

**Assessing the Efficacy of Pictorial Preference Assessments for
Children with Developmental Disabilities**

by

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Abstract

A pictorial preference assessment is a potentially valuable tool because it allows clinicians to quickly assess preferences for complex stimuli that cannot easily be presented during an assessment. Past research has demonstrated that pictorial preference assessments are effective for individuals with developmental disabilities only when access to the stimulus is provided contingent on a pictorial selection. The purpose of this investigation was to extend this line of research by assessing the feasibility of the pictorial format with children with developmental disabilities. In Experiment 1, matching and mand assessments were conducted to further evaluate the role of prerequisite skills. The role of contingent reinforcer access was also assessed by comparing the results from the pictorial format without access to the results of a progressive-ratio reinforcer assessment. If access was found to be necessary, the effects of schedule thinning were evaluated to determine if a pictorial format could be made more practical in Experiment 2. In general, results indicated that the pictorial format without access was only successful with 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 preference assessment for a subset of participants.

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Assessing the Efficacy of Pictorial Preference Assessments with Children with Developmental Disabilities

Assessing preferences of individuals with developmental disabilities (DDs) is of great importance to practicing behavior analysts. Preferred stimuli identified via stimulus preference assessments (SPAs) are often used in behavioral programming to increase skills (e.g., communication; Hernandez, Hanley, Ingvarsson, & Tiger, 2007) and decrease aberrant behavior (e.g., environmental enrichment; Ringdahl, Vollmer, Marcus, & Roane, 1997). Although the majority of the preference assessment literature focuses on identifying reinforcers to be used in behavioral programming, SPA methods can also be used to assess other important preferences related to self-determination (i.e., the right to make choices about important aspects of life rather than rely on the decisions of caretakers) and quality of life. Some aspects of self-determination and quality of life that can be assessed using SPAs are preferred leisure activities, housing or roommate options, and vocational preferences (Cobigo, Morin, & Lachapelle, 2007). Self-determination for individuals with DDs is a core societal value and has been identified as a critical factor in the quality of life for this population (Graziano, 2001; Lachapelle et al., 2005).

Assessing preferences of individuals with DDs can be difficult for several reasons. First, simply asking individuals with limited verbal repertoires to nominate items or activities they prefer may not produce valid outcomes (Northup, 2000). Second, preferences for this population have been found to be idiosyncratic and change over time (Mason, McGee, Farmer-Dougan, & Risely, 1989; Zhou, Iwata, Goff, & Shore, 2001). Finally, clients in some circumstances may not naturally be exposed to a variety of reinforcers. Due to these difficulties, early efforts were made

to identify reinforcers using indirect methods (i.e., client responses are not directly observed) such as standard lists and caregiver report. For example, Matson et al. (1999) developed a standardized checklist of 49 items that were listed as preferred by direct-care staff with 185 individuals with severe or profound intellectual disabilities. In addition, the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD), a structured interview that assesses categories of stimuli (e.g., visual, auditory), was developed by Fisher, Piazza, Bowman, and Amari (1996) in which the rank of putative reinforcers is determined by the caregiver.

Although indirect preference assessment methods have the advantage of being time efficient with multiple informants, they also have some significant limitations. Standardized lists are based on the preferences of groups rather than individuals. However, research has indicated that client preferences are idiosyncratic (Northup, George, Jones, Broussard, & Vollmer, 1996; Northup, 2000). Therefore, standardized lists and surveys may not successfully capture preferences. For example, when the results of reinforcer assessments (i.e., an assessment of the predictive validity of SPA results) for 20 children diagnosed with attention-deficit/hyperactivity disorder (ADHD) were compared to a survey method administered to the children, the correspondence levels between the two assessments were only slightly greater than chance (Northup, 2000). In addition, informants, such as direct-care staff, can be helpful in nominating some preferred items or activities. However, variables such as high staff turnover in residential settings may lead to caregivers not knowing or being misinformed about clients' preferences (Hall & Hall, 2002). Overall, when the results of indirect methods have been compared to more direct SPA methods, a lack of concordance has been found with multiple populations, including typically developing toddlers (Cote, Thompson, Hanley, & McKerchar, 2007), adolescents and

adults with profound intellectual disabilities (Green et al., 1988; Parsons & Reid, 1990), and elderly adults diagnosed with dementia (Mesman, Buchanan, Husfeldt, & Berg, 2011).

Due to the limitations of indirect methods mentioned above, methods based on observable client choices (i.e., direct methods) have been developed to assess client preference. In direct methods, a client is systematically exposed to stimuli for a brief period of time using multiple trials. These stimuli are typically selected using caregiver input from a checklist or structured interview (e.g., RAISD). On each trial, a client's choice of a stimulus generally results in brief access to that stimulus (e.g., the consumption of a small edible, 30 s of access to a toy), and a researcher or practitioner records approach responses or level of engagement with a stimulus. In most cases, a selection percentage (i.e., the number of times a stimulus is chosen divided by the number of times the stimulus was available across trials) is calculated for each stimulus being assessed. The stimuli are then ranked from most to least preferred, and a preference hierarchy of the stimuli can be graphed. Typically, the stimuli with the highest selection percentages are used in ongoing behavioral programming. In addition, a reinforcer assessment (RA) may be conducted to validate the results of the SPA. While RAs are helpful in establishing whether there is a parametric relation between the SPA and reinforcer assessment results, these procedures are mostly conducted in a research context rather than in everyday practice with individuals with DDs.

Direct Observation Stimulus Preference Assessments

The first direct SPA method -- the single-stimulus method -- was developed in 1985 by Pace, Ivancic, Edwards, Iwata, and Page. In this assessment, approach responses are measured when individuals are presented with a single stimulus in each trial. Each stimulus being assessed is presented the same number of times. Although this assessment was shown to have high

predictive validity (i.e., the items identified as highly preferred did subsequently function as reinforcers), it is one of the most time consuming SPAs to conduct. In addition, clients may select indiscriminately when this method is used; meaning the client may choose to engage with the item placed in front of him rather than choose to do nothing. In these cases, false positives may be identified and a useful preference hierarchy is less likely to be produced.

Fisher et al. (1992) later developed a briefer and more valid arrangement termed the paired-stimulus or forced-choice method. In this procedure, clients are presented with two concurrently available stimuli during each trial, and asked to choose one stimulus (e.g., “Pick one”) by the person administering the assessment. Each stimulus is compared to each other the same number of times, and the left-right placement of the stimuli is counterbalanced to identify side biases should they occur. Fisher et al. found that the percentage of selections across trials in this arrangement proved to be a predictor of subsequent reinforcement effects. However, this method may be complicated to design because of the equal number of comparisons and counterbalancing. For example, if eight stimuli are to be assessed, 28 comparisons will need to be presented to the client. Therefore, this arrangement requires additional preparation time for the administrator (e.g., development of a precise data sheet) compared to other SPAs.

Multiple-stimulus assessments were subsequently developed in which an array of stimuli (e.g., 5-8 stimuli) is presented to a client who is then allowed to choose one (Windsor, Piche, & Locke, 1994). The chosen item is then either placed back in the array (multiple stimulus with replacement [MSW]; Windsor et al.) or is removed from the array (multiple stimulus without replacement [MSWO]; DeLeon & Iwata, 1996) before the subsequent trial. Once each item has been chosen in an MSWO, the next array (i.e., the same 5-8 stimuli) is presented. When these assessments were compared to the paired-stimulus method, the MSWO method was found to

have comparable results and required much less time to administer (DeLeon & Iwata). The MSW arrangement has been found to be limited in that a client may only chose one or two items, and in these cases, this arrangement will not produce information on the relative preference of all items in the array. The development of the MSWO as a brief and valid SPA is important because preferences have been found to change over time and thus, need to be assessed frequently. In addition, Carr, Nicolson, and Higbee (2000) evaluated the use of an even briefer MSWO (i.e., three stimulus arrays instead of five) with three children with autism and found that three arrays were sufficient to identify reinforcers. The authors also found that the rank of stimuli from the first array was highly correlated with the rank from all three arrays, suggesting that a one-array MSWO may also be valid.

Roane, Vollmer, Ringdahl, and Marcus (1998) developed an additional multiple-stimulus method -- the free-operant method -- in which a client is presented with multiple stimuli and allowed to freely interact with all of the stimuli for a brief period of time (e.g., 5 min). In this arrangement, the stimuli are not removed from the client during the assessment, and duration of engagement is typically measured. Roane et al. demonstrated that this method identified items that functioned as reinforcers, took less time to administer than the paired-stimulus method, and was associated with fewer aberrant behaviors. This arrangement also gives practitioners the advantage of being able to simultaneously record problem behavior concurrently with item interaction to identify items that may compete with problem behavior for later behavioral programming. While this method is brief and may be a good alternative for clients with problem behavior maintained by access to a tangible item, it does have the disadvantage of only identifying one or two preferred items if the client only interacts with a few stimuli during the assessment. When Kodak, Fisher, Kelley, and Kisamore (2009) compared this method to a MSW

arrangement, the authors found that each method identified a different most preferred item, and the results of the RAs indicated that the MSW arrangement identified the item that functioned as the most effective reinforcer for two of the four participants.

The Use of Alternative Stimulus Modalities

Within the SPA methods, different stimulus modalities have been evaluated to assess the reinforcing value of protracted events and events that are difficult to present during an actual assessment (e.g., going on a walk or to a favorite restaurant). Rather than presenting tangible items to a client, the use of alternative formats involves presenting pictures, verbal descriptions (e.g., “Would you rather have X or Y”), textual descriptions, or short video segments of the items or activities to the client. These modalities offer convenience over tangible presentations because it is easier for practitioners to manage and display stimuli. For example, if a practitioner chooses to use a verbal SPA, she would not be required to have pictures of the items or activities she would like to assess, decreasing assessment preparation time. Also, the use of an alternative modality decreases the overall administration time of an SPA because the practitioner does not have to wait for the client to consume or interact with an item after a selection before beginning the next trial.

Since the mid-1990s, a line of research evaluating the efficacy of different stimulus modalities in SPAs has emerged. Northup, Jones, Broussard, and George (1995) were the first authors to compare a verbal modality (using a paired-stimulus method) to a tangible SPA (using a free-operant arrangement) with 10 children diagnosed with ADHD to identify preferred toys. The authors also included a comparison of the children’s nomination of their favorite toy out of an array of five items. The top item from each modality was then assessed in an RA where access to each high-preference (HP) toy was associated with a different table with identical tasks

in a simultaneous treatments design. The results indicated that the assessments (i.e., verbal, tangible, child nomination) disagreed more often than they agreed. In addition, the verbal and tangible modalities were about equally as likely to identify a reinforcer, with child nomination having the least predictive validity.

Northup, George, Jones, Broussard, and Vollmer (1996) conducted a similar comparison of a reinforcer survey to verbal and pictorial modalities using a paired-stimulus arrangement to identify preferred categories of stimuli (e.g., edibles, activities, attention) with four children diagnosed with ADHD. Using a subsequent RA, the authors found that verbal and pictorial modalities identified HP and low-preference (LP) categories for three of the four participants. These modalities also had 70% and 80% accuracy with the RA results, and the verbal modality required the least amount of time to administer. The survey identified multiple categories as HP, was less likely to identify LP categories, and was less likely to be predictive of participants' preferences. A systematic extension of this study was conducted with 20 children diagnosed with ADHD (Northup, 2000). This investigation included three procedural differences (i.e., an additional stimulus category, different RA task, different RA arrangement), and the survey method continued to have poor predictive validity.

Wilder, Ellsworth, White, and Shock (2003) later extended this line of research using similar procedures to Northup et al. (1996) to investigate self-report in four adults diagnosed with schizophrenia. However, the results of this study suggested that there were few differences in the accuracy of the survey, verbal, and pictorial modalities, and the authors also found that no modality was over 70% accurate when compared to the results of the RAs. While the above investigations did not find the survey method to be predictive of client preferences, it should be noted that these investigations were conducted with clinical populations. When a survey method

was compared to a verbal paired-stimulus assessment with four adult employees (administrative assistants) with subsequent RAs, the survey method was found to be more accurate and slightly faster to complete (Wilder, Therrien, & Wine, 2005).

Prerequisite skills assessment. In the late-1990s, the studies mentioned above suggested collectively that verbal and pictorial modalities were successful in identifying reinforcers for children diagnosed with ADHD. While these investigations were conducted with a clinical population, children with ADHD typically have normal intellectual functioning. Thus, it remained unclear if alternative modalities would be successful with other clinical populations (e.g., individuals with DDs). Parsons, Harper, Jensen, and Reid (1997) were the first authors to compare the utility of a pictorial SPA to a tangible presentation using a paired-stimulus method with this population (i.e., older adults diagnosed with profound intellectual disabilities). The pictorial format was only successful in establishing a leisure activity preference for two participants. However, the predictive validity of the identified leisure activities was not assessed in subsequent RAs. The authors also reported that the participants had no verbal communication skills, but no formal assessment of any potentially necessary prerequisite skills were conducted in this investigation.

IQ, matching skills, and language repertoires. To further investigate the role of client prerequisite skills and the success of verbal SPAs, Cohen-Almeida, Graff, and Ahearn (2000) compared tangible and verbal modalities to assess edible items in six individuals with intellectual disabilities using a paired-stimulus method. The participants in this investigation had a range of IQ scores, all used vocal speech as their primary mode of communication, and had achieved at least a 3-year age-equivalent score on the Peabody Picture Vocabulary Test - Revised. Participants were also able to demonstrate comprehension of two-step instructions, sentence

constructions using the conjunction “or”, and had spoken-word/object match-to-sample skills for the stimuli assessed in the SPAs. Both modalities yielded the same two HP items and the same LP item for the majority of participants, and IQ level did not necessarily predict the correlation between the two modalities. Similar results were found when the procedures from the Cohen-Almeida et al. investigation were replicated with adults with schizophrenia to identify preferred edible items (Wilder, Wilson, Ellsworth, & Heering, 2003). Wilder et al. (2003) found that both verbal and tangible modalities identified the same HP item for three of the four participants and the same LP item for all participants. In addition, no positive relationship between IQ scores and correspondence between the two modalities was found, and the verbal modality took slightly less time to administer. Although both of these investigations had similar findings, no RAs were conducted in either study to validate the results of the SPAs. Therefore, the extent to which the items identified in the verbal SPAs functioned as reinforcers is unknown.

In addition to assessing the relationship between IQ scores and the success of alternative stimulus modalities, researchers have investigated the role of other prerequisite skills such as matching abilities and verbal repertoires. For example, Graff and Gibson (2003) compared tangible and pictorial SPAs using a paired-stimulus method to identify preferred edibles for four adolescents with a diagnosis of a developmental disability or behavior disorder. Prior to conducting the SPAs, the participants’ picture-to-object and object-to-picture matching skills were assessed using a match-to-sample task. The authors also included an RA using an arbitrary task (i.e., a free operant button press). The participants all demonstrated matching abilities with 100% accuracy, and the pictorial and tangible modalities had similar results for three of the four participants. Each modality identified a different HP item for the fourth participant. When these HP items were assessed in the RA, both functioned as a reinforcer when singly available.

However, the HP item from the tangible condition had higher response rates when it was concurrently available with the HP item from the pictorial SPA. On the other hand, Clevenger and Graff (2005) compared tangible and pictorial modalities using a paired-stimulus assessment to identify preferred foods for six adults with developmental disabilities and found that only the participants with matching skills had similar results across the two modalities.

Aspects of participants' verbal repertoires have also been assessed as potential prerequisite skills that are necessary for alternative SPA modalities to be successful in identifying reinforcers for individuals with DDs. Ardoin, Martens, Wolfe, Hilt, and Rosenthal (2004) assessed the accuracy of a paired-stimulus pictorial SPA by comparing the results to a concurrent-operant RA using HP, moderate-preference, and LP items. Three adolescents with mild to moderate intellectual disabilities participated in the investigation, and the participants' ability to identify the items from the picture card was assessed prior to the SPA. If the participant was unable to identify the item, the actual item was shown to the participant. The SPA was not conducted until the participant could identify each item from the picture cards. Although the participants were able to demonstrate this language skill (i.e., tacts) prior to the pictorial SPA, the authors only found partial predictive validity for this modality. However, the pictorial SPA included stimuli from multiple classes (e.g., attention, edibles, activities, tangible items) even though there is evidence suggesting that combining classes of stimuli in an SPA may confound the results (i.e., items from one class of stimuli may be displaced by another stimulus class; Bojak & Carr, 1999; DeLeon, Iwata, & Roscoe, 1997; Ortega, Iwata, Nogales-González, & Frades, 2012).

Higbee, Carr, and Harrison (1999) also assessed participants' language abilities prior to comparing pictorial and tangible modalities with two adults diagnosed with intellectual

disabilities using an MSWO arrangement. Even though both of the participants could reliably tact the items on picture cards, the tangible SPA produced a larger preference gradient than the pictorial modality and was also more successful in identifying items that functioned as reinforcers. In addition, Kuhn, DeLeon, Terlonge, and Goysovich (2006) assessed both tact and receptive identification repertoires of three children diagnosed with a developmental disability prior to assessing the predictive validity of a verbal paired-stimulus SPA. Although the participants were able to reliably tact and identify all of the stimuli in the stimulus pool, the authors found that the verbal modality was not predictive in identifying reinforcers. It should be noted that both of these investigations are limited in that they simultaneously assessed multiple classes of stimuli. Therefore, systematic replications assessing only one stimulus class are warranted.

Discrimination skills. Researchers have also evaluated the role of discrimination skills in the success of certain SPA modalities. One assessment that has been used to measure the discrimination skills of individuals with DDs within this line of research is the Assessment of Basic Learning Abilities (ABLA; Kerr, Meyerson, & Flora, 1977). The ABLA is organized in a hierarchical manner of six levels, in which individuals are assumed to exhibit the discrimination skills necessary to perform at lower levels of the assessment if they pass higher levels. For example, if an individual exhibits auditory-visual discrimination skills that are necessary to pass Level 6 of the assessment, it is assumed that they also possess the two-choice visual discrimination skill that is necessary to pass Level 3. For researchers interested in the success of alternative modalities, Levels 3, 5, and 6 are of particular interest as the skills necessary to pass the levels are directly related to the skills that are assumed to be needed to be able to differentially respond to auditory and visual stimulus modalities. Level 3 of the ABLA test

evaluates two-choice visual discriminations (used in a tangible modality), Level 4 evaluates two-choice visual quasi-identity match-to-sample discriminations (used in a pictorial modality), and Level 6 evaluates two-choice auditory-visual combined discriminations (used in a verbal modality).

During each level of the ABLA test, the evaluator presents the participant with simple discrimination tasks. For example, the participant will be asked to place a piece of foam into a red container while the position of the container is alternated across trials with another container of a different color. The evaluator then delivers praise following correct responses and corrective feedback following incorrect responses (i.e., a demonstration, a guided trial, and an opportunity to complete the task independently). Passing each level of the assessment is contingent on eight consecutive correct trials, and the assessment is completed when eight consecutive incorrect trials occur (i.e., a level is failed). The ABLA test has high inter-tester reliability and test-retest reliability, and is a brief assessment that requires approximately 30 min for administration (Vause, Yu, & Martin, 2007).

Conyers et al. (2002) first used the ABLA as a prerequisite skill assessment to compare tangible, pictorial, and verbal modalities using a paired-stimulus method to identify both preferred food and nonfood items with adults with developmental disabilities. The authors hypothesized that participants' ABLA scores would be predictive of which modality would successfully identify reinforcing items. That is, only a tangible SPA would be successful for Level 3 participants, tangible and pictorial modalities would be successful for Level 4 participants, and all three modalities would be successful for participants scoring at a Level 6. The investigation included three participants at Levels 3, 4, and 6 for a total of nine participants. An initial tangible assessment was conducted with six edible items, and the HP and LP items

were then assessed in subsequent tangible, pictorial, and verbal SPAs using a reversal design. These procedures were later replicated with nonfood items. Participants' ABLA level predicted the effectiveness of different presentation modalities. The authors also noted that the participants' level of intellectual disability did not predict if they could accurately state preferences using a verbal modality, suggesting that discrimination skills should be further investigated as a method of identifying which modality of SPA to use with clients with DDs. These findings were replicated using similar procedures with adults with DDs to assess additional food items (Schwartzman, Yu, & Martin, 2003), leisure activities (de Vries et al., 2005), and work tasks (Reyer & Sturmey, 2006). However, none of these investigations included an RA to verify the results of the SPAs, and the authors' measure of accuracy in these investigations was based on the participants' choice of the HP item when only compared to an LP item (i.e., the moderately preferred items were not assessed using the alternative modalities).

The ABLA has also been used in alternative modality SPA comparison studies with clinical populations outside of individuals with DDs. For example, LeBlanc, Cherup, Feliciano, and Sidener (2006) compared tangible, pictorial, verbal, and textual SPA modalities using a paired-stimulus arrangement with four adult males diagnosed with dementia. The authors also included an engagement assessment using the HP item from each modality as well as a subsequent intervention designed to increase engagement using the modality that was most predictive. Participants' scores on the Mini-Mental State Examination ranged from 7 to 17, indicating moderate to severe cognitive impairment. Two of the participants scored a Level 6 on the ABLA, one scored a Level 4, and one participant was able to pass Levels 1, 2, 4, and 6 but did not pass Level 3. Although the ABLA results were not clearly predictive of which modality to use for the participants, the verbal modality was found to be most predictive of subsequent

engagement for three of the four participants, and the tangible modality was most predictive for the fourth participant. In addition, the authors found moderate to substantial increases in engagement for all participants when choices were provided in their day program suggesting the future use of SPAs in this population.

In another example, Heinicke, Carr, Eastridge, Kupfer, and Mozzoni (2013) compared tangible, pictorial, and verbal modalities were using a paired-stimulus method to identify preferred food items with six adults with severe acquired brain injury. The HP item identified from each modality was then evaluated in an RA using progressive-ratio schedules. Each modality identified a different food item that had the highest selection percentage for three participants while the remaining three participants had highly consistent SPA results across modalities. However, the results of all subsequent RAs demonstrated that all modalities made valid predictions of foods that would function as reinforcers for acquisition programming. The success of all three modalities in identifying reinforcers for the six participants might have been a function of their discrimination abilities. However, no comparisons could be made across participants in this investigation because all six participants scored at Level 6 on the ABLA.

Effects of differential consequences. As mentioned previously, alternative modalities offer multiple conveniences over tangible presentations. One of the main advantages of alternative presentation formats is the decreased preparation and administration time associated with not providing access to a stimulus following a pictorial, verbal, textual, or video selection. However, the majority of the alternative modality SPA comparison research has included brief access to stimuli following participant selection across modality conditions. Including access following a selection across modalities does allow researchers to compare equivalent conditions, but it also creates an assessment that is not as useful to practitioners. That is, if access is

provided, the practitioner is limited on which stimuli she can assess (e.g., items that are immediately available, items that can be presented on a table top), and the preparation and administration times become comparable to a tangible SPA. Therefore, contingent access following selection eradicates the main benefits of alternative modalities for practitioners. To further investigate this limitation, researchers began investigating the effects of differential access following stimulus selection in the late-1990s.

Stimulus access in pictorial assessments. Hanley, Iwata, and Lindberg (1999) compared a pictorial modality with contingent access to a pictorial modality without access using a nonconcurrent multiple baseline design (with embedded reversals) across activities with four adults with DDs. Preferences for activities were assessed using a concurrent-schedules arrangement in which participants were asked to choose between three picture options (two potentially reinforcing activities and one control activity), akin to a paired-stimulus method with a control option. The authors found undifferentiated preferences for 11 of the 12 activity comparisons in the no-access condition. However, providing access following the no-access condition produced differentiated results for all comparisons. It should be noted that no RAs were conducted in this investigation; therefore, the predictive validity of these assessments is unknown. Similarly, Higbee et al. (1999) found that pictorial MSWO assessments without contingent access were not as successful in identifying reinforcers when compared to a tangible presentation with two adults diagnosed with intellectual disabilities. Ardoin et al. (2004) also found similar results when assessing the accuracy of pictorial SPAs with three adolescents with mild to moderate intellectual disabilities. In this investigation, HP items were delivered at the end of a session (to reinforce participation) rather than contingent on selection. The results of the concurrent operant RAs demonstrated only partial predictive validity for all participants.

Groskreutz and Graff (2009) compared a tangible paired-stimulus SPA to pictorial SPAs with and without access to assess the edible preferences of five adolescents with DDs. While the SPAs yielded similar preference hierarchies for four of the five participants regardless of the presentation format, the subsequent RAs suggested that the pictorial method without access might only be predictive for some but not all participants. Finally, Davis et al. (2010) compared paired-stimulus tangible and pictorial modalities with and without access with six adolescents with diagnoses of autism and related disorders (e.g., pervasive developmental disorder - not otherwise specified; PDD-NOS) using a paired-stimulus method to assess preferred edibles, activities, or toys. The authors found similar preference hierarchies for 4 of the 6 participants, and the HP items identified through these assessments functioned as reinforcers for 3 of the 4 participants. However, the pictorial no-access condition was only successful with some participants, and the authors mention, “more research is required to determine which method can be utilized the most efficiently” (Davis et al., pp. 452).

Stimulus access in verbal assessments. Two comparison studies have been conducted to assess the success of verbal SPAs without contingent access. Kuhn et al. (2006) conducted a comparison of a verbal paired-stimulus assessment with and without contingent access to the selected stimuli with three children ages 10-12 with a diagnosis of a developmental disability. In the verbal with-access condition, a participant was presented with two stimuli and was given the same instruction as in the verbal without-access condition (i.e., “Would you rather X or Y?”), and approximately 30 s of contingent access was provided following a selection. The subsequent RAs suggested that the verbal with-access SPA more accurately identified reinforcers for all participants in the study. However, this investigation was limited in that multiple classes of stimuli were included in the SPAs and the authors manipulated two variables between the

modalities being compared. That is, the stimuli were presented during the instruction (i.e., the antecedent) and after selection (i.e., the consequence) in the verbal with-access condition rather than only manipulating contingent access.

Tessing, Napolitano, McAdam, DiCesare, and Axelrod (2006) compared verbal paired-stimulus SPAs (with and without access) to assess preferred activities of seven adolescents with developmental disabilities. Although the verbal SPA without-access condition required significantly less time than the verbal SPA with-access condition (i.e., 25 min vs. 90 min), different SPA outcomes were found for 6 of the 7 participants. In addition, RAs (conducted with only 2 participants) indicated that the verbal with-access condition was more successful in identifying reinforcers.

Novel video modality. In addition to pictorial, verbal, and textual (e.g., LeBlanc et al., 2006) SPA modalities, two recent investigations have assessed the efficacy of a video modality with both children and adults with DDs. A video presentation format may offer a greater ability to present complex activities or protracted events with greater accuracy than other alternative formats. To investigate the potential advantages of a video format, Lee et al. (2008) compared a brief video segment presentation format to tangible, pictorial, and verbal modalities using a paired-stimulus method with seven adults diagnosed with moderate to severe developmental disabilities with differing ABLA levels (i.e., 3 participants at Level 3 and 2 participants at Levels 4 and 6, respectively). The authors used similar methods to Conyers et al. (2002) to assess potentially reinforcing leisure activities using a reversal design. The authors were able to partially replicate earlier findings (e.g., Conyers et al.; de Vries et al., 2005) concerning the association between ABLA scores and SPA results. However, similar to earlier studies, this investigation did not include an RA to validate the results of the SPAs. In addition, contingent

access to selected stimuli was provided across modalities, and the video segments used were played without sound, potentially decreasing the effectiveness of this novel modality. Future studies in this line may consider the addition of sound with the video segments (i.e., the presentation of compound stimuli); however, successive (rather than simultaneous) presentations of videos with sound may have to be considered with this addition to decrease potential interference.

More recently, Snyder, Higbee, and Dayton (2012) compared video presentations to a tangible SPA using a paired-stimulus method to assess preferred toys with six children with a diagnosis of autism. Video-to-object matching skills were assessed prior to administering the SPAs, and all participants could match with at least 80% accuracy across trials. The authors used 10-s video clips of a full body of an unfamiliar child engaging with the toy and an additional clip that highlighted the salient features of the toy being manipulated for each stimulus being assessed. The authors found significant correlations between the SPAs for 4 of the 6 participants with the HP items and LP item corresponding for 5 and 4 participants, respectively. However, some limitations of this preliminary investigation are worth noting. First, the videos were always played in left-right succession. Due to side bias for one participant, the authors revised the videos (i.e., created a point-of-view segment) and played the clips simultaneously for the four remaining participants. Future researchers interested in using video SPAs might consider either simultaneous video presentation or counterbalancing the video segments if played in succession. Second, researchers should consider the use of RAs and comparing no access and access conditions as contingent access was provided in this investigation. Finally, the authors also suggest the use of a delayed match-to-sample prerequisite assessment when using a video SPA format.

Limitations of Alternative Stimulus Modality Comparison Research

Although the line of research comparing alternative stimulus modalities has grown significantly over the past two decades, some key limitations of this research should be noted. First, types of prerequisite skill assessments have varied widely across studies, and only a small number of studies have demonstrated that the skills assessed were associated with success of certain modalities (e.g., Conyers et al., 2002; Clevenger & Graff, 2005). It may also be the case that some pertinent prerequisite skill sets have not been assessed. Higbee et al. (1999) noted that, "...the inaccuracy of the pictorial assessment could be attributable to the participants' inexperience with using pictures to request tangible stimuli" (pp. 71). Many investigations have noted that some participants communicated through the use of a picture exchange communication systems (PECS; e.g., Graff & Gibson, 2003; Graff, Gibson, & Galiatsatos, 2006; Groskreutz & Graff, 2009). However, no study to date has formally assessed participants' PECS repertoires to evaluate whether the ability to mand with picture cards is necessary for the success of a pictorial SPA.

Second, it has been noted that, "If objects or other stimuli will be used to represent settings, activities, or other abstractions beyond the immediate context, some prescreening and training may be needed to ensure that the person comprehends these symbols" (Lohrmann-O'Rourke & Browder, 1998, pp. 157.). To date, only one investigation has focused on teaching prerequisite skills that may be necessary to perform successfully in SPAs with nontangible stimuli. Browder, Cooper, and Lim (1998) used an errorless teaching procedure with a progressive time delay to teach three adults with severe intellectual disabilities a tact for leisure settings to later assess the participants' preferences for those settings using a paired-stimulus method. The authors chose to use objects as the basis of the tact (e.g., a golf ball for the choice to

practice putting in golf) because the participants were not able to respond differentially to pictures. Although the treatment package successfully taught object selection to assess preference, contingent access was provided following selections and no replications of this study have been conducted to teach picture or verbal selections.

Third, the majority of comparison studies have included the use of contingent access even though these comparisons are not particularly helpful to practicing behavior analysts. Practitioners need evidence to guide their use of alternative stimulus modalities without access to assess preferences for the multitude of reinforcers that cannot be assessed in a tangible tabletop arrangement or be presented immediately and decrease preparation and administration time of SPAs. The results from comparison studies with and without contingent access seem to differ considerably. That is, alternative modalities can be successful in identifying reinforcers. However, research also indicates that alternative modalities only have partial predictive validity when administered without contingent access (e.g., Hanley et al., 1999; Higbee et al., 1999). 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, to date, no empirical investigations of these procedural manipulations have been conducted.

Fourth, in the last five years researchers have begun to investigate novel presentation formats (e.g., video) rather than assessing the feasibility of the alternative modalities that are currently being administered by practitioners. Even though a video modality may have some utility for practitioners, it seems that a greater understanding of the viability of the most heavily researched alternative modality (i.e., the pictorial modality) or the modality with the quickest administration time (i.e., the verbal modality) may be warranted before resources are allocated to

video formats that require additional resources such as time, funds, and technical expertise to create and maintain.

Purpose

The purpose of this investigation was to extend the line of SPA modality research by assessing the feasibility of pictorial SPAs with children with DDs. 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 reinforcer contingent access. First, the role of contingent access was assessed by comparing the results of a pictorial SPA without contingent access to the results of an RA. Matching and pictorial mand assessments were conducted prior to pictorial SPA and RA sessions to further evaluate the role of hypothesized prerequisite skills. Second, if contingent access was found to be a necessary component of a pictorial SPA, the effects of schedule thinning were evaluated (i.e., conditions where access to the stimuli depicted on the pictures was delivered on a schedule that was thinned to extinction [i.e., no contingent access]) to determine if a pictorial SPA could be made more practical for those participants.

Experiment 1

Method

Participants. Participants in this experiment included two girls (Keron, 5 years old; Annah, 9 years old) and two boys (Connor, 11 years old; Jeff, 11 years old). Annah, Connor, and Jeff had received diagnoses of Autistic Disorder according to the criteria described in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; DSM-IV-TR; American Psychiatric Association, 2000), and Annah had an additional diagnosis of ADHD. Keron had a diagnosis of Noonan Syndrome, an autosomal dominant multisystem disorder characterized by distinctive facial features, short stature, congenital heart disease, feeding difficulties, developmental delay, and communication and social difficulties (Roberts, Allanson, Tartaglia, & Gelb, 2013). Participants were recruited from early intervention day programs, local school systems, and after-school programs that serve children with developmental disabilities, and each participant's ASD diagnosis was confirmed using the Gilliam Autism Rating Scale-2 (GARS-2; Gilliam, 2006)¹. Three of the four participants were receiving behavior-analytic services. Of these, one participant was receiving school-based services, and two were receiving services in a structured after-school socialization program. Keron had recently been exposed to both paired-stimulus and MSWO preference assessments, and she was the only participant who had been exposed to alternative modality SPAs (both pictorial and verbal formats). Both Annah and

¹ The GARS-2 is a commonly used norm-referenced screening tool with suitable psychometric properties that is designed to identify the probability that the individual in question has or does not have an autism spectrum disorder. The GARS-2 is based on the American Psychiatric Association's (2000) definition of autism and has good test-retest reliability with a coefficient alpha of .94 for the total test (Gilliam, 2006).

Connor had received EIBI programming in the past where they were exposed to SPAs; however, neither participants' parents were able to report which methods they had experienced. Preference assessments were not being conducted at Annah and Connor's after-school program during the course of the study. Jeff's caregivers reported that he had no history with SPAs. All participants' caregivers reported that their children had received other forms of therapy outside of ABA in the past, such as equine therapy and music therapy. Additionally, participants were able to follow one-step instructions and had appropriate physical and sensory abilities to allow them to fully participate in the assessment and training environments. One participant was excluded from the study due to high levels of problematic behavior (i.e., aggression, noncompliance, elopement) during the pre-experimental procedures portion of the protocol. See Table 1 for a detailed summary of participant information.

Setting and session duration. All sessions were conducted in a small treatment room on a university campus, in a small room or partitioned area of the participant's school or day program site, or in a quiet partitioned area of the participant's home. 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 to two other trained, independent observers were also present during a subset of sessions for interobserver agreement (IOA) and procedural integrity data collection purposes.

The duration of sessions ranged from 2 min 46 s to 12 min 42 s, depending on the session type (see Table 2). More than one session was conducted within a visit, and visits lasted no longer than an hour. At least one 10-min free-play break was provided for every hour of session time. Visits were conducted 2 to 4 days per week. Participants' total time commitment in this

experiment ranged from 2 to 4 weeks and depended on their individual performance, level of compliance, and availability.

Materials. One caregiver and one staff member (who worked closely with the participant) were asked to list and rank each participant's favorite activities and foods using the RAISD structured interview (Fisher et al., 1996). Eight edible items were chosen from the pool of stimuli generated by the RAISD interviews, and these stimuli were used in all subsequent phases of the study. The edible stimuli identified in the RAISD, two-dimensional pictures of the edible stimuli (i.e., 10.2 cm x 15.2 cm, laminated, color photographs), a timer, a data sheet, and a pen were used in prerequisite assessments and SPA sessions. Additional materials for the RA sessions included ping pong balls, paperclips, four containers, and preferred toys identified via the RAISD.

Experimental design. For Keron, Annah, and Jeff, reinforcer assessments were experimentally evaluated using an alternating treatments design with the HP and LP items identified via a pictorial SPA as well as a control item (Barlow & Hayes, 1979). For Connor and Jeff, reinforcer assessments were experimentally evaluated using a concurrent-schedules design (Piazza, Fisher, Hagopian, Bowman, & Toole, 1996). Data were analyzed using visual inspection (i.e., data path separation), which is the convention for within-subject experimental designs.

Pre-experimental procedures. One caregiver and one staff member (e.g., a teacher) were asked to list and rank their student or child's favorite foods and toys, as well as list any food allergies, or foods or toys that they preferred their student or child not be given during the study using the RAISD (see appendix A for complete assessment). The top eight foods (or toys if the participant had a limited number of potentially reinforcing food items due to restricted interests) were used in subsequent pre-experimental and experimental phases.

Prerequisite assessments. Prior to experimental sessions, participants were exposed to the following three prerequisite skill assessments using the 8 foods and pictures of those food items (described above in Materials) identified via the RAISD: a picture-to-object (P-O) matching assessment, an object-to-picture (O-P) matching assessment, and a pictorial mand assessment. These assessments took place in a structured one-to-one teaching context with the child seated at a table across from the experimenter. In the P-O assessment, the experimenter placed a photo of one of the food items in front of the participant and instructed the participant to match that photo (e.g., “Match”) to the correct food item in an array of three foods. Each of the eight photos was presented two times in a random order for a total of 16 P-O matching trials. Similarly, in the O-P assessment, the experimenter placed a food item in front of the participant and instructed the participant to match the food item to the correct picture in an array of three foods. Each food item was presented two times in a random order for a total of 16 O-P matching trials. In both P-O and O-P matching assessments, the stimuli in the array varied across trials. Data were collected on the participant’s response (correct, incorrect, or no response). During all P-O and O-P assessment trials, a highly preferred toy was delivered within 3 s of a correct response. Toy reinforcers were identified through the RAISD, and a subset of eight stimuli was included in a brief MSWO preference assessment (Carr et al., 2000). The toys with the 2 or 3 highest selection percentages were used as reinforcers in matching assessment sessions (see below). If toys were being assessed rather than food items for a participant, then access to preferred food items identified through the RAISD and brief MSWO preference assessment were delivered as reinforcers for independent correct responding.

If the participant responded incorrectly, the experimenter provided a nonspecific statement redirecting the child to the next trial (e.g., “Let’s try this one”, “Now it’s time to try

this”) was provided following an incorrect response. If no response occurred, the experimenter waited 5 s before providing a nonspecific statement and starting the next trial. The percentage of correct trials was calculated for both the P-O and O-P assessments by dividing the number of correct trials by the total number of trials (i.e., 16) and converting the ratio to a percentage.

In the pictorial mand assessment, the experimenter held up one of the eight highly preferred food items for approximately 3 s in the participant’s line of vision and then placed the stimulus out of view to ensure the features of a pure mand were present (e.g., in an opaque bag, on the experimenter’s lap under the table). The experimenter then placed the corresponding picture of that food item in front of the participant. If the participant picked up the picture and began to move the picture toward the experimenter, the experimenter put out her hand. If the participant correctly responded by handing the picture to the experimenter (i.e., an exchange), the participant received access to the item for 30 s. After 30 s, the experimenter provided a nonspecific statement (see above), and presented the next trial. If the participant either picked up the picture but did not hand the picture to the experimenter or did not respond within 10 s, the experimenter removed the picture from the participant, provided a nonspecific statement, and presented the next trial. The experimenter also collected data on the occurrence of vocal mands (e.g., if the participant said the name of the food item) during all trials. Each food item was assessed two times in a random order, and data were collected on the participant’s response (correct, incorrect [e.g., touches the picture but does 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 (i.e., 16) and converting the ratio to a percentage.

Experimental procedures.

Pictorial SPA without contingent access. Prior to the first SPA session, participants were given 30 s of access to each of the eight edible stimuli in a random order. Following stimulus sampling, participants were exposed to a pictorial SPA using a paired-stimulus method (Fisher et al., 1992). In all pictorial SPA 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’ without saying the name of the stimuli. Following the selection of one stimulus (defined as the participant touching or pointing to the picture), the experimenter presented the next pair of picture stimuli. If the participant did 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 following the verbal prompt, the next trial was presented. If the participant did not respond in the 5 s after the verbal prompt, the next trial was presented. Each stimulus was paired with each other stimulus one time in a random order, and the order of left-right positions of the stimuli was counterbalanced for a total of 28 trials. Selection percentages (i.e., the number of times a stimulus was selected divided by the number of times it was available, converted to a percentage) 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 if the items from the pictorial SPA without contingent access functioned as reinforcers (i.e., if the pictorial SPA without access was a valid assessment for the participant).

Single-operant progressive-ratio RA. Items identified as HP and LP (i.e., the items with the highest and lowest selection percentages) as well as a control item were delivered contingent on responding during an arbitrary task in a single-operant progressive-ratio arrangement for Keron, Annah, and Jeff (Roane, Lerman, & Vondran, 2001). The experimenter presented the

arbitrary task to the participant at the beginning of each session. This included one open container of either ping pong balls (Jeff only) or paperclips approximately 25 cm in front of the participant and one colored container approximately 25 cm behind the container of ping pong balls or paperclips. The participant was provided with a model of how to perform the task (i.e., the experimenter placed one ping pong ball or paperclip from the open container into the colored container). The participant was then physically prompted to complete the task. During the prompted trial, the experimenter provided 30 s of access to the item associated with the colored container (i.e., blue for the HP item, red for the LP item, yellow for control). The control condition was included to ensure that the arbitrary task was not automatically reinforcing (i.e., reinforcing in and of itself), and the item used in the control condition was a nonpreferred item nominated by the participants' caregivers via the RAISD. Following 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 either the ping pong balls or paperclips) from here to here (pointed to the empty container). You can stop anytime."

Sessions were 10 min in duration, and the timing of the session began immediately following the experimenter's instruction. The order of the conditions (i.e., HP, LP, control) was quasi-randomized 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 visible to the participant (i.e., behind the colored container). Once the first criterion was met (i.e., placing 3 ping pong balls or paperclips into the colored container one at a time), the edible item was delivered for 30 s. Using an additive progressive-ratio (PR) 3 schedule, each time a response criterion was met, it was increased by three responses. For example, when the initial response criterion of 3 responses was

met and the stimulus being evaluated was delivered, the stimulus was then delivered following 6 responses, then 9 responses and so on.

The experimenter sat across from the participant during all RA sessions and delivered the item designated for the condition contingent on the participant meeting the response criterion. When the item was delivered, the experimenter simultaneously removed the task materials, allowed the participant 30 s to consume the food item and then re-presented the task materials. Break points, the last completed schedule value, were recorded for each stimulus evaluated in the RA. Sessions were terminated either when 10 min (i.e., the predetermined session duration) elapsed or if 1 min elapsed with no responding (i.e., a break point) occurred. The data were graphed and analyzed using visual inspection to determine which item functioned as the most powerful reinforcer compared to the alternatives through data path separation (Fisher & Mazur, 1997).

Concurrent-operant RA. Items identified as HP and LP as well as a control item were delivered contingent on responding during the same arbitrary task described above in a concurrent-operant arrangement for Jeff and Connor (Piazza et al., 1996). In this arrangement, the experimenter presented one open container of either ping pong balls (Jeff only) or paperclips approximately 25 cm in front of the participant and three colored containers approximately 25 cm behind the container of ping pong balls or paperclips and 25 cm apart from one another. The experimenter provided a model of how to perform the task by placing one ping pong ball or paperclip from the open container into the colored containers one at a time. The participant was then physically prompted to complete the task. During the three prompted trials (one trial for each colored container), the experimenter provided 30 s of access to the item associated with the colored container (i.e., blue for the HP item, red for the LP item, yellow for control). Following

the prompted trials, the experimenter provided an instruction to the participant to begin such as, “You can move as many ping pong balls (or paper clips) from here (pointed to the open container) to here (pointed to each of the colored containers) as you want. You can stop anytime.”

Sessions were 5 min in duration, and the timing of the session began immediately following the experimenter’s instruction. The left-middle-right placement of the containers was quasi-randomized 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 visible to the participant (i.e., behind the colored containers). The experimenter sat across from the participant during all RA sessions. When the participant placed either a ping pong ball or a paperclip in one of the colored containers, the experimenter delivered the item associated with that container. When the item was delivered, the experimenter simultaneously removed the task materials, allowed the participant 30 s to consume the food item and then re-presented the task materials. Rate of responding was recorded for each stimulus evaluated in the RA. The data were then graphed and analyzed using visual inspection to determine which item functioned as the most powerful reinforcer compared to the alternatives through data path separation (Piazza et al., 1996).

Interobserver agreement. A second trained observer (e.g., an undergraduate research assistant) collected IOA data either during experimental sessions or from videotape for each participant. These data were compared to the data collected by the experimenter who conducted the session to calculate point-by-point agreement. The definition of an agreement depended on the type of experimental session being conducted (see below for detailed descriptions of each session type). Interobserver agreement was calculated by dividing the number of agreements by

the number of agreements plus disagreements and converting the ratio to a percentage. See Table 3 for the mean and range of IOA scores per participant per session type.

Prerequisite assessments. An agreement was defined as the experimenter and secondary observer recording a correct, incorrect, or non-response for a trial.

SPA sessions. An agreement was defined as the experimenter and secondary observer recording the same stimulus selection for a trial.

RA sessions. An agreement was defined as the experimenter and secondary observer recording the same break point per session in the single-operant progressive-ratio arrangement or recording the same number of responses for each container in the concurrent-operant arrangement.

Procedural Integrity. To assess procedural integrity, the experimenter's behavior was videotaped and a second, trained observer collected data on the experimenter's behavior to determine whether the experimental procedures were implemented correctly. Procedural integrity scores were calculated as the percentage of correct responses made by the experimenter during a session, and the number of responses depended on the type of experimental session conducted (see below for detailed descriptions of each session type). In addition, IOA was assessed for the procedural integrity data that were collected. A third, trained observer collected procedural integrity data from videotape and compared them with data collected by the second, trained observer. Data were compared using the point-by-point agreement formula. An agreement was defined as the two independent observers agreeing on whether the experimenter's response during a trial was correct or incorrect. See Tables 4 and 5 for the mean and range of procedural integrity scores per participant per session type and the mean and range of IOA of procedural integrity scores.

Prerequisite assessments.

Matching assessments. Procedural integrity data were collected using a 3-step checklist of experimenter behavior. The steps included (1) presenting each picture or tangible stimulus two times along with a quasi-random array of either picture or tangible stimuli, (2) providing the instruction “Match”, and (3) providing the correct consequence for the response (i.e., a reinforcer and praise for a correct response, a nonspecific statement of redirection following an incorrect response or a non-response).

Pictorial mand assessments. Procedural integrity data were collected using a 5-step checklist of experimenter behavior. The steps included (1) presenting each stimulus for approximately 3 s in the participant’s line of vision, (2) placing the item out of view, (3) placing the corresponding picture card in front of the participant, (4) the experimenter extending her hand if necessary, and (5) providing the correct consequence for the response (i.e., 30 s of access to the item contingent on a picture exchange, providing a nonspecific statement for an incorrect or non-response).

SPA sessions. Procedural integrity data were collected using a 5-step checklist of experimenter behavior. The steps included (1) presenting the correct stimulus pair to the participant in the correct left-right order, (2) asking the participant to ‘pick one’ for each stimulus-pair presentation, (3) using the correct prompting procedure, (4) allowing the participant to interact with (or consume) the item following a selection for 30 s using the predetermined schedule (i.e., FR-1 [with access], VR-3, VR-5, EXT [without access]) and (5) removing the pictures (and chosen item, if applicable) from the table.

RA sessions. Procedural integrity data were collected using an 8-step checklist of experimenter behavior. The steps included (1) presenting the arbitrary task, (2) providing a

model of the task, (3) correctly prompting the participant to engage in the task, (4) providing the instruction for the participant to begin the task, (5) starting the timer immediately following the instruction, (6) providing 30 s of access to the correct stimulus when a response criterion was met, (7) blocking the task materials for 30 s after a response criterion was met, and (8) ending the session after the predetermined session duration had elapsed or after 1 min of no responding.

Results and Discussion

Keron's data are depicted in Figure 1. Keron had 100% correct responding across her three prerequisite assessments (top panel), and her pictorial SPA without contingent access (middle panel) produced a clear gradient with selection percentages ranging from 0% to 100%. The pictorial SPA without access identified crackers as her HP item and chips as her LP item, and marshmallows were identified as Keron's control item via the RAISD. When these three items were assessed in a subsequent single-operant progressive-ratio RA (bottom panel), break points were consistently higher for her HP item ($M = 11$) compared to the LP ($M = 4.5$) and control items ($M = 3.5$), confirming the predictions of the pictorial SPA without contingent access.

Annah's data are depicted in Figure 2. Annah scored at 100% on her mand assessment, 81% on her O-P matching assessment, and 6% on her P-O matching assessment (top panel). Because O-P and P-O matching are thought to be symmetric relations and the P-O matching assessment was conducted immediately following the mand assessment, the experimenters conducted an additional P-O assessment following Annah's RA. Annah's low score on the P-O matching assessment was replicated when conducted approximately two weeks after its initial administration, suggesting that potential carryover effects from the mand assessment were unlikely. Annah's pictorial SPA without access (middle panel) produced a clear gradient and

identified Pringles[®] as her HP item with a selection percentage of 86%. Both Starburst[®] and pretzels were identified as her LP items with selection percentages of 14%. When the same selection percentage was calculated for more than one stimulus (i.e., there was a tie), the experimenters randomly chose one item to be used in the subsequent RA. This practice was used throughout the study, and the item that was chosen is depicted as the last stimulus in all SPA bar graphs. Pretzels were used as Annah's LP item in her subsequent single-operant progressive-ratio RA, and celery was identified as her control item via the RAISD. As seen in the bottom panel of Figure 2, break points were higher for Annah's HP item ($M = 13.3$) during her RA compared to the LP ($M = 5.6$) and control ($M = 4.3$) items, validating the results of the pictorial SPA without contingent access.

Connor's data are depicted in Figure 3. Connor scored 100% in each of his three prerequisite assessments (top panel). His pictorial SPA without contingent access (middle panel) produced a gradient with selection percentages ranging from 14% to 71%. The pictorial SPA without access identified both chips and fruit snacks as his HP items, and grapes were identified as Connor's LP item. Grape tomatoes were used as his control item. When Connor's HP, LP, and control items were assessed in a subsequent concurrent-operant RA (bottom panel), Connor's rate of responding was much higher for his HP item ($M = 2.4$ responses per min) compared to the LP ($M = 0.1$ responses per min) and control items ($M = 0.03$ responses per min), confirming the predictions of the SPA without contingent access.

Jeff's data are depicted in Figures 4 and 5. Jeff scored at 100% on his mand assessment, 31% on his O-P matching assessment, and 19% on his P-O matching assessment (top panel of Figure 4). Jeff's initial pictorial SPA without access (middle left panel of Figure 4) produced a moderate gradient with selection percentages ranging from 0% to 71%. This pictorial SPA

without access identified Reese's Peanut Butter Cups[®], crackers, cookies, and chips as HP items and suckers as Jeff's LP item. In Jeff's initial RA (bottom left panel of Figure 4), the experimenters evaluated his responding in a concurrent-operant arrangement using the ping pong ball task described above in the RA section with the exception that responding in the control container resulted in the delivery of no item (i.e., an extinction contingency was in place) rather than a nonpreferred item. During this assessment, Jeff responded at a high rate in the control container, leading the experimenters to modify his RA arrangement. Before this modification, the experimenters conducted an additional pictorial SPA without access in the event that Jeff's preferences had changed in the time since his initial pictorial SPA.

Jeff's second pictorial SPA without access (middle right panel of Figure 4) also produced a moderate gradient, and Hershey's Kisses[®] (selected on 86% of opportunities) and fruit cocktail (selected on 0% of opportunities) were identified as Jeff's HP and LP items, respectively. In Jeff's second RA, the experimenters used a single-operant progressive-ratio arrangement with the same task and control contingency from his initial RA. However, Jeff continued to respond at a high rate in the control condition (bottom right panel of Figure 4), and his second RA was terminated.

A third pictorial SPA without access was conducted with Jeff (top left panel of Figure 5), and this SPA identified both Reese's Peanut Butter Cups[®] and cookies as HP items with selection percentages of 71%. Suckers were identified as Jeff's LP item with a selection percentage of 14%. In Jeff's third RA, the experimenters used the paperclip task described above in the RA section rather than the ping pong ball task, and green olives were added as a control item. However, Jeff continued to respond at high rates during this modified RA (bottom left panel of Figure 5), and this assessment was terminated.

A fourth pictorial SPA without access was conducted with Jeff (top right panel of Figure 5). This SPA produced a moderate gradient and identified Hershey's Kisses[®] as Jeff's HP item with a selection percentage of 71%. Both suckers and popcorn were identified as LP items with selection percentages of 29%. In Jeff's fourth RA, the experimenters evaluated Jeff's responding using the initial concurrent-operant arrangement with the ping-pong ball task with the addition of green olives as a control item. As seen in the bottom right panel of Figure 5, Jeff did not have clear separation between his HP, LP, and control data paths. Upon further analysis, Jeff's pattern of responding during this assessment was likely under the control of a positional bias toward the center container. Jeff's participation was terminated after this fourth unsuccessful attempt at modifying his RA procedures.

In Experiment 1, the results of pictorial SPAs without access were validated by subsequent reinforcer assessments for Keron, Annah, and Connor. Jeff did not complete the protocol due to likely automatic reinforcement properties and positional bias observed in multiple reinforcer assessment arrangements. In addition, Keron and Connor scored at 100% for all three prerequisite assessments. Annah scored at or near 100% during the mand and O-P matching assessment, but she scored at or near 0% on the P-O matching assessments. During her P-O assessments, 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 Annah's caregiver and former case manager reported that she had mastered P-O matching during her EIBI programming. For these reasons, it is likely that the low scores on Annah's P-O assessments were due to faulty stimulus control during the assessment rather than a true deficit in her P-O matching repertoire.

Overall, this experiment suggests that certain prerequisite skills (i.e., pictorial mands, O-P/P-O matching) may be correlated with the success of pictorial SPAs without access. However, the alternative modality SPA literature indicates that pictorial SPAs are only successful with some individuals with DDs (e.g., Hanley et al., 1999; Higbee et al., 1999). Therefore, the purpose of Experiment 2 was to further investigate the role of contingent reinforcer access 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. Participants in this experiment included one girl (Lisa, 4 years old) and two boys (Eric, 4 years old; Sean, 2 years old). Eric and Lisa had received diagnoses of Autistic Disorder according to the criteria described in the DSM-IV-TR (American Psychiatric Association, 2000), and Sean had received an educational eligibility classification of a developmental delay and was being evaluated for a formal ASD diagnosis during the course of the study. Participants were recruited from early intervention day programs and local school systems that serve children with developmental disabilities, and each participant's ASD diagnosis was confirmed using the GARS-2 (Gilliam, 2006). Both Eric and Lisa were receiving behavior-analytic services in school-based settings for children with ASDs, and Sean was receiving services in a center-based ABA program. Eric had recently been exposed to a MSWO preference assessment. Lisa had not been exposed to any formal SPA methods, but she was given the choice between 2 or 3 preferred stimuli to be used in her programming multiple times per day. Sean had no reported history with SPAs, and none of the participants had any reported history with alternative modality SPAs. All participants' caregivers reported that their children had received at least one other form of therapy outside of ABA in the past. Similar to Experiment 1, all participants were able to follow one-step instructions, fully participate in the assessments, and had minimal problem behavior. See Table 1 for a detailed summary of participant information.

Setting, session duration, and materials. Sessions were arranged as described above in Experiment 1. Participants' total time commitment in this experiment ranged from 6 to 8 weeks. The materials described above in Experiment 1 were also used in Experiment 2 with the addition of three 10.2 cm x 15.2 cm pieces of different colored paper (i.e., blue, red, yellow) and clear adhesive tape used in Lisa and Sean's RA sessions.

Experimental design. Reinforcer assessments were experimentally 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, a nonconcurrent multiple-probe design across participants was employed. Using staggered lengths of baseline data collection, this design allowed for control of maturational confounds while replicating treatment effects across participants (Cooper, Heron, & Heward, 2007). Data analysis was performed by visual inspection of graphed performance.

Procedures. The pre-experimental procedures (i.e., the RAISD, P-O and O-P matching assessments, pictorial mand assessment) and pictorial SPA without contingent access described above in Experiment 1 were also conducted in Experiment 2.

Single-operant progressive-ratio RA. The same single-operant RA procedures described above in Experiment 1 were conducted in Experiment 2 for Eric. An alternative arbitrary task was used for Lisa and Sean due to evidence of automatic reinforcement properties of the paperclip transfer task (i.e., high break points in the control condition). The alternative task included placing a piece of colored paper 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 when she was standing on her toes with her heels fully raised (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 standing flat on the ground because he did not possess the motor skills necessary to jump to make contact with the paper.

The experimenter presented the arbitrary task to the participant at the beginning of each session, provided a model of how to perform the task, and physically prompted the participant to complete the task following the model. During the prompted trial, the experimenter provided 30 s of access to the item associated with the colored paper (i.e., blue for the HP item, red for the LP item, yellow for control). Following 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 can touch the paper as many times as you want. You can stop anytime.” All other procedural details of this assessment were consistent with the description above in Experiment 1 except that an additive PR-2 (rather than a PR-3) schedule was used.

Pictorial SPA with contingent access and RA. The trials for this assessment were conducted in the same manner as described above for the pictorial SPA without contingent access except that the participant was given the opportunity to consume a small amount of the edible stimulus following each selection. This assessment also consisted of 28 trials, however the duration of the assessment varied depending on each participant’s individual pace and reinforcer consumption time if edibles were being assessed.

A subsequent single-operant progressive-ratio RA was conducted following the pictorial SPA with contingent access using the HP, LP, and control items. These sessions were conducted in the same manner as described above.

Schedule thinning. These schedule manipulations were conducted with participants with 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). Access to the stimuli depicted on the pictures was delivered on a schedule that was thinned to extinction (i.e., no contingent access) to determine if a pictorial SPA could be made more practical for those participants. To demonstrate experimental control over the effects of schedule thinning on discriminate responding in RA sessions, a nonconcurrent multiple probe design across participants was employed. The results of the previous RAs using the HP, LP, and control items from the SPA without contingent access served as the baseline data for each participant in this subset.

First, three pictorial SPAs were conducted where contingent access was provided on a VR-3 schedule of reinforcement. That is, participants received access to a stimulus following an average of three selections. If a clear gradient was achieved (i.e., selection percentages ranged from at least 14% to 86%) and the gradients were consistent across the three SPAs (i.e., the three SPAs all identified the same HP and LP items), three RA sessions evaluating the HP and LP items from the SPAs with the VR-3 schedule and the control item were conducted in a quasi-random order. If the participant's rate of responding was higher for the HP item compared to the LP and control (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 achieved, the three SPAs were repeated using the same schedule value. This was the case for Sean during his first VR-3 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

(i.e., Sean's first VR-3 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. This was the case for Eric at the VR-3 schedule value of schedule thinning.

Interobserver agreement and procedural integrity. Interobserver agreement, procedural integrity, and procedural integrity IOA data were collected in the same manner as described above in Experiment 1. See Tables 3-5 for the mean and range of these scores per participant per session type.

Results and Discussion

Eric's data are depicted in Figures 6 and 7. Eric had 100% correct responding across his three prerequisite assessments (top panel of Figure 6). His pictorial SPA without contingent access (middle left panel of Figure 6) produced a moderate gradient and identified Hershey's Kisses[®] as Eric's HP item with a selection percentage of 86%. The pictorial SPA without access identified both Skittles[®] and M&Ms[®] as his LP items with selection percentages of 29%, and raw broccoli was used as Eric's control item. During Eric's single-operant progressive-ratio RA (bottom left panel of Figure 6), break points were higher for his LP item ($M = 12$) compared to the HP ($M = 9$) and control items ($M = 1.5$), suggesting that the predictions of the pictorial SPA without contingent access were not valid. The experimenters then conducted a second pictorial SPA to evaluate if contingent access was necessary for the pictorial modality to be effective in identifying reinforcers for Eric.

Eric's pictorial SPA with contingent access (middle right panel of Figure 6) produced a clear gradient and identified both Hershey's Kisses[®] and gummy candy as his HP item with selection percentages of 86% and popcorn as his LP item with a selection percentage of 0%. As

seen in the bottom right panel of Figure 6, break points were higher for Eric's HP item ($M = 4$) during his second RA compared to the LP ($M = 1$) and control ($M = 2$) items, confirming the predictions of the pictorial SPA when contingent access was delivered. The experimenters then conducted a schedule thinning manipulation for Eric to determine if conditioned reinforcement properties could be established for pictorial stimuli to create a more practical preference assessment.

Eric had highly consistent results across his first three VR-3 pictorial SPAs (top left panel of Figure 7), and each pictorial SPA produced a clear gradient. Gummy candies were identified as Eric's HP item during the first two pictorial SPAs with selection percentages of 100%, and the third pictorial SPA identified gummy candies, Skittles[®], and Hershey's Kisses[®] as Eric's HP items with selection percentages of 86%. All three VR-3 pictorial SPAs identified Cheetos[®] as Eric's LP item (selected on 0% of opportunities). However, Eric had the same high break point for his HP and control items when compared to his LP item when these items were assessed in a subsequent, brief RA. Because Eric's brief RA results did not validate the predictions from his VR-3 pictorial SPAs, these procedures were repeated.

Eric's results continued to be consistent during his second set of three VR-3 pictorial SPAs (bottom left panel of Figure 7), with Hershey's Kisses[®] identified as his HP item during the first and third SPA with selection percentages of 100%. Hershey's Kisses[®] and gummy candies were both identified as Eric's HP item during his second VR-3 pictorial SPA, and all three SPA identified Cheetos[®] as his LP item. Eric had a higher break point for his HP item compared to his LP and control items in his subsequent brief RA, validating the results of his second set of VR-3 pictorial SPAs. When the schedule of reinforcement was thinned to VR-5 (top right panel of Figure 7) and then to EXT (bottom right panel of Figure 7), Eric's results

were even more consistent with Hershey's Kisses[®] and Cheeots[®] being identified as his HP and LP items, respectively. In addition, Eric had much higher break points for his HP item compared to his LP and control items when assessed in brief RAs that followed his VR-5 and EXT manipulations. These results suggest that systematically thinning the schedule of reinforcement across pictorial SPAs was a successful procedure to establish conditioned reinforcement properties of the pictorial stimuli for Eric.

Lisa's data are depicted in Figures 8 and 9. Lisa scored at 100% on her mand assessment, 0% on her P-O matching assessment, and 44% on her O-P matching assessment (top panel of Figure 8). Her pictorial SPA without contingent access (middle left panel of Figure 8) produced only a slight gradient with selection percentages ranging from 43% to 71%. Saltine crackers were identified as Lisa's HP item, and there was a five-way tie for her LP item. Raw cauliflower was used as Lisa's control item. As seen in the bottom left panel of Figure 8, a clear separation between break points was not found for her HP ($M = 5$) and LP ($M = 5$) items during her RA. However, these break points were higher than the control condition ($M = 1$), suggesting that the HP and LP items likely had similar reinforcing properties.

Because the RA did not validate the results of Lisa's pictorial SPA without access, a second pictorial SPA was conducted with contingent access (middle right panel of Figure 8). This SPA produced a much clearer gradient and identified fruit snacks as Lisa's HP item with a selection percentage of 100%. There was a three-way tie between her LP items with selection percentages of 14%. There was a clear separation between Lisa's break points for her HP item ($M = 5.3$) when compared to her LP ($M = 0.7$) and control items ($M = 0.7$) in her second RA (bottom right panel of Figure 8), suggesting that contingent access was necessary for the pictorial modality to be effective in identifying reinforcers for Lisa.

Schedule thinning manipulations were also conducted for Lisa. Lisa had consistent results across her three pictorial SPAs conducted with VR-3 contingent access (top panel of Figure 9). Fruit snacks were identified as her HP item during the first and second SPAs, and the third SPA identified fruit snacks as her second most preferred item. Saltines were identified as her LP item across all three VR-3 SPAs. When these items were assessed along with her control item in a subsequent brief RA, Lisa had a higher break point for the HP item when compared to her LP and control items. When the schedule of reinforcement was thinned to VR-5 (middle panel of Figure 9) and then to EXT (bottom panel of Figure 9), Lisa continued to have consistent SPA results with fruit snacks identified as her HP item and either string cheese or saltine crackers identified as her LP item. Lisa also had higher break points for her HP item compared to her LP and control items when assessed in brief RAs that followed her VR-5 and EXT manipulations. These results suggest that schedule thinning was also a successful procedure for Lisa.

Sean's data are depicted in Figures 10-12. Sean scored at 0% on his mand assessment and 87.5% on both of his matching assessments (top panel of Figure 10). His pictorial SPA without access (middle left panel of Figure 10) identified cereal as his HP item with a selection percentage of 86% and apple slices as his LP item with a selection percentage of 0%. Raw broccoli was used as his control item. When these items were assessed in a subsequent RA (bottom left panel of Figure 10), Sean had higher break points for his LP item ($M = 3.5$) when compared to his HP ($M = 1$) and control ($M = 1.5$) items, suggesting that the pictorial SPA without access was not a valid assessment for Sean. When contingent access was added to a second pictorial SPA (middle right panel of Figure 10), the assessment produced a clearer gradient and identified dried fruit and Cheez-It[®] crackers as his HP and LP items with selection percentages of 100% and 0%, respectively. When these items were assessed along with Sean's

control item in a second RA (bottom right panel of Figure 10), a clear separation between data paths was observed with higher break points in the HP condition ($M = 3.7$) when compared to the LP ($M = 1.3$) and control ($M = 0$) conditions. These results suggested that the pictorial modality was successful for Sean only when contingent access was implemented.

Schedule thinning manipulations were also conducted for Sean. Unlike Eric and Lisa, Sean did not have consistent results across his pictorial SPAs when these assessments were conducted using a VR-3 schedule of reinforcement (top panel of Figure 11). His first VR-3 SPA identified dried fruit as his HP item; however, his second and third VR-3 SPAs identified apple slices as his HP item. In addition, the first and third VR-3 SPA produced the same three-way tie between Sean's LP items, but his second VR-3 SPA identified two different stimuli as his LP items. Due to these inconsistencies, three additional pictorial SPAs were conducted using the same items and the same VR-3 schedule of reinforcement (middle panel of Figure 11). Sean continued to have inconsistent results across his second set of VR-3 pictorial SPAs. Apple slices were identified as his HP item across all three SPAs; however, apple slices were tied as Sean's HP item with bananas during his first SPA, Ritz[®] crackers and cranberries during his second SPA, and with Ritz[®] crackers during his third SPA. In addition, different LP items were identified across his second set of VR-3 SPAs.

Because the VR-3 schedule of reinforcement was not proving successful for Sean, the experimenters implemented three VR-2 pictorial SPAs to evaluate whether a denser schedule value was needed for the pictorial modality to remain effective (bottom panel of Figure 11). Sean had consistent results across his VR-2 SPAs with apple slices identified as his HP item (or tied for his HP item) across all three assessments. Raisins were also identified as Sean's LP item (or tied for his LP item) across his VR-3 SPAs. When these items were assessed along with his

control item in a subsequent, brief RA, Sean had a much higher break point for his HP item compared to his LP and control items. These results suggest that a denser schedule value was necessary for Sean at the beginning of schedule thinning. The experimenters then continued with Sean's schedule thinning manipulation by evaluating the VR-3 schedule of reinforcement again.

Sean continued to have consistent results across his VR-3 SPAs (top panel of Figure 12). Apple slices were identified as Sean's HP item during his first and second VR-3 SPAs, and apple slices were tied as Sean's HP item with raisins during his third VR-3 SPAs. Dried fruit was identified as Sean's LP item during his first VR-3 SPA, and dried fruit was tied as Sean's LP item with raisins during his second VR-3 SPA and with Ritz[®] crackers during his third VR-3 SPA. When these items were assessed in a subsequent, brief RA, Sean had a higher break point for his HP item (i.e., a break point of 6) compared to his LP and control items (i.e., break points of 4 and 2, respectively). These results suggest that the VR-3 schedule of reinforcement was successful in identifying reinforcers for Sean only following the denser VR-2 schedule.

Sean did not have consistent results when the experimenters continued with his schedule thinning manipulation using a VR-5 schedule of reinforcement (bottom panel of Figure 12). The first and second VR-5 SPAs identified the same HP (apple slices) and LP (Cheez-It[®] crackers) items. However, the third VR-5 SPA had little to no gradient with selection percentages only ranging from 43% to 57%. The experimenter reported that Sean engaged in abnormally high rates of noncompliance and elopement during the third VR-3 SPA. The experimenters conducted a fourth VR-5 SPA to rule out the possibility that Sean's problem behavior produced the inconsistent results during his third VR-5 SPA. However, Sean's fourth VR-5 SPA identified a different LP item (i.e., Ritz[®] crackers) compared to his previous VR-5 SPAs. The experimenters

are currently conducting three additional SPAs at the VR-5 schedule value to assess if this schedule value continues to be too lean to produce meaningful SPA outcomes.

A nonconcurrent multiple probe design across participants was employed to demonstrate experimental control over the effects of schedule thinning on discriminate responding in RA sessions (see Figure 13). In baseline, low levels of correspondence were observed between the results of the pictorial SPAs without access and the subsequent RAs for Eric, Lisa, and Sean. That is, there was not a 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. When schedule thinning was introduced using a VR-3 schedule of contingent access, high correspondence was observed for both Eric (top panel) and Lisa (middle panel), and this high correspondence remained stable as the schedule of reinforcement was thinned to a VR-5 schedule and then to EXT (i.e., no access). RAs were not conducted following 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 Eric and Lisa during schedule thinning was also observed for Sean when a denser schedule value was implemented (bottom panel). Sean continued to have high correspondence when his schedule of reinforcement was thinning to a VR-3 value; however, RAs were not conducted following the VR-5 SPAs for Sean because of inconsistent results across his four assessments.

In Experiment 2, the results for Eric, Lisa, and Sean demonstrate that the pictorial format without access is only successful for some children with DDs. Schedule thinning was found to be an effective method to establish conditioned reinforcement properties for pictorial stimuli for these participants. Beginning schedule thinning using a VR-3 schedule of contingent access was effective for Lisa. Eric required a second VR-3 manipulation due to high responding in his first

RA control condition, and Sean required a denser schedule of reinforcement at the beginning of his schedule thinning manipulation.

In addition, the three participants from Experiment 2 had different results on their prerequisite assessments. Eric scored at 100% for all three assessments. Lisa scored at 100% on her mand assessment, but she scored at 0% on her P-O matching assessment and slightly above chance levels (i.e., 44%) on her O-P matching assessment. Sean scored at 0% on his mand assessment, but he scored at 87.5% for both of his matching assessments. Sean's need for a denser schedule may have been due to deficits observed in his pictorial mand repertoire.

Although Sean had a growing vocal mand repertoire during the course of the study, he did not have a history with using PECS. 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 alternative modality SPA line of research indicates that alternative SPA formats only have partial predictive validity when administered without contingent access (e.g., Hanley et al., 1999; Higbee et al., 1999). The main purpose of Experiment 1 was to extend this line of research by a) further investigating the role of potentially necessary prerequisite skills (i.e., pictorial mands) for the pictorial format, b) investigating the success of pictorial SPAs without contingent access for children with DDs, and c) including RAs to validate the results of alternative modality SPAs. 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. 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, to date, Experiment 2 is the first empirical investigation of these procedural manipulations to be conducted. The results of Experiment 2 demonstrate that schedule thinning may be a successful procedure to create a more practical pictorial SPA; however, certain prerequisite skills (e.g., pictorial mands) may also be correlated with the success of this procedure.

Many different prerequisite skills have been assessed in past alternative modality SPA studies. For the verbal modality, these skills have ranged from measuring the IQ of participants to assessing participants' receptive language abilities using norm-referenced assessments such as the PPVT-R (Cohen-Almeida et al., 2000). For the pictorial modality, researchers have assessed

participants' matching abilities (Clevenger & Graff, 2005; Graff & Gibson, 2003), tact repertoires (Ardoin et al., 2004; Higbee et al., 1999), receptive identification repertoires (Higbee et al., 1999), and discrimination skills via the ABLA (Conyers et al., 2002; de Vries et al., 2005; Heinicke et al., 2013; LeBlanc et al., 2006; Reyer & Sturmey, 2006; Schwartzman, et al., 2003). However, only a few studies have demonstrated that the prerequisite skills assessed were associated with the success of the pictorial modality (e.g., Conyers et al., 2002; Clevenger & Graff, 2005).

In the current investigation, pictorial mands were assessed to evaluate if the ability to mand with picture cards was necessary for the success of a pictorial SPA. Matching assessments were also conducted because there has been some evidence that these skills may also be necessary prerequisite assessments for the pictorial format (Clevenger & Graff, 2005; Graff & Gibson, 2003). In Experiment 1, these three prerequisite assessments seemed to be correlated with the success of the pictorial SPA without contingent access. Annah was the only exception with scores at or near 0% on her P-O matching assessment; however, there is evidence to support that these low scores were due to faulty stimulus control rather than a true P-O matching deficit. If this same pattern of responding is observed in future studies investigating matching as a prerequisite skill for alternative SPA formats, researchers might consider continuing to conduct P-O matching assessment trials (perhaps including error-correction procedures on a few trials) until breaking the faulty stimulus control to assess the pure matching repertoire.

In Experiment 2, prerequisite-skill deficits seemed to be correlated with the need for contingent access in 2 of the 3 participants. That is, deficits were identified in Lisa's O-P/P-O matching repertoire and in Sean's pictorial mand repertoire. However, this was not the case for Eric who scored at 100% across his three prerequisite assessments. Unlike the participants in

Experiment 1 who also had high prerequisite assessment results, Eric's pictorial SPA without access was not successful in identifying reinforcers. One explanation for Eric's differing results could be that the prerequisite assessments in this study only assessed the eight stimuli that were identified as preferred via the RAISD. Perhaps a more comprehensive assessment of matching or the participants' level of success with PECS would yield more predictive information regarding the efficacy of the pictorial format. Another explanation for Eric's results compared to the participants in Experiment 1 could be that we did not assess all pertinent prerequisite skill sets. It may be the case that the participants in Experiment 1 had certain skill sets that Eric did not possess. Researchers interested in extending the line of alternative SPA modality studies might consider broadening their battery of prerequisite assessments to investigate other potentially necessary skills for the pictorial modality such as participants' discrimination or tact repertoires.

Another explanation for the SPA without access results between the participants in Experiments 1 and 2 (beyond prerequisite skills) is that the learning histories may have differed between these two sets of participants. However, through schedule thinning, the results of the SPAs became valid for the participants in Experiment 2. Lisa showed the most success with schedule thinning, only requiring one set of SPAs at each schedule value (i.e., VR-3, VR-5) before making meaningful choices in her pictorial SPAs conducted without access (i.e., EXT). 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. Eric's 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 his 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 where gummy candies were being delivered. He would also occasionally consume the control item during the RA sessions whereas he would push the LP item out of his reach and never consumed this item. 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 of reinforcement. In addition, Sean did not have consistent results when we implemented a leaner schedule value (i.e., VR-5). One possible explanation for Sean's inconsistent VR-3 and VR-5 pictorial SPA results is that his preferences changed over the course of these 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 Sean's inconsistent VR-3 pictorial SPA results were due to his history with using pictures to request items. That is, Sean's therapists reported that he did not use PECS, and his 0% score on his pictorial mand prerequisite assessment support this verbal report.

Overall, schedule thinning was a successful procedure for establishing conditioned reinforcement properties of the pictorial stimuli assessed in the SPAs. One limitation of the current schedule thinning procedures was that we conducted a brief RA following 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 schedule thinning effects. 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 intervals following the end of schedule thinning both with the stimuli originally assessed and with a novel stimulus set to assess maintenance and generalization.

A few potential 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 self-determination and quality of life. Future studies should consider evaluating the use of alternative modality SPAs for other classes of stimuli since 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, the majority of studies investigating the effectiveness of the pictorial modality have compared the results of a pictorial SPA back to a traditional tangible SPA. However, we chose to validate our pictorial SPA results by conducting subsequent RAs. Although conducting a tangible SPA with the same stimuli following a successful SPA without access might have provided more evidence to support the results of the pictorial modality, it seems that conducting the single-operant progressive-ratio RAs was sufficient.

Third, we chose to evaluate schedule thinning for participants who scored poorly on their prerequisite skill assessments and did not have valid SPA without access results. 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 et al., 1998). Investigators

interested in extending the line of alternative modality SPA research might consider further evaluating the role of hypothesized prerequisite skills by conducting remediation training to evaluate the effects of prerequisite skill acquisition on the success of a pictorial presentation format. Our findings in Experiment 2, especially for Eric, call into question whether the repertoires assessed in the current investigation are meaningful prerequisites for pictorial SPAs without contingent reinforcer access. 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 prerequisite assessment failures.

Fourth, 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 further examined because it has been the most heavily researched alternative presentation format, yet no firm conclusions have been drawn on its efficacy without contingent access with clinical populations. Researchers interested in this area are encouraged to replicate the procedures of this study with other alternative modalities. It may prove useful to focus on the verbal modality because this modality has the quickest administration time rather than assessing the feasibility of novel presentation formats such as a video modality.

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. However, the results of the investigation and the list of reinforcers identified were shared with the participants' lead therapists or case managers to aid in future 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 when using the concurrent-operant arrangement for Connor's RA compared to the other participants, suggesting the use of this arrangement in future studies. However, a single-operant progressive-ratio arrangement does allow therapists to obtain information about absolute reinforcement effects (Roscoe, Iwata, & Kahng, 1999). Future studies should consider directly comparing the results of these different RA arrangements.

The results of this study have clinical implications for behavior analysts working with the DD population. We found that pictorial SPAs were only successful for 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 following item selection eradicates the main benefits of alternative modalities. That is, practitioners' use of alternative modalities is most likely dictated by their 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.

We also found that the pictorial SPA without access was more likely to be successful if participants engaged in pictorial mands and could accurately match pictures of the edible stimuli to corresponding pictures of the stimuli and vice versa. These findings suggest that practitioners might assess these repertoires before attempting a pictorial SPA. However, this implication is preliminary given that one participant (i.e., Eric) did score highly on these prerequisite skill assessments yet he did not have valid pictorial SPA outcomes when contingent access was not provided. Practitioners who are working with clients with strong matching repertoires who also have a reliable history using PECS may consider the use of the pictorial format. However, if the practitioner finds that little progress is being made while using the items identified from the pictorial SPA, the clinician should consider administering the pictorial SPA with contingent access and compare the results to determine their correspondence. If little correspondence is found, it is recommended that the practitioner either consider schedule thinning (if the items being assessed cannot be presented on a tabletop) or the use of a tangible SPA.

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Table 1

Participant Demographic Information

| | Age | Diagnosis | GARS Autism Index | Hours of Behavioral Services Received | History with SPAs | History with Alternative Modality SPAs | Other Therapy Received |
|-------------------|--------------|------------------------|-------------------------|---|----------------------|--|--|
| Keron | 5 yrs, 11 mo | Noonan Syndrome | 74 | 31-40 per week | Paired MSWO | Pictorial Verbal | OT, Speech, PT |
| Annah | 9 yrs, 8 mo | Autism ADHD | 83 | 0-10 per week | Yes | No | OT, Speech, GFCF diet, Behavioral Feeding Services |
| Connor | 11 yrs, 0 mo | Autism | 76 | 11-20 per week | Yes | No | Music Therapy |
| Jeff | 11 yrs, 4 mo | Autism | 79 | None | No | No | Speech |
| Eric | 4 yrs, 9 mo | Autism | 89 | 31-40 per week | MSWO | No | Equine, OT, Speech |
| Lisa | 4 yrs, 8 mo | Autism | 98 | 11-20 per week | Yes | No | OT, Speech, PT |
| Sean (Ongoing) | 2 yrs, 8 mo | Developmental Delay | 113 | 0-10 per week | No | No | Speech |

Note. ADHD = attention deficit hyperactivity disorder; GARS = Gilliam Autism Rating Scale; GFCF = gluten-free/casein-free; MSWO = multiple stimulus without replacement; OT = occupational therapy; PT = physical therapy; SPA = stimulus preference assessment.

Table 2

Session Duration Per Session Type

| Session Type | <i>M</i> Duration |
|-------------------------------|-------------------|
| Prerequisite Assessments | |
| Mand Assessment | 10 min 8 s |
| P-O Assessment | 7 min 56 s |
| O-P Assessment | 9 min 18 s |
| SPAs | |
| Without Access/EXT | 7 min 13 s |
| With Access | 12 min 42 s |
| VR-3 | 7 min 12 s |
| VR-5 | 6 min 30 s |
| Reinforcer Assessments/Probes | |
| HP Condition | 7 min 3 s |
| LP Condition | 3 min 33 s |
| Control Condition | 2 min 46 s |
| Concurrent-Operant | 5 min |

Note. EXT = extinction; O-P = object-to-picture; P-O = picture-to-object; SPA = stimulus preference assessment; RA = reinforcer assessment; VR = variable-ratio.

Table 3

Interobserver Agreement Scores For Each Participant Per Session Type

| Participant | Prerequisite Assessments | | SPA Sessions | | RA Sessions | |
|-------------------|--------------------------|------------------|---------------|------------------|---------------|-------------------|
| | % of Sessions | <i>M</i> (range) | % of Sessions | <i>M</i> (range) | % of Sessions | <i>M</i> (range) |
| Keron | 100 | 100% | 100 | 100% | 75 | 100% |
| Annah | 100 | 100% | 100 | 100% | 100 | 98.8% (75-100) |
| Connor | 100 | 100% | 100 | 100% | 100 | 100% |
| Eric | 100 | 100% | 100 | 100% | 100 | 99.1% (75-100) |
| Lisa | 100 | 100% | 100 | 100% | 100 | 100% |
| Sean (Ongoing) | | | | | | |

Note. SPA = stimulus preference assessment; RA = reinforcer assessment.

Table 4

Treatment Integrity Scores For Each Participant Per Session Type

| Participant | Prerequisite Assessments | | SPA Sessions | | RA Sessions | |
|-------------------|--------------------------|-----------------------|---------------|----------------------|---------------|------------------|
| | % of Sessions | <i>M</i> (range) | % of Sessions | <i>M</i> (range) | % of Sessions | <i>M</i> (range) |
| Keron | 100 | 100% | 100 | 100% | 75 | 100% |
| Annah | 100 | 97.92% (93.75-100) | 100 | 100% | 100 | 100% |
| Connor | 100 | 100% | 100 | 100% | 100 | 100% |
| Eric | 100 | 100% | 100 | 99.7% (96.4-100%) | 100 | 100% |
| Lisa | 100 | 100% | 100 | 100% | 100 | 100% |
| Sean (Ongoing) | | | | | | |

Note. SPA = stimulus preference assessment; RA = reinforcer assessment.

Table 5

Treatment Integrity Interobserver Agreement Scores For Each Participant Per Session Type

| Participant | Prerequisite Assessments | | SPA Sessions | | RA Sessions | |
|-------------------|--------------------------|------------------|---------------|------------------|---------------|------------------|
| | % of Sessions | <i>M</i> (range) | % of Sessions | <i>M</i> (range) | % of Sessions | <i>M</i> (range) |
| Keron | 100 | 100% | 100 | 100% | 50 | 100% |
| Annah | 100 | 100% | 100 | 100% | 100 | 100% |
| Connor | 100 | 100% | 100 | 100% | 87.5 | 100% |
| Eric | 100 | 100% | 78.6 | 100% | 100 | 100% |
| Lisa | 100 | 100% | 100 | 100% | 100 | 100% |
| Sean (Ongoing) | | | | | | |

Note. SPA = stimulus preference assessment; RA = reinforcer assessment.

Figure 1. Results of Keron's prerequisite skills assessments (top panel), pictorial paired-stimulus preference assessment without contingent access (middle panel), and single-operant progressive-ratio reinforcer assessment (bottom panel).

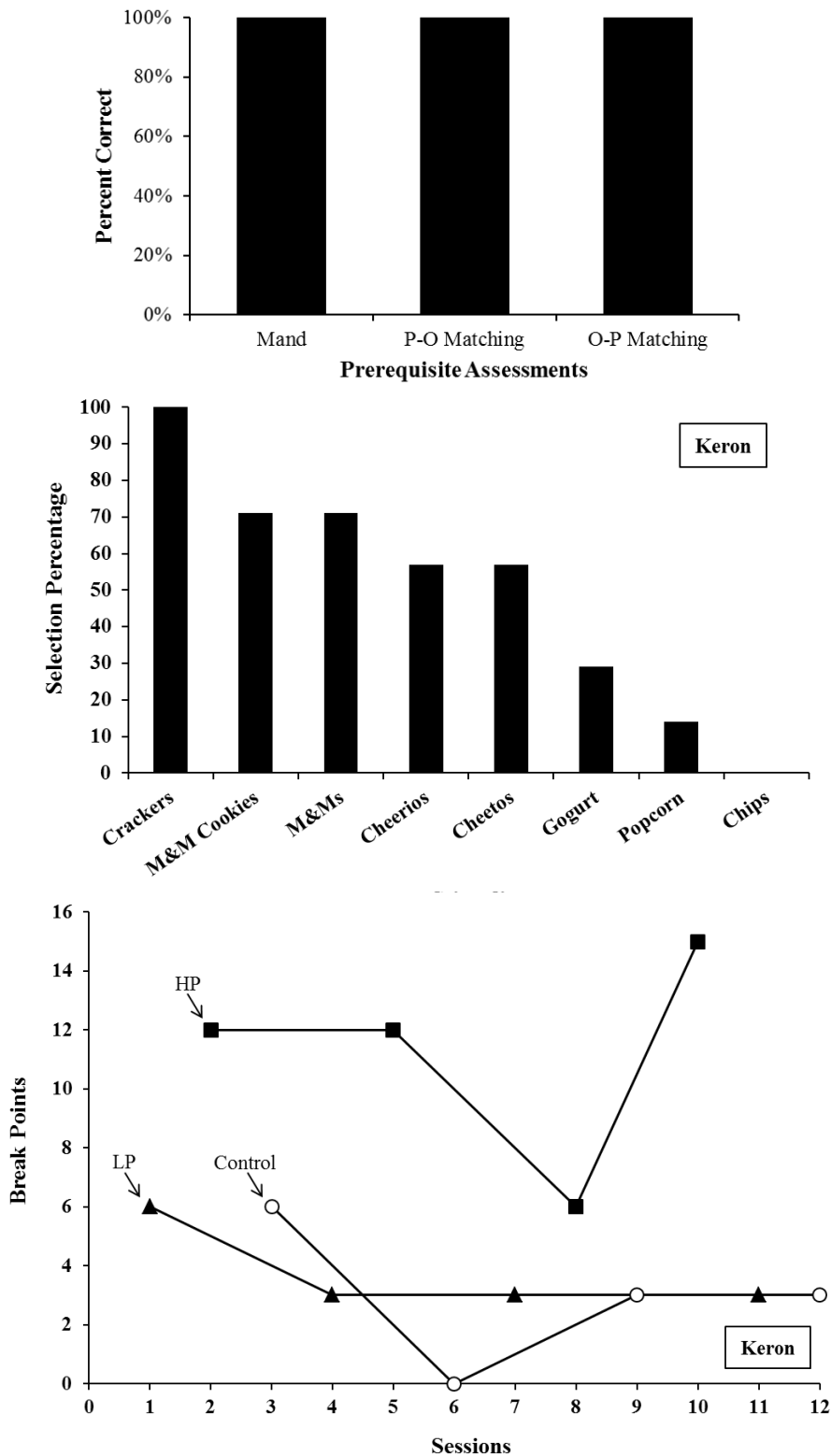


Figure 2. Results of Annah's prerequisite skills assessments (top panel), pictorial paired-stimulus preference assessment without contingent access (middle panel), and single-operant progressive-ratio reinforcer assessment (bottom panel).

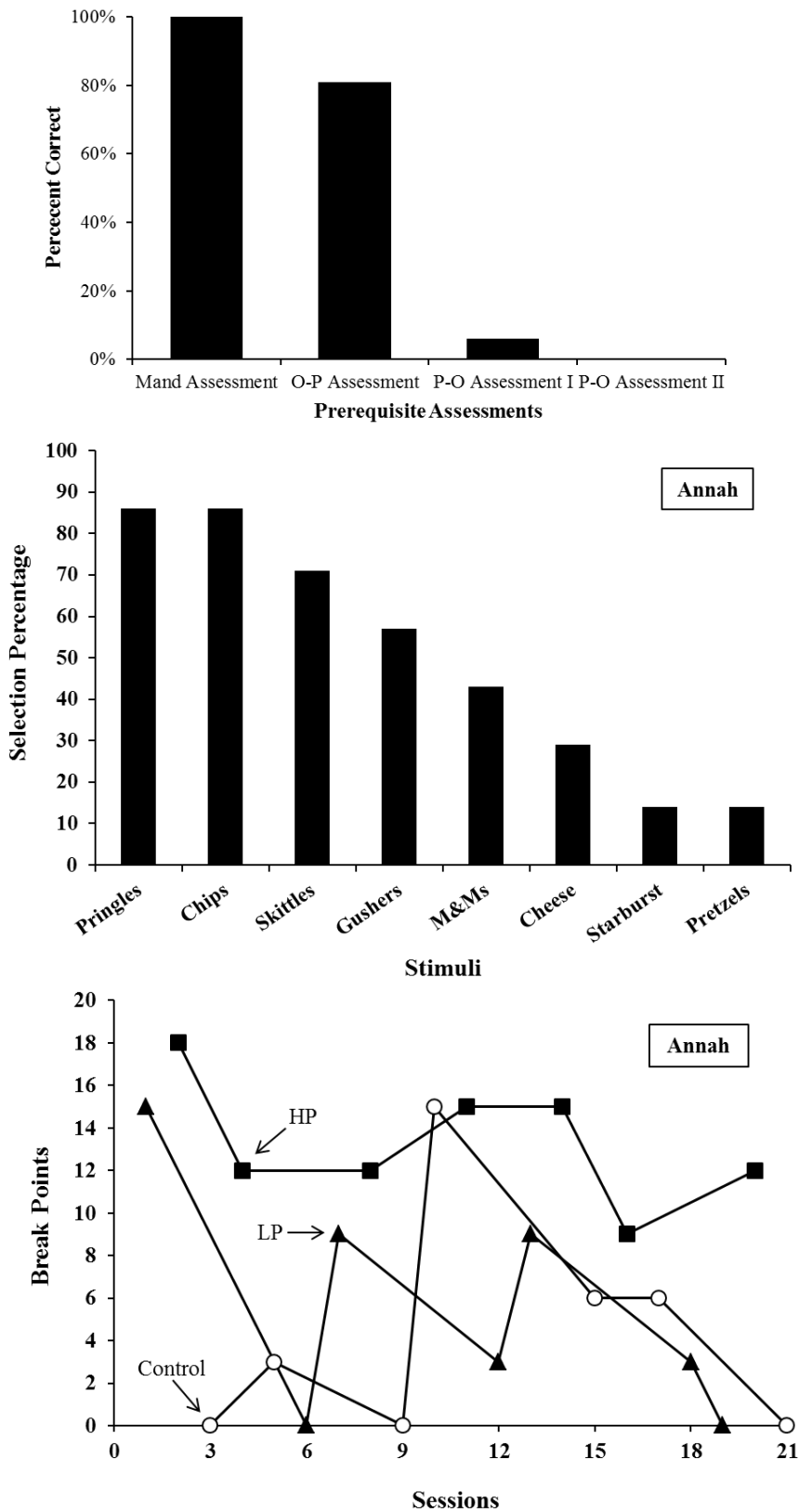


Figure 3. Results of Connor’s prerequisite skills assessments (top panel), pictorial paired-stimulus preference assessment without contingent access (middle panel), and concurrent-operant reinforcer assessment (bottom panel).

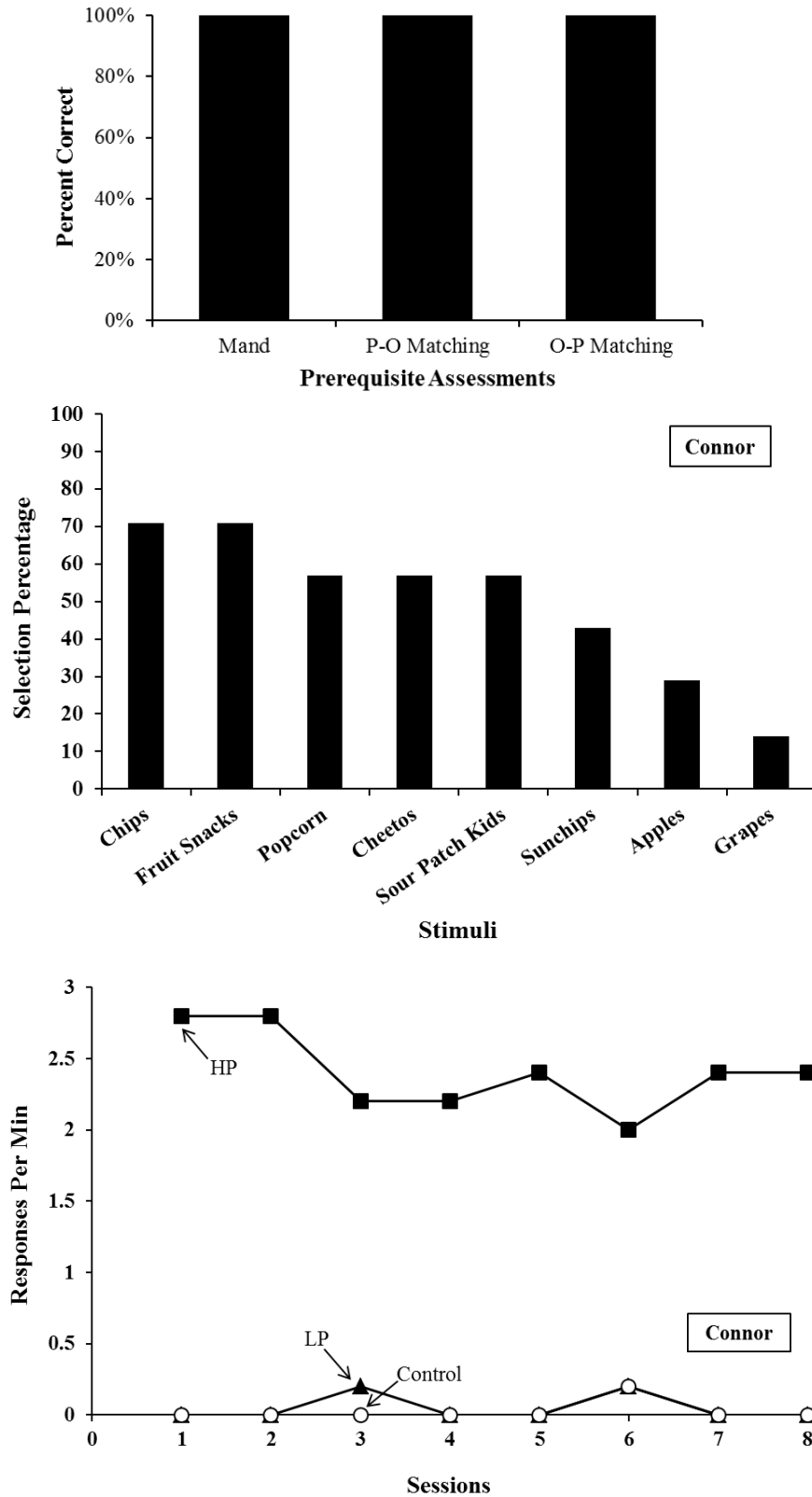


Figure 4. Results of Jeff's prerequisite assessments (top panel), pictorial paired-stimulus preference assessments without contingent access (middle panels), and reinforcer assessments (bottom panels).

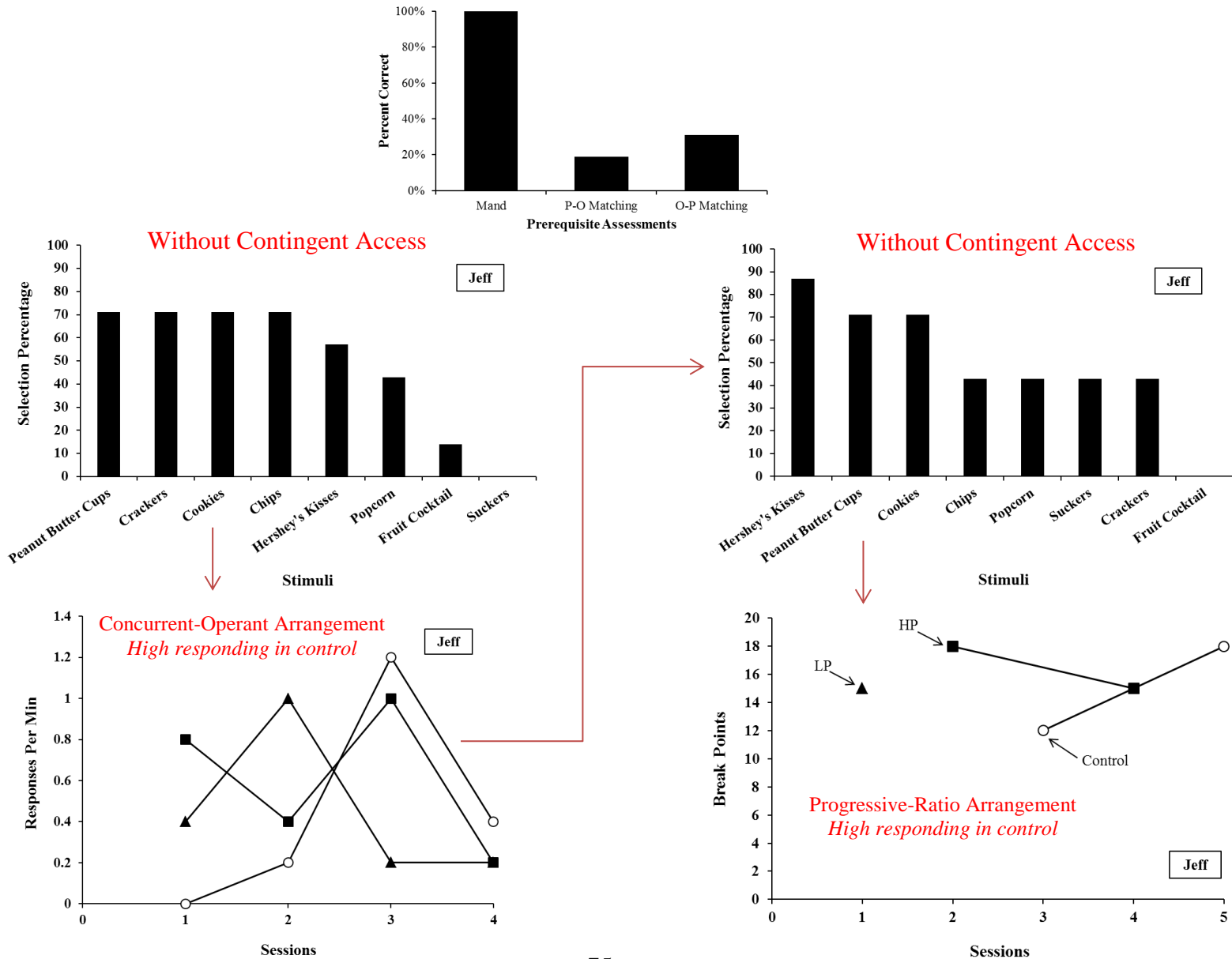


Figure 5. Results of Jeff's pictorial paired-stimulus preference assessments without contingent access (top panels) and reinforcer assessments (bottom panels).

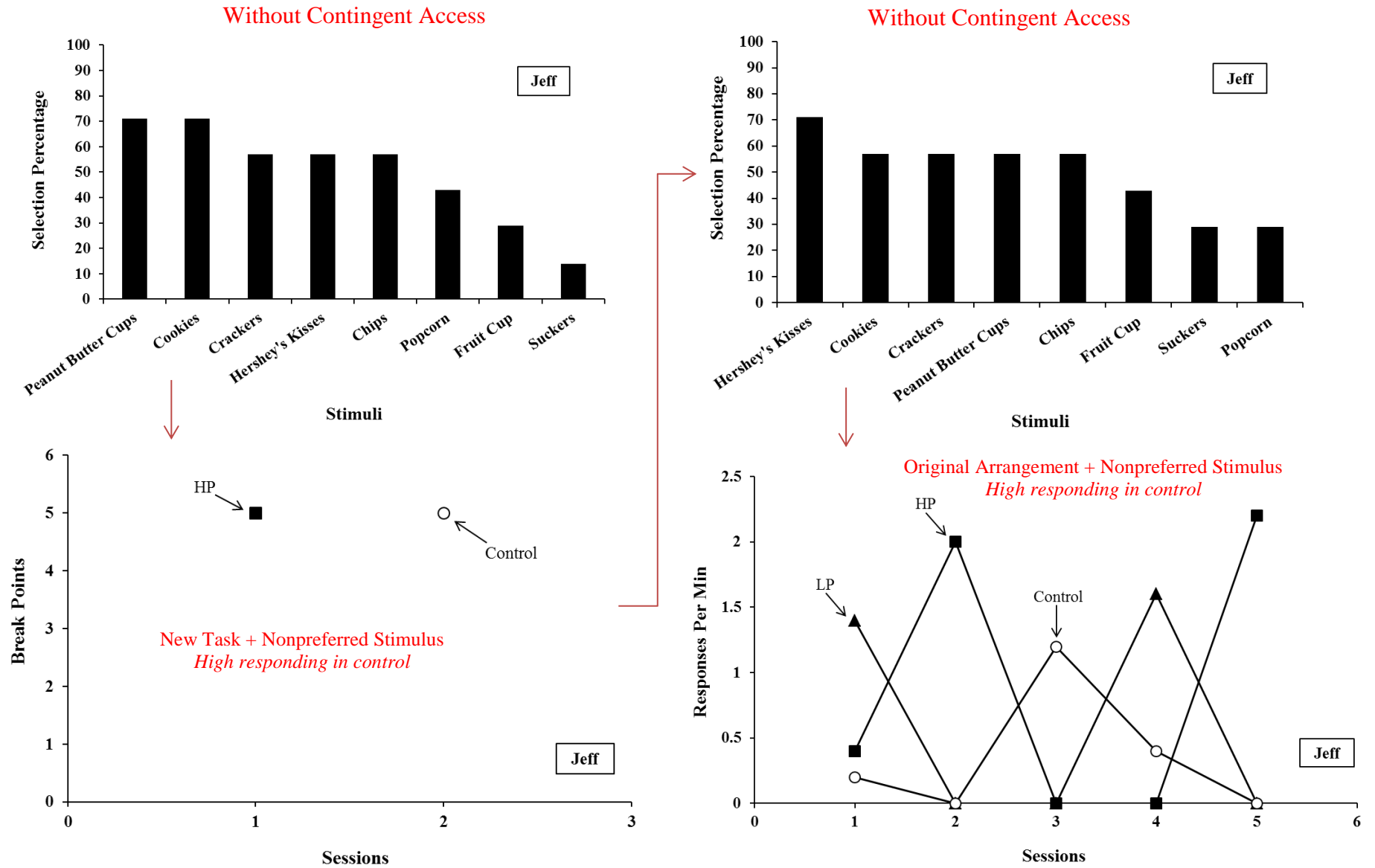


Figure 6. Results of Eric's prerequisite assessments (top panel), pictorial paired-stimulus preference assessments without and with contingent access (middle panels), and reinforcer assessments (bottom panels).

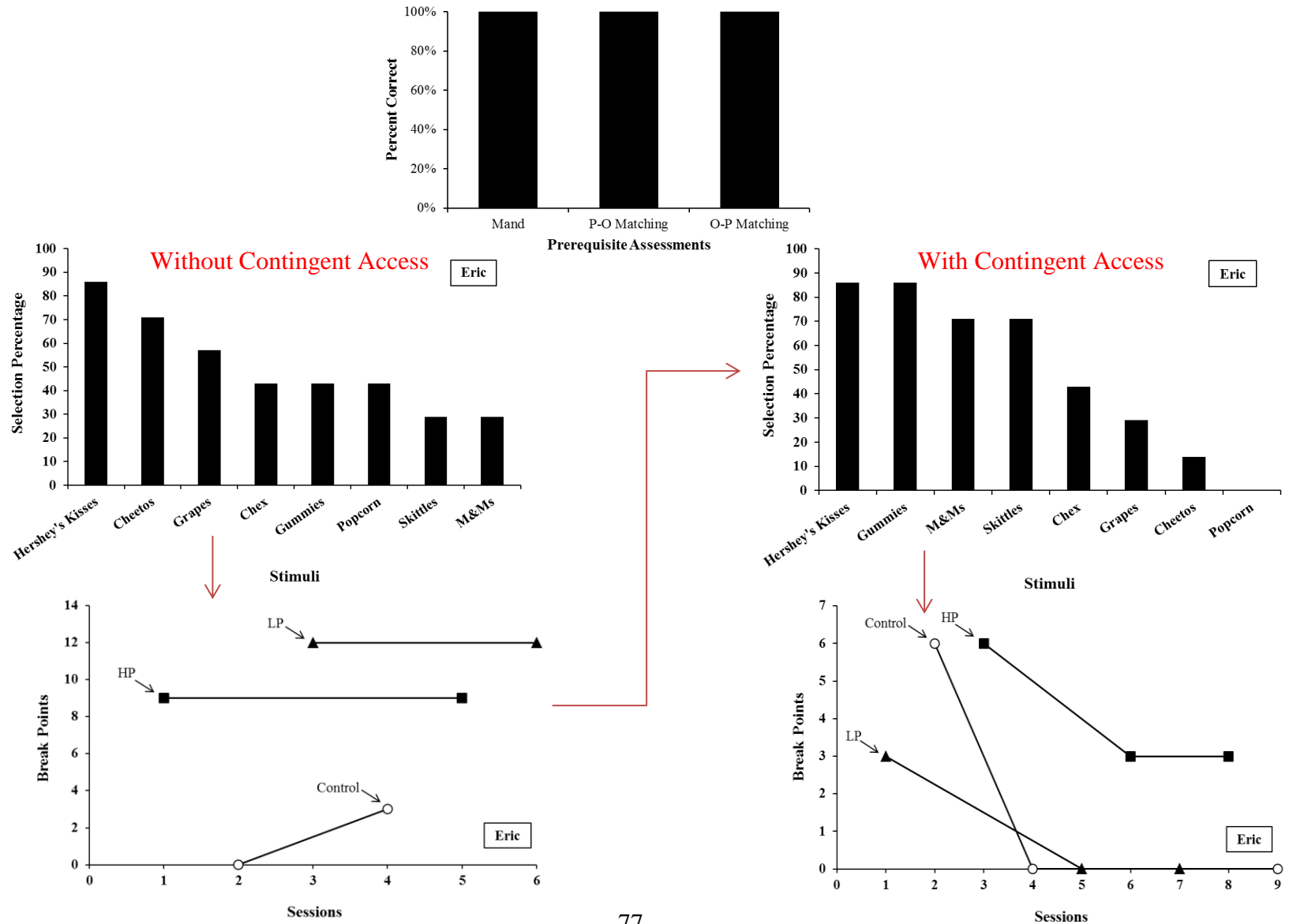


Figure 7. Results of Eric's schedule thinning manipulation. Each bar graph depicts selection percentages from pictorial preference assessments conducted on VR-3 (left panels), VR-5 (top right panel), and EXT (bottom right panel) schedules followed by brief PR-2 reinforcer assessments. Preference assessment data are expressed in the primary Y-axis, and reinforcer assessment data are expressed on the secondary Y-axis.

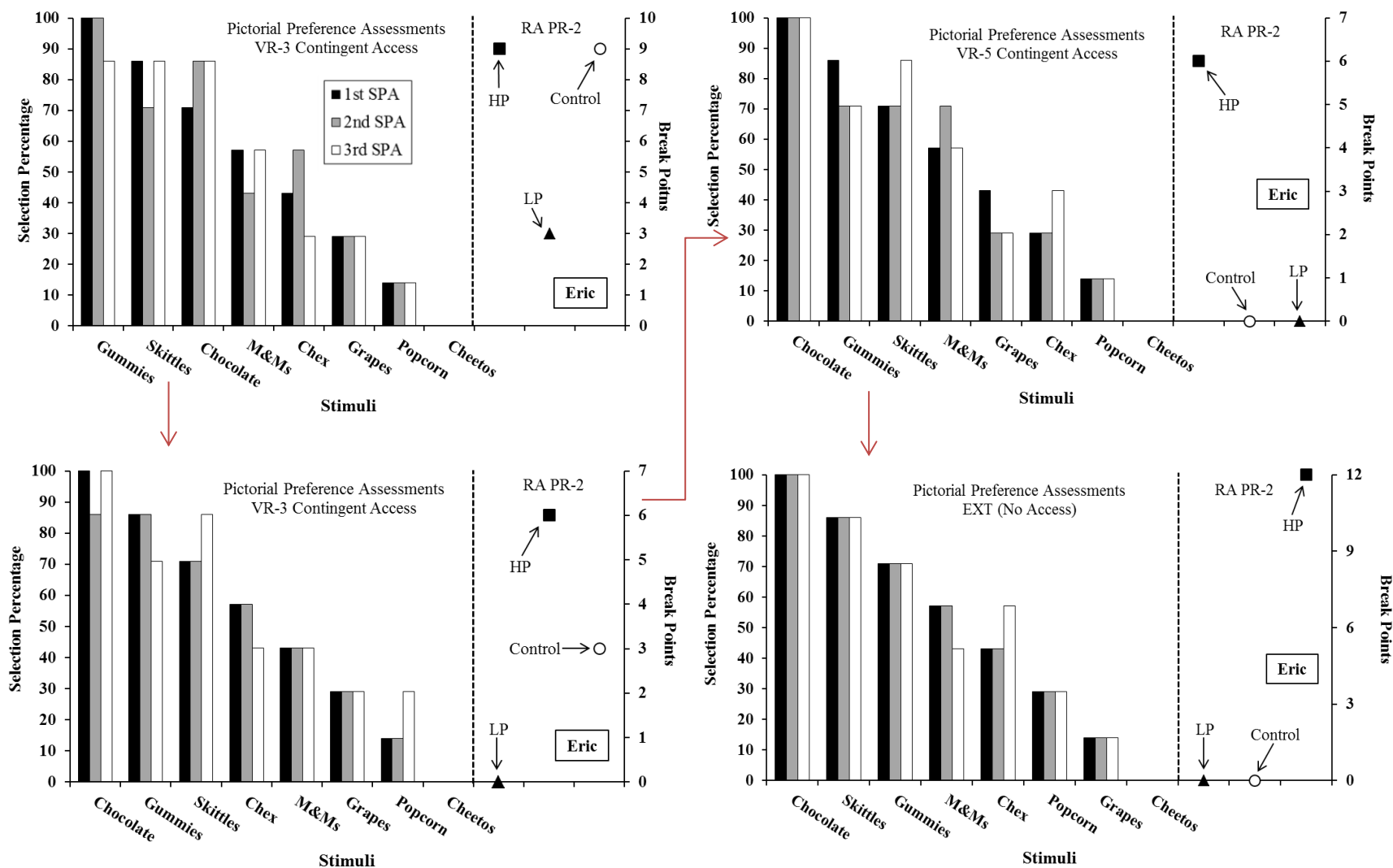


Figure 8. Results of Lisa's prerequisite assessments (top panel), pictorial paired-stimulus preference assessments without and with contingent access (middle panels), and reinforcer assessments (bottom panels).

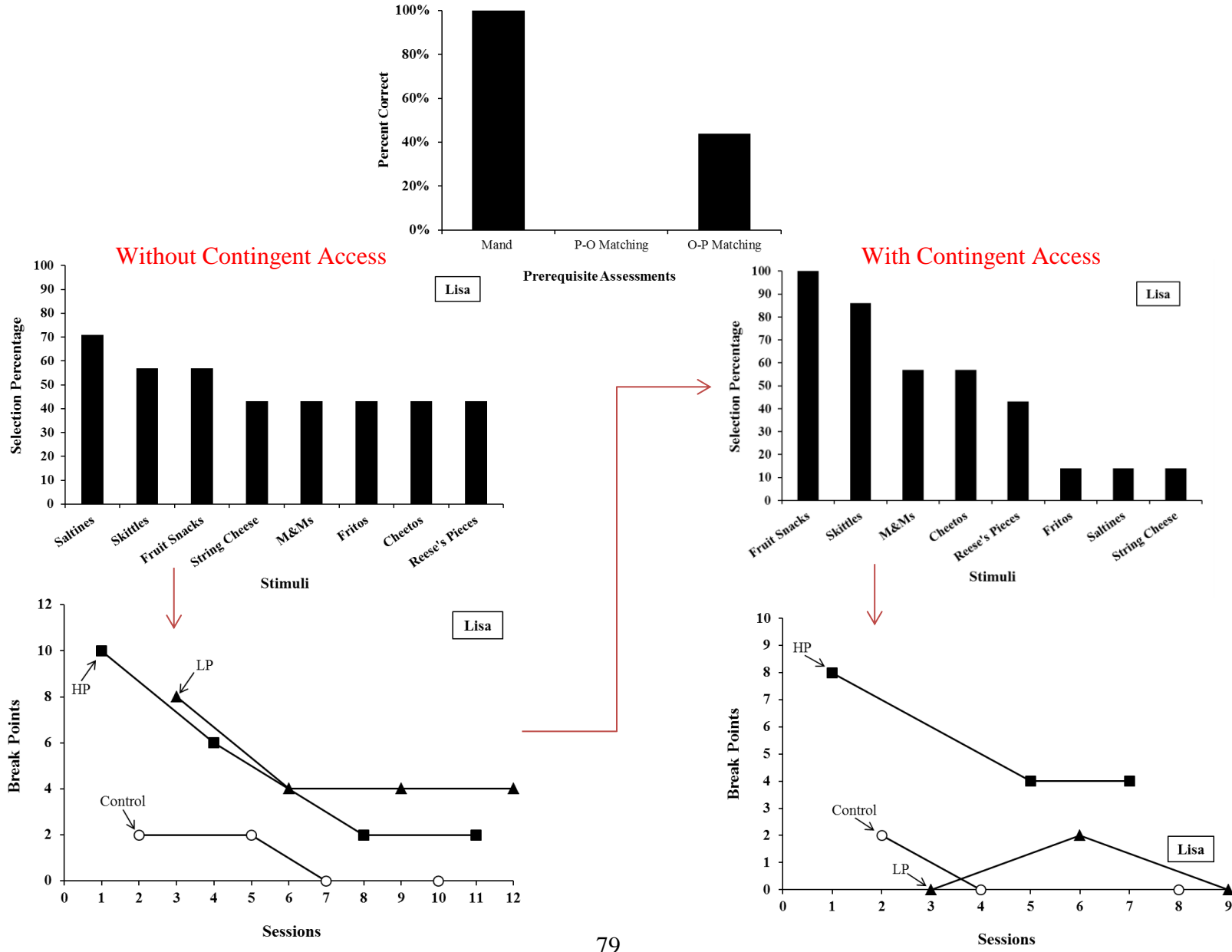


Figure 9. Results of Lisa's schedule thinning manipulation. Each bar graph depicts selection percentages from pictorial preference assessments conducted on VR-3 (top panel), VR-5 (middle panel), and EXT (bottom panel) schedules followed by brief PR-2 reinforcer assessments. Preference assessment data are expressed in the primary Y-axis, and reinforcer assessment data are expressed on the secondary Y-axis.

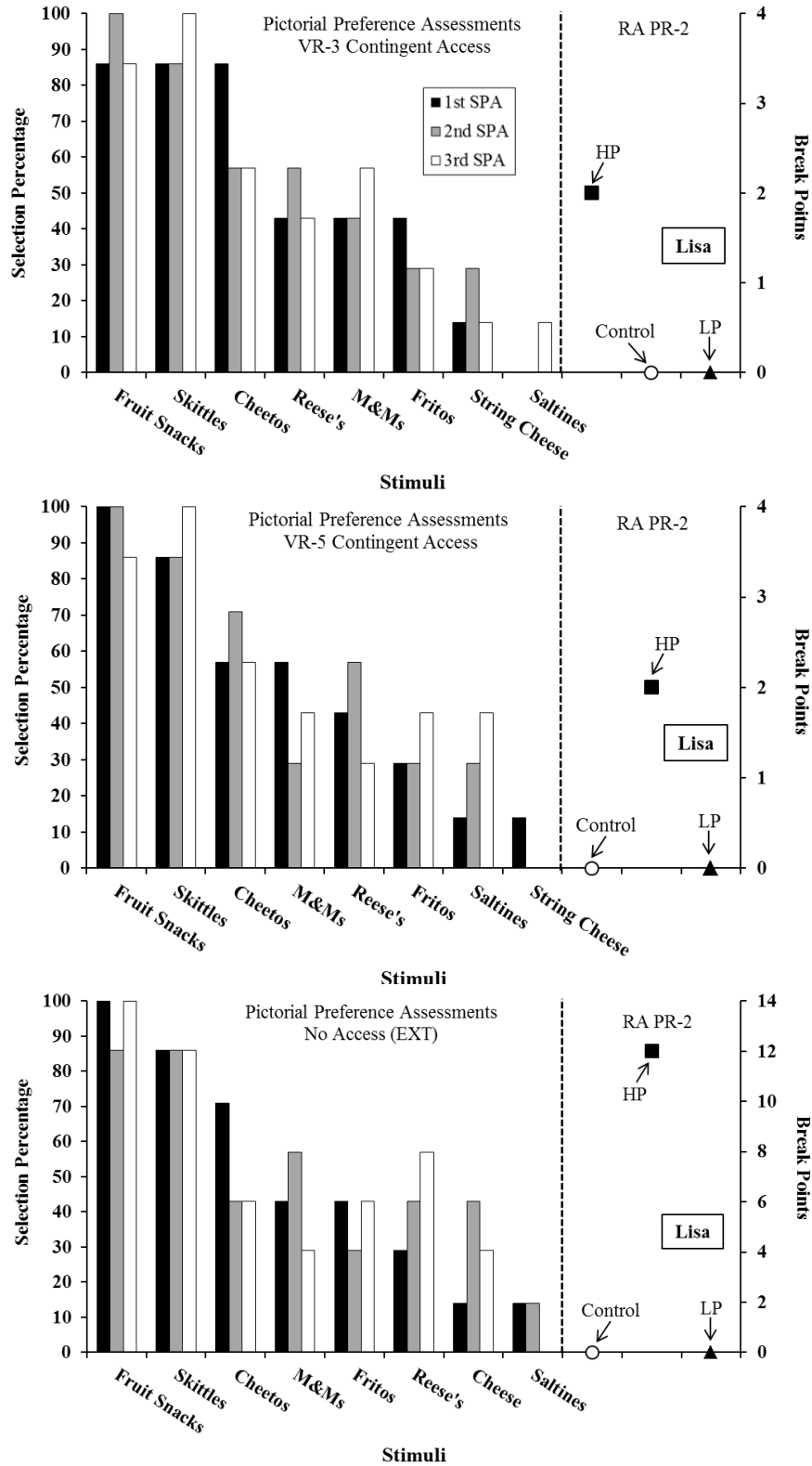


Figure 10. Results of Sean's prerequisite assessments (top panel), pictorial paired-stimulus preference assessments without and with contingent access (middle panels), and reinforcer assessments (bottom panels).

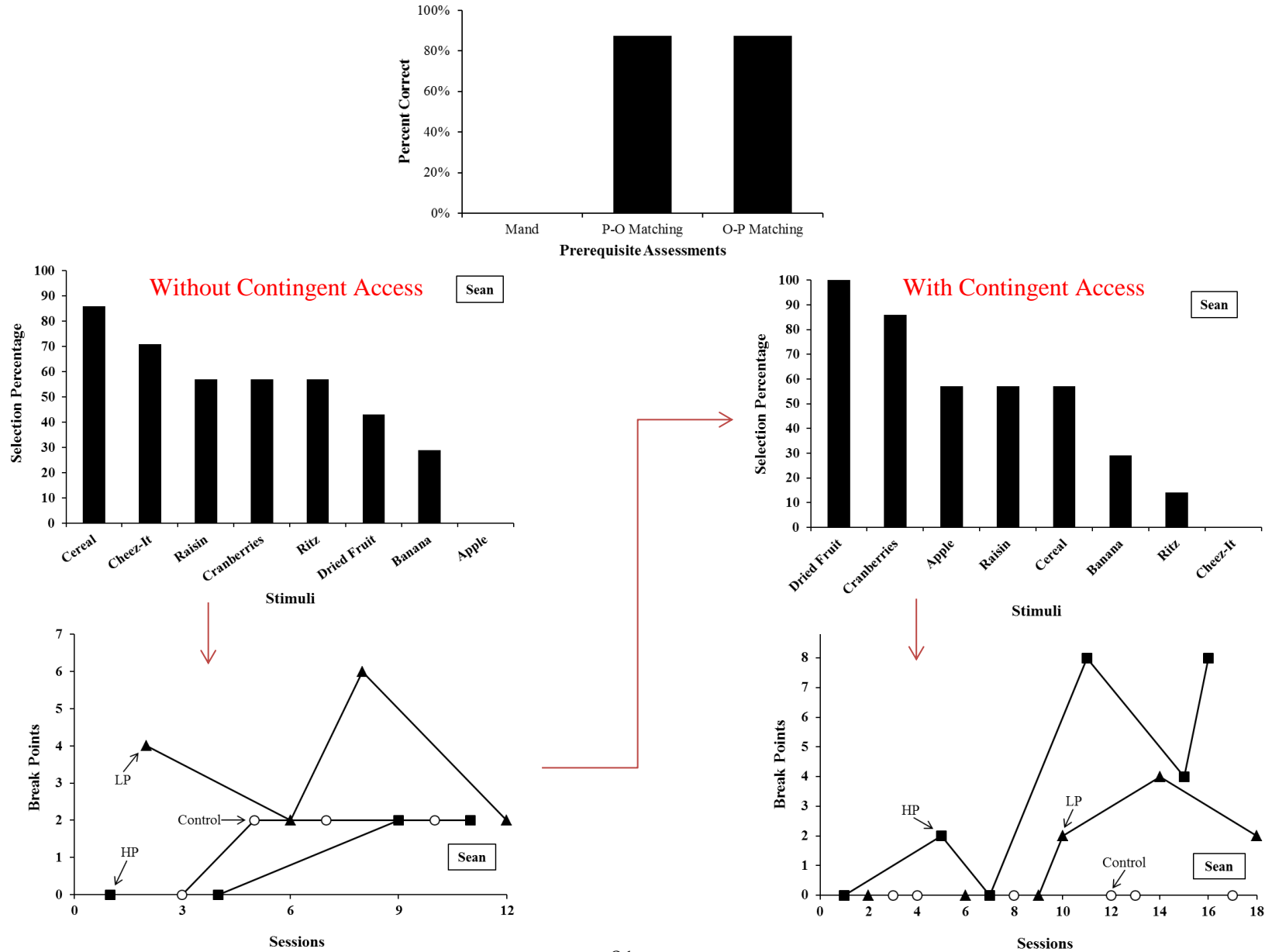


Figure 11. Results of Sean’s schedule thinning manipulation. Each bar graph depicts selection percentages from pictorial preference assessments conducted on VR-3 (top and middle panels) and VR-2 (bottom panel), schedules. The results of a brief PR-2 reinforcer assessments are also depicted following the VR-2 schedule (bottom panel) where preference assessment data are expressed in the primary Y-axis and reinforcer assessment data are expressed on the secondary Y-axis.

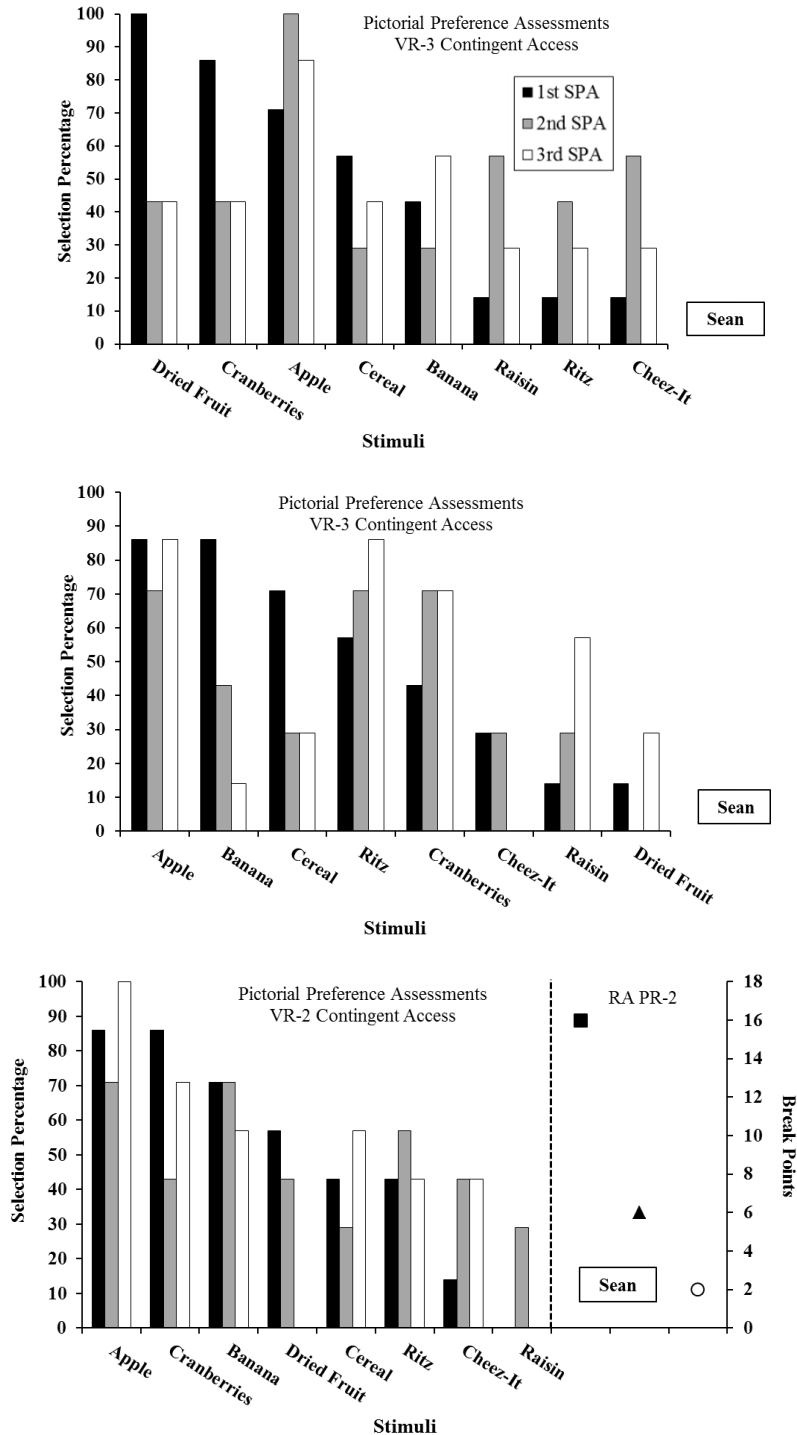


Figure 12. Results of Sean's schedule thinning manipulation. Each bar graph depicts selection percentages from pictorial preference assessments conducted on VR-3 (top panel) and VR-5 (bottom panel) schedules. The results of a brief PR-2 reinforcer assessment are also depicted following the VR-3 schedule (top panel) where preference assessment data are expressed in the primary Y-axis and reinforcer assessment data are expressed on the secondary Y-axis.

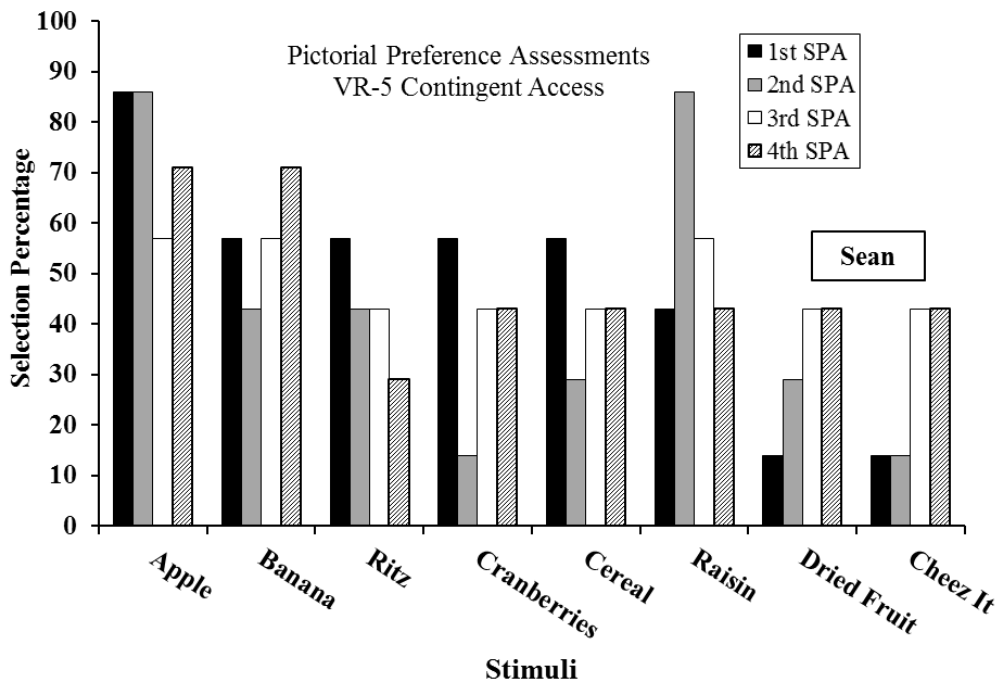
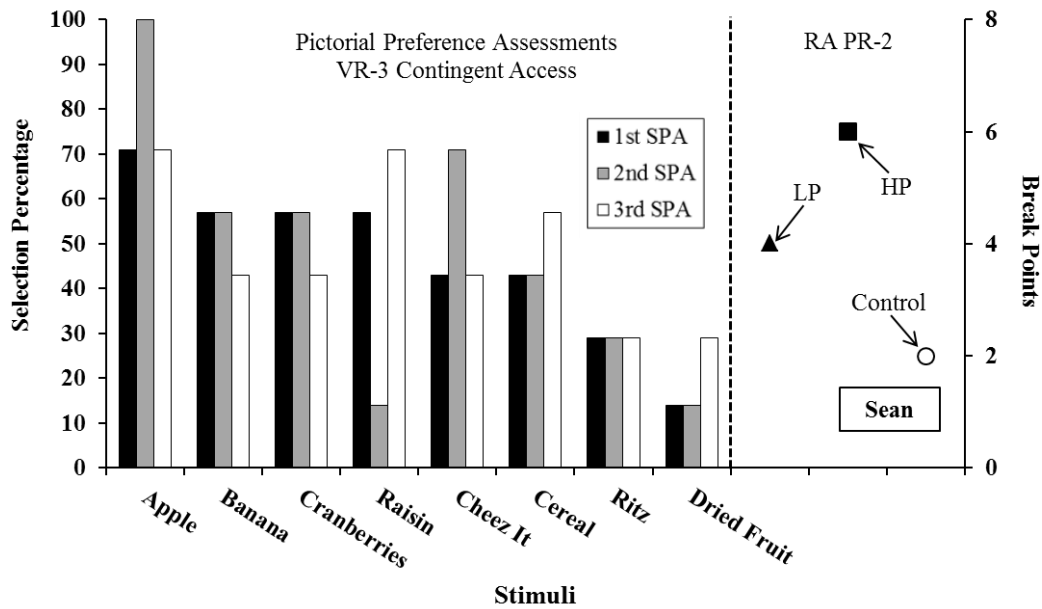
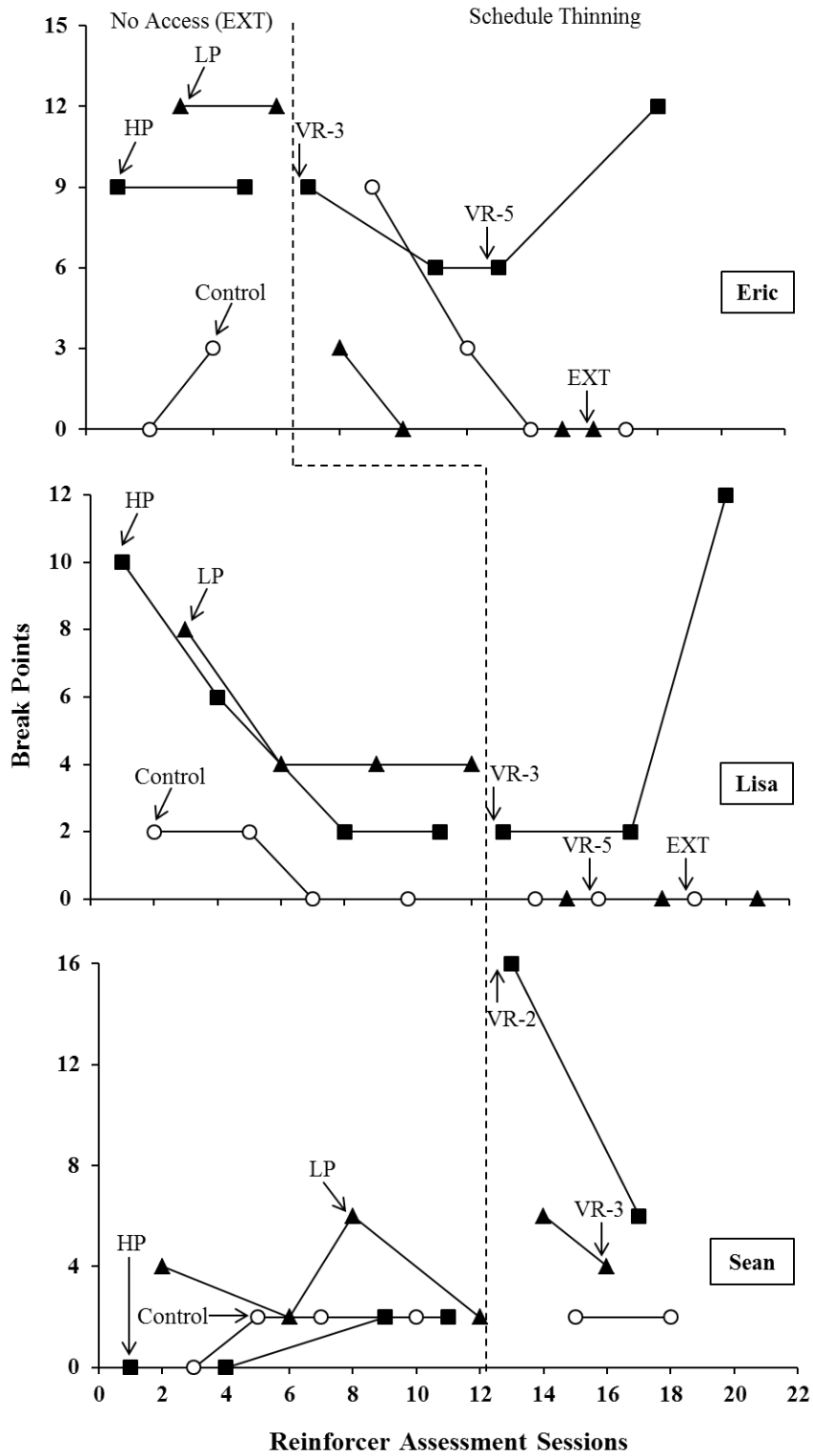


Figure 13. Results of progressive-ratio reinforcer assessments following pictorial paired-stimulus preference assessments without access (EXT) and during schedule thinning for Eric, Lisa, and Sean.



Appendix A

The Reinforcer Assessment for Individuals with Severe Disabilities (RAISD)

CHILD'S NAME: _____ DATE: _____

NAME OF REPORTER: _____

The purpose of this structured interview is to get as much specific information as possible from the parent (or caregiver) as to what they believe would be useful reinforcers for the client. Therefore, this survey asks parents questions about categories of stimuli (e.g., visual, auditory, etc.). After the parent has generated a list of preferred stimuli, ask additional probe questions to get more specific information on his/her preferences and the stimulus conditions under which the object or activity is most preferred (e.g., What specific TV shows are his favorite? What does she do when she plays with a mirror? Does she prefer to do this alone or with another person?)

We would like to get some information on _____'s preference for different items and activities.

1. Some children really enjoy looking at things such as a mirror, bright lights, shiny objects, spinning objects, TV, etc. What are the things you think _____ most likes to watch?

RESPONSE TO PROBE QUESTIONS:

2. Some children really enjoy different sounds such as listening sounds such as listening to music, car sounds, whistles, beeps, sirens, clapping, people singing, etc. What are the things you think _____ most likes to listen to?

RESPONSE TO PROBE QUESTIONS:

3. Some children really enjoy different smells such as perfume, flowers, coffee, pine trees, etc. What are the things you think _____ most likes to smell?

RESPONSE TO PROBE QUESTIONS:

4. Some children really enjoy certain foods or snacks such as ice cream, pizza, juice, graham crackers. McDonald's hamburgers, etc. What are the things you think _____ most likes to eat?

RESPONSE TO PROBE QUESTIONS:

5. Some children really enjoy physical play or movement such as being tickled, wrestling, running, dancing, swinging, being pulled on a scooter board, etc. What activities like this do you think _____ most enjoys?

RESPONSE TO PROBE QUESTIONS:

6. Some children really enjoy touching things of different temperatures, cold things like snow or an ice pack, or warm things like a hand warmer or a cup containing hot tea or coffee. What activities like this do you think _____ most enjoys?

RESPONSE TO PROBE QUESTIONS:

7. Some children really enjoy feeling different sensations such as splashing water in a sink, a vibrator against the skin, or the feel of air blow on the face from a fan. What activities like this do you think _____ most enjoys?

RESPONSE TO PROBE QUESTIONS:

8. Some children really enjoy it when others give them attention such a hug, a pat on the back, clapping, say “Good job”, etc. What forms of attention do you think _____ most enjoys?

RESPONSE TO PROBE QUESTIONS:

9. Some children really enjoy certain toys such as puzzles, toy cars, balloons, comic books, flashlights, bubbles, etc. What are _____’s favorite toys or objects?

RESPONSE TO PROBE QUESTIONS:

10. What are some other items or activities that _____ really enjoys?

After completion of the survey, select all the stimuli that could be presented or withdrawn contingent on target behaviors during a session or classroom activity (e.g., a toy could be presented or withdrawn, a walk in the park could not). Write down all of the specific information about each selected stimulus on a 3" x 5" index card (e.g., "Having a female adult read him the "Three Little Pigs' story"). Then have the parents select the top 16 stimuli and rank them using the cards. Then list the ranked stimuli below.

- | | |
|----------|-----------|
| 1. _____ | 9. _____ |
| 2. _____ | 10. _____ |
| 3. _____ | 11. _____ |
| 4. _____ | 12. _____ |
| 5. _____ | 13. _____ |
| 6. _____ | 14. _____ |
| 7. _____ | 15. _____ |
| 8. _____ | 16. _____ |