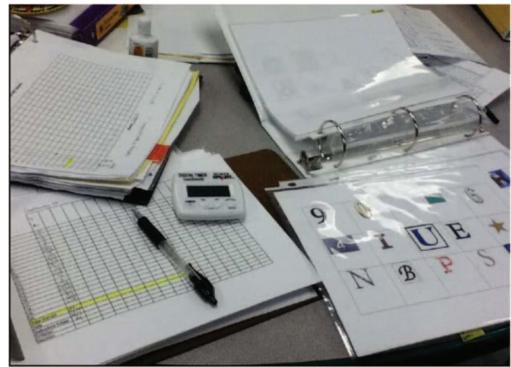


Figure 3. The materials used during the intervention and pre- and postconditioning intervention probe sessions (i.e., a digital timer, black pen, data forms, graphs, and pages containing 2D visual print stimuli).

(i.e., nonconcurrent multiple probes), with Participant A receiving one probe session each for the responses to the identical and abstraction stimuli, respectively; Participant B receiving two probe sessions for each of the identical and abstraction stimuli; and Participant C receiving three probe sessions for each. The implementation of the IV for Participant A was followed by a second pre-experimental probe for Participant B. Also at this time, the first pre-experimental probe was conducted for Participant C. The design provided controls for short-term maturation and instructional histories for Participants B and C and instructional history for Participant A.


Figure 4. An example of a page of nonpreferred visual print stimuli used during the pre- and poststimulus pairing conditioning intervention probes testing the implementation of print as a conditioned reinforcer for observing responses.

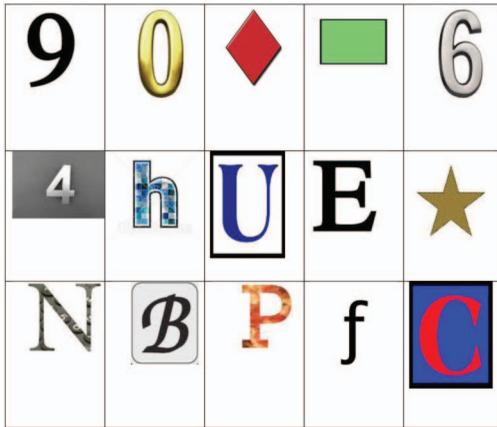


Figure 5. A page containing nonpreferred visual print stimuli. Pages like these were used in the first phase of the conditioning intervention sessions for Participants A, B, and C.

The sequence of the design was as follows: (a) pre-intervention probes for looking at a the five test pages containing 15 nonpreferred stimuli on each page; (b) pre-intervention consequated probe trials on the emission of correct identical MTS responses; (c) pre-intervention consequated probe trials on the emission of correct abstraction (i.e., nonidentical) MTS responses; (d) 60 pre-intervention 5-s continuous interval measures of observing responses for book stimuli in the free-play area; (e) implementation of a 2D print-stimuli-conditioning intervention with sets of training pages using graduated 5-s intervals of S-S training and test trials, until 60 5-s, whole-interval session probes for looking at a set of five pages containing 15 nonpreferred stimuli on each page showed that the participants were conditioned to looking at the test pages; (f) postintervention assessments of correct (i) identical and (ii) abstraction MTS responses; and (g) postintervention observing responses for book stimuli in 60 5-s whole-interval sessions testing generalization of the conditioned reinforcement to the conditioned reinforcement for the book stimuli. The sequence is illustrated in Figure 8.

### Dependent Variables

The three DVs measured before and after participants' looking at the pages of stimuli, were established as conditioned reinforcers for

observing the test pages. The first dependent was 77 consequated probe trials for the emission of consequated responses to identical 2D visual stimuli to identical MTS responses to the C-PIRK (Greer & McCorkle, 2009) curriculum (i.e., match all upper- and lowercase alphabet letters, Arabic numbers, colors, shapes, and common identical animals). The second DV was the emission of correct MTS consequated responses to categorical or variations (different fonts, sizes, colors) of the same 77 stimuli. The pre- and postconditioning probe trials consisted of instructional probe trials involving reinforcement for any correct responses and corrections for incorrect responses. Each of the 77 stimuli in the identical and the abstraction probes were presented only once in the pre- and postconditioning probes. The third DV was a test for generalization to conditioned reinforcement and preference for looking at books in the free-play area.

### Identical and abstraction MTS responses.

A correct MTS response was defined as looking at two stimuli (i.e., one exemplar stimulus and one nonexemplar stimulus) on the desktop and placing the target print stimulus on top of the exemplar stimulus. For example, two index

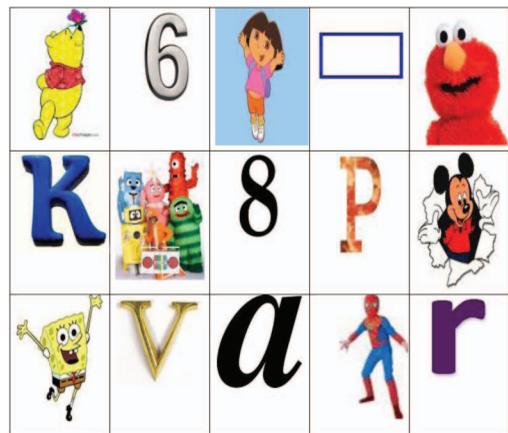


Figure 6. A page containing an example of preferred visual stimuli embedded within nonpreferred stimuli. These were used, as necessary, during the second phase of the pair and test conditioning sessions for Participants A and B. This step was not necessary for Participant C. Winnie-the-Pooh, Mickey Mouse, and Spider-Man, copyright 2015 by The Walt Disney Company; Elmo, copyright 2015 by Sesame Workshop; Dora the Explorer and SpongeBob SquarePants, copyright 2015 by Viacom International, Inc.; Yo Gabba, copyright 2015 by GabbaCaDabra, LLC.

Table 4  
*Visual Two-Dimensional (2D) Set Stimuli on Index Cards Used during Pre- and Postconditioning Intervention Probe Sessions to Determine the Presence of Match 2D Repertoire Using C-PIRK Assessment for Both Identical Match and Abstraction Match Responses*

Pre- and Postconditioning	
Identical match-to-sample	Matching 26 uppercase alphabet letters (A-Z)
	Matching 26 lowercase alphabet letters (a-z)
	Matching 10 Arabic numbers (0-9)
	Matching five colors
	Matching five shapes
Abstraction match-to-sample	Matching five animals (e.g., cat, dog, horse, elephant)
	Matching 26 uppercase alphabet letters (A-Z)
	Matching 26 lowercase alphabet letters (a-z)
	Matching 10 Arabic numbers (0-9)
	Matching five colors
	Matching five shapes
	Matching five animals (e.g., cat, dog, horse, elephant)

cards containing the letters “H” and “L” were placed on the desktop. Next, the participant was required to place his index card (e.g., his H) on top of the exemplar H on the desktop within a 3-s intraresponse time after hearing the experimenter’s vocal antecedent (i.e., “match letter H with letter H”). Placing his card on a non-H stimulus constituted an incorrect response.

Identical MTS responses required that the participants match two identical stimuli with exactly the same color, shape, size, and font (e.g., matching the letter H with the identical letter H using two white index cards that included a printed letter H in red using Cosmic Sans MS font) in the presence of one nonexemplar (i.e., irrelevant stimuli; e.g., dog, triangle, etc.) while the experimenter said the relevant dimension (e.g., “match the letter H with the letter H”).

Abstraction MTS responses required that the stimulus to be matched contain essential stimuli, such as shapes, colors, and categories including letters, numbers, shapes, and animals with varied irrelevant characteristics of the matching stimulus (e.g., dogs of different breeds; matching Schnauzer to Beagle) in the presence of one nonexemplar (e.g., triangle, British Longhair cow, etc.). Also, multiple exemplars across different fonts (e.g., Cosmic Sans MS, Times New Roman, Cambria) were used for abstraction letter MTSs. The vocal instruction for identical and abstraction matches was, “Match \_\_\_ with \_\_\_\_.” Figures 7A, 7B, and 7C illustrate identical and abstraction MTS stimuli and the setting for the probe sessions.

### Observing responses for book stimuli.

We tested the generalization of conditioned reinforcement for the print pages to reinforcement for looking at books using continuous 60 5-s whole-intervals during 5-min observations. Intervals of observing responses to book stimuli as conditioned reinforcement were measured prior to and following the acquisition of the conditioned reinforcement for 2D visual print stimuli. For this and the other duration measures, we used digital timers, black pens, and data forms. The free-play area included stacks of children’s books on a desktop, a bookshelf with various books, and several bins filled with stuffed animals, toys, building blocks, cars, puzzles, and animal figures. A minimum of one of each participant’s peers was present and engaged in free-play activity in the toy area during these probe sessions.

An observing response (i.e., looking at books) was defined as touching or making eye contact with a book, touching pictures (e.g., “Elmo is eating cereal”) while looking at a book, textually responding to the letters (e.g., “it’s a letter ‘E’”) while looking at a book, or choosing other books. That is, observing responses for book stimuli consisted of responses involved in the children observing books, choosing books, and reaching for books.

### Data collection for the DV and the IV.

The participants’ emissions of correct and incorrect responses for all MTS sessions or intervals of observing responses were recorded with

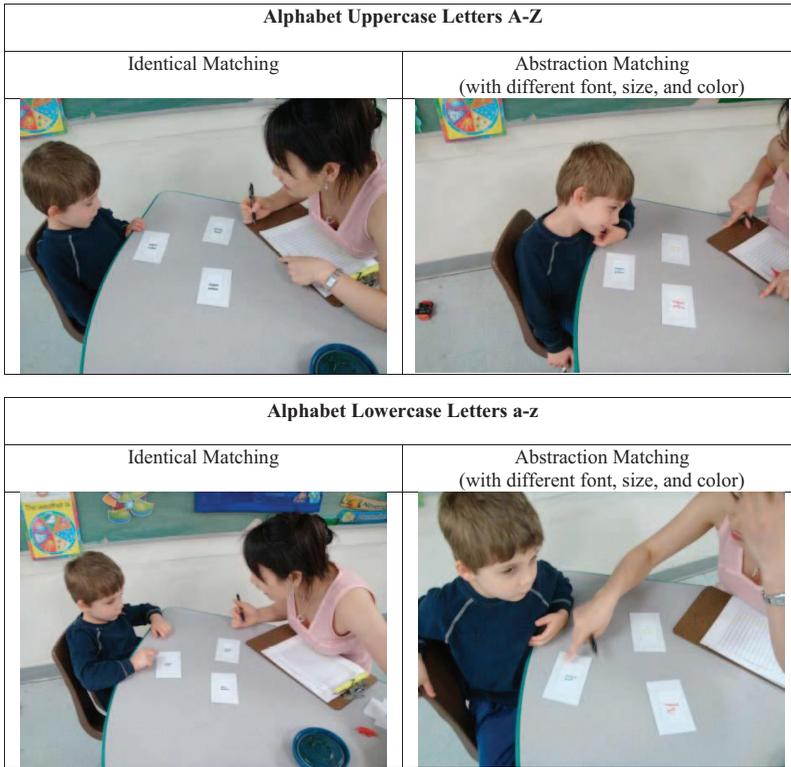
**a**

Figure 7A. Pre- and postconditioning intervention probe sessions using visual 2D set-stimuli on index cards for identical and abstraction MTS for alphabet letters.

a black pen on relevant data forms using “plus” for correct responses and “minus” for incorrect responses. The probe data for the intervals of correct observing responses for book stimuli were collected using 60 5-s whole-interval measurements during the 5-min observations in free-play settings that contained books, toys, and other play items. Observing throughout an entire 5-s period resulted in a plus and not observing or not observing for an entire 5-s interval resulted in a minus.

We also recorded data on the various stages of the conditioning intervention. The S-S conditioning protocol consisted of blocks of 20 training and test trials. A training trial consisted of a successful pairing trial in which the participants continuously looked at the training pages for 5-, 10-, or 15-s intervals (See Figure 8) while they received two or three pairings of the primary reinforcers and observing the stimuli. Pairing trials rotated two or three pairings even

if time increments were required (see Figure 8). The training trial was repeated as necessary until the participants emitted the correct responses for the required duration (i.e., a successful pairing trial). Once that was done for each training trial respectively, a test trial was conducted with no pairings. If the participant looked at the page for the specified interval in the test trial, a plus was recorded; if not, a minus was recorded. During the S-S intervention sessions, the data for 20 test trials were graphed as the numbers of correct responses to the test trials using a line graph (see Figure 13). After mastery of a pairing and testing S-S session, we tested to determine if the stimuli were conditioned as reinforcers by presenting the five pages of nonpreferred stimuli. The data for looking at 2D nonpreferred print stimuli on a page were measured as 10 s or more observing time for each of the five pages.

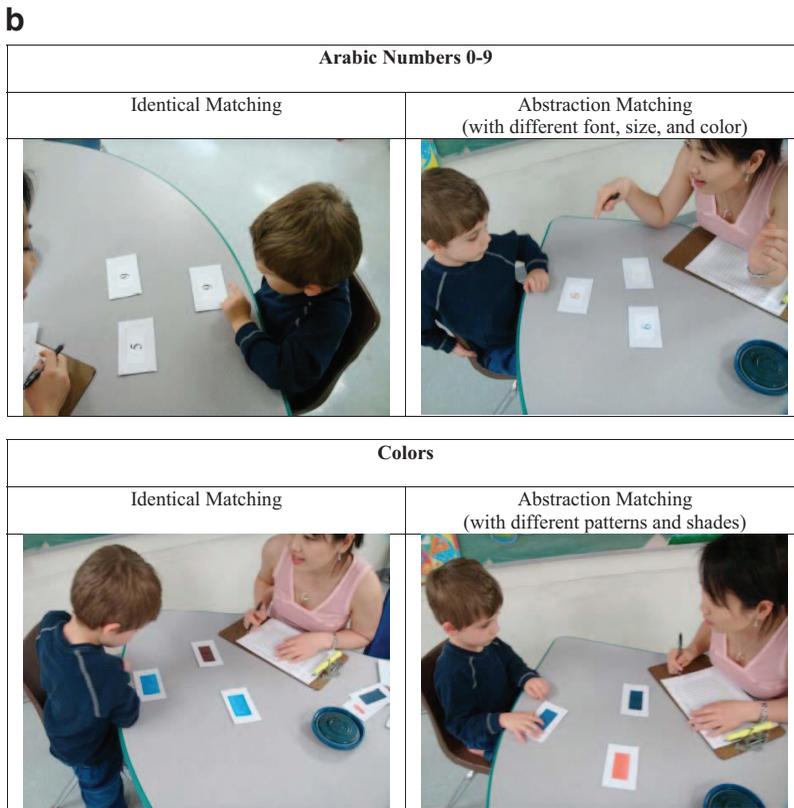


Figure 7B. Pre- and postconditioning intervention probe sessions using visual 2D S-S on index cards for identical and abstraction MTS for Arabic numbers and colors.

### Conditioning Intervention Stages

**Sequence of S-S and testing for establishment of conditioned reinforcement for observing responses.** We implemented an S-S reinforcement pairing procedure to condition nonpreferred 2D visual print stimuli as conditioned reinforcement. This protocol was derived from prior experiments using the S-S protocol (Greer, Becker, Saxe, & Mirabella, 1985; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002; Pereira-Delgado et al., 2008; Tsai & Greer, 2006).

The sequence of the S-S pairing procedure, as illustrated in Figure 8, is as follows: (a) We began with 5-s training trial in which the experimenter paired an unconditioned stimulus (i.e., edible) or a conditioned stimulus (i.e., praise if praise functioned as a reinforcer) with nonpreferred visual stimuli (i.e., the training pages) by requiring the participant to look at the various

visual stimuli on the pages for the specified entire 5-s training interval while the experimenter alternated between two and three pairings of the conditioned or unconditioned reinforcers (e.g., delivery of a food item and/or praise). (b) If the participant stopped looking at the pictures before the specified target interval was up (i.e., 5 s), then the timer was stopped and reset for the target time interval, after ensuring that the participant was attending again and the edible item was consumed; the pairing interval continued until a successful training trial was obtained. (c) A successful training trial was immediately followed by a test trial for the 5-s target time interval (i.e., no pairing reinforcement was given). (d) During the test trial, if the participant looked at the visual stimuli on the pages for the entire 5-s interval, a plus was recorded on the data sheet; however, if the participant did not emit correct responses (i.e.,

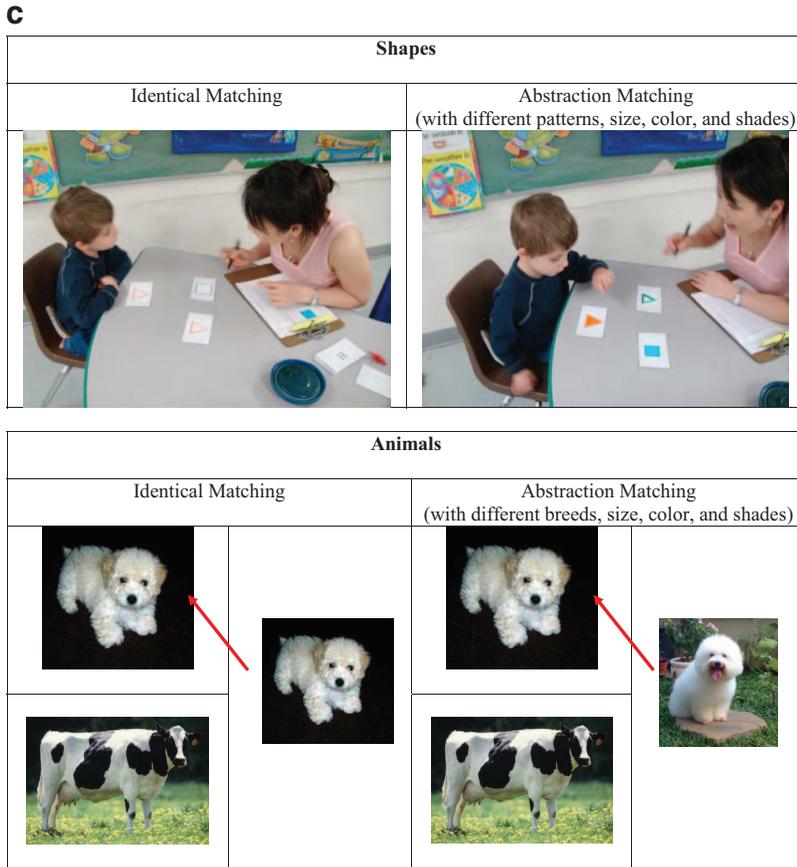


Figure 7C. Pre- and postconditioning intervention probe sessions using visual 2D S-S on index cards for identical and abstraction MTS for shapes and animals.

not looking at the stimuli for the entire 5-s interval or emitting stereotypy or passivity), then a minus was recorded. (e) The next training trial began for the target time interval. These continued until a block of 20 train and test trials were completed.

At the end of the sixth S-S pairing conditioning-intervention session with 5-s interval, Participants A and B did not show an ascending trend. Thus, in order to provide additional visual reinforcing stimuli embedded within the S-S pairing procedure, we used this modified set of stimuli beginning with the 5-s time-interval criterion (see Figures 6 and 13). We modified the stimuli such that the training pages had preferred visual stimuli embedded with the nonpreferred stimuli for Participants A and B only.

However, Participant C achieved the mastery criterion for the intervention during the first phase and did not require the embedding of the preferred with the nonpreferred stimuli. We remind the reader that the function of the conditioning procedures was to establish the initially nonpreferred stimuli as reinforcers for observing responses. As in the cases of many protocols to induce cusps, several tactics are often needed to instantiate the conditions that constitute the implementation of the IV (Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009; Keohane et al., 2009).

The mastery criteria consisted of 90% accuracy across two consecutive sessions or 100% accuracy in one session. Sessions were blocks of the 20 test trials for each time-interval stage

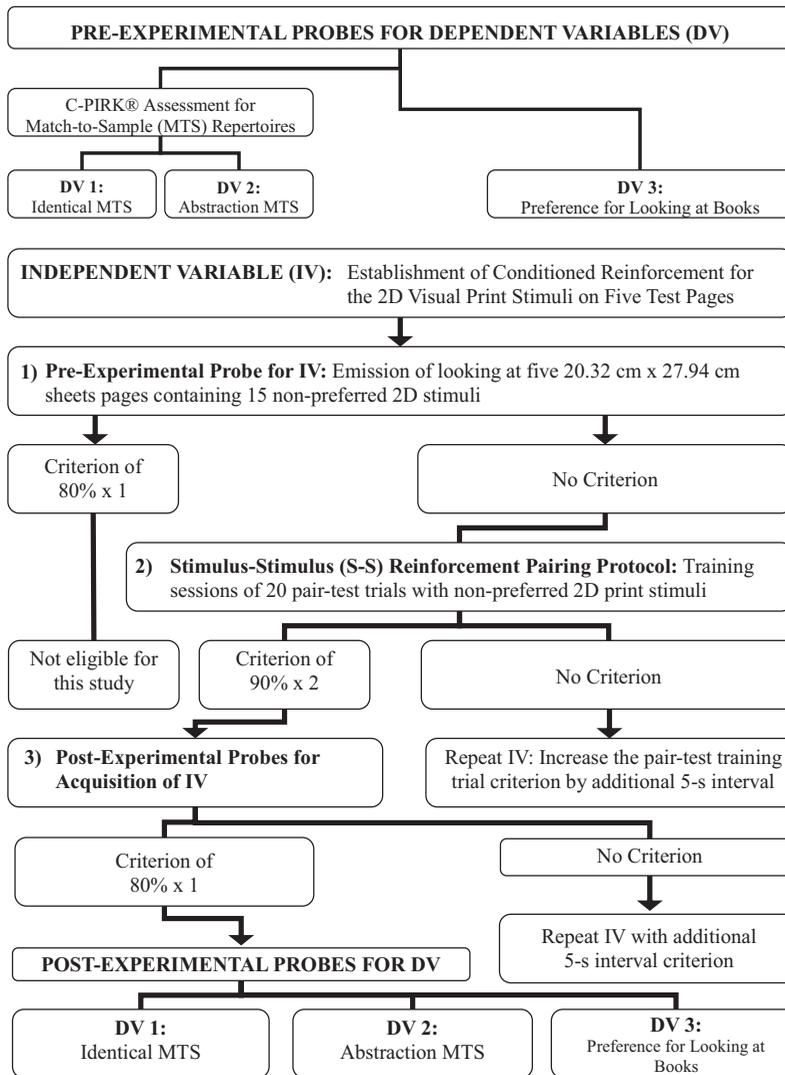


Figure 8. The sequence of components of the experimental design.

in the train and test conditions. Once a participant achieved criterion on the pair-test procedure, probes were conducted on the amount of time each participant took to look at five pages of nonpreferred stimuli that were used during the pre-intervention probe session. If the participant did not meet the 10-s observing time for four of the five pages, or criterion for this stage, then the duration of the S-S pair-test conditioning procedure for looking at stimuli on a page was increased by an additional 5-s interval (i.e., 5 s followed by 10 s, if necessary). The number

of pairings (alternation of two and three pairings in a training trial) remained the same even though the interval time increased. Some participants in other studies have required up to 45 s before meeting the criterion for the establishment of stimuli as conditioned reinforcers (Greer et al., 2011). The time interval was increased only if the probes for conditioned reinforcement showed an ascending trend. When other students who are in need of this or other protocols are having difficulty mastering the protocols, tests are done for any possible pre-

requisites that might be missing and procedures to provide these are done as described in Greer and Ross (2008).

**Pre- and post-S-S reinforcement pairing probes.** Pre- and post-S-S probes were conducted following each phase of the S-S reinforcement; train and test pairing procedures were done to determine when the 2D print stimuli were conditioned as reinforcers, as described above. These consisted of the following components: The experimenter presented five pages, each with different arrangements of preferred stimuli, one at a time, and timed the duration that the participant looked at each page. Page 1 was presented and the duration of observing was timed. When the participant stopped observing, the timer was stopped and a new page presented. This continued until all five pages were presented. If the participant continuously looked at each individual page for 10 consecutive s without stereotypy (this is an issue only if children have stereotypy when professionals implement the protocol) or passivity (i.e., not looking at the picture or staring without visually tracking the stimuli on the page, as determined by not moving his or her eyes while looking at the page), then the page was counted as a correct response and a plus was recorded. An incorrect response was recorded as a minus if the participant did not look at each page for 10-consecutive s or emitted stereotypy or passivity at any point during the 10-s interval. During the probe sessions, no consequences were given for either correct or incorrect responses. After all five pages were presented individually, the experimenter totaled the correct responses out of five opportunities (i.e., responses to each of the pages). The criterion was determined as the emission of correct 10-s observing responses in four of the five pages.

## Interobserver Agreement

Interobserver agreement (IOA) was conducted to ensure the accuracy of the data across both the probe and the intervention sessions. Two experimenters simultaneously but independently recorded data on the DV as correct or incorrect for 92% of the pre- and postintervention probe sessions on average across all participants.

IOA was calculated by dividing the number of interval-by-interval agreements by the total number (i.e., the number of agreements plus the number of disagreements), and then multiplied by 100 (Cooper, Heron, & Heward, 2007). The mean agreement was 93% and 99% for Participants A and C, respectively. The rate of agreement was 100% for Participant B. Detailed data for IOA during probe and instructional sessions are shown in Table 5.

## Procedural Fidelity

Fidelity of treatment was assessed using the Teacher Performance Rate Accuracy test (TPRA; Ingham & Greer, 1992; Ross, Singer-Dudek, & Greer, 2005) in 32% of the intervention sessions for all participants. The results showed that the treatment was implemented with a mean of 90% accuracy (range, 85%–100%) for Participant A and 100% accuracy for Participants B and C.

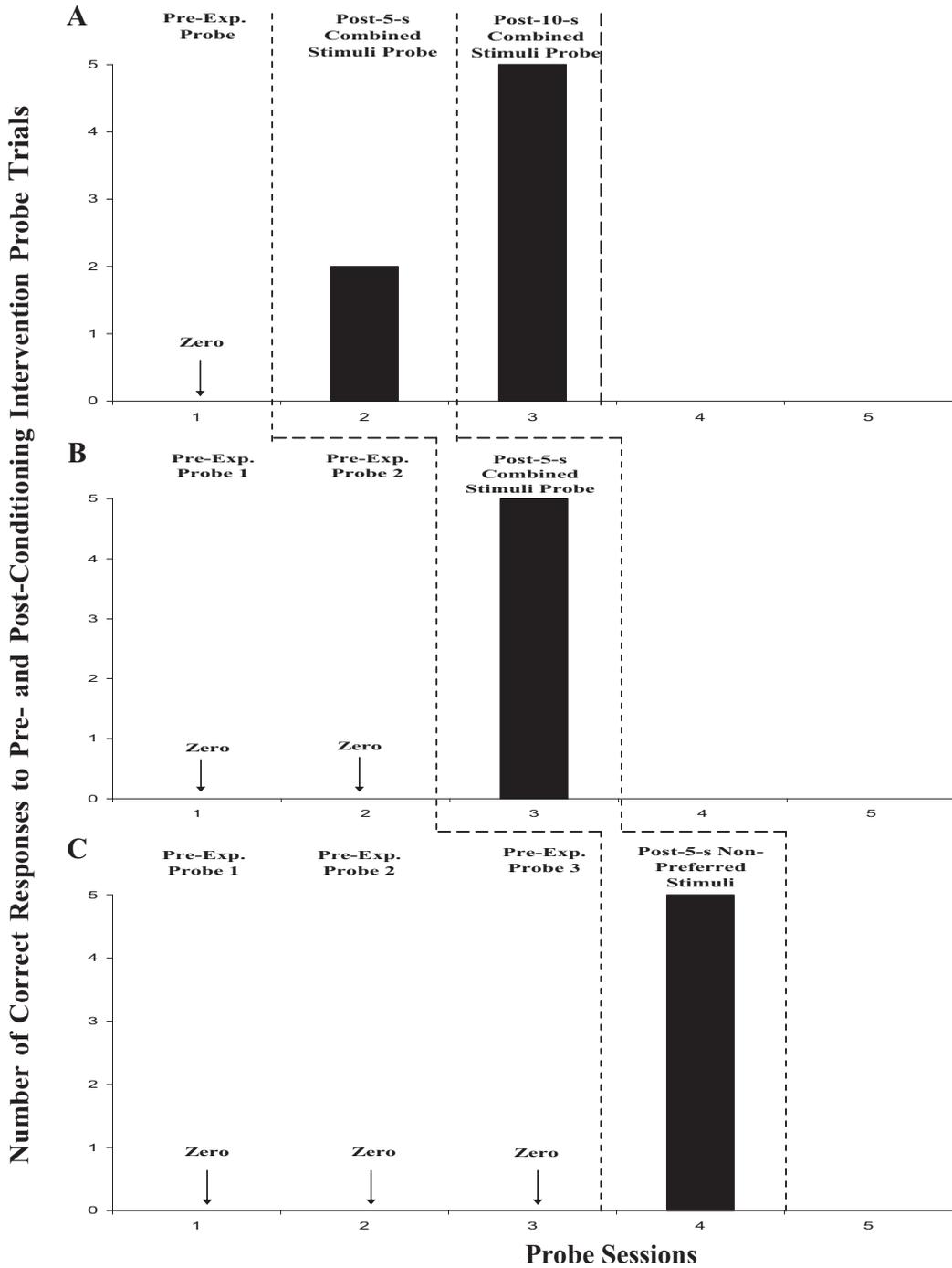
## Results

We first report the data on the establishment of the conditioned reinforcement as a measure of implementation for the IV (see the IV box in Figure 8) followed by the results of the DV (the last row of boxes in Figure 8). Figure 9 shows

Table 5  
Mean and Range of IOA for all Participants During Probe and Intervention Sessions

Participant	IOA			
	Probe		Intervention	
	<i>M</i> (range)	% of sessions with IOA	<i>M</i> (range)	% of sessions with IOA
A	93% (85%–100%)	75%	95% (90%–100%)	39%
B	100%	75%	98% (95%–100%)	33%
C	99% (94%–100%)	100%	100%	67%

*Note.* IOA = interobserver agreement (Cooper, Heron, & Heward, 2007); Probe = IOA including both the pre- and postexperimental condition probes.



*Figure 9.* The implementation of the IV, or the establishment of nonpreferred visual stimuli as reinforcers for observing. Correct responses for the five trials consisted of observing each page (one trial) for each session for 10 s or more. Participant A required 5-s and 10-s pairing interventions before meeting the criterion; Participants B and C required the 5-s pairing only.

the correct number of responses emitted by the participants to the probes conducted for looking at nonpreferred stimuli on a page showing the implementation of the IV. Participant A emitted no correct responses out of five to looking at the pages with the nonpreferred visual stimuli during the pre-intervention probe session. Following the first S-S interval stage (i.e., 5-s pair and test trial in the S-S pairing phase using combined set stimuli), the participant emitted 40% correct responses. Following the second interval objective of the 10-s conditioning procedure, the postconditioning intervention probe was conducted again and the participant emitted 100% correct responses to looking at all of the pages. Similarly, Participant B did not emit any correct responses during the preconditioning intervention probe sessions for the pages containing nonpreferred stimuli; however, following the 5-s 2D print stimuli conditioning procedure with combined stimuli, the participant emitted 100% correct responses on the pages with nonpreferred stimuli. Participant C did not emit any correct responses during the preconditioning intervention probe session. However, following the 5-s 2D print stimuli conditioning procedure with nonpreferred stimuli only, the participant emitted 100% correct responses on the pages with nonpreferred stimuli. These data show the establishment of the criterion for conditioned reinforcement for observing 2D stimuli that constituted implementation of the IV.

Figure 10 shows the number of correct 2D identical visual print MTS responses for the pre- and postintervention probe sessions, given a total of 77 trials. Participant A emitted two correct responses during the pre-intervention probe session. However, after the 2D visual print stimuli were conditioned as reinforcement for observing responses, he emitted 73 correct MTS responses (i.e., 95% accuracy) during the postintervention probe session. Participant B emitted four and three correct MTS responses, respectively, during two pre-intervention probe sessions; after the 2D visual print stimuli were conditioned as reinforcement for observing responses, he emitted 76 correct match responses (i.e., 99% accuracy) during the postintervention probe session. Similarly, Participant C emitted 16 and 17 correct MTS responses during two pre-intervention probe sessions. However, following the acquisition of the conditioned reinforcement for 2D print stimuli as observing

responses, he emitted 77 correct responses (i.e., 100% accuracy).

Figure 11 shows the number of correct 2D visual abstraction MTS responses during pre- and postconditioning probe sessions given a total of 77 trials. Participant A emitted no correct responses during the pre-intervention probe session. After the 2D visual print stimuli were conditioned as reinforcement for observing responses, he emitted 73 correct abstraction MTS responses (i.e., 95% accuracy) during the postintervention probe session. Participant B emitted either no or one correct response during two pre-intervention probe sessions, respectively. However, after the 2D visual print stimuli were conditioned as reinforcement for observing responses, he emitted 77 correct match responses (i.e., 100% accuracy) during the postintervention probe session. Similarly, Participant C emitted 12 correct MTS responses during the pre-intervention probe sessions. Following the acquisition of the conditioned reinforcement for 2D print stimuli as observing responses, he emitted 77 correct responses (i.e., 100% accuracy).

Figure 12 shows the number of 5-s intervals out of 60 possible intervals before and after the intervention for participants' looking at books and choosing to look at books in free time. Participant A emitted two correct observing intervals before the conditioning intervention for a single session. Following the intervention he emitted 56 correct observing intervals (i.e., 93% accuracy). Participant B emitted zero correct intervals during two pre-intervention observation sessions. However, following the intervention, he emitted 54 correct intervals. Participant C emitted only one correct interval during pre-intervention probe. He emitted 54 intervals of observing (i.e., 90% accuracy) during the postintervention probe session.

Figure 13 shows the number of whole-interval test probes in the 20 train and test blocks of S-S pairing sessions. Participants A and B required the embedded procedure extending the sessions to 10 s and 5 s, whereas Participant C only required the 5-s interval without the embedded procedure.

The results suggest that the acquisition of conditioning 2D visual print stimuli as conditioned reinforcers resulted in the emergence of 2D MTS accuracy for both identical and non-identical matches (see Figures 10 and 11). Fur-

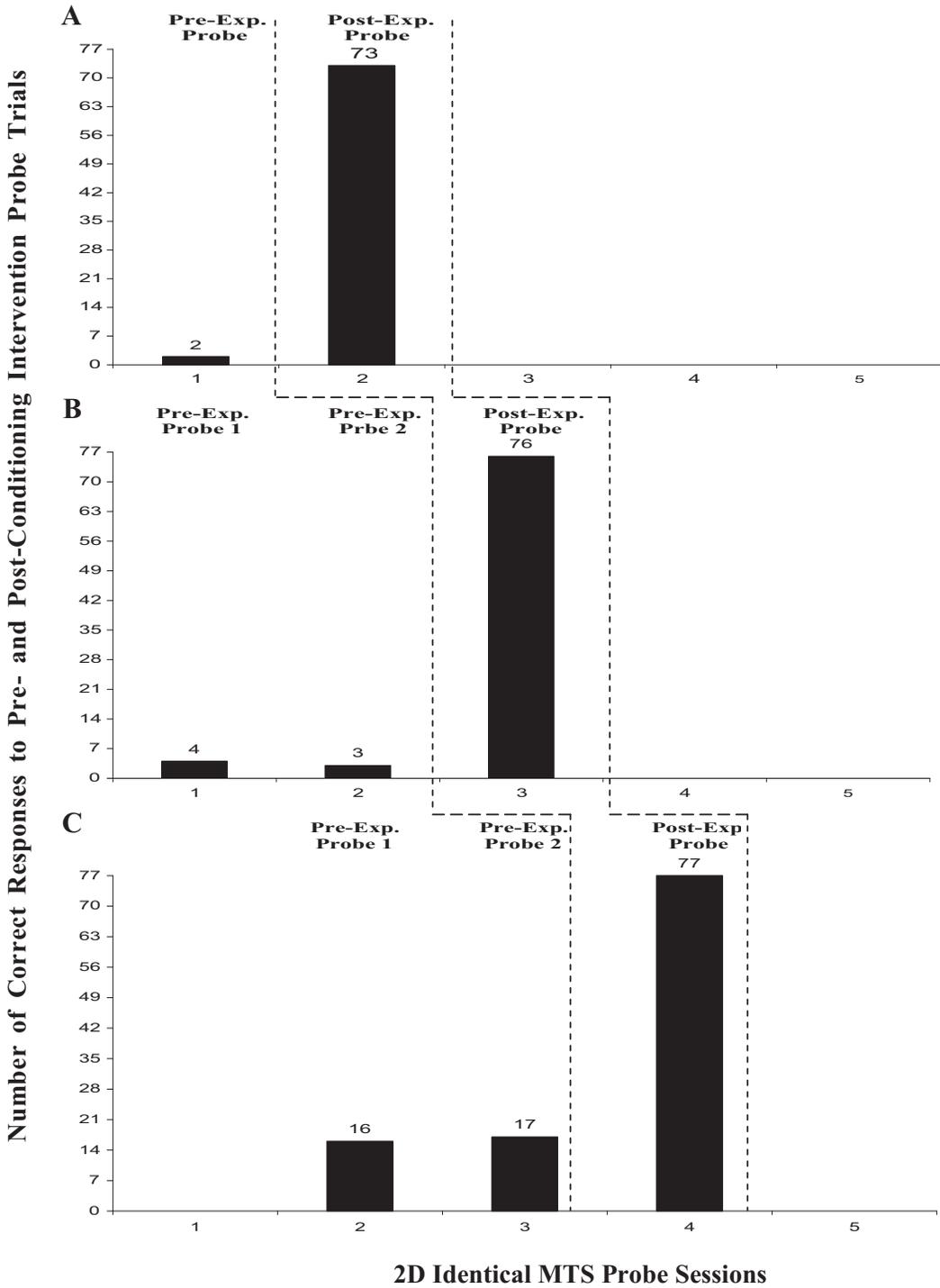


Figure 10. Pre- and postintervention correct MTS responses for identical stimuli. The 77 stimuli included matching 52 upper- and lowercase alphabet letters, 0–9 Arabic numbers, five colors, five shapes, and five animals.

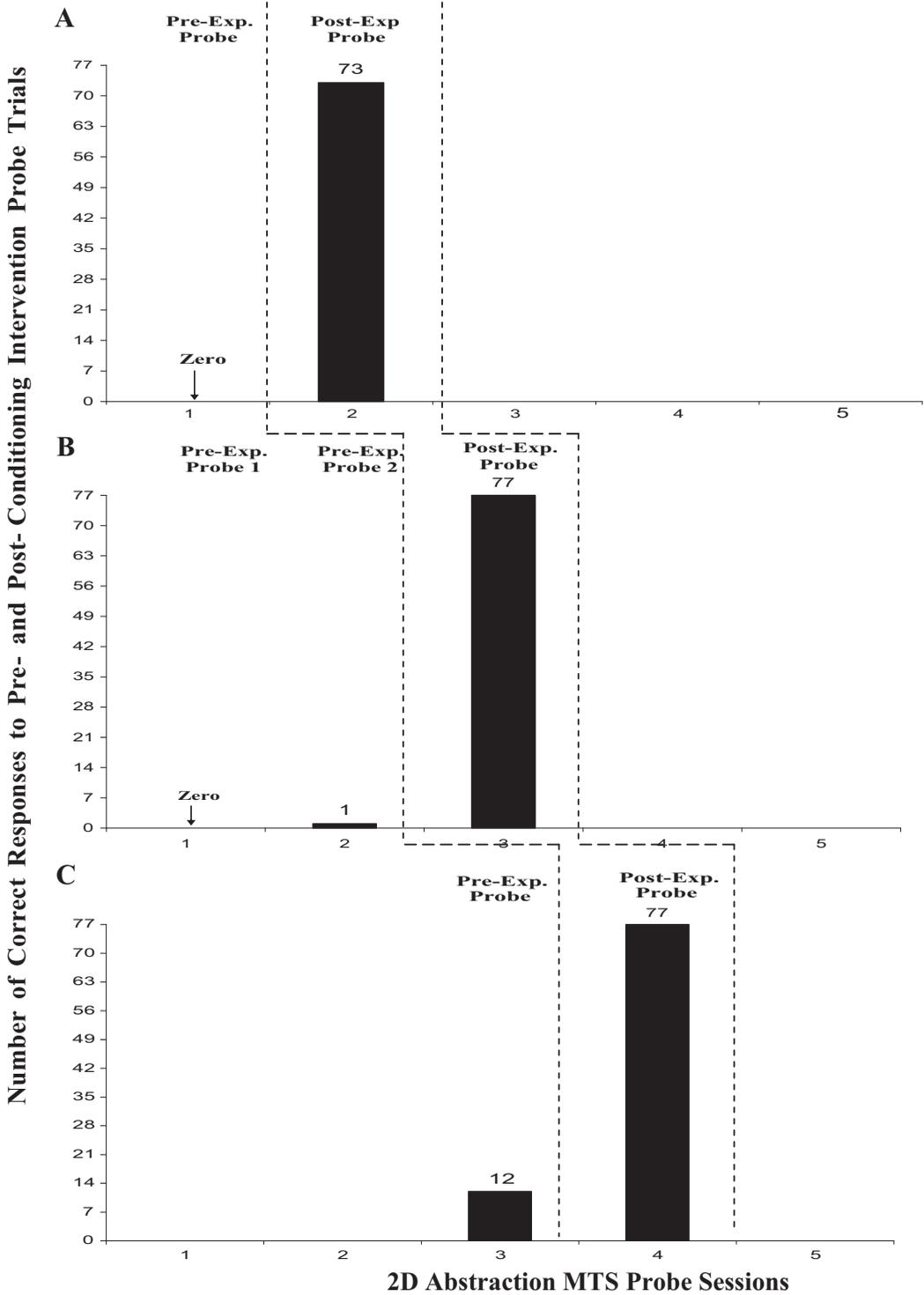


Figure 11. The emergence of the participants' numbers of untaught correct abstraction MTS responses for the three participants.

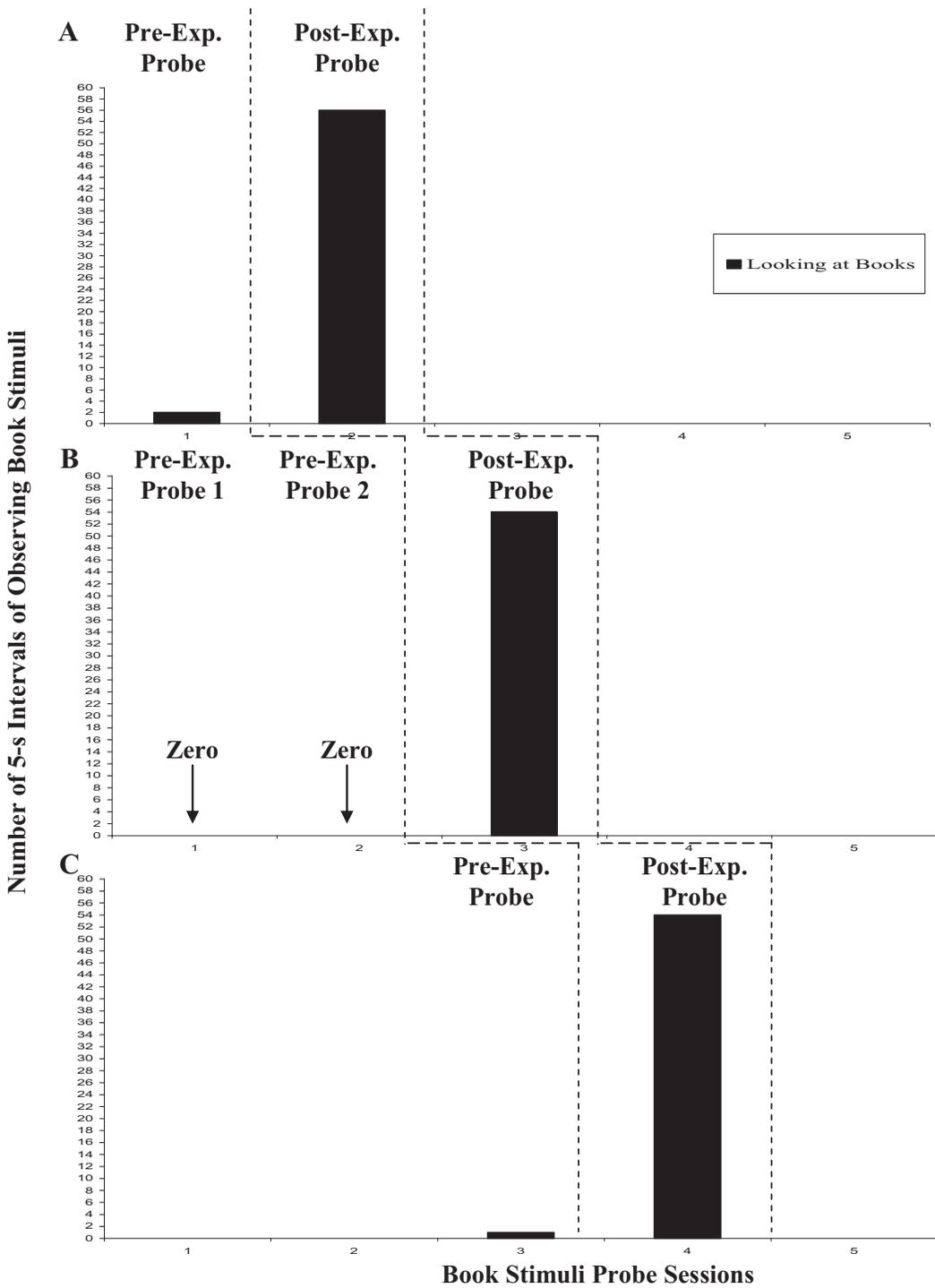


Figure 12. The numbers of intervals of observing responses to book stimuli (i.e., a total of 60 continuous 5-s intervals) before and after conditioning 2D print stimuli as conditioned reinforcement for observing.

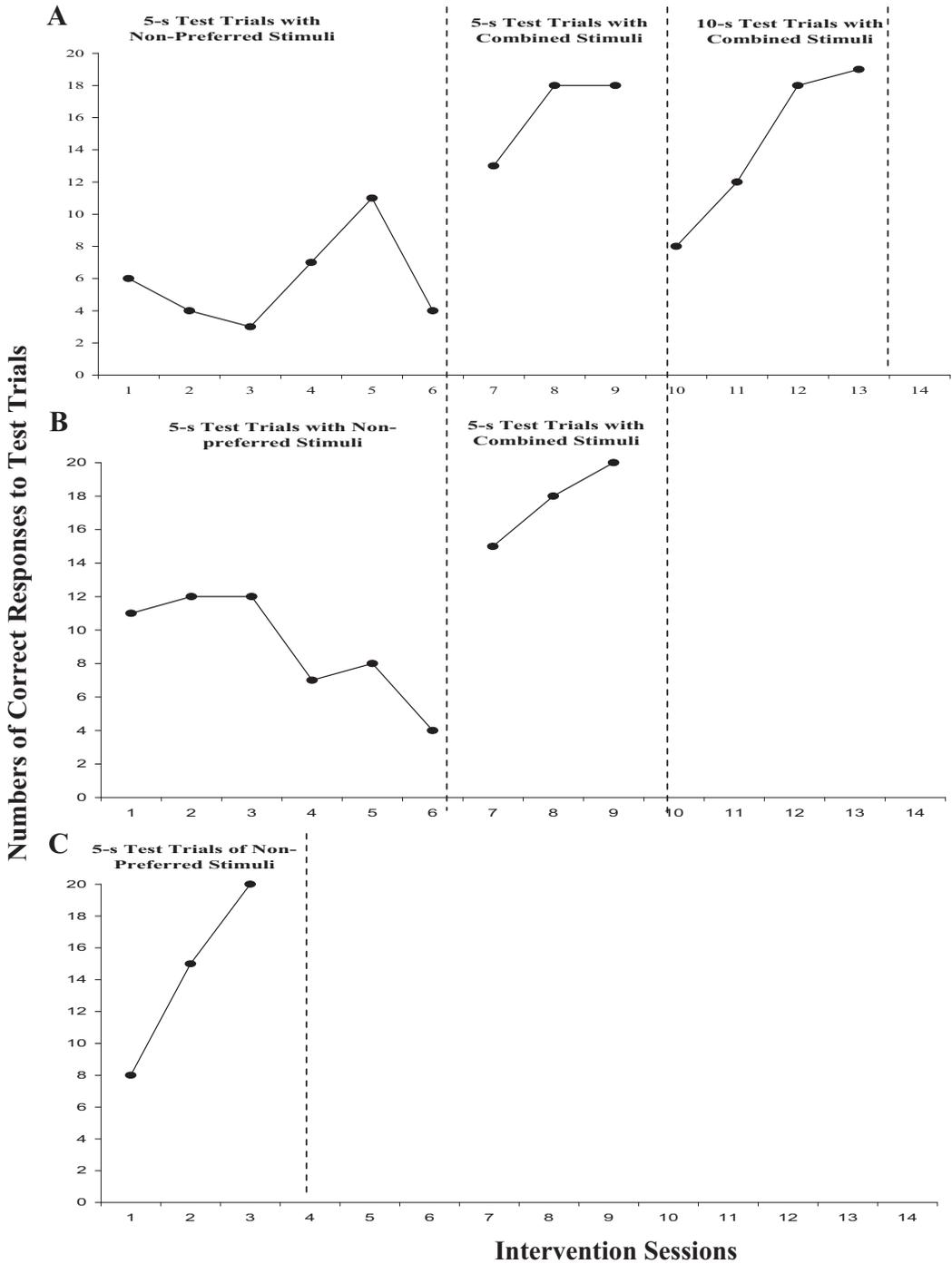


Figure 13. The numbers of whole intervals looking at 2D print in S-S conditioning test intervals in the pair and test trials, and graduated time increments together with the progression from preferred to nonpreferred stimuli required to establish the nonpreferred stimuli as conditioned reinforcers for observing for Participants A, B, and C.

thermore, as a function of conditioning 2D print stimuli as reinforcers for observing pages of visual stimuli, observing generalized to conditioned reinforcement for looking at book stimuli for Participants A, B, and C.

### Discussion

Prior to the establishment of the 2D print stimuli as conditioned reinforcement for observing responses, the three participants did not attend to 2D visual stimuli on pages. As a result, the participants had difficulty learning and being taught the curricular objectives associated with visual discriminations that are part of what children need to learn (see Table 3). Moreover, in cases like this, when visual discriminations are too difficult, students cannot learn correspondence between a word spoken by teachers and parents and an object seen. Thus, these deficits are obstacles to learning word–object relations and the learning of word–object relations is foundational to becoming verbal. However, following the acquisition of conditioned reinforcement for 2D print stimuli, Participants A, B, and C attended to the 2D visual print stimuli, which resulted in the ability to emit MTS responses or visual-identity responses without instruction. This constituted the onset of a new developmental cusp allowing the participants to come into contact with stimuli they could not contact before. Once they are able to contact the visual sameness between stimuli, they can learn visual discriminations, making it possible to learn the correspondence between what is seen and spoken and new types of visual–relational responding. This would suggest that they now can learn and be taught cross-modal relations that are fundamental to verbal development.

Although there were only three participants in this study, the data replicate and extend earlier research reporting accelerated learning of MTS responding following the conditioning of print stimuli as reinforcers for visual observing responses (Pereira-Delgado et al., 2008). Moreover, in the study reported herein, visual-identity matching emerged and the participants did not need to be taught visual MTS responding for stimuli like those we studied. It should be noted that the probe trials in the pre- and postinterventions were reinforced trials that incorporated reinforcement for correct responses

and corrections for incorrect responses. They could not emit them with reinforcement prior to the conditioning intervention, even when corrections were given for incorrect responses; however, they were able to do so after the intervention. The postconditioning probes resulted in corrections only for the few stimuli that the student responded to incorrectly. Thus, the postconditioning probes involved reinforcement for correct responses in most cases. Assessments of curriculum-based instruction use reinforcement and corrections because this procedure avoids possible extinction effects. However, one of the limitations of the study is that it was possible that Participant A, who received only one preconditioning probe for the identical and abstraction stimuli, could have learned from the feedback (corrections and reinforcement) that occurred during the preconditioning probes. However, this was not the case with the other two participants who received two or three preconditioning probe sessions. Also, there is no evidence in Participant A's instructional history over the course of study in the school that he could master objectives like this at this rate before the conditioning intervention.

Our findings, and related findings described in the introduction, lead us to speculate that when this basic cusp is missing and children are taught basic MTS responses and visual discriminations, there are some inherent problems that may be present even if they meet the objectives after prolonged instruction. That is, if children require many instructional presentations or learn units that incorporate various response and stimulus prompt tactics, the attainment of objectives may be a kind of false positive. That is, they may learn the particular color, picture, number, or letter match; however, each new stimulus MTS must be taught separately. A kind of conditional responding to the specifics of instruction is learned rather than the general class of identity matching. A prosthetic reinforcer, not the direct reinforcement for the observing responses, controls the observation needed to master each MTS response. The result is that the nature of the instruction teaches idiosyncratic prompted attention that is reinforced with prosthetic reinforcers. However, we speculate that once the conditioned reinforcer for observing is present, visual-identity matching can be present or can be attained with minimal instruction. As Skinner (1968) pointed out,

educational or prosthetic reinforcers are used to bridge the gap between the point at which natural reinforcers for behavior are not present and the point at which they become present. If the natural reinforcers, in this case, reinforcement control of the print stimuli, are not acquired, the natural control over the behavior is thwarted.

Moreover, we speculate that this is the case for the range of repertoires that require the establishment of conditioned reinforcement for observing responses that are related to the range of sensory discriminations. Evidence to this effect has been reported for auditory speech (Greer & Du, 2015), music (Greer et al., 1980), and textual reading (Tsai & Greer, 2006). Similarly Dinsmoor et al. (1983) reported that same effect for pigeons. Dinsmoor and colleagues noted that it is observation that is fundamental to discrimination learning, not vice versa. Some 28 years after the Dinsmoor study and 31 years after the auditory conditioning studies (Greer et al., 1980), the obvious utility of this finding for applied work with children with autism or other learning delays becomes apparent. Moreover, the Tsai and Greer (2006) study on textual responding and the Greer et al. (1980) study on auditory conditioning suggest that this is also the case for typically developing children.

Skinner (1957) argued for the initial independence of the speaker and listener, and this might be extended to the range of observing and performing responses. Subsequent research and theory (Greer & Longano, 2010; Greer & Speckman, 2009) have affirmed that the joining or intercept of the observing and performing responses is key to becoming verbal. Greer and Longano (2010) suggested this was true also for the intercept of observing and performing responses that are found in the behaviors involved in the performance of complex musical, dance, and art works. This intercept may be crucial for a range of cultural activities that have demonstrated emergent and “creative” behavior. Perhaps the reinforcement for the stimuli that reinforce the range of observing responses critical to production may simply be basic. Although this point remains speculative, there is a growing body of research that suggests this is a possibility. At any rate, there is evidence that establishment of reinforcement for observing stimuli is fundamental to several types of learning.

For the participants, the intervention phase also resulted in the establishment of conditioned reinforcement for observing 2D print stimuli, replicating the numerous studies cited herein. That is, the S-S pairing procedure conditioned the participants’ emissions of looking at print stimuli as reinforcement for observing responses. Therefore, the results of the current study confirmed the findings from former and recent research which have consistently shown the effectiveness of S-S pairing procedures on the establishment of previously nonpreferred or neutral stimuli as conditioned reinforcers for observing responses (Greer et al., 1985; Greer et al., 1973; Greer et al., 1974; Greer, Dorow, Wachhaus, et al., 1973; Greer et al., 1980; Nuz-zolo-Gomez et al., 2002; Tsai & Greer, 2006). Furthermore, as the results of these studies have shown, we have provided further evidence in the current study that once the participants acquired the nonpreferred visual stimuli as conditioned reinforcement for observing responses, the visual print stimuli for their instructional programs selected out their attention and led to the emergence of generalized visual MTS responding.

Not surprising, perhaps, is that the intervention also resulted in conditioned reinforcement for looking at books. Books contain pictures, letters, shapes, and colors and because the intervention included these stimuli, it is not altogether unexpected that books would also acquire conditioned reinforcement control. Reading researchers have implied that appreciation for looking at books and listening to stories is basic to learning to read (McGuinness, 2004). Furthermore, Tsai and Greer (2006) demonstrated this to be the case with typically developing young children. Thus, the establishment of conditioned reinforcement for observing book stimuli has apparent benefits to the participants’ future education.

Anecdotal observation in the classroom led us to infer that the participants became more attentive to a range of stimuli in their environment, both during and outside of the instruction, although this was not systematically tested. However, this possibility was tested for voice conditioning, from which measures of general awareness emerged (Greer et al., 2011). It was also anecdotally observed that the participants’ emission of vocal verbal operants increased throughout the school day, although verbal vo-

cal instruction occurred simultaneously. However, it is possible that the intervention enhanced the learning of object–word relations as generalized visual-identity matching emerged. This suggests that research on intervention-enhanced learning of object–word relations is called for.

As Greer and Ross (2008) and Greer and Speckman (2009) stated, and our findings support, the acquisition of conditioned reinforcement for 2D visual print stimuli as observing responses may be a developmental cusp, as this acquisition allowed the participants to learn things that they could not learn before coming into direct contact with the contingencies related to their new environment. Therefore, reaching this developmental cusp not only allowed the participants to learn things that they could not learn before, but also prepared them to acquire more advanced developmental cusps, such as basic listener literacy for word–object relations (Greer & Ross, 2008). The present study adds further evidence that conditioned reinforcement for observing stimuli is a developmental cusp consistent with the verbal behavior development theory (Keohane et al., 2009).

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