ASSESSING THE EFFICACY OF PICTORIAL PREFERENCE ASSESSMENTS FOR CHILDREN WITH DEVELOPMENTAL DISABILITIES

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Past research has demonstrated that pictorial preference assessments can predict subsequent reinforcement effects for individuals with developmental disabilities only when access to the selected stimulus is provided contingent on a pictorial selection. The purpose of the present investigation was to assess more comprehensively the feasibility of the pictorial format with children with developmental disabilities. In Experiment 1, prerequisite skill assessments were conducted, and the role of a contingent reinforcer was assessed by comparing the results from the pictorial assessment without contingent access to a reinforcer assessment. If contingent access was found to be necessary, the effects of schedule thinning were evaluated to determine whether a pictorial format could be made more practical in Experiment 2. The pictorial format without contingent access was successful with only some participants. However, schedule thinning was found to be an effective method to establish conditioned reinforcement properties for pictorial stimuli to create a more practical assessment for a subset of participants.

Key words: developmental disabilities, pictorial modality, preference assessment, prerequisite skills, reinforcer assessment, schedule thinning

Behavior analysts are often faced with the challenge of identifying reinforcers for individuals with developmental disabilities. Reinforcers such as preferred edible items, tangible items, and activities are often used to increase the effectiveness of skill-acquisition (e.g., language training) and behavior-reduction (e.g., environmental enrichment) programming for this population (Volkert, Lerman, Trosclair, Addison, & Kodak, 2008; Watkins & Rapp, 2014). A common method for identifying reinforcers is a stimulus preference assessment (SPA), in which an individual selects a stimulus from an array of options often nominated by caregivers (e.g., DeLeon & Iwata, 1996; Fisher et al., 1992; Roane, Vollmer, Ringdahl, & Marcus, 1998).

Graff and Karsten (2012) conducted a survey to determine how often behavior analysts use SPA methods with their clients with developmental disabilities. Nearly 90% of behavior analysts reported using at least one method. However, over 80% of those same respondents also reported a lack of time as a major barrier to conducting SPAs regularly, and the majority of behavior analysts reported conducting SPAs less than once per month. The time barrier is concerning because there is evidence to suggest that preferences are idiosyncratic and may change over time; therefore, regular SPAs should be conducted to capture changing preferences and help bolster behavioral programming (Mason, McGee, Farmer-Dougan, & Risley, 1989; Zhou, Iwata, Goff, & Shore, 2001). One potential solution for decreasing the duration of SPAs is to conduct the assessment using an alternative format or modality.

Alternative-modality SPAs involve presenting pictures or verbal descriptions (e.g., "Would you rather have X or Y?") of putative reinforcers rather than presenting actual tangible items on a tabletop. Alternative modalities offer the benefit of a shorter SPA because clients are not given access to a stimulus following a selection. That is, after a client makes a stimulus selection, the next pictorial or verbal choice is presented. Alternative formats may also save behavior analysts time in preparing SPAs, especially in the case of the verbal modality in which one would only need access to a data sheet and a pencil (i.e., no pictorial or tangible materials would be required). In addition, pictorial and verbal SPAs offer practitioners a format to assess larger items (e.g., bean bag chair), activities (e.g., playing basketball), and protracted events (e.g., going to a local park) that are not often feasible to assess during a standard, tangible SPA.

Previous studies that have compared pictorial and verbal SPAs to the tangible format suggest that alternative-modality SPAs are successful with only some individuals with developmental disabilities. For example, Parsons, Harper, Jensen, and Reid (1997) conducted a comparison of the pictorial and tangible formats for seven older adults with profound intellectual disabilities and found that the pictorial format was successful in identifying reinforcing leisure items for only two participants. These authors did note that participants had limited verbal communication abilities, and there were no formal assessments of participants' skill levels before the comparison was conducted. Researchers then began to investigate the role of hypothesized prerequisite skills such as IQ (e.g., Cohen-Almeida, Graff, & Ahearn, 2000; Wilder, Ellsworth, White, & Schock, 2003), matching abilities (e.g., Clevenger & Graff, 2005; Cohen-Almeida et al., 2000; Graff & Gibson, 2003), verbal repertoires (e.g., Higbee, Carr, & Harrison, 1999; Kuhn, DeLeon, Terlonge, & Goysovich, 2006), and discrimination abilities (e.g., Conyers et al., 2002; de Vries et al., 2005). Overall, multiple prerequisite skills have been assessed across numerous investigations; however, it is difficult to draw conclusions on which skills are pertinent because they have not been assessed systematically. There is some evidence that matching skills may be necessary for the pictorial format to be effective (e.g., Clevenger & Graff, 2005), but

there may be some skills that have not yet been empirically investigated (e.g., pictorial manding; Higbee et al., 1999).

The majority of the alternative-modality SPA comparison investigations have included brief access to a stimulus following its selection rather than immediately presenting the next pictorial or verbal choice. Researchers likely provide contingent access to equate their comparison conditions (e.g., tangible vs. pictorial); however, in doing so, they are evaluating a less practical form of the assessment. That is, providing contingent access increases the duration of the assessment and no longer allows behavior analysts the benefit of assessing other classes of stimuli related to quality of life (e.g., protracted events, residential and employment options). It seems that the mixed results in this line of alternative-modality comparison studies may be due in part to the use of contingent reinforcer access in some studies and not in others. More recently, researchers have directly compared the efficacy of pictorial and verbal SPAs with and without contingent access (e.g., Groskreutz & Graff, 2009; Hanley, Iwata, & Lindberg, 1999; Tessing, Napolitano, McAdam, DiCesare, & Axelrod, 2006), and these studies generally suggest that alternative-modality SPAs have partial predictive validity only when they are used without contingent stimulus access.

Recently, step-by-step flowcharts have been published to guide practitioners who serve individuals with developmental disabilities in using SPA methods (Karsten, Carr, & Lepper, 2011; Virués-Ortega et al., 2014). In one of these models, Karsten et al. (2011) suggested that alternative modalities may be useful when large tangible items, activities, and protracted events are evaluated, but these authors caution the use of alternative-modality SPAs without contingent access. Virués-Ortega et al. (2014) guided practitioners to use a paired-stimulus method with pictorial stimuli if clients are able to match pictorial and tangible stimuli reliably and to make choices from an array of pictorial stimuli. In their survey, Graff and Karsten (2012) found that behavior analysts report the use of alternative-modality SPAs even though they have only partial predictive validity when used without contingent access for individuals with developmental disabilities.

The purpose of the present investigation was to assess the feasibility of pictorial SPAs with children with developmental disabilities. The pictorial modality was examined because it has been the most heavily researched alternative presentation format, yet no firm conclusions can be drawn on its efficacy with clinical populations without contingent access to the reinforcer. First, the role of contingent access to the stimulus was assessed by comparing the results of a pictorial SPA without contingent access to the results of a reinforcer assessment (RA). Matching and pictorial mand assessments were conducted before pictorial SPA and RA sessions to evaluate the role of hypothesized prerequisite skills. Second, if contingent access to the stimulus was found to be a necessary component of a pictorial SPA, the effects of schedule thinning were evaluated to determine whether a pictorial SPA could be made more practical for those participants.

EXPERIMENT 1
METHOD
Participants

Participants included three girls and five boys (2 to 11 years old; see Table 1 for a detailed summary of participant characteristics). Keron, Eric, Lisa, Greg, and Mitch received school-based behavioral services during the course of the study, and Sean received services in a center-based behavioral program. Annah and Connor received services in a structured after-school socialization program and had received early intensive behavioral intervention in the past, during which they were exposed to SPAs. However, neither participant's parents were able to report which methods they had experienced.

Table 1
Participant Demographic Information

	Age	Diagnosis	GARS	Communication modality and skills	History with SPAs	History with alternative-modality SPAs
Keron	5 years 11 months	Noonan syndrome	74	Vocal using 4 to 5+ word sentences	Paired MSWO	Pictorial Verbal
Annah	9 years 8 months	Autism, ADHD	83	Vocal using 4 to 5+ word sentences	Yes	No
Connor	11 years	Autism	76	Vocal using 4 to 5+ word sentences	Yes	No
Eric	4 years 9 months	Autism	89	Vocal using 4 to 5+ word sentences	MSWO	No
Lisa	4 years 8 months	Autism	98	Vocal using 1 to 2 word utterances; some icon exchange	Yes	No
Sean	2 years 8 months	Developmental delay	113	Vocal using 1 to 2 word utterances	No	No
Greg	5 years	Autism	96	Vocal using 1 to 2 word utterances; some icon exchange	No	No
Mitch	4 years 3 months	Autism	113	Vocal using 2 to 4 word sentences	Paired Free operant	No

Note. ADHD = attention deficit hyperactivity disorder; GARS = Gilliam Autism Rating Scale (Gilliam, 2006); MSWO = multiple stimulus without replacement; SPA = stimulus preference assessment.

Preference assessments were not being conducted at Annah's and Connor's after-school program during the course of the study. Lisa had not been exposed to any formal SPA methods, but she was given the choice between two or three preferred stimuli multiple times per day to be used in her programming. Keron was the only participant who had been exposed to alternative-modality SPAs. All participants were able to follow one-step instructions, fully participate in the assessments, and had minimal problem behavior.

Setting and Session Duration

All sessions were conducted in a small treatment room on a university campus or in a small room or partitioned area of the participant's school. During all sessions, the experimenter sat across from the participant at a table. All materials necessary for conducting the sessions were placed near the experimenter and out of reach of the student. One or two trained independent observers also were present during a subset of sessions for interobserver agreement and procedural integrity data collection.

Sessions ranged from 1 min (an RA control session) to 17 min 45 s (a picture-to-object prerequisite assessment session). Experimental sessions were conducted 2 to 4 days per week, and participants' total time commitment ranged from 2 to 4 weeks.

Materials

One caregiver and one staff member (who had worked closely with the participant) were asked to list and rank each participant's favorite toys and foods using the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD) structured interview (Fisher, Piazza, Bowman, & Amari, 1996). The top eight edible items ranked by the caregivers and staff were used in all subsequent phases of the study. Caregivers also were asked to nominate one food item that their child would be unlikely to consume, which was used in RA control conditions throughout the study. The edible stimuli identified in the RAISD, laminated color photographs (10.2 cm by 15.2 cm) of the edible stimuli, a timer, a data sheet, and a pen were used in prerequisite assessments and SPA sessions. Additional materials for the RA

sessions included paper clips, four containers, three pieces of different-colored paper (i.e., blue, red, yellow; 10.2 cm by 15.2 cm), clear adhesive tape, and preferred toys identified via the RAISD.

Design and Procedure

For all participants (with the exception of Connor), RAs were evaluated using an alternating treatments design (Barlow & Hayes, 1979) with the high-preference (HP) and low-preference (LP) items identified via a pictorial SPA. For Connor, RAs were evaluated using a concurrent-schedules design (Piazza, Fisher, Hagopian, Bowman, & Toole, 1996). The order of preexperimental and experimental conditions is depicted in Figure 1.

Prerequisite assessments. Before experimental sessions, participants were exposed to the following three prerequisite skill assessments: a picture-to-object (P-O) matching assessment, an object-to-picture (O-P) matching assessment, and a pictorial mand assessment. In the P-O assessment, the experimenter placed a photo of one of the food items in front of the participant and instructed him or her to match that photo (e.g., "match") to the correct food
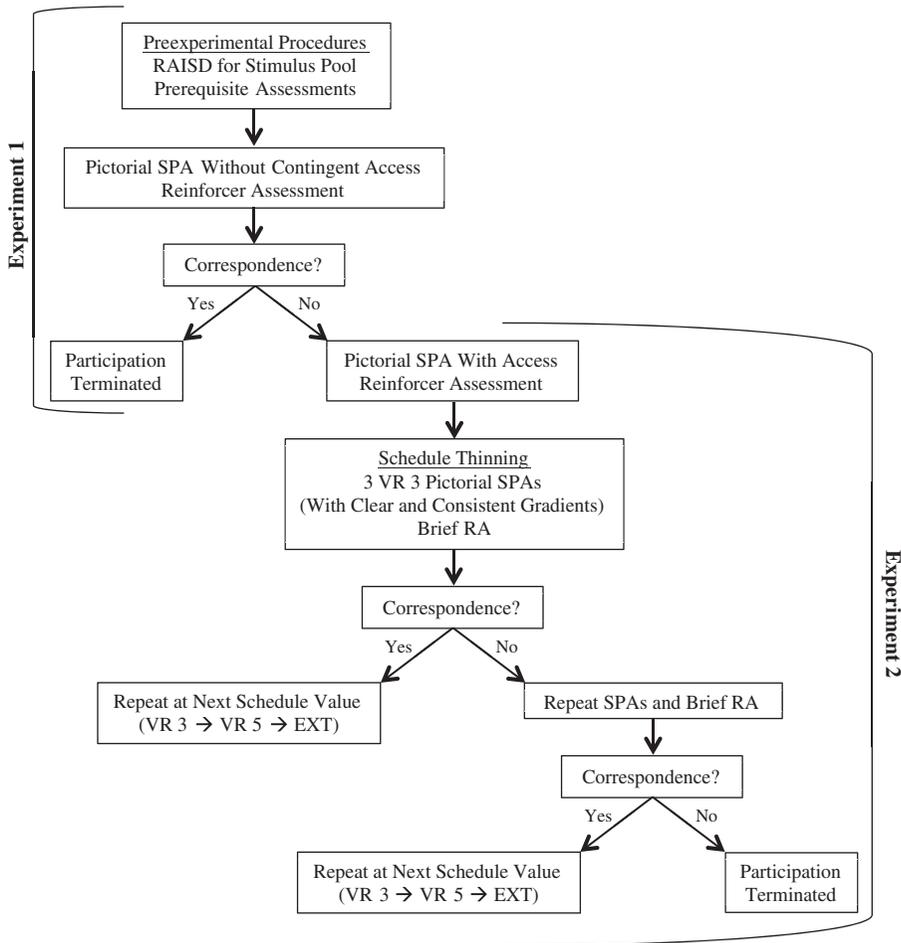

Figure 1.   Sequence of preexperimental and experimental conditions for Experiments 1 and 2.

item in an array of three foods. Similarly, in the O-P assessment, the experimenter placed a food item in front of the participant and instructed him or her to match the food item to the correct picture in an array of three pictures. Each of the eight photos or food items was presented twice in a random order, for a total of 16 P-O and 16 O-P matching trials, and the stimuli in the array varied across trials. Data were collected on the participant's response (correct, incorrect, or no response).

During the P-O and O-P assessments, the experimenter provided 30 s to 1 min of access to a preferred toy within 3 s of a correct response. If the participant responded incorrectly or did not respond after 5 s, the experimenter provided a nonspecific statement redirecting the child to the next trial (e.g., "Let's try the next one"). The percentage of correct trials was calculated for the P-O and O-P assessments by dividing the number of correct trials by the total number of trials and converting the ratio to a percentage.

In an effort to contrive an establishing operation for food items used during pictorial mand assessments, sessions were conducted immediately before lunch or dinner, and caregivers and staff members were asked to restrict access to the food items before the session on that day. In the pictorial mand assessment, the experimenter held up one HP food item for approximately 3 s in the participant's line of vision and then placed the stimulus out of view (e.g., in an opaque bag, on the experimenter's lap under the table) to ensure the features of a pure mand were present. The experimenter placed the corresponding picture of that food item in front of the participant and put out her hand if the participant picked up the picture and began to move the picture toward the experimenter. If the participant handed the picture to the experimenter, he or she received access to the item for 30 s. After 30 s, the experimenter provided a nonspecific statement and presented the next trial. If the participant

did not respond within 10 s, the experimenter removed the picture, provided a nonspecific statement, and presented the next trial. If the participant engaged in a vocal mand, the experimenter did not provide any differential consequences or access to the requested stimulus. The experimenter collected data on vocal mands (data available from the first author), which rarely occurred. Each food item was assessed twice in a random order, and data were collected on the participant's response (correct, incorrect [e.g., touched the picture but did not hand it to the experimenter], or no response) and vocal mands. The percentage of correct trials was calculated for the mand assessment by dividing the number of correct trials by the total number of trials and converting the ratio to a percentage.

Pictorial SPA without contingent access. Before the first SPA session, participants were given 30 s of access to each of the eight edible stimuli in a random order. Thereafter, they were exposed to a pictorial SPA using a paired-stimulus method (Fisher et al., 1992). In all trials, the experimenter presented a pair of picture stimuli in front of the participant (approximately 25 cm apart) and asked the participant to "pick one." After selection of one stimulus, the experimenter presented the next pair of picture stimuli. If the participant did not respond during a trial, the experimenter waited 10 s and then provided a verbal prompt (i.e., "pick one") followed by an opportunity for the participant to make a selection. If a selection was made or 5 s elapsed without a response after the verbal prompt, the next trial was presented. Each stimulus was paired with every other stimulus once in a random order, and the order of left–right positions of the stimuli was counterbalanced for a total of 28 trials. Selection percentages were calculated, and these data were graphed to represent the hierarchical rankings of the stimuli.

Reinforcer assessment. The purpose of this assessment was to evaluate whether the items

from the pictorial SPA without contingent access functioned as reinforcers (i.e., if the pictorial SPA without access was a valid assessment). The RA format and progressive-ratio (PR) schedules were determined based on participants' patterns of responding and task requirements. We used a single-operant RA with a paper clip transfer task with an additive PR 3 schedule with Keron, Annah, Eric, Greg, and Mitch. An alternative task was selected for Lisa and Sean due to the persistence of responding on the paper clip transfer task in the absence of social consequences, suggesting potential automatic reinforcement properties of the task. Finally, we used an alternative format (concurrent-operants RA) with Connor due to problem behavior in the control condition of his initial single-operant RA.

Single-operant PR RA. Items identified as HP and LP (i.e., the items with the highest and lowest selection percentages) and a control item were delivered contingent on responding during an arbitrary task in a single-operant PR arrangement for all participants except Connor (Roane, Lerman, & Vorndran, 2001). The experimenter presented the arbitrary task to the participant at the beginning of each session. This included one open container of paper clips approximately 25 cm in front of the participant and one colored container approximately 25 cm behind the container of paper clips. The experimenter modeled how to perform the task by placing one paper clip from the open container into the colored container and used a least-to-most prompting procedure during the task. During the prompted trial, the experimenter provided 30 s of access to the item associated with the colored container. The control condition was included to ensure that the arbitrary task was not automatically reinforcing, and the item used in the control condition was a nonpreferred item nominated by the participants' caregivers via the RAISD. After the prompted trial, the experimenter provided an instruction to the participant to begin such as,

"If you would like [the item associated with the condition], you will have to move these [pointed to the paper clips in the open container] from here to here [pointed to the empty container]. You can stop anytime."

Sessions lasted 10 min, and the timing of the session began immediately after the experimenter's instruction. The order of the conditions (i.e., HP, LP, control) was quasirandomized across sessions. However, the color of the container paired with the HP, LP, or control item remained consistent across sessions to aid in the discrimination of contingencies. During all sessions, the HP, LP, and control items were behind the colored container. When the first criterion was met (i.e., placing three paper clips into the colored container), the edible item was delivered for 30 s. Using an additive PR 3 schedule, the ratio increased by three responses each time responding met the response criterion (e.g., 3, 6, 9).

An alternative, arbitrary task was used for Lisa and Sean due to high break points in the control condition. The alternative task included placing a piece of laminated colored paper (10.2 cm by 15.2 cm) on a wall and requiring the participant to touch the paper with his or her hand. For Lisa, the paper was placed approximately 5 cm above where her fingertips touched the wall, requiring her to jump slightly off the ground to make contact with the paper. For Sean, the paper was placed at a height where he could touch the paper with his fingertips while he stood flat on the ground because of a deficit in his jumping skills. All other procedures were consistent with the paper clip transfer task, except that an additive PR 2 schedule was used.

The experimenter sat across from the participant during all RA sessions, delivered the item designated for the condition contingent on the participant meeting the response criterion, blocked the task materials during the 30-s reinforcement interval, and then re-presented the task materials. The session timer was not stopped during reinforcer access. Break points

were recorded for each stimulus evaluated in the RA. Sessions were terminated either when 10 min elapsed or 1 min elapsed with no responding (i.e., a break point).

Concurrent-operants RA. Items (HP, LP, control) were delivered contingent on responding during the same arbitrary task described above in a concurrent-operants arrangement for Connor. The procedures used in the concurrent-operants RA were identical to the single-operant RA, with the following exceptions. First, the experimenter presented three colored containers behind the open container of paper clips approximately 25 cm apart from one another. Second, when the participant placed a paper clip in one of the colored containers, the experimenter delivered the item associated with that container on a continuous schedule (i.e., no PR schedule was used). Finally, sessions lasted 5 min, and we recorded the rate of responding for each stimulus evaluated in the RA.

Interobserver Agreement

We compared data from a second trained observer, collected either during experimental sessions or from videotape, to the data collected by the experimenter to calculate trial-by-trial interobserver agreement. For prerequisite assessments, an agreement was defined as both observers recording a correct, incorrect, or no response for a trial. For SPA sessions, an agreement was defined as both observers recording the same stimulus selection for a trial. For RA sessions, an agreement was defined as both observers recording the same break point per session in the single-operant PR arrangement or recording the same number of responses in each container in the concurrent-operants arrangement. All agreement scores were averaged and reported per participant per session type. Agreement was calculated for 97% of sessions (range, 81% to 100%), and the average score for all participants across session types was 99.5% (range, 98% to 100%).

Procedural Integrity

A trained observer collected data to determine whether the procedures were implemented correctly. Procedural integrity scores were calculated as the percentage of correct responses made by the experimenter using a checklist of experimenter behavior specific to each type of experimental session. In addition, interobserver agreement was assessed for the procedural integrity data. Data were compared using the trial-by-trial agreement formula. An agreement was defined as both independent observers scoring an experimenter's responses during a trial as either correct or incorrect. All integrity scores were averaged and reported per participant per session type. Integrity scores were calculated for 97% of sessions (range, 81% to 100%), and the average integrity score for all participants across session types was 99.7% (range, 99% to 100%). Mean procedural integrity interobserver agreement scores fell within the acceptable range for the discipline and are available from the first author, along with the checklists of experimenter behavior mentioned above.

Results and Discussion

Figure 2 shows high levels of correspondence between the SPAs without contingent access and subsequent RAs for Keron, Annah, and Connor. Keron's pictorial SPA without contingent access (top left) produced a clear gradient, with selection percentages ranging from 0% to 100%. When Keron's HP, LP, and control items were assessed in a subsequent single-operant PR RA (bottom left), break points were consistently higher for her HP item ($M = 11$) than for the LP ($M = 4.5$) and control items ($M = 3.5$), confirming the predictions of the pictorial SPA without contingent access.

Annah's pictorial SPA without access (Figure 2, top middle) produced a clear gradient with selection percentages of 86% for her two HP items. Two LP items were identified
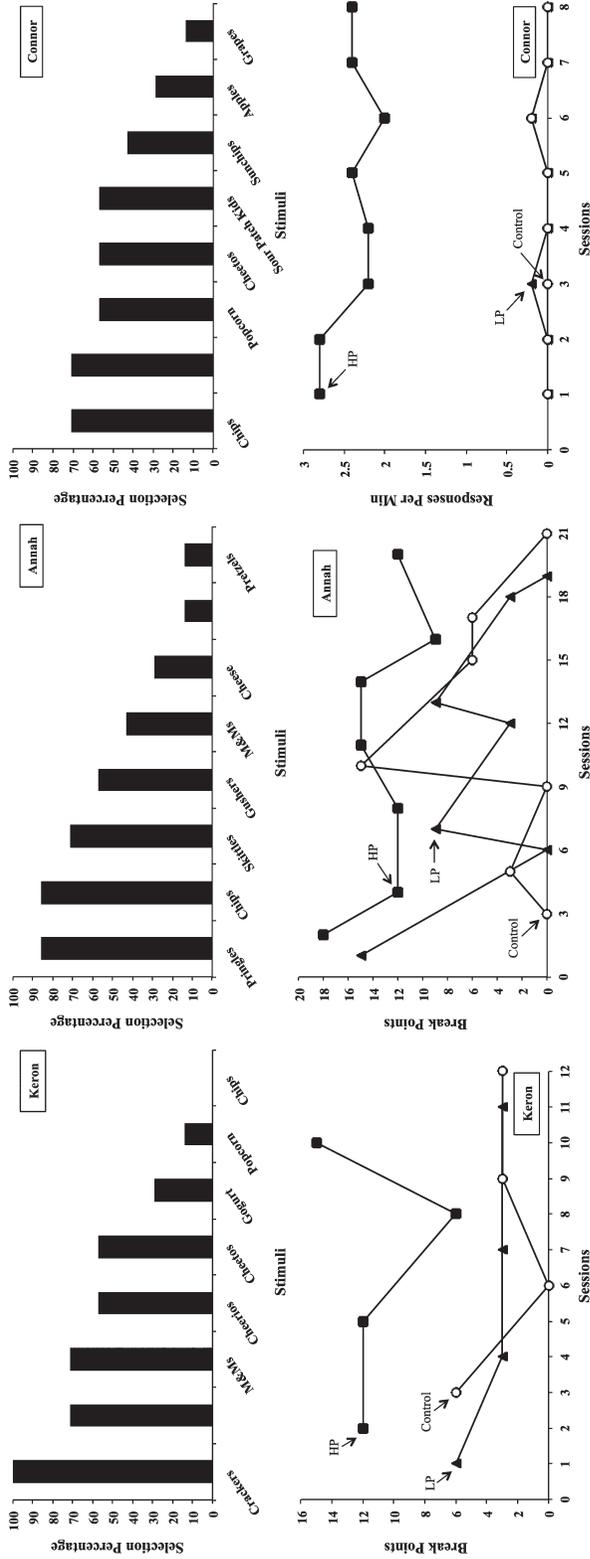
Figure 2. Results of Keron's, Annah's, and Conner's pictorial paired-stimulus preference assessments without contingent access (top) and single-operant progressive-ratio (Keron and Annah) and concurrent-operants (Connor) reinforcer assessments (bottom).
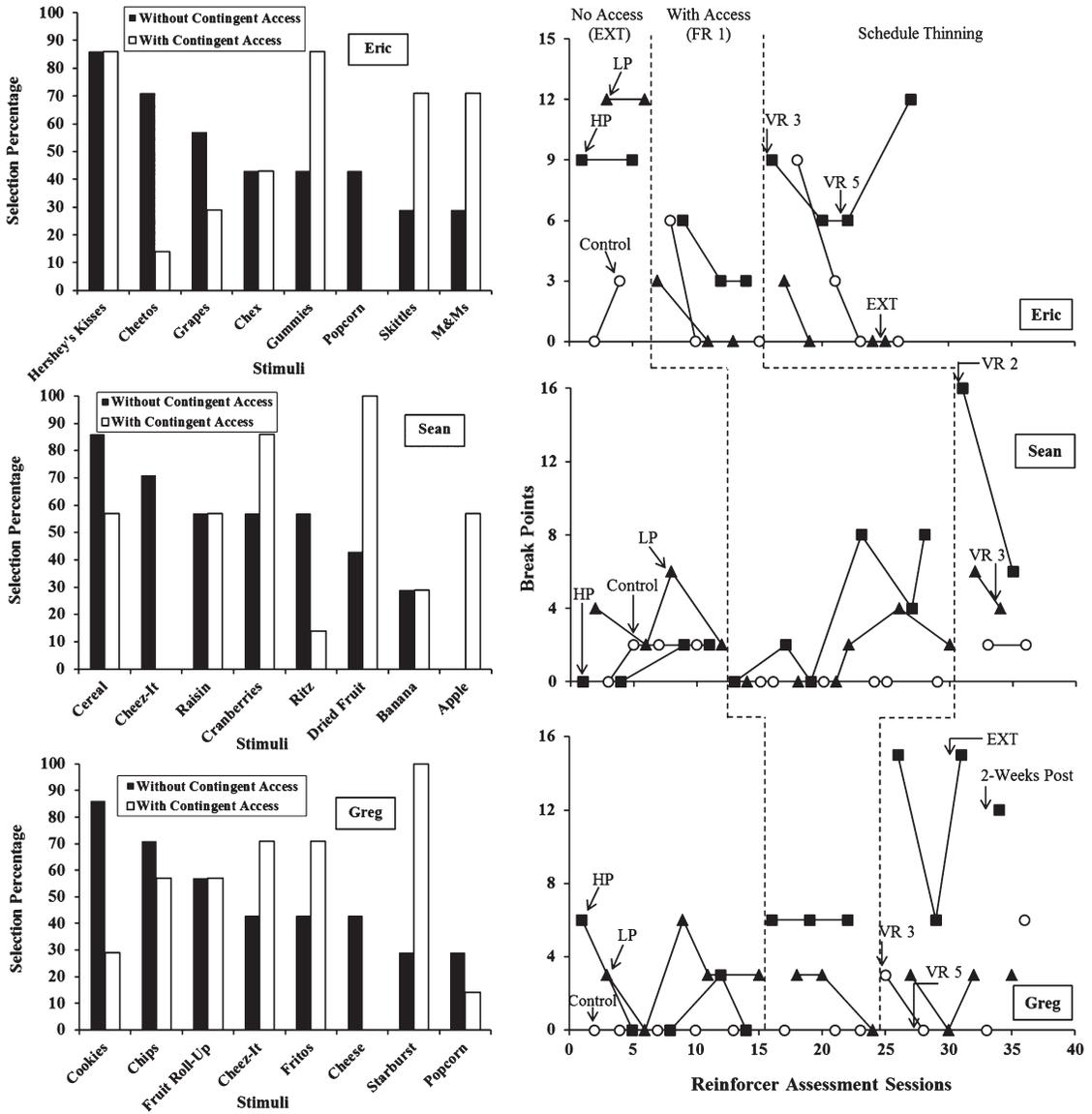
Figure 3.   Results of pictorial paired-stimulus preference assessments without and with contingent access for Eric, Sean, and Greg (bar graphs). Results of progressive-ratio reinforcer assessments following pictorial paired-stimulus preference assessments without access (EXT) and with access (FR 1) and during schedule thinning for Eric, Sean, and Greg (line graphs).

with selection percentages of 14%. Thus, the experimenters randomly chose one HP and LP item to be used in the subsequent RA, which are depicted as the first and last stimuli in all SPA bar graphs. The control (celery), HP, and LP items were evaluated in a subsequent

single-operant PR RA. Break points were higher for Annah's HP item ($M = 13.3$) than for the LP ($M = 5.6$) and control ($M = 4.3$) items (Figure 2, bottom).

Connor's pictorial SPA without contingent access (Figure 2, top right) produced a gradient
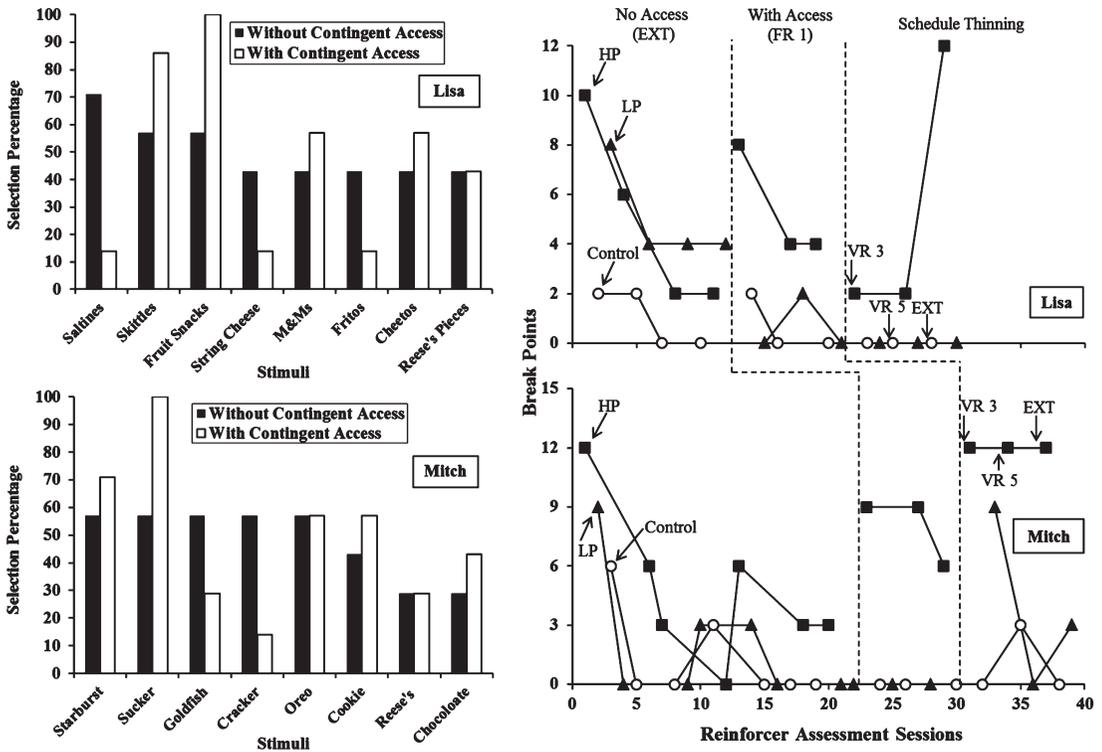
Figure 4.   Results of pictorial paired-stimulus preference assessments without and with contingent access for Lisa and Mitch (bar graphs). Results of progressive-ratio reinforcer assessments following pictorial paired-stimulus preference assessments without access (EXT) and with access (FR 1) and during schedule thinning for Lisa and Mitch (line graphs).

with selection percentages ranging from 14% to 71%. During his subsequent concurrent-operants RA (bottom right), rate of responding was much higher for his HP item ($M = 2.4$ responses per minute) than for the LP ($M = 0.1$ responses per minute) and control items (grape tomatoes; $M = 0.03$ responses per minute).

Figures 3 and 4 show results for the remaining five participants who had low correspondence between the results of their SPAs without contingent access (displayed as black bars in the left panel) and subsequent RAs (displayed in the first "No Access [EXT]" phase of the line graphs in the right panel). Eric's pictorial SPA without contingent access (Figure 3, top left) produced a moderate gradient, with selection

percentages ranging from 29% to 86%. During Eric's single-operant PR RA (Figure 3, top right), break points were higher for his LP item ($M = 12$) than for the HP ($M = 9$) and control items ($M = 1.5$), suggesting that the pictorial SPA without contingent access did not produce valid results. The results of Sean's pictorial SPA without access (Figure 3, middle left) were also not validated by his subsequent RA (middle right). Sean had higher break points for his LP item ($M = 3.5$) than for his HP ($M = 1$) and control ($M = 1.5$) items. Greg's pictorial SPA without contingent access (Figure 3, bottom left) produced a moderate gradient, with selection percentages ranging from 29% to 86%. During his single-operant PR RA (Figure 3, bottom right), breakpoints were higher for his

LP item ($M = 3$) than for the HP ($M = 1.8$) and control ($M = 0$) items, suggesting that the predictions of the pictorial SPA without contingent access were not valid.

Lisa's pictorial SPA without contingent access (Figure 4, top left) produced a slight gradient, with selection percentages ranging from 43% to 71%. A clear separation between break points was not found for her HP ($M = 5$) and LP ($M = 5$) items during her initial RA (top right). However, these break points were higher than in the control condition ($M = 1$), suggesting that the HP and LP items likely had similar reinforcing properties. Mitch's pictorial SPA without contingent access (Figure 4, bottom) produced a slight gradient, with selection percentages ranging from 29% to 57%. There was no clear separation among the HP ($M = 4.7$), LP ($M = 2.1$), and control ($M = 1.3$) data paths during Mitch's subsequent RA (bottom right), suggesting that the predictions of the pictorial SPA without contingent access were not valid.

The results of pictorial SPAs without access were validated by subsequent RAs for Keron, Annah, and Connor. In addition, Keron and Connor scored at 100% for all three prerequisite assessments (see Table 2 for summaries of all participants' prerequisite assessments scores).

Annah scored at or near 100% during the mand and O-P matching assessments, but she scored only 6% on the P-O matching assessment. During her P-O assessment, Annah consistently engaged in pictorial mands by handing the sample picture to the experimenter rather than matching the picture to the correct object in the array. Furthermore, both her caregiver and former case manager reported that she had mastered P-O matching. For these reasons, it is likely that the low score on her P-O assessment was due to faulty stimulus control during the assessment rather than a true deficit in her P-O matching repertoire.

Some participants with low correspondence between their SPAs without access and RAs had different results on their prerequisite assessments (see Table 2), suggesting that certain prerequisite skills (i.e., pictorial mands, O-P/P-O matching) may be correlated with the success of pictorial SPAs without access. Lisa scored 100% on her mand assessment, 0% on her P-O matching assessment, and slightly above chance levels (i.e., 44%) on her O-P matching assessment. Similarly, Greg scored 100% on his mand assessment and slightly above chance levels on his P-O and O-P matching assessments (i.e., 44% and 56%,

Table 2

Summary of Results for Experiments 1 and 2

	% of correct responding in prerequisite skills assessments			Correspondence between reinforcer assessments and SPA types				
	P-O matching	O-P matching	Pictorial mand	Without contingent access SPA	With (FR 1) contingent access SPA	VR 3 contingent access SPAs	VR 5 contingent access SPAs	Extinction SPAs
Keron	100	100	100	Yes				
Annah	6	81	100	Yes				
Connor	100	100	100	Yes				
Eric	100	100	100	No	Yes	Yes[a]	Yes	Yes
Lisa	0	44	100	No	Yes	Yes	Yes	Yes
Sean	87.5	87.5	0	No	Yes	Yes[b]		
Greg	44	56	100	No	Yes	Yes	Yes	Yes
Mitch	93.8	93.8	100	No	Yes	Yes	Yes	Yes

Note. P-O = picture to object; O-P = object to picture; SPA = stimulus preference assessment.
[a] Correspondence was observed for Eric only following two sets of VR 3 SPAs.
[b] Correspondence was observed for Sean only following a set of denser (VR 2) SPAs.

respectively). Sean scored 0% on his mand assessment and 87.5% for both of his matching assessments.

The alternative-modality SPA literature indicates that pictorial SPAs without contingent access are not successful with some individuals with developmental disabilities (e.g., Hanley et al., 1999; Higbee et al., 1999), and the results for five of our participants were consistent with these previous findings. Nevertheless, the addition of contingent access to the reinforcer in alternative-modality SPAs creates a less practical form of the assessment. Although Groskreutz and Graff (2009) suggested that researchers should examine intermittent schedules of contingent access (e.g., delivering access to stimuli on an interval or ratio schedule) to maintain both meaningful selections and the benefits of an alternative modality for such individuals, to date, no empirical investigations of these procedural manipulations have been conducted. Therefore, the purpose of Experiment 2 was to investigate the role of contingent access to the reinforcer for participants who did not have valid results from a pictorial SPA without access when compared to a subsequent RA. For this subset of participants, the effects of schedule thinning were evaluated to determine if a pictorial SPA could be made more practical. That is, access to the stimuli depicted on the pictures was delivered on a schedule that was thinned to extinction (i.e., no contingent access).

EXPERIMENT 2

METHOD

Participants, Setting, Materials, and Session Duration

Eric, Lisa, Sean, Greg, and Mitch participated in Experiment 2. Session arrangements and materials were consistent with Experiment 1. Sessions ranged from 1 min (RA control) to 16 min 22 s (SPA with contingent access). Sessions were conducted 2 to 4 days per week, and each participant's total time commitment ranged from 4 to 8 weeks.

Design and Procedure

Reinforcer assessments were evaluated using an alternating treatments design (Barlow & Hayes, 1979). To demonstrate experimental control over the effects of schedule thinning on discriminated responding in RA sessions, we used a nonconcurrent multiple baseline design across participants. The order of preexperimental and experimental conditions is depicted in Figure 1.

Pictorial SPA with contingent access and RA. The trials for this assessment were conducted in the same manner as described for the pictorial SPA without contingent access, except that the participant was given the opportunity to consume a small amount of the edible stimulus after each selection. A single-operant PR RA was conducted after the pictorial SPA with contingent access using the HP, LP, and control items. These sessions were conducted in the same manner as described in Experiment 1.

Schedule thinning. These schedule manipulations were conducted with participants who showed high levels of correspondence between the results of the pictorial SPA with contingent access and the RA to evaluate whether conditioned reinforcement properties could be established for the pictorial stimuli to create a more practical pictorial SPA (i.e., to eliminate the need for contingent access). During schedule thinning, access to the stimuli depicted on the pictures was delivered on a schedule that was thinned to extinction (i.e., no contingent access). The results of the previous RAs using the HP and LP items from the SPA without contingent access served as the baseline data for each participant.

First, three pictorial SPAs were conducted, with contingent access provided on a variable-ratio (VR) 3 schedule. If a clear gradient was achieved and the gradients were consistent

across the three SPAs, three RA sessions (i.e., a brief RA) that evaluated the HP and LP items from the VR 3 schedule SPAs and the control item were conducted in a quasirandom order. A clear gradient was defined as each SPA producing selection percentages ranging from at least 14% to 86%. A consistent gradient was defined as all three SPAs identifying the same stimulus as the HP item (i.e., having the highest or second highest selection percentage) and the LP item (i.e., having the lowest or second lowest selection percentage). If the participant's break points were higher for the HP item than for the LP and control in the brief RA (i.e., the RA validated the prior SPA's prediction), three pictorial SPAs, using a VR 5 schedule of reinforcement, were conducted.

Schedule thinning progressed (i.e., VR 3, VR 5, extinction) until no access was provided in a 28-trial SPA session. If clear gradients or consistent results across the SPAs were not obtained, the three SPAs were repeated using the same schedule value. If preference gradients remained unclear or results continued to be inconsistent, participation was either terminated or the experimenters implemented schedule thinning at a denser schedule value. In addition, if the RA did not validate the SPA for any of the schedule values, the experimenter conducted an additional three SPAs at the same schedule value with subsequent RA sessions.

No more than one schedule-thinning SPA occurred each day, and all SPAs at each schedule value were conducted within the same week. The brief RA after schedule-thinning SPAs was conducted within the same week as the SPAs, and each RA session within the brief RA was separated by a 5- to 10-min play break.

Interobserver Agreement and Procedural Integrity

Data on interobserver agreement and procedural integrity were collected in the same manner as described above in Experiment 1. All interobserver agreement and procedural integrity scores were averaged and reported per participant per session type. Interobserver agreement was calculated for 100% of sessions, and for all participants across session types it was 100%. Procedural integrity was calculated for 99.8% of sessions (range, 97% to 100%), and the average score for all participants across session types was 100%.

RESULTS AND DISCUSSION

The duration of pictorial SPA sessions without contingent access were shorter (*M* = 6 min 52 s) than those that included contingent access (*M* = 13 min 59 s) for all participants. The results of all participants' SPAs with contingent (FR 1) access are displayed as white bars in Figures 3 and 4 (left), and subsequent RA data are displayed in the second "With Access (FR 1)" phase of the line graphs in Figures 3 and 4 (right). Greg's pictorial SPA with contingent access (Figure 3, bottom left) produced a clear gradient, with selection percentages ranging from 0% to 100%. Break points were higher for Greg's HP item (*M* = 6) during his second RA than for the LP (*M* = 2) and control (*M* = 0) items (bottom right), confirming the predictions of the pictorial SPA with contingent access. We then conducted a schedule-thinning manipulation. Due to space constraints, we describe and display all schedule-thinning data (including bar graphs of pictorial SPAs at each schedule value of the manipulation) for Greg as a representative participant and display the PR RA data after pictorial SPAs without access (extinction), with access (FR 1), and during schedule thinning for the remaining participants.

Greg had consistent results across his first three VR 3 pictorial SPAs (Figure 5, top left), and each pictorial SPA produced a clear gradient. The first pictorial VR 3 SPA identified the HP item with a selection percentage of 100%, and the second and third pictorial SPA
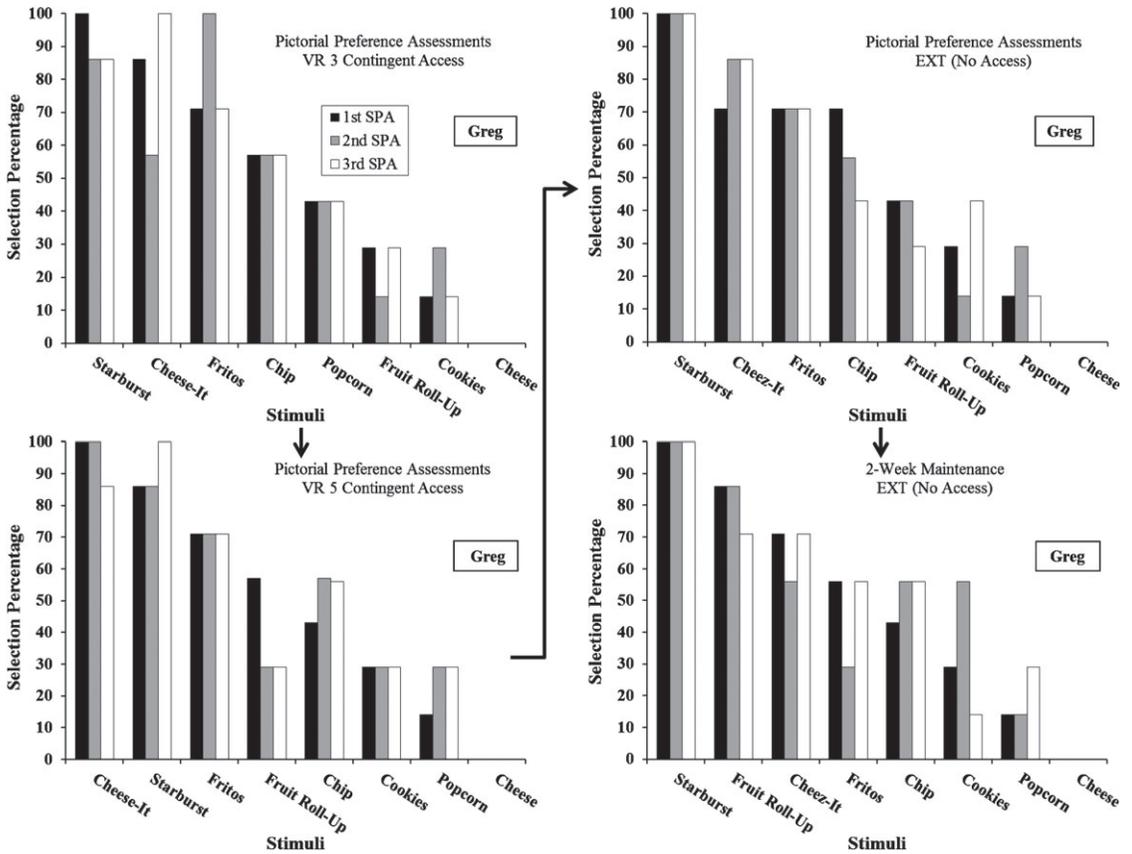
Figure 5.   Results of Greg's schedule-thinning manipulation. Each bar graph depicts selection percentages from pictorial preference assessments conducted on VR 3 (top left), VR 5 (bottom left), and EXT (top right) schedules. The bar graph in the bottom right panel depicts selection percentages conducted without contingent access (EXT) at 2-week maintenance sessions.

identified this same item as having the second highest selection percentage (i.e., 86%). All three VR 3 pictorial SPAs identified the same LP item (selected on 0% of opportunities). Greg had a higher break point for his HP item than for his LP and control items in his subsequent brief RA (see "Schedule Thinning" phase in Figure 3, bottom right), validating the results of his VR 3 pictorial SPAs. When the schedule of reinforcement was thinned to VR 5 and then to extinction (Figure 5, bottom left and top right), results were consistent; the same two items were identified as HP and LP. In addition, Greg had higher break points for his HP item than for his LP and control items when they were assessed

in brief RAs that followed his VR 5 and extinction manipulations (Figure 3, bottom right). The SPA without contingent access (i.e., extinction) and brief RA results remained consistent when they were tested 2 weeks after his last schedule-thinning sessions (Figure 5, bottom right, and Figure 3, bottom). These results suggest that systematic thinning of the reinforcement schedule across pictorial SPAs was a successful procedure to establish conditioned reinforcement properties of the pictorial stimuli for Greg.

Eric's pictorial SPA with contingent access produced a clear gradient, with selection percentages ranging from 0% to 86% (Figure 3,

top left), and the break points were higher for his HP item (*M* = 4) during his RA (Figure 3, top right) after the pictorial SPAs with contingent access than for the LP (*M* = 1) and control (*M* = 2) items. Eric had highly consistent results across his first three VR 3 pictorial SPAs, and each pictorial SPA produced a clear gradient. However, he had the same high break point for his HP and control items as he did for his LP item when these items were assessed in a subsequent brief RA. Thus, the VR 3 pictorial SPAs were repeated. Results were consistent during his second set of three VR 3 pictorial SPAs, and a new HP item was identified. Eric had a higher break point for his HP item than for his LP and control items in his subsequent brief RA, validating the results of his second set of VR 3 pictorial SPAs. When the reinforcement schedule was thinned to VR 5 and then to extinction, results were consistent, and he had higher break points for his HP item than for his LP and control items during the brief RAs.

Sean's RA and schedule-thinning data are depicted in Figure 3 (left and right middle, respectively). The assessment with contingent access produced a clearer gradient and identified new HP and LP items. His RA showed a clear separation between data paths, with higher break points in the HP condition (*M* = 3.7) than in the LP (*M* = 1.3) and control (*M* = 0) conditions. These results suggested that the pictorial modality was successful when contingent access was implemented.

Unlike the other participants, Sean did not have consistent results across his VR 3 pictorial SPAs after schedule thinning. Despite the three additional pictorial SPAs with the same items and the same schedule value, Sean continued to have inconsistent results. He did have successful VR 3 pictorial SPA results after exposure to a denser (i.e., VR 2) schedule; however, we were unable to replicate these findings when we used a VR 5 schedule. Due to these inconsistencies, Sean's participation was terminated.

These data suggest that the VR 5 schedule value was too lean to produce valid SPA outcomes.

Lisa's SPA with contingent access produced a clearer gradient, with selection percentages ranging from 14% to 100%, and separation between break points for her HP item (*M* = 5.3) and her LP (*M* = 0.7) and control (*M* = 0.7) items in her RA (Figure 4, top right). Lisa had consistent results across her three pictorial SPAs conducted with VR 3 and VR 5 contingent access and with no access (i.e., extinction) during schedule thinning. When these items were assessed along with her control item in subsequent brief RAs, she had a higher break point for the HP item than for the LP and control items. These results suggest that schedule thinning was a successful procedure for Lisa.

Mitch's SPA with contingent access produced a clear hierarchy, with selection percentages ranging from 14% to 100%, and this SPA identified new HP and LP items. In a subsequent RA (Figure 4, bottom right), break points were higher for the HP item (*M* = 8) than for the LP (*M* = 0) and control (*M* = 0) items, suggesting that contingent access was necessary for a pictorial SPA to be valid. During schedule-thinning manipulations, Mitch had consistent results across his three pictorial SPAs conducted with VR 3 contingent access. However, the results from his first set of VR 5 pictorial SPAs did not identify a consistent LP item. His results were consistent during his second set of VR 5 pictorial SPAs and when the pictorial SPAs were conducted with no access (i.e., extinction). During subsequent brief RAs, he had consistently higher break points for the HP items, suggesting that schedule thinning was successful in creating a valid pictorial SPA for Mitch.

A nonconcurrent multiple baseline design across participants was used to demonstrate experimental control over the effects of schedule thinning on discriminated responding in

RA sessions (Figures 3 and 4). In baseline, low levels of correspondence were observed between the results of the pictorial SPAs without access and the subsequent RAs for all participants. That is, there was no clear separation of the HP data paths from the LP and control data paths, suggesting that the results of the pictorial SPAs without access were not valid. However, pictorial SPAs became valid when contingent access was provided after stimulus selections on an FR 1 schedule for all participants. When schedule thinning was introduced, high correspondence continued to be observed for Eric, Greg, Lisa, and Mitch, and this high correspondence remained stable as the schedule of reinforcement was thinned to a VR 5 schedule and then to extinction (i.e., no access). Reinforcer assessments were not conducted after the initial VR 3 pictorial SPAs for Sean because of inconsistent results across his three assessments. However, the same high correspondence that was observed for the four other participants during schedule thinning was also observed when a denser schedule value was implemented (Figure 3, middle). Sean continued to have high correspondence when the schedule was thinned to a VR 3 value; however, RAs were not conducted after the VR 5 SPAs because of inconsistent results across his pictorial SPAs.

The results of Experiment 2 demonstrate that schedule thinning was an effective method to establish conditioned reinforcement properties for pictorial stimuli for participants who did not have correspondence between pictorial SPAs without access and subsequent RAs. Beginning schedule thinning using a VR 3 schedule of contingent access was effective for Lisa, Greg, and Mitch. Eric required a second VR 3 manipulation due to high responding in his first RA control condition. Mitch required a second VR 5 manipulation due to inconsistencies in identifying an LP item, and Sean required a denser schedule of reinforcement at the beginning of his schedule-thinning manipulation. Sean's need for a denser schedule

may have been due to deficits observed in his pictorial mand repertoire. Although he had a growing vocal mand repertoire during the course of the study, he did not have a history with using pictorial mands. Overall, this experiment suggests that schedule thinning may be a useful procedure to make pictorial SPAs more practical for participants who require contingent access to make meaningful pictorial selections.

GENERAL DISCUSSION

The research on alternative-modality SPAs indicates that alternative SPA formats have only partial predictive validity when they are administered without contingent access (e.g., Hanley et al., 1999; Higbee et al., 1999). The results of Experiment 1 demonstrate that certain prerequisite skills, such as pictorial mands and O-P/P-O matching, might be correlated with the success of the pictorial modality when contingent access is not provided. Two of the eight participants had high scores on the prerequisite skills and consistent outcomes for the pictorial SPA without contingent access and RA. In addition, three participants had low scores on the prerequisite skills, and the results of their pictorial SPAs without contingent access and RAs were inconsistent. Thus, the results for five of eight participants show correlations between their prerequisite skills and the validity of the pictorial SPA without contingent access.

Annah was an exception in Experiment 1, with a low score of 6% on her P-O matching assessment, although the RA confirmed the accuracy of her SPA without contingent access. However, there is anecdotal evidence to show that these low scores were due to faulty stimulus control rather than a true P-O matching deficit. Also, despite high prerequisite assessment results, Eric's and Mitch's pictorial SPAs without access were not successful in identifying reinforcers. One explanation for Eric's and

Mitch's differing results could be that we used a brief initial assessment to determine if participants had basic exchange-based communicative skills, similar to what would be observed in early mand training. However, we did not evaluate discriminated responding to ensure that the participant selected the picture of the HP item when multiple icons were presented in an array. It may be that a discrimination between nonpreferred and preferred icons (e.g., Boelter & Hagopian, 2011) would be more predictive of the effectiveness of pictorial SPAs. Future researchers might consider gathering more information on participants' prior exposure to picture exchange communication systems and directly evaluating different skills related to pictorial mands to help inform necessary prerequisite skills.

It could also be the case that conducting the pictorial SPA under extinction (i.e., without contingent access) was not sufficient to identify reinforcers for Eric and Mitch. That is, these participants may have made meaningful selections during the initial trials of the SPA without access, but indiscriminate responding may have occurred over successive trials of no access. Researchers interested in the topic of contingent access in alternative-modality SPAs might consider attending to this concern via a within-session analysis of selection percentages during the initial and final trials of an SPA without access compared to a pictorial SPA with access. Such an analysis may help to determine if invalid results of SPAs without access are related to prerequisite skill deficits or possible extinction-induced variability in responding.

Another explanation for the results for the SPA without access between the participants in Experiments 1 and 2 is that the learning histories may have differed between these two sets of participants. For example, participants who had valid results for the SPA without access in Experiment 1 were older and may have had a longer history of engagement in selection responses under lean reinforcement schedules.

However, through schedule thinning, the results of the SPAs became valid for the participants in Experiment 2. Lisa and Greg showed the most success with schedule thinning, only requiring one set of SPAs at each schedule value (i.e., VR 3, VR 5) before they made meaningful choices in their pictorial SPAs conducted without access (i.e., extinction). Mitch required a second set of pictorial SPAs at the VR 5 schedule value because a clear LP item was not consistently identified during his first set of VR 5 pictorial SPAs. Eric required a second set of pictorial SPAs at the VR 3 schedule value due to a high control break point in his first brief RA. The similar HP and control break points during his first schedule-thinning RA may have been due to automatic reinforcement properties associated with the task. However, this explanation seems unlikely because responding during subsequent RA control conditions was low. Anecdotally, he vocally manded for "blue" (i.e., the HP condition) during the first control condition, and he manded for "chocolate" (i.e., the Hershey's Kisses) during the first HP condition when gummy candies were being delivered. He also occasionally consumed the control item during the RA sessions but pushed the LP item out of his reach and never consumed it. This anecdotal evidence suggests that the LP item may have been less preferred than the nonpreferred item nominated via the RAISD. Therefore, it seems likely that the results of Eric's first schedule-thinning RA were accurate in invalidating the results of his first set of VR 3 SPAs.

Sean did not have initial success with schedule thinning at the VR 3 schedule value; however, he did have consistent results when we implemented the pictorial SPA using a denser (i.e., VR 2) schedule. In addition, he did not have consistent results when we implemented a leaner schedule (i.e., VR 5). One possible explanation for these inconsistent VR 3 and VR 5 pictorial SPA results is that his preferences changed over the course of the repeated

assessments. This possibility is unlikely because he did have consistent results when the amount of access was increased, and he did have high break points during his subsequent RA. It is more likely that that the inconsistent results for the VR 3 pictorial SPA were due to the novelty of using pictures to request items. That is, Sean's therapists verbally reported that he did not use pictorial mands, and his 0% score on his pictorial mand prerequisite assessment supports this report.

Overall, schedule thinning was successful for establishing conditioned reinforcement properties of the pictorial stimuli assessed in the SPAs. One limitation of these schedule-thinning procedures was that we conducted a brief RA after each schedule value rather than an extended RA. Another limitation of our schedule-thinning procedures was that we did not collect follow-up data to assess the maintenance of effects for the participants other than Greg. Researchers interested in extending the line of research on schedule thinning for alternative-modality SPAs should consider conducting an additional SPA without access at week-long intervals after the end of schedule thinning both with the original stimulus set and with a novel stimulus set to assess maintenance and generalization.

Some additional limitations of the investigation should be mentioned. First, we assessed edible reinforcers in this study. Edible reinforcers can be quite powerful in motivating behavior, but practicing behavior analysts also need to assess the reinforcing effects of other classes of stimuli, such as toys and activities, to use in behavioral programming. Alternative-modality SPAs may also be useful in identifying other important preferences related to quality of life (e.g., Whitehouse, Vollmer, & Colbert, 2014). Future studies should consider evaluating the use of alternative-modality SPAs for other classes of stimuli because most stimuli in other classes are difficult or impossible to present during a traditional tangible SPA (e.g., riding a bike, going to the movies, vocational preferences).

Second, we chose to evaluate schedule thinning for participants who scored poorly on their prerequisite skill assessments and did not have valid results for the SPA without access. Although Lohrmann-O'Rourke and Browder (1998) made the recommendation to teach prerequisite skills that may be necessary to perform successfully in SPAs with nontangible stimuli, to date only one investigation has focused on this potential solution (Browder, Cooper, & Lim, 1998). Future research could evaluate the role of hypothesized prerequisite skills by conducting remediation training to examine the effects of prerequisite skill acquisition on the success of a pictorial presentation format. Our findings in Experiment 2, especially for Eric and Mitch, call into question whether the repertoires assessed in the current investigation are meaningful prerequisites for pictorial SPAs without contingent access to the reinforcer. It may be the case that the prerequisite skills needed for alternative-modality SPAs will remain speculative until a more rigorous assessment (i.e., remediation training) is conducted to assess failures of prerequisite assessments.

Third, we chose to focus solely on the pictorial modality in the current investigation. That is, we did not include comparisons of the other alternative SPA formats (i.e., verbal, textual, video). The pictorial modality was selected because it has been the most heavily researched alternative presentation format. Researchers are encouraged to replicate the procedures of this study with other alternative modalities. It may be useful to focus on the verbal modality because it has the quickest administration time.

In addition, some limitations of our RA procedures should be mentioned. First, we used an arbitrary task in our RAs rather than evaluating the reinforcing effects of the HP and LP stimuli in the participants' ongoing behavioral programming. Second, we identified the

nonpreferred item used in the RA control conditions via informant assessment rather than using a direct observation measure. Even though the RA data for each participant support the function of the control stimulus as nonpreferred (i.e., break points during the control conditions were consistently low), researchers interested in continuing this line of research using a similar RA arrangement should consider identifying nonpreferred items via a single-stimulus preference assessment. Third, we decreased the duration of participation considerably with the concurrent-operants arrangement for Connor's RA compared to that of the the other participants, suggesting that this arrangement could be advantageous in future studies. However, a single-operant PR arrangement does allow therapists to obtain information about absolute reinforcement effects (Roscoe, Iwata, & Kahng, 1999). Future studies should directly compare the results of these different RA arrangements.

The results of this study have implications for behavior analysts who work with individuals with developmental disabilities. We found that pictorial SPAs were successful for less than half of the participants who completed the protocol when these assessments were conducted without contingent access. We also found that providing contingent access to the participants who did not have success with the initial pictorial SPA created an effective SPA. However, this solution is not practitioner-friendly because contingent access after item selection eradicates the main benefits of alternative modalities. That is, alternative modalities are most likely dictated by the need to assess preferences for the multitude of reinforcers that cannot be assessed in a tangible tabletop arrangement and the need to decrease preparation and administration time of SPAs. However, schedule thinning may be a viable solution for practitioners to maintain both meaningful selections and the benefits of a pictorial format for clients who require contingent access.

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