An Evaluation of an Electronic Picture-Based Multiple-Stimulus-Without-Replacement Preference Assessment

By

Kathryn A. Gorycki

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Chairperson: Pamela L. Neidert, Ph.D., BCBA-D

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Claudia L. Dozier, Ph.D., BCBA-D, LBA

_____

Kelley L. Harrison Ph.D., BCBA, LBA-KS

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The Thesis Committee for Kathryn A. Gorycki

certifies that this is the approved version of the following Thesis:

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Chairperson: Pamela L. Neidert, Ph.D., BCBA-D

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Abstract

Reinforcers are critical for skill acquisition and behavior reduction for children with intellectual and developmental disorders (IDD). Identifying reinforcers is often a routine part of the assessment and treatment development process (Hagopian et al., 2004). To date, no studies have examined the efficacy of using pictures of edibles in an electronic format (e.g., pictures of food on a tablet) to identify preferred edibles. Thus, the purpose of this study is to extend the literature on preference assessment modalities using technology by examining the extent to which results of multiple-stimulus-without-replacement (MSWO) preference assessments using electronic pictures as selection stimuli (and without contingent access to edibles for selection) correspond to standard MSWO assessments using edibles as selection stimuli (with contingent access for selection). Additionally, reinforcer assessments were conducted to assess validity of the results for both stimulus preference assessment (SPA) modalities. A secondary purpose was to assess prerequisite skills that may be necessary to perform accurately in an electronic-picture preference assessment. Overall, results suggest that the electronic-picture modality was effective for four of the five participants; however, two of the four participants required modifications to the reinforcer assessment procedure to reveal efficacy. Future research with more participants (including individuals with intellectual and developmental disabilities (IDD) is warranted.

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An Evaluation of an Electronic Picture-Based Multiple-Stimulus-Without-Replacement Preference Assessment

Reinforcers are critical for skill acquisition and behavior reduction for children with intellectual and developmental disorders (IDD). Identifying reinforcers using some type of preference assessment is a routine part of the assessment and treatment development process (Hagopian et al., 2004). Potential preferred stimuli are often identified via a stimulus preference assessments (SPA). An SPA refers to a variety of procedures used to determine (a) stimuli the individual prefers, (b) preference values of included stimuli, and (c) the conditions under which those preference values change when tasks, deprivation states, or schedules of reinforcement are altered (Cooper et al., 2020). Ultimately, the primary goal of SPAs is to identify stimuli that are most likely to function as reinforcers. Preferred stimuli may be identified from indirect or direct preference assessments. Indirect SPAs rely on caregiver or staff opinions via checklists or unstructured interviews (e.g., Fisher et al.,1996; Hagopian, 2004; Matson et al., 1999). In contrast, direct assessments systematically expose an individual to tangible stimuli briefly over multiple trials (e.g., Heinicke et al., 2019) allowing behavioral responses to the stimuli (e.g., approaches, selection, engagement) to be directly observed and measured.

Stimulus Preference Assessments

A variety of methods to assess preference have been described in the literature (Deleon & Iwata, 1996; Fisher et al., 1996; Pace et al., 1985). The basic arrangement of most methods is to provide access to food or leisure items contingent on an "approach" response, which requires the use of stimuli that can be delivered immediately. Four commonly used (and researched) methods include: free operant (e.g., Fehr et al., 1979), single stimulus (SS; Pace et al., 1985),

paired stimulus (PS; Fisher et al., 1992), and multiple stimulus (MS; DeLeon & Iwata, 1996; Windsor et al., 1994). Each method is associated with distinct advantages and disadvantages.

During a free-operant preference assessment, an individual can choose freely from multiple activities. Total duration of time an individual engages with each stimulus is recorded and ranked. Longer durations of item engagement suggest stronger preference (Cooper et al., 2020). Free-operant assessments are often chosen by clinicians because they may (a) be less time consuming (e.g., Roane et al., 1998), (b) result in less problem behavior because the items are not removed during the assessment, and (c) be easier for assessing large stimulus items (e.g., trampoline) as the items do not have to be removed for each trial. However, one disadvantage is that the assessment may not provide relative preference information (i.e., a preference hierarchy) if an individual engages with the same stimulus exclusively.

The SS assessment, described by Pace et al. (1985), involves presenting one item at a time and recording the individual's responses to the stimuli. An advantage is that it can be administered to individuals who have difficulties choosing from an array (e.g., scanning deficits). However, the primary disadvantages of this assessment are (a) it may produce a false positive, as individuals may approach every item presented, and (b) it does not allow for a hierarchy of preferred stimuli, as individuals may approach every item presented.

The PS preference assessment, described by Fisher et al. (1992), involves presenting two items simultaneously and all stimuli are presented with all other stimuli in the assessment. An advantage of this assessment is that it allows for detecting a preference hierarchy. However, the disadvantages of this assessment are (a) the more stimuli included, the longer it takes to conduct, and (b) when more than one item is presented at a time, there is a potential for side-bias to occur.

The MS assessment, described by Windsor et al. (1994), includes presenting three or more stimuli at a time. Three variations of this assessment consist of multiple stimulus with replacement (MSW), multiple stimulus without replacement (MSWO), and brief MSWO. The MSW includes each item replaced in the array following a selection. The MSWO differs in that, following the selection of an item, the stimuli are not replaced in the subsequent selection array. The primary advantage of the MSWO is that it allows detection of a preference hierarchy. However, a potential disadvantage of the MS and MSWO is that they require the pre-requisite skill of scanning an array. The advantages of the MSWO are that it (a) allows for a more detailed ranking hierarchy (i.e., high preferred, moderately preferred, low preferred) of items compared to the MS and (b) suggests that highly preferred (HP) items identified are likely to function as reinforcers (Brodhead, Al-Dubayan, et al., 2016; Kang et al., 2013). The primary disadvantage of the MSW is that it often more time-consuming than the MSWO.

DeLeon and Iwata (1996) used an adaptation of the MSWO to reduce the time it takes to conduct a SPA. The brief MSWO differs in that the stimuli are presented in three sessions instead of five sessions, which might be an optimal choice in early intensive behavioral intervention (EIBI), as conducting fewer sessions may allow reinforcers to be identified in a shorter amount of time. Research has demonstrated that the brief MSWO is often effective in identifying high-preferred items (e.g., DeLeon et al., 2001). Results from DeLeon and Iwata (1996) found that high-preferred items were identified in approximately half the time compared to a PS. The advantages of this assessment are that it (a) is more efficient to conduct than standard MSWO (e.g., Brodhead, Al-Dubayan, et al., 2016), (b) can be administered multiple assessments a day and, thereby, accommodate the fluctuations in preference, and (c) allows multiple choices to be presented which could prevent satiation of different stimuli throughout the

day (DeLeon et al., 2001). Additionally, the MSWO may require less time to conduct. To date, only one study has reported completion in approximately three minutes (Kang et al., 2010). There are two disadvantages of the brief MSWO. One disadvantage is that it may be impractical for the size of stimuli (e.g., large toys) and multiple arrays of items at once (e.g., Brodhead, Al-Dubayan et al., 2016). A second disadvantage is that one- and two-session MSWOs may be less reliable than three-sessions. Results from brief MSWOs utilizing either a one- or two- session MSWO may not consistently produce the same hierarchies as a three-session MSWO regarding the stimuli that are highest-preferred (Conine et al., 2021). Results from DeLeon et al. (2001) showed that an MSWO was effective when presented once. Conine et al. (2021) examined data from 157 MSWO SPA outcomes in previous research with 49 total participants and analyzed the extent to which a one- or two-session variation would have produced similar results as a three-session assessment. Rank-order correlation results from Conine et al. suggest that one- or two-sessions may yield similar results to a three-session MSWO, but with fewer sessions. However, results analyzing the extent to which each assessment format would have identified the same highest-preferred stimuli suggest that neither a one- nor a two-session MSWOs would have consistently identified the same high-preferred stimulus as the three-session (Conine et al., 2021). Nonetheless, results from Conine et al. suggest that if the goal of a preference assessment is to consistently identify the highest-preferred stimulus or stimuli to use as reinforcers, a three-session MSWO may be necessary.

Reinforcer Assessment

Systematic preference assessments (SPAs) identify stimuli potential reinforcers. However, a reinforcer assessment is required to validate the results of an SPA because the ultimate goal is to identify stimuli that will increase the future likelihood of a response when

delivered contingent upon the emission of that response. Researchers have evaluated whether relative preferences identified by SPAs predict relative reinforcer effectiveness using a variety of methodological arrangements.

Target Response

Researchers frequently have used simple (arbitrary), free-operant (repeatable) responses (e.g., button pressing, hand raising, etc.) to assess the effectiveness of SPA stimuli as reinforcers. Pace et al., (1985) evaluated the extent to which the highest- and lowest-ranked items from a single-stimulus presentation SPA functioned as reinforcers for simple behaviors (looking, raising hand, reaching) of adults with intellectual and developmental disabilities. Results showed higher percentages of correct responding for the high-preferred item relative to responding for low-preferred items and no-item (baseline). Saini, Retzlaff, Roane, and Piazza (2021) noted that using arbitrary, repeatable responses during reinforcer assessments is advantageous when the primary goal is preference assessment validation because individuals of various functioning levels can easily emit the response and discriminate the contingencies resulting in a time-efficient assessment. However, researchers have also used more complex, presumably more socially valid, responses during reinforcer assessments. For example, Paramore and Higbee (2005) validated the effects of brief MSWO preference assessments with three adolescent boys with emotional-behavior disorder. They used a multielement design to compare the effects of high-, moderately, and low-preferred stimuli on levels of on-task behavior in the participants' educational setting, defined as sitting appropriately at desk, working on assigned tasks, asking only task-related questions, and speaking only after raising their hand. Results showed highest levels of on-task behavior occurred in the high-preference item condition.

Reinforcement Schedule

Researchers have used concurrent schedules of reinforcement to assess the degree to which information about relative preference from SPAs correlate with reinforcement efficacy. A concurrent schedule is a procedure in which the participant can respond on one of two (or more) simple reinforcement schedules that are available simultaneously. For example, in the study by Fisher et al. (1992) that described the paired-choice presentation method of SPA, the authors used a concurrent schedule to compare the relative reinforcer efficacy of high-preference (HP) stimuli identified by the single-stimulus SPA to that of a paired-choice SPA. The advantage of using a concurrent schedule is that one can assess the relative strength of a reinforcer to that of other available reinforcers (Saini et al., 2021). However, Roscoe, Iwata, and Kahng (1999) compared single- and concurrent-schedule arrangements. Results showed that when both HP and low-preference (LP) stimuli were available concurrently, seven of the eight participants preferred the HP stimulus and when seven participants were exposed to only the LP stimulus, six of the seven participants showed similar rates of responding to the concurrent schedule. One limitation of a concurrent operant arrangement is that it may mask absolute reinforcement effects (Call et al., 2012; Francisco et al., 2008).

Response Effort

Previous research including a reinforcer assessment has been evaluated under different schedules of reinforcement such as fixed-ratio (e.g., Wolfe et al., 2018; Brodhead, Abel, et al., 2016), variable-ratio (e.g., Call et al., 2012; Clevenger & Graff, 2005; Groskreutz & Graff, 2009), and progressive ratio (e.g., Heinicke et al., 2016). Previous research suggests that stimuli that are similarly effective reinforcers under dense schedule requirements may be differentially effective reinforcers under leaner schedule requirements (e.g., DeLeon et al., 1997; Glover et al.,

2008; Roane et al., 2001). Additionally, several studies have used progressive ratio (PR) schedules to evaluate reinforcer efficacy (e.g., Call et al., 2012). Progressive ratio schedules of reinforcement involve an increasing response requirement for reinforcer delivery during or across sessions, which continues until responding ceases for a specified period of time. Roane, Lerman, and Vorndran (2001) used PR schedules to compare reinforcer efficacy of two stimuli that were both identified as HP from a paired-choice SPA. Results showed similar reinforcer efficacy under FR-schedule requirements; however, differential reinforcer efficacy was observed under PR-schedule requirements. As noted by Call et al. (2012), a potential benefit of reinforcer assessments using PR schedules is that it may be well suited for clinical settings when identifying stimuli to include as reinforcers for more effortful responses or responses to be reinforced on leaner schedules.

Alternative Modality SPAs

Various stimulus modalities have been evaluated to assess the reinforcing efficacy of protracted events and events that are difficult to present during an assessment, such as leisure activities (Heinicke et al., 2019). Unlike traditional SPA methods that use tangible items as the presentation stimuli and brief access to selected items, alternative modality SPA methods use alternate formats of the stimuli to be assessed. Researchers have evaluated the use of pictures (e.g., Higbee et al., 1999; Graff & Gibson, 2003; Northup et al., 1996; Nuernberger et al., 2012), vocal descriptions (e.g., Cohen-Almedia et al., 2000; Northup et al., 1996), videos (e.g., Clark et al., 2015; Huntington & Higbee, 2017; Snyder et al., 2012; Wolfe et al., 2018), and graphic-interchange-format images or GIFs (Morris & Vollmer, 2020). Alternative modalities may decrease the amount of time it takes to conduct SPAs, as practitioners do not have to wait for the individual to consume or engage with an item after selection before beginning the next trial

(Heinicke et al., 2019). Alternative modality SPA researchers have examined preferences for edibles (e.g., Clevenger & Graff, 2005; Graff & Gibson, 2003; Graff et al., 2006; Groskreutz & Graff, 2009; Heinicke et al., 2016; Schwartzman et al., 2003), tangibles (e.g., Brodhead et al., 2017; Clark et al., 2015; Snyder et al., 2012), activities (e.g., Hanley et al., 1999; Lee et al., 2008; Mechling & Moser, 2010; Parsons et al., 1997), and social interactions (e.g., Jerome & Sturmey, 2008, 2014; Kelly et al., 2014).

Pictures

Previous research has evaluated the efficacy of using a pictorial modality (e.g., Ardoin et al., 2004; Brodhead, Abel, et al., 2016; Clevenger & Graff, 2016; Conyers et al., 2002; Davis et al., 2010; de Vries et al., 2005; Graff & Gibson, 2003; Graff et al., 2006; Groskreutz & Graff, 2009; Hanley et al., 1999; Heinicke et al., 2016; Higbee et al., 1999; Jerome & Sturmey, 2008; Jerome & Sturmey, 2014; Kelly et al., 2014; Lee et al., 2008; Nguyen et al., 2009; Parsons et al., 1997; Reyer & Sturmey, 2006; Schwartzman et al., 2003). All but one study (i.e., Hanley et al., 1999) included validation of the pictorial modality by comparing the results to either a tangible SPA or a reinforcer assessment (RA; Heinicke et al., 2019) – inclusion of an RA is critical for determining whether the preferred stimuli identified function as a reinforcer.

There are numerous advantages to using pictures, including that they (a) may be more cost-effective (no need to buy foods to conduct assessment), (b) offer the representation of less manipulable items, (c) they may decrease assessment time despite being methodologically similar to tangible preference assessments (Clevenger & Graff, 2005; Groskreutz & Graff, 2009), and (d) may eliminate problem behavior during the assessment because the actual stimuli are not repeatedly removed.

Pictorial evaluations have varied on four procedures. The first variation is what validation benchmark(s) have been utilized. Most research has compared results of the preference assessment to a tangible SPAs (e.g., Clevenger & Graff, 2016; Conyers et al., 2002; Davis et al., 2010; de Vries et al., 2005; Graff & Gibson, 2003; Graff et al., 2006; Groskreutz & Graff, 2009; Higbee et al., 1999; Lee et al., 2014; Nguyen et al., 2009; Parsons et al., 1997; Reyer & Sturmey, 2006; Schwartzman et al., 2003) or to a RA. Comparing SPA results to tangibles reduces the likelihood that other variables (e.g., preference for the modality in which the video is displayed) are not controlling selections (Heinicke et al., 2019). To date, 70% of pictorial SPA evaluations have compared SPA results to a tangible assessment. In contrast, only 55% of previous studies tested whether highly preferred stimuli identified in a SPA function as a reinforcer with an RA inclusion.

The second variation of procedures has evaluated contingent reinforcer access. During contingent reinforcer access, access to the tangbile item is provided following selection (e.g., Brodhead, Abel et al., 2016; Clevenger & Graff, 2016; Conyers et al., 2002; de Vries et al., 2005; Graff & Gibson, 2003; Graff et al., 2006; Kelly et al., 2014; Lee et al., 2008; Nguyen et al., 2009; Parsons et al., 1997; Reyer & Sturmey, 2006; Schwartzman et al., 2003). During no reinforcer access, no access is provided following stimulus selection (e.g., Ardoin et al., 2004; Higbee et al., 1999; Jerome & Sturmey, 2008; Jerome & Sturmey, 2014). Studies evaluating contingent access vs. no access compared the results of SPAs when access is provided and when access is not provided (e.g., Davis et al., 2010; Groskreutz & Graff, 2009; Hanley et al., 1999; Heinicke et al., 2016). A total of 12 studies evaluating contingent access included a validation benchmark (i.e., comparison to tangible SPA or RA). Results were accurate for 54% of participants. In comparison, a total of four studies evaluating no access were accurate for 63%.

In addition, results from four studies comparing contingent access vs. no access found that the pictorial modality was more accurate when access was provided for 95% of participants, whereas results were accurate for 52% of participants when access was not provided (Davis et al., 2010; Groskreutz & Graff, 2009; Hanley et al., 1999; Heinicke et al., 2016).

A third variation of procedures is the type of SPA. Picture modality evaluations have primarily been conducted using a PS assessment. Two studies (Brodhead, Abel et al., 2016 & Higbee et al., 1999) have evaluated the use of pictorial modalities using an MSWO. Given the clinical relevance of selecting a preference assessment, the inclusion of an MSWO may require the fewest resources and least time while producing an accurate hierarchy of preferences (Morris & Vollmer, 2020). However, with only two studies varying in procedures, more research is necessary to determine whether MSWO results accurately identify HP stimuli.

A fourth variation of procedures is assessing pre-requisite skills. Pictorial modality pre-requisite assessments have assessed P-O/O-P matching (Brodhead, Abel, et al., 2016; Clevenger & Graff, 2005; Groskreutz & Graff, 2009; Heinicke et al., 2016; Nguyen et al., 2009), ABLA (Conyers et al., 2002; De Vries et al., 2005; Lee et al., 2008; Reyer & Sturmey, 2006; Schwartzman et al., 2003), tact repertoires (Higbee et al., 1999), pictorial mands (Heinicke et al., 2016), receptive identification (Ardoin et al., 2004), and Pearson Vineland Adaptive Behavior Scales (Vineland-II; Kelly et al., 2014). Results for P-O/O-P matching skills identified concordance with the accuracy of the pictorial modality in 68% across six studies. ABLA assessments were evaluated across five studies and found concordance in 75%. Pictorial mands were evaluated in one study and had concordance in 9 of the 13 (69%) evaluations (Heinicke et al., 2019). Tact repertoires were assessed in one study; however, correct tasks were not predictive of accuracy for any participants. Results for both receptive identification and Pearson

Vineland Adaptive Behavior Scales were unclear. However, only two pre-requisite discrimination skills (P-O/O-P and ABLA) have been evaluated in three or more studies and appear to have concordance with P-O/O-P and ABLA (Heinicke et al., 2019).

Videos

Although pictorial preference assessments may be accurate for some individuals, video-based preference assessments (VPAs) can provide a more detailed depiction of the stimuli to be assessed (e.g., going to the park, social interactions) as compared to pictures of those stimuli. Therefore, some researchers have examined the use of video clips in preference assessments (e.g., Brodhead et al., 2017; Wolfe et al., 2018). VPAs have evaluated preferences for activities, toys, or job tasks (e.g., Brodhead et al., 2017; Brodhead, Al-Dubayan, et al., 2016; Chelbi & Lanovas, 2016; Clark et al., 2015; Lee et al., 2008; Mechling & Moser, 2010; Snyder et al., 2012).

Similar to pictorial evaluations, VPAs have varied on four procedures. For instance, studies have varied on whether SPA results are compared to a tangible and/or conducted an RA to test the high-preferred stimuli identified. Thus far, approximately 46% of VPA research has compared SPA results to a tangible and conducted an RA. However, three studies did not compare the results to either a tangible SPA or an RA (Brodhead et al., 2017; Mechling & Moser, 2010), making it difficult to conclude whether the video modality was accurate in identifying reinforcers.

The second variation of procedures is whether contingent access was provided following selection. Research thus far, suggests that VPAs may produce similar results to tangible preference assessments when access is provided (e.g., Chelbi & Lanovas, 2016; Curiel & Curiel, 2019; Snyder et al., 2012) and when access is not provided (e.g., Brodhead et al., 2019; Clark et

al., 2015; Horrocks & Morgan, 2009). Six studies evaluating contingent access included a validation benchmark and found that results were accurate for approximately 74% of participants. In contrast, four studies evaluating no access produced accurate results for approximately 94% of participants. Two studies examined contingent vs. no access and found accurate results for approximately 66% for both access and no access. However, there is less research on video modality SPAs; therefore, more research is needed, given the limited number of participants to determine the generality of access vs. no access (Heinicke et al., 2019).

A third variation on procedures is the SPA used. A total of nine studies have evaluated stimuli using a PS, five studies included an MSWO, and one study used an MSW. Research should continue to evaluate preferences using more SPAs. Similar to the pictorial modality, more research using an MSWO is critical, as the inclusion of an MSWO may require the fewest resources and least time while producing an accurate hierarchy of preferences (Morris & Vollmer, 2020).

A fourth variation is the pre-requisite skills assessed. Video modality pre-requisite assessments including a validation benchmark have assessed video-to-object- (V-O) and object-to-video- (O-V) matching/ activity matching (Brodhead et al., 2019; Clark et al., 2016; Morris & Vollmer, 2020; Snyder et al., 2012; Wolfe et al., 2018), P-O/O-P (Brodhead, Al-Dubayan, et al., 2016; Morris & Vollmer, 2020), ABLA scores (Lee et al., 2011), clinical data (Brodhead & Rispoli, 2017). Results for V-O/O-V matching skills identified concordance with the accuracy of the VPA modality in approximately 75% (n=18) across five studies that included a validation benchmark. Two studies evaluating P-O/O-P matching skills found concordance in approximately 87.5% (n=8). One study evaluating ABLA scores was unclear, given that the two participants scoring at Level 4 of the ABLA had mixed results. Results for IQ tests, adaptive

behavior, and clinical data have been evaluated in one study, but the relationship between the results of the VPA modality was not clear. O-V/V-O is the only pre-requisite discrimination skill that has been assessed in three or more studies and appears to have concordance with the accuracy of the VPA alternative modality (Heinicke et al., 2019). Further research is necessary for evaluating the role of assessing P-O/O-P, V-O/O-P, and ABLA skills. Previous research indicates ABLA results may be a more accurate predictor of an individual's performance on everyday tasks than global measures of intellectual ability (e.g., standardized tests; Schwartzman et al., 2009). For alternative modalities, the ABLA may be beneficial for researchers as the skills needed are directly related to the skills necessary for different modalities. Given high concordance in the pictorial modality, VPA research should continue to evaluate ABLA scores' role and predict an individual's performance. However, with VPA evaluating different variables, more research is necessary to determine whether contingent access is necessary.

Electronic Pictures

Despite the advantages of video-based assessments, one limitation is that creating videos may be time-consuming. Wolf et al. (2018) noted that editing videos for each participant took an average of 1.5 hour. Therefore, graphic-interchange-format images (GIFs) may be a more practical option for video-based preference assessments. Morris and Vollmer (2020) noted that. GIFs may be advantageous because they (a) automatically play short video clips "on loop", (b) do not produce sound (which may be practical when stimuli are presented concurrently in SPAs), and (c) can be made quickly and are easily accessible among several applications for smartphones and tablets. Morris and Vollmer compared electronic-pictures and GIFs using an SPA. Prior to the SPA, a pre-assessment tested whether participants could match pictures and GIFs of actions or social interactions to in-vivo actions or social interactions. Participants

included in the study responded correctly in less than 45% of trials across sessions. Preference assessments were conducted using a PSPA to identify preferred social interactions. Selection of either GIF resulted in access to the social interaction (e.g., tickles, dancing, high five). Results for the GIF-based preference assessment found similar hierarchies to the reinforcer assessment for all participants, whereas the picture-based preference assessment found similar hierarchies to the reinforcer assessment for two of the four participants. Results from a modality preference assessment indicated that three of the four participants preferred GIFs over pictures. Future research should evaluate the efficacy of GIFs without access.

Brodhead, Abel, et al. (2016) compared the results of an electronic-picture MSWO preference assessment to a tangible MSWO in five children with autism. Both SPAs identified a match between high-preferred toys for four of five participants and low-preferred toys for three participants. A reinforcer assessment was conducted with three participants, and all high preferred toys identified in the electronic picture MSWO functioned as reinforcers. Given the increased use of tablet-mediated interventions in our field (e.g., inclusion of tablets to use as potential reinforcer), it is likely that practitioners will also increase their use of technology to assess their client's preferences (Heinicke et al., 2019). Additionally, the use of electronic-pictorial preference assessments may be more favorable compared to the standard MSWO, such that it takes less time to conduct in relation to other SPAs (i.e., PS).

Discrimination Assessments

Preference assessment effectiveness relies on both the presentation modality (i.e., picture, video, tangible item) of the stimuli and the discrimination skills of the individual being assessed (Lee et al., 2008). Parsons et al. (1997) was the first study to test the utility of an alternative-modality SPA using the pictorial modality with individuals with IDD (Heinicke et al., 2019).

Following this study, researchers began to examine the role of pre-requisite and standardized assessments in the accuracy of alternative modality SPAs. That is, studies have included participants with certain pre-requisite skills, including picture-to-object (P-O) and object-to-picture (O-P, e.g., Clevenger & Graff, 2005; Graff & Gibson, 2003; Heinicke et al., 2016), Assessment of Basic Learning Abilities (ABLA; e.g., Heinicke et al., 2013; Conyers et al., 2002), video-activity matching (e.g., Brodhead, Al-Dubayan et al., 2016), video-to-object identification (Clark et al., 2015), Pearson Vineland Adaptive Behavior Scales (Vineland-II; Kelly et al., 2014), and skills from clinical data (Brodhead & Rispoli, 2017). Previous research has included participants (a) that are unable to match (e.g., Morris & Vollmer, 2020), (b) with- and without- matching P-O/O-P matching skills (e.g., Clevenger & Graff, 2005; Heinicke et al., 2016), and (c) with various discrimination skills identified from the ABLA (e.g., Conyers et al., 2002; De Vries et al., 2005; Lee et al., 2008; Michalyshyn, et al., 2016; Murphy et al., 2014; Schwartzman et al., 2009).

The ABLA, developed by Kerr et al. (1977), uses standard prompting and reinforcement procedures to assess an individual's strengths and weaknesses in learning the motor, visual, and auditory discriminations necessary to perform the task. The ABLA test consists of six hierarchy levels presented in a specific order to assess an individual's abilities at each level. ABLA levels include (1) imitation, (2) position discrimination, (3) visual discrimination, (4) visual identity match-to-sample discrimination, (5) visual non-identity match-to-sample discrimination, and (6) auditory-visual combined discrimination.

Previous research on the ABLA has demonstrated that most individuals who pass a specific level also pass the lower levels of the hierarchy (e.g., Kerr et al., 1977; Martin et al., 2008). Kerr et al. (1977) examined ABLA results for 117 individuals. Approximately 95% of the

participants with developmental disabilities followed the expected pattern of passing all levels below the highest level passed, and failed levels above the first level failed. A statistical method of order analysis (Krus et al., 1975) revealed that the probability the results happened by chance is less than .01. Similar, Martin et al. (1983) found that for 135 individuals with developmental disabilities, 98.5% followed the expected pattern. Further, research has demonstrated the ABLA has high test-retest and intertester reliability (Vause et al., 2007). Martin et al. (1983) re-tested 42 individuals with IDD 3 months later and there were no changes in levels passed from the initial test.

Previous research indicates the ABLA often accurately provides information on what discrimination skills are present; thus, allowing clinicians to identify what skills should be targeted (Vause et al., 2007). For example, Vause and colleagues (2007) evaluated the use of ABLA discrimination skills to predict whether tangible, pictorial, or spoken stimuli should be included in preference assessments. Generally, ABLA results suggest that for individuals who passed up to (a) Level 3, selected their preferred stimuli consistently with tangibles but not with pictorial or spoken stimuli, (b) Level 4, selected their preferred stimuli consistently with both tangibles and pictorial stimuli, but not with spoken stimuli, and (c) Level 6, consistently selected their preferred stimuli in all three modalities (Vause et al., 2007). However, the types of pre-requisite skill and standardized assessments have varied widely across studies. In addition, only a limited number of studies have demonstrated that the skills evaluated were associated with the accuracy of certain modalities (Heinicke et al., 2019). Given that recent studies have begun to evaluate additional alternative modalities (e.g., GIFs and videos), more research including discrimination assessments is necessary to determine what prerequisite skills are required for certain modalities.

Purpose

The purpose of this study was to evaluate the utility of an alternative-modality SPA (electronic-picture MSWO) that included comparison with both a tangible MSWO and a reinforcer assessment as validation benchmarks. A secondary purpose was to assess prerequisite skills that may be necessary to perform accurately in an electronic-picture MSWO by conducting a discrimination assessment (i.e., ABLA-R) prior to the SPA evaluation.

Method

Participants and Setting

Participants included four young children with no-known-diagnoses enrolled in one of two child development programs affiliated with a midwestern University. Participants included Libby (2 years), Thomas (2 years), Maddy (2 years), Ellen (3.5 years), and Riley (3.5 years). Children were selected based on parental consent and regular attendance (e.g., approximately less than one absence per month) as reported by classroom teachers. There were no pre-requisite skills required to participate in the study; however, children with dietary restrictions (e.g., gluten allergy, vegan, vegetarian, peanut allergy, etc) were excluded unless their restrictions could be accommodated and were approved by the parent.

All sessions were conducted in participants' classrooms or adjacent session rooms in areas that contained child-sized furniture (chairs and table) and minimal distractions. Classroom teachers, supervisors (graduate students), or research assistants, all of whom were familiar to the participant, served as therapists and conducted sessions. Classroom teachers, supervisors (graduate students), or research assistants, all of whom were familiar to the participant, served as therapists and conducted sessions; However, due to COVID-19, only vaccinated graduate

students conducted sessions. Data collection for sessions was done remotely (and recorded) or in an adjacent room equipped with a one-way window.

Therapists were trained to implement procedures prior to conducting sessions. Prior to all sessions, the therapist obtained assent from the participants. If a participant refused, the session was either canceled or delayed 30 minutes.

Materials

Materials for the ABLA included a yellow can, red box, small piece of foam, yellow wooden cylinder, small red cube, silver colored piece of wood shaped into capital letters spelling the word BOX, and a purple piece of wood shaped into the upper- and lower-case word spelling the word can.

A total of six edible stimuli were included in the preference assessment for each participant. The specific stimuli used for each participant during preference assessments are indicated by the x-axis labels in the preference assessment figures. Additionally, preference assessment sessions required an iPad (iPad mini 4 series) to conduct the electronic SPA, paper plates or plastic cups in which to deliver the edible items, and electronic pictures of the edible items to be assessed. Pictures were uploaded to a file in the application Keynote and sized to 250 x 250 pixels to enhance visibility. Similar to Brodhead, Al-Dubayan et al. (2016), pictures were arranged in two rows (2 x 3).

Materials for the reinforcer assessment included the highest and lowest preferred edible items identified via the preceding preference assessments, a paper plate or plastic cup in which to deliver the edible items, pictures of edibles associated with the response options during the reinforcer assessment, materials necessary to complete age-appropriate arbitrary responses tailored to the individual participants (i.e., card sorting and button press), and four tally counters.

Materials for data collection included paper and pencil to collect data for preference assessments (See Appendix A), two Microsoft laptops with the application BDataPro™ (Bullock et al., 2017) to collect data, one iPod touch to record sessions, and three tally counters for the therapist to track completed PR-schedules during the reinforcer assessment.

Pre-Experimental Assessments

Stimulus Identification

Research assistants asked classroom teachers familiar with the participants and/or caregivers to list and rank each participant's favorite foods using the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD) structured interview (Fisher et al., 1996). Six edible stimuli were chosen for subsequent use in the study. Additionally, these informants were asked to identify one to two preferred tangible items. Finally, these informants were asked to identify each participant's least preferred (LP) foods. Non-preference for one of these foods was directly assessed prior to the start of the study (see Stimulus Avoidance Assessment section below). Following the stimulus avoidance assessment, pictures of the identified LP and preferred edibles were taken with a smartphone and uploaded to Keynote.

Pre-requisite Skills Assessment

The Assessment of Basic Learning Abilities Revised (ABLA-R) described by DeWiele et al. (2011) was administered to participants prior to the study. Unless stated, the procedures used to conduct the ABLA-R were identical to the procedures described in the self-instruction manual for administering the ABLA-R (DeWiele et al.). Table 1 displays a description of the discrimination skills assessed in each level of the ABLA-R. For purposes of the current study, Levels 3, 4, and 6 were of primary interest as the skills likely to predict the relative efficacy of the three most common presentation modes for assessing preference (objects, photos, and spoken

words; Heinicke et al., 2019). In a review of the ABLA for predicting learning of persons with intellectual disabilities, Martin et al. (2008) reported that individuals who successfully completed ABLA Level 6 would be able to make consistent choices during preference assessments involving an object, pictorial, and vocal-verbal presentation modalities. Therefore, given that previous research demonstrated approximately 95% of participants followed the expected pattern of passing all levels below the highest level passed, and failed levels above the first level failed, in attempt to maximize assessment efficiency, the six ABLA levels were assessed in descending order, beginning with Level 6 and systematically assessing lower levels in the event that a participant was unable to demonstrate mastery on a preceding level (Kerr et al., 1977).

Stimulus Avoidance Assessment

To ensure that the LP edible identified by the child's teacher/parent was a non-preferred item, a Stimulus Avoidance Assessment was conducted similar to the single-stimulus presentation method described by Pace et al. (1985). The session consisted of 10 trials during which the 2 identified low-preference edibles were presented five times each, in a counterbalanced order. Prior to the session, participants had the opportunity to sample the available edible items. During each trial, one edible item was presented for 5 s. An approach response was followed immediately by access to the edible. If no approach response was made within 5 s of item presentation, the item was removed, and the trial ended. The item selected on fewer than 2 trials was selected as the non-preferred item for use in the study.

Response Measurement and Reliability

Response Measurement

During the ABLA-R assessment, data collection was conducted until the participant independently completed a correct response (i.e., test trials were not scored). During all levels,

correct responses were scored if a participant completed the correct response within 5s of the therapist's instruction. Similarly, during all levels, an incorrect response was scored if the participant did not correctly complete the therapist's instruction within 5s. For Level 6, *correct responses* were defined as a participant independently placing the foam into the requested container. For Level 5, *correct responses* were defined as the participant correctly placing the "BOX" in the box or the "Can" in the can. For Level 4, *correct responses* were defined as the participant correctly placing the cube in the box or the cylinder in the can. For Level 3, *correct responses* were defined as the participant correctly placing the foam in the can. For Level 2, *correct responses* were defined as any instance a participant placed the foam in the can on the right. For Level 1, *correct responses* were defined as the participant placing the piece of foam in the yellow can following the therapist's instruction and model.

During preference assessments, *selection* was defined as any instance when the participant touched the picture or edible item with his/her finger or vocally stated the name of one edible item. Attempts to touch more than one stimulus at a time were not counted as selection, and the therapist blocked the response, removed, and represented the stimuli and told the participant to "pick one". *Consumption* was defined as the participant consuming the chosen edible. *Approach* of an item following selection was defined as the participant selecting a stimulus but did not attempt to consume the edible. *No selection* was defined as the participant refusing to select a stimulus or vocally/physically removing the stimulus from the array within 5 s elapsing from the experimenter's instruction to "pick one". If a participant did not select a stimulus within 5 s, the therapist repeated the instruction two more times. If no selection was made after three instructions, the therapist removed the remaining stimuli, and the session ended.

Avoidance was defined as the participant verbally (i.e., "no") and/or physically (i.e., physically pushing the stimuli away) refusing a stimulus.

The child's therapist circled the position of the selected stimuli in the order in which the participant selected each edible or picture for each MSWO assessment. Trained data collectors recorded the duration of each assessment using the video from each session. Session time began when the first stimulus was presented during pre-session exposure and concluded when either (a) the last stimuli was selected, (b) the last edible was consumed, or (c) no stimulus was selected after three verbal prompts. Sessions that included access to the edible item(s) ended after the participant finished consuming the last edible item (Libby and Maddy). Following completion of the third pair of MSWOs, edibles were ranked from 1 (HP) to 6 (LP) based on the sum of lowest to highest number of trials each edible was available for selection. Edibles with identical sums were equally ranked. Data were converted to ranks based on selection. That is, selection did not include instances of no selection or avoidance. Data were analyzed for each stimulus in the array as a rank. Rank order data was then used to calculated Kendall's Tau to further examine the results of the SPA modalities. Kendall's Tau correlation was calculated for each session block by comparing the E-pic results to the MSWO. The rank order Kendall's Tau correlation evaluates the similarity of the ranks between two groups.

Data collection during reinforcer assessments were collected by an observer using the data collection application Countee. During the reinforcer assessment, trained observers recorded the frequency of *task completion,* which was defined as any instance in which the participant completed the assigned academic task (e.g., participant used any part of their hand to depress the button until it made an audible "beep"). Instances in which the participant attempted and/or successfully completed more than one task at a time (e.g., pressing two buttons at the same time)

were not scored as task completion. Additionally, data were collected on session duration. Session time began after the therapist provided pre-session exposure to each of the contingencies and vocally stated the contingencies for each of the tasks. Sessions concluded after either (a) 5-mins elapsed, (b) the child vocally stated or signed they wanted to be all done, or (c) the participant did not engage in the academic task for 1 min.

Interobserver Agreement

Reliability of the measurement systems described above was assessed by having two observers simultaneously, but independently, collect data on at least 33% of all conditions (i.e., ABLA-R, stimulus avoidance assessment, preference assessments, and reinforcer assessment). Agreements for the ABLA-R were defined as any instance in which the primary and secondary data collector scored the same response (correct or incorrect) for the same trial. IOA was calculated by dividing the total number of agreements for each trial divided by the sum of agreements and disagreements and were multiplied by 100% to obtain a percentage. IOA for ABLA-R was 100% for all participants.

Agreements for the MSWO assessments were defined as any instance in which the primary and secondary data collector recorded the same item as selected for the same trial. Interobserver agreement (IOA) was calculated by dividing the total number of agreements for each assessment by the sum of agreements and disagreements and were multiplied by 100% to obtain a percentage. IOA was 100% for all behaviors (i.e., selection, avoidance, no choice, and expulsion).

During reinforcer assessments, IOA was collected on child (task completion and request to terminate session) and therapist behaviors (reinforcer delivery). IOA was calculated using the partial agreement within intervals method (Mudford et al., 2009) for task completion and

reinforcer delivery. IOA was calculated by dividing each session into 10-s intervals and dividing the smaller number of recorded responses for each interval by the larger number of recorded responses and were multiplied by 100% to obtain a percentage. Then, percentages obtained for each interval were averaged together. Mean IOA for task completion was 93.71% (range, 93.71% – 100%) for Libby, 96.43% (range, 94.01% – 100%) for Thomas, 97.82% (range, 95.06% – 97.33%) for Maddy, 97.82% (range, 93.00% – 100%) for Ellen, and was 95.94 (range, 83.87% – 100%) for Riley. Mean IOA for reinforcer delivery was 96.88% for Libby, 96.43 % for Thomas, 100% for Maddy, 97.80% for Ellen, and 96.29% for Riley.

Graduate and undergraduate students collected data on the application Countee using smartphones (application available in apple store and play store). Data collectors completed training that consisted of observing six videos that increased in difficulty of data collection. Criterion to advance to the next video consisted of scoring each video with at least 90% integrity for each response. Additionally, data collectors practiced scoring RA sessions prior to data collection, until a 90% criterion was scored for each response.

Procedures

Pre-requisite Skills Assessment

During the assessment, a therapist was seated across the table from the participant. Six different levels (i.e., tasks) were tested. See Appendix B and C for summary guidelines for each level (e.g., containers and position, test object presented, verbal prompt or question, and correct response). Prior to each test, the therapist followed a three-step prompt sequence to introduce, practice (i.e., model), and allow an independent opportunity to complete the task. Specifically, the therapist demonstrated the required response (e.g., stated, “when I say, ‘where does it go? It goes in here’ and modeled the correct response), provided a guided-practice trial (e.g., stated,

"let's try together… where does it go?" and guided the participant to complete the task correctly), and provided an opportunity for the participant to complete the instruction independently by stating, "Now you try." No data were collected. Subsequently, trials were conducted during which the therapist asked the participant to complete the task. *Correct responses* resulted in reinforcement consisting of verbal praise and a small edible. Edibles delivered during the ABLA were not included in the MSWO or RA. Procedures differed from DeWiele et al. (2011) such that a preferred toy was not delivered with an edible. DeWiele et al. delivered a preferred edible with access to a preferred tangible for 30s. The rationale for this decision attempted to reduce the amount of time it took to conduct the ABLA. *Incorrect responses* (or no response within 5 s) resulted in an error-correction procedure, in which the therapist used full-physical guidance to prompt the participant to complete the task correctly. Trials at a given level continued until the participant demonstrated eight consecutive, independent correct responses (not including correct responses during error correction) or was unsuccessful on eight cumulative trials. Following eight consecutive correct or eight cumulative incorrect responses (whichever happened first), tested ended for the level and the participant was exposed to the next Level (if applicable). That is, with conducting the ABLA backward, the next level was tested if the participant failed the level tested. For example, if a participant failed level 6, level 5 was assessed, and the process continued until a participant passed a level. Procedures for the initial prompting sequence were identical across all Levels. See Appendix D for datasheets associated with each level. For Levels 2-6, the location of the objects was identical to the positioning denoted on the datasheet (alternated left-right position).

Level 6 (auditory-visual discrimination), the therapist assessed the participant's ability to hear one of two auditory cues ("red box" or "yellow can"), then look for the right-left (randomly

alternated) positions of the containers and place the foam in the container named. Therapist instruction differed from previous levels in that instead of asking "where does it go?", the therapist's verbal prompt consisted of saying either "yellow can" or "red box". Test trials for the yellow can were conducted first. Following the demonstration, guided trial, and opportunity for an independent response, the therapist repeated the test trial steps with the verbal prompt "red can". During Level 6, the auditory prompt differed in that the therapist said yellow can as "y-e-l-l-o-w…c-a-n" slowly, using a low-pitched voice. In contrast, red box was stated quickly in a high-pitched voice. The purpose of differing the verbal prompt sounds was to determine if the participant could discriminate between two different sounds. If a participant attempted to place the foam in either container before completing the verbal prompt, the response was not scored, and the therapist removed the foam from the container and held onto it, re-stated the entire verbal prompt, and handed the foam to the participant. Similar to Levels 2-5, the positions of the container randomly alternated.

Testing for Level 5 (visual non-identity match-to-sample discrimination) is similar to Level 4, with the exception that instead of the yellow cylinder and red cube a (a) silver piece of wood that spelled *BOX* and (b) a purple piece of wood spelling *Can* was presented. The initial prompting sequence consisted of the therapist placing the box and can in front of the participant and demonstrated completing the task using the *Can.* That is, the therapist said, "when I say, 'where does it go'?... it goes here," while demonstrating placing the *Can* into the can. Identical to previous levels, the therapist conducted a guided trial and then allowed a correct independent correct response. Following a correct independent response, the therapist repeated the process with the silver wood that spelled *BOX* and the big box. Following a correct independent response for *BOX* and *Can*, testing continued until either meeting the pass or fail criterion.

Testing for Level 4 (visual identity match-to-sample discrimination) assessed whether a participant could learn to consistently place the red cube in the red box, and the yellow cylinder in the yellow can. During the demonstration, the therapist started with the cylinder and presented a verbal instruction (e.g., "when I say, 'where does it go'?.. It goes in here," while demonstrating placing the cylinder in the can). Following a correct independent response, the therapist first re-presented the demonstration using the red cube and red box, conducted the guiding trial, and then provided the opportunity for an independent response. After the participant correctly responded for both trials, scoring began. The placement of the box and can alternated after each trial.

Testing for Level 3 (visual discrimination) was similar to Level 2, with the exception that during Level 3, the container's location alternated left-right positions across trials. The first trial consisted of the can on the left and the box on the right. The purpose of Level 2 was to test for two-choice visual discrimination in that the student must visually locate the position of the can and place the foam in it.

Testing for Level 2 (position discrimination) consisted of the therapist placing both containers (i.e., red box and yellow can) and the foam in front of the participant in fixed locations across trials. That is, for all trials the box was positioned on left and the can was positioned on the right. Procedures for the test trial (three-step prompting) was identical to Level 1, with the exception that the therapist modeled placing the foam into the can. For testing Levels 2-6, an error was defined as the participant placing an object into an incorrect container.

Testing for Level 1 (imitation) skills consisted of a simple motor response and testing immediately began following a correct independent response. During level 1, the therapist placed the red box and piece of foam in front of the participant and provided the verbal cue, "when I say, 'where does it go'… it goes in here." On each scoring response (i.e., trial), the therapist

repeated the verbal cue and modeled the correct response. If the participant did not complete the task within 10s, the therapist repeated the instruction. A *correct response* was defined as the participant placing/dropping the object in the correct container. An *incorrect response* was defined as the participant placing/dropping the object anywhere other than the container. However, following three repeated instructions to complete the task, the therapist began error correction. The criterion for passing Level 1 consisted of 8 consecutive correct trials (4 correct with the red box, followed by 4 with the yellow can). Following four consecutive correct responses with the red box, the therapist removed the red box, placed the yellow can on the table, and repeated scoring trials with the yellow can. That is, the prompting sequence was not repeated with the yellow can. If the participant made an error during a trial with the yellow can, the therapist removed the can, and presented the red box and repeated the process until the participant met the pass criterion or fail criterion (8 cumulative incorrect responses). Remaining levels (2-6) consisted of two-choice position, visual, and auditory discriminations.

Preference Assessment Modality Comparison

Session blocks were conducted with participants 1-4 times per week. Each session block consisted of a preference assessment modality comparison immediately followed by a reinforcer assessment using the items identified as high- and low-preference by the MSWOs from the same day. During each session block, the results of an MSWO using pictures of edible stimuli presented electronically (E-Pic-MSWO) was compared to the use of the traditional, edible MSWO format. We will refer to the edible MSWO as Edible MSWO and the electronic pictorial MSWO as E-pic. Specifically, three pairs of E-Pic-MSWO and MSWO assessments were conducted. Each pair consisted of one six-item, six-trial E-Pic-MSWO (no access) and one six-item, six-trial MWSO (access) assessment. The same six stimuli were used for both modalities.

A random number generator determined the order of assessment within each pair. Following the completion of each preference assessment modality session block, a reinforcer assessment was conducted to determine whether the edibles identified functioned as reinforcers (see Reinforcer Assessment below).

Following the completion of each preference assessment session block, stimuli were ranked from 1 (HP) to 6 (LP) based on the sum of the lowest to highest number of trials each stimulus was available for selection (Brodhead, Al-Dubayan, et al., 2016). For example, if broccoli was chosen on the first, second, and first trial, a score of four was denoted for the assessment block. If pretzels were chosen on the second, third, and third trial, it resulted in a score of eight. Broccoli would then be ranked as more highly preferred than the pretzel. If two edible stimuli were equally ranked as the highest-selected edible (most preferred) in the same PA modality, an additional session (i.e., one pair) was conducted for both modalities. The rationale for conducting both assessments was to ensure participants had equal exposure to both modalities. The rank-order was used to determine the HP edible(s) and LP edible(s) to be included in the reinforcer assessment.

Additionally, rank data was used to identify any matches for HP and LP stimuli. That is, stimuli were counted as a match if both modalities resulted in an equal rank. The purpose of this was to provide a secondary measure to the extent to which both SPA modalities accurately identified HP and LP edibles (Brodhead, Al-Dubayan et al., 2016). Last, statistical tests were calculated to supplement visual analysis. Using rank-ordered preference assessment data, Kendall's Tau correlation coefficient was calculated for each participant. The purpose of Kendall's Tau was to examine correlations between the E-Pic and MSWO preference assessment results. The coefficient returns a value of +1 and -1, where 0 indicates no relationship and 1

indicates a perfect relationship. A value of -1 indicates the groups are exactly reversed (Groskreutz & Graff, 2009). Correlations can be interpreted as extremely weak (less than .10), weak (.10 to .19), moderate (.20 to .29), and strong (.30-1; Botsch, 2011). A p-value of <.05 indicates that the results are statistically significant.

Electronic-Picture Multiple-Stimulus-Without-Replacement (E-Pic MSWO)

The purpose of this condition was to assess whether results produced similar rankings as the edible preference assessment using the electronic presentation of pictures of the stimuli. Prior to each assessment, the researcher briefly exposed participants to the edibles by presenting all pictures individually on the iPad and stated the name of the edible (without providing the edible). Subsequently, the E-Pic MSWO started when the researcher presented all six pictorial stimuli (3 x 2) using Keynote on an iPad and vocally prompted the participant to select one stimulus (e.g., "pick your favorite"). The instruction was repeated if the participant did not make a selection within 5 s. After the selection, the therapist deleted the picture from the array, and the remaining pictures were re-arranged in a quasi-random order (3 x 2) for the second trial. This process continued as the participant selected stimuli on the third (2 x 2), fourth (2 x 1), fifth (2 x 1), and sixth trial (one picture). The assessment ended after the participant selected all six stimuli or made no selection on a given trial after the therapist provided a second prompt to pick.

Edible-Multiple-Stimulus-Without-Replacement (MSWO)

The purpose of the Edible MSWO with access condition was to serve as a comparison to the E-Pic-MSWO modality, to examine whether different SPA modalities produced similar results (i.e., edible stimuli vs. E-Pics of edible). The Edible MSWO was conducted in a similar manner to the E-Pic-MSWO with access except (a) the participant was given access to consume the selected edible and (b) the edible stimuli were presented in one row. Similar to the E-Pic

MSWO, the researcher briefly exposed participants to the edibles by presenting each edible individually and stated the name of the edible and provided access to consume the edible (for first round of Edible MSWO only). Edible MSWO sessions started when the researcher presented all six edibles and prompted the participant to select an edible. The instruction was repeated if the participant did not make a selection within 5s. After selection, the remaining edibles were re-arranged in the row and the process continued until the participant (a) selected and consumed all six stimuli, or (b) did not select an edible after the vocal prompt.

Reinforcer Assessment

The purpose of the reinforcer assessment (RA) was to evaluate whether the edibles from the E-Pic-MSWO (no access) and Edible MSWO (with access) functioned as reinforcers. The RA was conducted within a day following completion of the preference assessment. The RA consisted of a concurrent operant experimental design. The concurrent schedules arrangement consisted of three- or four- response options. The simultaneously available response options were identical tasks, however each option was correlated with distinct stimuli (e.g., color) to facilitate discrimination. On days in which participant's MSWO identified the same HP edible, three response options were available (HP edible, LP edible, and control [no edible]). On days in which participant's MSWO identified two different HP edibles from each modality, four response options were included (HP E-Pic, HP Edible, LP, and control). Contingent upon successfully completing the PR schedule, the corresponding edible was delivered (except for the control task).

Session duration was a maximum of five minutes. Sessions ended if either (a) five min elapsed, (b) the participant indicated they wanted to be all done (vocally or sign-language), (c) the participant did not engage in the academic task for one min, or (d) the participant met the PR

schedule for a given task. Tasks selected were in the participant's repertoire (as reported by the participants' classroom teachers) and were free-operant tasks that participants could complete easily (e.g., button press, card sorting). Simple, free-operant tasks were selected because the primary purpose of the reinforcer assessment was to quickly assess the predictive validity of the e-pic MSWO preference assessment.

During pre-session exposure, participants were not required to consume the edible. For any instances in which the participant did complete the task following the therapist's instruction, three-step prompting was used. Three-step prompting consisted of the verbal instruction model, and physical. For example, during a three-concurrent operant arrangement, the therapists' instruction included, "press the blue button to earn an M&M," while pointing to the HP task; "press the red button to earn broccoli," while pointing to the LP; "press the green button but you won't get any food. You can stop at any time," while pointing to the control task.

The location of each task changed between each session. That is, prior to each session, the task location and consequence associated with each task were randomly assigned. To aid in discriminations between the different consequences, an edible associated with each task (excluding the control task), was placed on a small paper plate behind the academic task.

There were no programmed consequences for completing the progressive ratio (PR) schedule for the control task. Reinforcers (edibles) for the HP and LP task were delivered on a PR arithmetic (step size of one) follows: PR 1, 1, 2, 2, 4, 4, 6, 6, 8, 8, 10, 10 (similar to Roane et al., 2001). Similar to Roane et al. (2001), this PR schedule was developed in attempt to progress rapidly enough to reveal a difference in relative response rates. To prevent ratio strain, PR schedules include two exposures to each ratio requirements. For all conditions, the PR requirement increased individually for each task. The PR schedule was reset prior to each

session. A minimum of three RA sessions was conducted each day. A brief break between sessions (approximately 5 mins) was provided.

At least five session blocks were conducted for each participant. Additional sessions blocks were conducted for participants whose MSWO and RA results did not show clear differentiation or if edibles identified as HP in both MSWO modalities was not consistent.

Treatment Integrity

A second observer collected treatment integrity data for at least 33% of all sessions to evaluate the extent to which each preference assessment was accurately implemented. Treatment integrity data for the MSWO and reinforcer assessment were completed using a checklist (see Appendices E and F). The integrity measures for the MSWO collected data on therapist behaviors for (a) presenting correct number of stimuli for each trial, and (b) correct consequence upon selection (i.e., access to consume selected edible in edible MSWO only). Treatment integrity data were calculated by dividing the number of occurrences by the sum of occurrences and non-occurrences and were multiplied by 100% to obtain a percentage. Treatment integrity measures with contingent access during the E-Pic were identical, with the exception that the correct consequence upon selection was the therapist providing access to consume the selected edible during the E-Pic. Treatment integrity was 100% across all participants.

Integrity measures for the reinforcer assessment collected data on therapist behaviors. Procedural integrity measures were collected for reinforcer delivery and correct reinforcer delivery. Reinforcer delivery was defined as any instance in which the therapist delivered an edible within -1/+1 of the criterion response within 5 s. Integrity measures for correct reinforcer delivery was defined as any instance in which the therapist delivered the correct edible upon completing the PR schedule for a given task within -1/+1 of the criterion response within 5 sec.

Treatment integrity was calculated by dividing the number of occurrences by the sum of occurrences and non-occurrences and multiplied were by 100% to obtain a percentage. Integrity measures during reinforcer assessments that included an FR-1 schedule (Maddy and Thomas), were identical to the above definitions, with the exception that correct reinforcer delivery involved the therapist delivering the edible following each task completion.

Integrity measures for reinforcer delivery averaged 97.62% for Libby, 100% for Thomas, 99.47% for Maddy, 98.90% for Ellen, and 99.21% for Riley. Correct reinforcer delivery averaged 97.53% for Libby, 100% for Thomas, 97.47% for Maddy, 98.90% for Ellen, and 99.21% for Riley.

Results

Figure 1 displays the overall results of Libby's MSWO modality comparisons (i.e., the average rank of each stimulus item during both E-pic MSWO and Edible MSWO comparisons across all session blocks). Session blocks are scaled to the x-axis, and combined rank (i.e., average rank of 3 assessment administrations) is scaled to the y-axis. For each session block, the height of the black bar denotes preference ranking for the Edible MSWO and the height of the white bar denotes the ranking for the E-Pic MSWO. Green bars denote session blocks in which there was an identical rank for a given stimulus item across both modalities. Reliability of the E-Pic MSWO was assessed by determining the number of session blocks for which the rank of a given item suggested by the E-Pic MSWO was within one rank of the Edible MSWO's rank for that item and dividing by the total number of session blocks (and converting to a percentage). E-Pic MSWO reliability was 53.9% for four of the six edibles (skittle, smartie, pretzel, and M&M), 46.2% for fruit snack, and 38.5% for tofu. These data do not suggest that the E-Pic MSWO rankings corresponded closely with the Edible MSWO preference assessment. Surprisingly, the

edible item identified as LP for Libby in the Stimulus Avoidance Assessment (i.e., tofu) was associated with the lowest E-Pic MSWO reliability score (38.5%).

Figure 2 displays aggregate task completion during Libby's reinforcer assessment across session blocks (i.e., average number of tasks completed across all session blocks). Session blocks are scaled to the x-axis are sessions and the average number of tasks is scaled to the y-axis. Purple squares denote responding for the E-Pic HP item, red circles denote responding for the Edible HP item, open triangles denote responding for the LP item, and open squares denote responding for the control option (i.e., no consequence). For session blocks in which the E-Pic and Edible MSWO both identified the same item as HP, black diamonds denote responding for that item. For session blocks 1-5, modifications were made including task change, presenting one card at a time, and receptive identification during pre-session exposure. Data for session blocks 6-13 show a consistently high (although variable) level of responding for the Edible MSWO HP item, as compared to responding for the control option. The level of responding for the E-Pic MSWO HP item was also consistently higher than control; however, the level was lower than the Edible MSWO HP option. The overall responding for the LP item was low (and decreased over the course of session blocks). Note, the E-Pic MSWO identified the LP item as HP in session blocks 8-10. Therefore, the reinforcer assessment for these session blocks consisted of three concurrently available response options (i.e., HP Edible, LP, control). These data suggest that the predictive validity of Edible MSWO was more consistent than that of the E-Pic MSWO.

Figures 3-7 display the results of preference assessment comparisons (left panels) and reinforcer assessments (right panels) across individual session blocks for Libby. For preference assessment comparison graphs, white bars depict the E-Pic MSWO rankings and the black bars depict the Edible MSWO rankings. The asterisks denote items identified as HP in each modality.

Kendall's Tau correlation coefficients are displayed under participant name. For reinforcer assessment graphs, sessions are scaled to the x-axis and task completion is scaled the left y-axis. PR schedule values are scaled to the right y-axis is the PR schedule (denoted by the horizontal lines). Black diamonds denote instances in which both modalities identified the same HP edible. Black circles denote HP edibles identified from the Edible MSWO. Black squares denote HP edibles identified from the E-Pic MSWO. Open triangles denote the LP edible identified from the Stimulus Avoidance Assessment, and the open triangles denote the control task. Asterisks along the x-axis denote sessions that the participant requested to terminate the session.

For session block one, the HP edibles identified were skittle (E-Pic) and smartie (Edible). The LP edibles identified were pretzel (E-Pic) and tofu (Edible). Overall, results show exact- or close- correspondence for three of the six edibles. Edibles included in the RA were smartie, skittle, and tofu. During the reinforcer assessment, higher levels of responding were allocated to the skittle (E-Pic) and similar levels of responding for tofu and control during the first session; however, with only two RA sessions and zero levels of task completion during session two, there is not enough data to suggest that either modality identified a HP food that functioned as a reinforcer.

For session block two, the HP edible identified was skittle (E-Pic and Edible). The LP edibles identified were pretzel (E-Pic) and tofu (Edible). Overall, results show exact- or close-correspondence for three of the six edibles. Edibles included in the assessment were skittle and tofu. During the reinforcer assessment, the task was modified to include mail sorting. Across sessions, there is no clear differentiation between the response options. These data do not suggest that the HP edible identified functioned as a reinforcer.

For session block 3, the HP edible identified was fruit snack (E-Pic and Edible). The LP edibles identified were tofu (E-Pic & Edible) and M&M (E-Pic). Overall, results show exact- or close- correspondence for three of the six edibles. Edibles included in the assessment were fruit snack and tofu. During the RA, low levels of task completion were observed across all sessions, with higher levels of responding for the LP and control task. These data do not suggest that the HP edible identified functioned as a reinforcer.

During session block 4, the HP edibles identified were fruit snack (E-Pic) and smartie (Edible). The Edible MSWO identified tofu as LP. The LP E-Pic produced a tie LP between skittle, pretzel, and tofu. Overall, results show exact- or close- correspondence for four of the six edibles. Edibles included in the assessment were fruit snack, smartie, and tofu. During the RA, low levels of task completion were observed across tasks. Results from the reinforcer assessment do not suggest that the HP edibles identified functioned as a reinforcer.

For session block 5, results from the MSWO identified a match for the HP edible (smartie). There was minimal correspondence for the LP edible. The LP edibles identified were fruit snack (E-Pic) and tofu (Edible). These data show minimal correspondence, such that close correspondence was observed for two of the six edibles. During the RA, a modification was made to include the therapist handing the participant one card at a time, in attempt to increase the frequency of tasks completed. Overall, results do not suggest that the HP edible identified functioned as a reinforcer. For each response option, variable levels of task completion were observed within- and across- sessions. High- to moderate- levels of task completion was observed for the control task. These data do not suggest either modality identified a HP edible identified functioned as a reinforcer.

For session block six, results identified two different high- and low- preferred edibles. The HP edibles identified were pretzel (E-Pic) and M&M (Edible). The LP edibles identified were skittle (E-Pic) and tofu (Edible). Results did not produce correspondence between both modalities for the HP- and LP- edible. These data show no correspondence, such that zero of the six edibles were close in rank. A modification was made to pre-session exposure in the RA to include receptive identification for each task. This modification was made due to variable levels of responding across tasks (i.e., control and LP). This modification was made in attempt to determine whether participants could accurately identify the consequences associated with each task. Pre-session exposure then consisted of exposure to each task on an FR-3, followed by receptive identification. During the RA, high levels of task completion were observed for the HP edible. These data suggest that the Edible MSWO was effective in identifying a reinforcer. The HP edible identified from the E-Pic did not function as a reinforcer.

For session block seven, results identified two different high- and low- preferred edibles. The HP edibles identified were M&M (E-Pic) and smartie (Edible). The LP edibles identified were pretzel (E-Pic) and tofu (Edible). Although two different LP edibles were identified, there was correspondence for the LP edible with similar rankings. Overall, results show exact- or close- correspondence for five of the six edibles. During the Ra, low- but variable- levels of task completion were observed across each session. During the last two sessions, high levels of task completion were observed for the control task. These data do not suggest that either of the HP edibles identified functioned as a reinforcer.

For session block eight, MSWO results identified two different high- and low- preferred edibles. The HP edibles identified were tofu (E-Pic) and smartie (Edible). The LP edibles identified were pretzel (E-Pic) and tofu (Edible). Overall, results show minimal correspondence

for two of the six edibles. During the RA, high levels of task completion were observed for smarties (Edible). Variable levels of task completion were observed for the control task. During one session, higher levels of task completion were observed for the control task. Across sessions, higher levels of task completed were allocated to the HP edible. These data suggest that the HP edible identified from the Edible MSWO functioned as a reinforcer.

Results for session block nine identified two different high- and low- preferred edibles. The HP edibles identified were tofu (E-Pic) and smartie (Edible). The LP edibles identified were pretzel (E-Pic) and tofu (Edible). These data show minimal correspondence, such that close correspondence was observed for only one of the six edibles. During the RA, high levels of task completion were observed for smartie (Edible). Variable levels of task completion were observed for the control task. During one session, higher levels of task completion were observed for the control task; however, with higher levels of task completion for the HP edible, these data suggest that the HP edible identified functioned as a reinforcer.

For session block 10, two different high- and low- preferred edibles were identified. The HP edibles identified were tofu (E-Pic) and smartie (Edible). The LP edibles identified were pretzel (E-Pic) and tofu (Edible). Overall, results show exact- or close- correspondence for four of the six edibles. During the RA, consistently higher levels of task completion was observed for the HP food identified from the edible MSWO. These data suggest that the Edible MSWO was effective in identifying a HP edible.

Results for session block 11 identified two different high- and low- preferred edibles. The HP edibles identified were fruit snack (E-Pic) and M&M (Edible). The LP edible identified in the Edible MSWO was pretzel and tofu and the E-Pic identified tofu. Overall, results show exact- or close- correspondence for four of the six edibles. Results from the RA suggest that both

high preferred edibles identified from each modality functioned as a reinforcer. Across sessions, preferences switched for the HP E-Pic and edible identified.

For session block 12, the HP edibles identified was smartie (E-Pic) and fruit snack (Edible). The LP edibles identified were M&M (E-Pic) and tofu (Edible). Overall, results show exact- or close- correspondence for four of the six edibles. Results from the RA suggest that both HP edibles identified functioned as a reinforcer.

For session block 13, two different HP- and LP-edibles were identified. The HP edibles identified was M&M (E-Pic) and fruit snack (Edible). The LP edibles identified was fruit snack (E-Pic) and tofu (Edible). Overall, results show exact- or close- correspondence for four of the six edibles. During the RA, variable levels of task completion were observed for both HP edibles. Higher levels of task completion were observed for the HP food identified from the MSWO.

Figure 8 displays the overall results of Maddy's MSWO modality comparisons. E-Pic MSWO reliability was 30% (skittle), 40% (fruit snack), 60% (veggie straw), 70% (smartie and kale), and 90% (M&M). Further, the LP edible (kale) was reliable for 70% of sessions. For five of the six edibles, these data do not suggest that the E-Pic MSWO rankings corresponded closely with the Edible MSWO.

Figure 9 displays aggregate task completion during Maddy's reinforcer assessment across session blocks. During the initial PR schedule (session blocks 1-5), variable averages of task completion were observed for the control, LP, and E-Pic task. Consistently higher levels of task completion were observed for the edible identified from the Edible MSWO. During the FR-1, consistently higher levels of task completion were observed for the HP edible identified from the Edible MSWO. Moderate levels of task completion were observed for the edible identified from

the E-Pic. Zero- to near-zero levels of task completion were observed for both the control- and LP- tasks. For session blocks 9 and 10, the schedule of reinforcement reversed back to the PR schedule and high levels of task completion were observed for HP edibles identified from both E-Pic MSWO and Edible MSWO. Near- to zero-levels of task completion were observed for the control- and LP- task. With varying levels of task completion during the initial PR schedule, it is possible that a more dense- and predictable- schedule of reinforcement should be included initially. Following modifications, these data suggest that E-Pic modality may be effective in identifying a reinforcer.

Figures 10-13 display the results of preference assessment comparisons and reinforcer assessments across individual session blocks for Maddy. For session block one, both MSWOs identified the same HP- and LP- edible for both modalities. Skittle was identified as HP and kale was identified as the LP edible. During the RA, high- and variable- levels of task completion were observed for each response option across each session. Following session three, pre-session exposure was modified to include receptive identification. These data suggest that the HP edible identified in both modalities may have functioned as a reinforcer; however, with only two data points following the modification, there is not enough data to determine whether a reinforcement effect was produced.

During session block two, the HP edibles identified were Skittle (E-Pic) and veggie straw (Edible). The LP edible (kale) matched across both modalities. A low degree of correspondence was observed for the combined rankings for four of the six edibles. Exact correspondence was identified for the LP (kale) and close correspondence was observed for veggie straw. During the RA, high levels of task completion were observed for skittle (E-Pic) and veggie straw (Edible). These data suggest that both modalities may be effective in identifying a reinforcer.

For session block three, MSWO results identified two different HP edibles. The HP edibles identified were skittle (E-Pic) and smartie (Edible). The LP edible (kale) matched across both modalities. Close- or exact- correspondence was identified for four of the six edibles. During the RA, high- and variable- levels of task completion were observed for smartie (Edible), skittle (E-Pic), and kale (LP). For three out of the seven sessions, high levels of task completion were allocated toward kale. For the remaining four sessions, high levels of responding were observed for the HP edibles. With high levels of responding toward the LP edible, neither modality identified a HP food that functioned as a reinforcer.

Results for session block four identified two different HP edibles. The HP edibles identified was smartie (E-Pic) and fruit snack (Edible). The LP edible (kale) matched across both modalities. Exact- or close correspondence was observed for four of the six edibles. During the RA, high levels of task completion were observed for smartie (E-Pic) and fruit snack (Edible). Results show alternating high levels of task completion across sessions for each HP edible. These data suggest that both modalities may be effective in identifying a reinforcer and show preferences may quickly change.

For session block five, two different HP edibles were identified. The HP edibles identified were skittle (E-Pic) and kale (Edible). The LP edibles identified were smartie (E-Pic) and veggie straw (Edible). A high degree of correspondence across both modalities was observed for three of the six edibles. During the RA variable levels of task completion were observed for each task. Without a clear trend, these data suggest that neither modality identified a HP edible that functioned as a reinforcer

For session block six, two different HP edibles were identified. The HP edibles identified was skittle (E-Pic) and fruit snack (Edible). The LP edibles identified were M&M (E-Pic) and

kale (Edible). A high degree of correspondence across both modalities was observed for three of the six edibles. During the RA, the schedule of reinforcement was modified to an FR-1. This modification was made due to consistently variable levels of task completion for the LP edible; thus, the purpose of the FR-1 was to determine whether a continuous schedule of reinforcement would enhance discrimination for the consequences associated with each task. High levels of task completion were observed for fruit snack (Edible) and skittle (E-Pic) across each session. Consistently higher levels of task completion were observed for fruit snack. These data suggest that both edibles identified functioned as a reinforcer.

For session block seven, two different HP edibles were identified. The HP edibles identified was skittle (E-Pic) and fruit snack (Edible). The LP edibles identified for the E-Pic was fruit snack and veggie straw. The LP edible identified in the Edible MSWO was kale. These data show minimal reliability with the E-Pic modality with only a high degree of correspondence for one of the six edibles. During the reinforcer assessment, high levels of task completion were observed for fruit snack (Edible) and skittle (E-Pic) across each session. Similar to the previous session block, consistently higher levels of task completion were observed for fruit snack. These data suggest that both edibles identified functioned as a reinforcer.

For session block eight, both modalities identified fruit snack as HP. The LP were veggie straw (E-Pic) and kale (MSWO). A high degree of correspondence was observed for three of the six edibles. During the RA, exclusive task completion was observed for the HP edible identified from both modalities. These data suggest that both modalities identified a HP edible that functioned as a reinforcer.

For session block nine, MSWO results identified different HP- and LP- edibles. The HP edibles identified were skittle (E-Pic) and fruit snack (Edible). The LP edibles identified were

veggie straw (E-Pic) and kale (Edible). A high degree of correspondence was observed for four of the six edibles. During the RA, the schedule of reinforcement was reversed back to a PR schedule. The purpose of this was to determine whether variable levels of task completion would reverse back to previous session blocks (i.e., 1-5). High- and variable levels of task completion were observed for both HP edibles across session blocks. These data suggest that both edibles identified functioned as a reinforcer.

For session block 10, MSWO results identified different HP- and LP- edibles. The HP edibles identified was M&M (E-Pic) and fruit snack (Edible). The LP edibles identified were veggie straw (E-Pic) and kale (Edible). A high degree of correspondence was observed for five of the six edibles. During the RA, consistently higher levels of task completion were observed for the fruit snack (Edible). High- to moderate- levels of task completion was observed for M&M (E-Pic). These data suggest that both edibles identified functioned as a reinforcer.

Figure 14 displays the overall results of Thomas's MSWO modality comparisons. E-Pic MSWO reliability was 50% (airhead), 57% (M&M), 71% (pretzel and kit kat), 78% (kale), and 86% (fruit snack). Further, the LP edible (kale) was reliable for 70% of sessions. For five of the six edibles, these data do not suggest that the E-Pic MSWO rankings corresponded closely with the Edible MSWO.

Figure 15 displays aggregate task completion during Thomas's reinforcer assessment across session blocks. Variable levels of task completion across all response options were observed in session blocks 1-4. Following FR-3 and receptive identification modification, the average of tasks completed was consistently higher for the control task; thus, the schedule was modified to an FR-1 for session blocks 8 and 9. The average level of tasks completed was still consistently higher for the control task. During session blocks 8-12, an environmental

manipulation consisted of modifying the task to a button press, in which all the response options were directly in front of the participant (i.e., lower response effort to switch between response options). The average number of tasks completed was high compared to the control task. Task completion for both the control- and LP- task decreased across session blocks. For session blocks 13 and 14, the task was reversed back to mail sorting to determine whether undifferentiated responding would re-emerge. High levels of task completion remained high compared to the control task. Zero- to near- zero levels of task completion was observed. These data suggest that either the reduced response effort to complete the task or having the response options directly in front of the participant increased differentiation between the concurrent operant arrangement. Following modifications, these data suggest that E-Pic may be an effective modality for identifying reinforcers.

Figures 16-20 display the results of preference assessment comparisons and reinforcer assessments across individual session blocks for Thomas. During session block one, the HP edibles identified were smartie (E-Pic) and fruit snack (Edible). The LP edible identified was kale. A high degree of correspondence was observed for four of the six edibles. During the RA, low levels of task completion were observed for each response option, with minimal differentiation. Results from the RA do not suggest that either modality identified a HP edible that functioned as a reinforcer.

For session block two, The HP edibles identified were airhead (E-Pic) and kit kat (Edible). Both MSWOs identified the same LP edible for both modalities. A high degree of correspondence was observed for five of the six edibles. During the RA, low levels of task completion were observed across sessions. Higher levels of task completion were observed for

the LP edible in one session. These data do not suggest that either modality identified a HP food that functioned as a reinforcer.

For session block three, the HP edibles identified were pretzel (E-Pic) and fruit snack (Edible). Correspondence was identified for three of the six edibles. During the RA, a modification was made to include (a) an FR-3 during pre-session exposure and (b) handing one card at a time. The purpose of modifying pre-session exposure from an FR-1 to an FR-3 was to provide exposure to the PR schedule. One card was handed one at a time due to low levels of task completion. Variable levels of task completion were observed for fruit snack (Edible) and kale (LP Edible MSWO). With variable levels of task completion for the LP edible, these results do not suggest that the edibles identified as HP functioned as a reinforcer. Results also suggest that the participant was not discriminating between the response options.

For session block four, results from the MSWO identified two different HP- and LP-edibles. The HP edibles identified was kit kat (E-Pic) and fruit snack (Edible) and the LP edibles identified was M&M (E-Pic) and kale (Edible). Overall, results show exact- or close-correspondence for four of the six edibles. Similar to previous participants, a modification was made during the pre-session exposure which consisted of receptive identification prior to each session. Results from the RA did not produce a reinforcement effect, suggesting that neither modality identified a HP edible that functioned as a reinforcer.

For session block five, the MSWO identified a match for the LP edible and two different HP edibles. The HP edibles identified was pretzel (E-Pic) and kit kat (Edible). The LP edible identified was kale. Correspondence was only observed for two of the six edibles. During the RA, low levels of task completion were observed across sessions for the HP edibles. These data do not suggest that the HP edibles identified functioned as a reinforcer.

For session block six, both the HP and LP identified the same edible. Fruit snack was identified as the HP and kale was identified as LP. Overall, results show exact- or close-correspondence for four of the six edibles. During the RA, variable levels of task completion were observed for each task. Consistently higher levels of task completion were observed for the control- and LP- task. These data do not suggest a reinforcement effect.

For session block seven, MSWO rankings produced a match for the HP edible (fruit snack). The LP edibles identified was pretzel (E-Pic) and kale (Edible). Overall, results show exact- or close- correspondence for three of the six edibles. During the RA, variable levels of task completion were observed across sessions. With consistently higher levels of task completion for either the control- or LP- task, these data do not suggest a reinforcement effect.

For session block eight, both the HP and LP identified the same edible. Fruit snack was identified as the HP and kale was identified as LP. Exact- or a high- degree of correspondence was observed for all six edibles. During the RA, the schedule of reinforcement was switched to an FR-1. This modification was made because it is possible that Thomas was not discriminating the consequences associated with each task on a PR schedule. The purpose was to determine whether a continuous schedule of reinforcement would enhance discrimination. Variable levels of task completion were observed for each task. Consistently higher levels of task completion were observed for the LP- task. Moderate levels of task completion were observed for both the HP- and LP- response options. These data suggest that neither modality identified a HP edible that functioned as a reinforcer.

For session block nine, both the HP and LP identified the same edible. Fruit snack was identified as the HP and kale was identified as LP. Exact- or high- correspondence was observed for five of the six edibles. During the RA, variable levels of task completion were observed

across each session for each task. These data suggest that neither modality identified a HP edible that functioned as a reinforcer.

For session block 10, results show exact correspondence between the HP- and LP- edible identified. Fruit snack was identified as the HP and kale was identified as LP. Exact- or high-correspondence was observed for five of the six edibles. During the RA, variable levels of task completion were observed across each session for each task. These data suggest that neither modality identified a HP edible that functioned as a reinforcer.

For session block 11, results show exact correspondence between the HP- and LP- edible identified. Fruit snack was identified as the HP and kale was identified as LP. Exact- or high-correspondence was observed for three of the six edibles. During the RA, the task was modified to a button press. The purpose of this was to determine if an environmental manipulation (i.e., response options in front of participant) would enhance discrimination. Zero- to near- zero levels of task completion were observed for both the control- and LP- task. Consistently high levels of task completion were observed for the HP edible. These data suggest that both modalities identified a HP edible that functioned as a reinforcer.

For session block 12, results show exact correspondence between the HP- and LP- edible identified. Fruit snack was identified as the HP and kale was identified as LP. Exact- or high-correspondence was observed for four of the six edibles. During the RA, zero- to near- zero levels of task completion were observed for both the control- and LP- task. Consistently high levels of task completion were observed for the HP edible. These data suggest that both modalities identified a HP edible that functioned as a reinforcer.

For session block 13, results show exact correspondence between the HP- and LP- edible identified. Fruit snack was identified as the HP and kale was identified as LP. Exact- or high-

correspondence was observed for four of the six edibles. During the RA, the task was reversed back to mail sorting. The purpose of this was to evaluate whether differentiation would reverse back to previous session blocks. Zero- to near- zero levels of task completion were observed for both the control- and LP- task. Consistently high levels of task completion were observed for the HP edible. During session block 13, only two sessions were conducted; however, with clear differentiation between task completion for the HP food, these data suggest that both modalities identified a HP edible that functioned as a reinforcer.

For session block 14, results show exact correspondence with the HP (fruit snack) identified. The LP edibles identified were pretzel (E-Pic) and kale (Edible). Exact- or high-correspondence was observed for five of the six edibles. During the RA, zero- to near- zero levels of task completion were observed for both the control- and LP- task. Exclusively high levels of task completion was observed for the HP edible. These data suggest that both modalities identified a HP edible that functioned as a reinforcer. Overall, these data suggest that the PR schedule did not produce differentiation and exposure to a different environmental manipulation (i.e., button press with all response options directly in front of participant) maintained when the task went back to mail sorting.

Figure 21 displays the overall results of Ellen's MSWO modality comparisons. E-Pic MSWO reliability was 40% (M&M), 60% (fruit snack), 80% (black licorice, smartie, and Cheeto), and 100% (kale). Further, the LP edible (kale) was reliable for 70% of sessions. For five of the six edibles, these data suggest that the E-pic modality corresponded closely with the Edible MSWO. Further, the LP edible (kale) had the highest correspondence with 100%.

Figure 22 displays aggregate task completion during Ellen's reinforcer assessment across session blocks. These data show consistently higher levels of responding for both HP edibles.

Across session blocks, a decreasing trend in task completion for the LP was observed. These data suggest that both modalities were effective in identifying a reinforcer.

Figures 23-24 display the results of preference assessment comparisons (left panels) and reinforcer assessments (right panels) across individual session blocks for Ellen. For session block one, MSWO rankings identified different HP edibles. The HP edibles identified were M&M (E-Pic) and fruit snack (Edible). These data show minimal correspondence, such that close correspondence was observed for only one of the six edibles. During the RA, moderate levels of task completion were observed for fruit snack, M&M, and kale. Zero levels of task completion were observed for the control task. Consistently higher levels of task completion were observed for both HP edibles. These data suggest that both the HP- and LP- foods functioned as a reinforcer.

For session block two, exact correspondence was observed for both the HP- and LP-edible identified. Cheeto was identified as HP and kale was identified as LP. Exact- or high-correspondence was observed for five of the six edibles. During the RA, moderate levels of task completion were observed for both the HP- and LP- edible. These data suggest that the HP- and LP- food identified functioned as a reinforcer.

For session block three, the HP edibles identified were Cheeto (E-Pic) and fruit snack (Edible). Both modalities identified kale as LP edible. Exact- or high- correspondence was observed for four of the six edibles. Reinforcer assessment results show moderate levels of task completion for both HP foods. Low levels of task completion were observed for the LP food. These data suggest that both HP foods functioned as a reinforcer.

For session block four, two HP edibles were identified. The HP edibles identified were Cheeto (E-Pic) and fruit snack (Edible). Both modalities identified kale as LP edible. Exact- or

high- correspondence was observed for all six edibles. During the RA, moderate levels of task completion were observed for both HP edibles. Low levels of task completion were observed for the LP edible. These data suggest that both the HP edibles identified functioned as a reinforcer.

For session block five, the HP edibles identified were Cheeto (E-Pic) and fruit snack (Edible). Both modalities identified kale as LP edible. Exact- or high- correspondence was observed for all six edibles. Reinforcer assessment results show low- to moderate- levels of task completion for both HP edibles. Zero- and near-zero levels of responding were observed for kale (LP). These data suggest that both the HP edibles identified functioned as a reinforcer.

Figure 25 displays the overall results of Riley's MSWO modality comparisons. E-Pic MSWO reliability was 15.4% (smartie), 38.5% (veggie straw), 46.2% (M&M), 61.5% (gummy worm, fruit snack, and tomato). These data do not suggest that the E-pic modality corresponded closely with the Edible MSWO.

Figure 26 displays aggregate task completion during Riley's reinforcer assessment across session blocks. The average frequency of task completion was consistently higher for the edible identified via the E-Pic for six of eight sessions. For session blocks in which only the HP Edible MSWO was included (session blocks 9-11), moderate levels of task completion were observed for the HP MSWO, with near- to zero- levels of task completion for both the control and LP tasks. During sessions blocks in which the RA alternated between both HP edibles and the HP Edible MSWO only (session blocks 12-13), these data show that the HP food identified from the E-Pic MSWO functioned as a more potent reinforcer and that the HP Edible only functioned as a reinforcer when the HP E-Pic was not included in the concurrent operant arrangement.

Figures 27-31 display the results of preference assessment comparisons and reinforcer assessments across individual session blocks for Riley. For session block one, both modalities

identified an exact match for the HP edible (gummy worm). The LP edibles from the E-Pic MSWO were fruit snack and M&M. the LP from the Edible MSWO was smartie. Rankings for both modalities show close- or exact correspondence for four of the six edibles. During the RA, consistently higher levels of responding were allocated for gummy worm and zero- and near-zero levels of responding for both the LP edible and the control task. These data suggest that both modalities were effective in identifying a reinforcer.

For session block two, results identified two different HP- and LP- edibles. The HP edibles were smartie (E-Pic) and gummy worm (Edible). The LP edibles from the E-Pic were fruit snack and tomato. The Edible MSWO identified tomato as LP. Rankings for both modalities show close- or exact correspondence for three of the six edibles. During the RA, consistently higher levels of responding were allocated for smartie (E-Pic). Zero- and near-zero levels of responding were observed for gummy worm (Edible), tomato (LP), and the control task. These data suggest that the edible identified from the E-Pic functioned as a reinforcer and the HP edible identified from the MSWO did not function as a reinforcer.

For session block three, results identified two different HP- and LP- edibles. The HP edibles was smartie (E-Pic) and fruit snack (Edible). The LP edibles identified was M&M (E-Pic) and tomato (Edible). Rankings for both modalities show close- or exact correspondence for two of the six edibles. For both modalities, the HP edible identified had no correspondence to the other modality. That is, smartie (E-Pic) and fruit snack (Edible) were identified as HP and for the other modality, both edibles ranked 5th. Results also show little correspondence to the LP edible (tomato). During RA, moderate- to high- levels of task completion were observed for smartie (E-Pic). Near zero- and zero- levels of responding were observed for fruit snack (Edible), tomato

(LP) and control. These data suggest that the edible identified from the E-Pic functioned as a reinforcer and the HP edible identified from the Edible MSWO did not function as a reinforcer.

For session block four, results identified two different HP- and LP- edibles. The HP edibles were tomato (E-Pic) and fruit snack (Edible). The LP edibles identified was veggie straw (E-Pic) and tomato (Edible). Rankings across both modalities show close- or exact correspondence for three of the six edibles. During the RA, consistently higher levels of responding were allocated for fruit snack (Edible). Zero- and near-zero levels of responding were observed for tomato (HP E-Pic) the control task. These data suggest that the edible identified from the MSWO functioned as a reinforcer and the HP edible identified from the E-Pic did not function as a reinforcer.

For session block five, the HP edibles were smartie (E-Pic) and gummy worm (Edible). The Edible MSWO identified tomato as LP and the E-Pic identified gummy worm and veggie straw as LP. These data show minimal correspondence, such that close correspondence was observed for two of the six edibles. During the RA, moderate levels of task completion were observed for smartie (HP E-Pic). Zero- and near-zero levels of responding were observed for gummy worm (HP Edible). These data suggest that the E-Pic modality identified a HP food that functioned as a reinforcer and the HP edible identified from the MSWO did not function as a reinforcer.

For session block six, results identified different HP- and LP- edibles. The HP edibles were gummy worm (E-Pic) and veggie straw (Edible). The Edible MSWO identified tomato as LP and the E-Pic identified fruit snack and veggie straw as LP. These data show minimal correspondence, such that close correspondence was observed for two of the six edibles. During the reinforcer assessment, consistently higher levels of task completion were observed for

gummy worm (HP E-Pic). Low levels of task completion were observed for HP food identified from the Edible MSWO (veggie straw). These data suggest that the E-Pic modality was effective in identifying a HP food that functioned as a reinforcer. Results suggest that HP food identified from the Edible MSWO did not function as a reinforcer.

For session block seven, MSWO rankings identified different HP edibles. The HP edibles identified was smartie (E-Pic) and fruit snack (Edible). Both modalities identified tomato as LP. Results show close- to exact- correspondence for four of the six edibles. Reinforcer assessment results show moderate- to high- levels of task completion for the HP edible identified from the E-Pic (smartie). Zero- and near-zero levels of responding were observed for fruit snack (HP Edible MSWO). These data suggest that only the E-Pic modality identified a HP food that functioned as a reinforcer.

For session block eight, different HP edibles were identified. The HP edibles identified were smartie (E-Pic) and M&M (Edible). Both modalities identified tomato as LP. Results show close- to exact- correspondence for four of the six edibles. During the RA, moderate- to high- levels of task completion were observed for the HP edible identified from the E-Pic (smartie). Zero- and near-zero levels of responding were observed for fruit snack (HP Edible MSWO). These data suggest that only the E-Pic modality was effective in identifying a HP food that functioned as a reinforcer.

For session block nine, two HP edibles were identified. The HP edibles identified was smartie (E-Pic) and M&M (Edible). Both modalities identified tomato as LP. These data show minimal correspondence, such that close correspondence was observed for two of the six edibles. During the RA, a modification was made to only include the HP edible identified from the MSWO. The purpose of this was to evaluate whether the HP food from the MSWO would

function as a reinforcer without the HP E-Pic response option. Moderate levels of task completion were observed for M&M (HP Edible MSWO). These data suggest that the Edible MSWO was effective in identifying a HP food that functioned as a reinforcer.

For session block 10, the HP edibles identified was M&M (E-Pic) and veggie straw (Edible). Both modalities identified tomato as LP. These data show minimal correspondence, such that close correspondence was observed for three of six edibles. During the RA, moderate levels of task completion was observed for M&M (HP Edible MSWO). These data suggest that the Edible MSWO was effective in identifying a HP food that functioned as a reinforcer.

For session block 11, different HP edibles were identified. The HP edibles identified was gummy worm (E-Pic) and veggie straw (Edible). Both modalities identified tomato as LP. These data show minimal correspondence, such that close correspondence was observed for only one of the six edibles. During the RA, low- to moderate- levels of task completion was observed for veggie straw (HP MSWO). These data suggest that the Edible MSWO was effective in identifying a HP food that functioned as a reinforcer.

For session block 12, different HP edibles were identified. The HP edibles identified was gummy worm (E-Pic) and veggie straw (Edible). Both modalities identified tomato as LP. Results show close- to exact- correspondence for four of the six edibles. A modification was made in session blocks to alternate RA sessions with both HP edibles (i.e., HP E-Pic and HP Edible) and the HP edible identified from the Edible MSWO. The purpose of this was to further evaluate whether the HP food from the Edible MSWO would function as a reinforcer without the HP E-Pic response option. During the RA, moderate levels of task completion was observed for gummy worm (HP E-Pic) in sessions that included both HP edibles. During the session in which only the HP Edible MSWO edible was included (veggie straw), moderate levels of task

completion were observed for veggie straw. Results show that for sessions in which both HP edibles were included, almost exclusive responding was observed for the HP edible identified from the E-Pic. These data suggest that the HP edible identified from the E-Pic was a more potent reinforcer and the HP identified from the Edible MSWO functioned as a reinforcer only when the HP E-Pic edible was not in the concurrent operants arrangement.

For session block 13, different HP edibles were identified. The HP edibles identified was smartie (E-Pic) and fruit snack (Edible). Both modalities identified tomato as LP. Results show close- to exact- correspondence for four of the six edibles. During the RA, moderate levels of task completion was observed for smartie (HP E-Pic) in sessions that included both HP edibles. During the session in which only the HP Edible MSWO edible was included (fruit snack), moderate levels of task completion were observed. Results show that for sessions in which both HP edibles were included, almost exclusive responding was observed for the HP edible identified from the E-Pic (smartie). These data suggest that the HP edible identified from the E-Pic was a more potent reinforcer and the HP from the Edible MSWO functioned as a reinforcer only when the HP E-Pic edible was not in the concurrent operants arrangement.

Discussion

Results of the current study suggest that the E-Pic MSWO may be efficacious for some individuals. Table 2 depicts summary results regarding reliability and validity for both SPA modalities. Overall, results suggest that the E-Pic MSWO was efficacious for four of the five participants (i.e., results of the MWSO modality comparisons showed a reasonable degree of correspondence for the highest- and lowest-ranked items, and subsequent reinforcer assessments provided validation of preference assessment results). However, conclusions regarding E-Pic MSWO efficacy for three of these four participants were not straightforward because they

required various procedural modifications to the reinforcer assessment to ensure validation. That is, reinforcer assessment procedure modifications were required in two cases to demonstrate that the E-Pic MSWO HP item would function as a reinforcer. For Libby, Maddy, and Thomas, the HP edibles identified in the E-Pic modality did not consistently function as a reinforcer until the schedule of reinforcement was changed (Maddy and Thomas) or modifications were made to the task (Libby and Thomas). Two interesting findings are worth discussing. First, for Libby and Maddy, the edible initially identified as LP by the Stimulus Avoidance Assessment was ranked as HP during the E-Pic modality in multiple session blocks; however, it never functioned as a reinforcer. These data suggest that the E-Pic modality may not be efficacious in identifying HP edibles for some participants without contingent access. Second, the preference assessment modality comparison data for Riley show an extremely low degree of correspondence. That is, the item identified as HP by the E-Pic MSWO rarely was of the same (or similar) rank. For example, Smarties were identified as HP by the E-Pic MSWO in five out of eight session blocks; however, Smarties never ranked higher than fourth in the Edible MSWO. Responding for the E-Pic MSWO HP item during the RA was consistently at a much higher level than responding for the Edible MSWO HP item. In an attempt to determine the absolute reinforcement effect of the Edible MSWO HP item, we conducted several session blocks in which we removed the E-Pic MSWO HP item response option (that is, only three response options were concurrently available). When the E-Pic MSWO HP item was no longer an option, a consistently high level of task completion for the Edible MSWO HP item was observed. This finding is similar to that of previous studies demonstrating that concurrently available reinforcement options may mask absolute reinforcement effects of an item (Glover et al., 2008; Roscoe et al., 1999).

Table 3 depicts a summary of the time to conduct each PA modality. Current results also suggest that the E-Pic modality may be less time-consuming. For instance, the average E-Pic time to conduct each PA ranged from 1.7 min to 2.9 min. The average time to conduct the edible MSWO ranged from 2.7 min to 3.8 min. These results suggest that over time, the E-Pic MSWO has the potential to save time. The significance of the time difference is that the E-Pic modality may identify reinforcers more quickly; thus, allowing for more time for teaching skills (such as in a EIBI program). For example, the E-Pic PA saved over 30 mins for Thomas (35 mins) and for Maddy (32.1 mins) as compared to the edible MSWO. It should be noted that only 12 of the 14 session blocks for Thomas were included in the time comparison because during two session blocks, one- to two- MSWO sessions, the entire video was not saved. The two-session blocks were excluded to ensure the analysis included an equal number of sessions for both modalities. Time savings for the remaining participants was 28.7 min (Riley), 19.2 (Libby), and 16.3 (Ellen). Nonetheless, time saved during the E-Pic may save even more time, as the present study did not account for time it took to prepare each MSWO.

There are several at least four limitations worth discussing. First, as previously mentioned, modifications to the reinforcer assessment procedures were necessary for three participants. We designed the RA as a concurrent operant arrangement to quickly identify whether the (a) HP items from both SPA modalities would function as reinforcers, and (b) LP item would not function as a reinforcer. Including a response option for the Edible MSWO item was important for providing a validation benchmark against which to compare the E-Pic alternative modality. Thus, cases in which reinforcer assessment results did not suggest that the Edible MSWO HP item was a reinforcer were problematic. The use of a concurrent operant arrangement may have prevented detection of absolute reinforcement effects of the currently

available stimuli. Additional research is needed to determine the ideal reinforcer assessment arrangements to validate alternative SPA modalities. Results for the two participants who experienced an FR-1 schedule of reinforcement suggest that initially using a PR did not produce discrimination across response options. . It is possible that because the PR schedule independently increased for each task, it may have affected responding. That is, participants may have matched their responding to HP task(s) associated with less effort (i.e., more dense PR schedule). Results may have differed if the amount of work required to earn the next reinforcer did not increase (e.g., FR). Future researchers should consider replicating the study with a different schedule of reinforcement to determine whether results would be similar with a different schedule of reinforcement, such as fixed-ratio (FR) or a different PR schedule.

Second, for four of the five participants, Kendall's Tau did not consistently produce statistically significant results. These results differ from previous studies (e.g., Brodhead, Abel, et al., 2016; Brodhead & Rispoli, 2017; Carr et al., 2000; Clevenger & Graff, 2005). It is possible that results from the present study did not produce statistically significant results because Kendall's Tau correlation was used instead of Spearman's rank. The rationale for including Kendall's Tau is that it is more appropriate when sample sizes are small (i.e., 6 pairs) and has tied ranks. Results were statistically significant correlations for one participant. That is, for Ellen, for four of five session blocks, a strong correlation was identified; however, results were only statistically significant for three session blocks. Results for two participants found strong correlations for six session blocks (Maddy) and 10 session blocks for Thomas. Correlations for Libby and Riley identified very weak correlations that were not statistically significant.

Third, the present study presented electronic pictures on an iPad equipped with Keynote. However, Keynote is only available in the Apple Store such. Therefore, it is unclear whether similar findings would occur on other types of devices (e.g., Samsung, Windows, etc.). Further, in the current study the therapist had to repeatedy remove the iPad briefly from the participant to re-arrange the electronic stimuli during the E-pic MSWO. Future research should attempt to design a program that allows for automated management of electronic stimuli, especially for cases in which problem behavior surrounding the removal of technology is likely to occur during a session. Allowing participants to have continuous access during the E-Pic may have important clinical implications for individuals with problem behavior surrounding the removal of technology.

The final limitation is that the preference assessment modality comparison involved interspersing E-pic MSWOs (in which picture selection did not result in access to actual items) with Edible MSWOs (in which selection *did* result in access to actual items) within daily session blocks. Therefore, high correspondence between the preference assessments may have been a result of intermittent, unplanned pairings of contingent reinforcer access in the presence of e-pictures of the stimuli. Both modalities were included in each session block to evaluate potential shifts in preference over time and overall reliability between the rankings. Interestingly, the LP item came out as HP in the E-Pic MSWO across multiple session blocks. In the current study, a more conservative test of reliability would have been to conduct all E-Pic MSWOs, followed by all Edible MSWOs, and then conduct the reinforcer assessment.

All participants included in the study were neurotypical children (no known diagnoses). The majority of alternative modality SPA research has been conducted with individuals with developmental disabilities (Heinicke et al., 2019). However, we are aware of only two previous

studies that have evaluated the electronic picture presentation in a SPA (Brodhead, Abel, et al., 2016; Morris & Vollmer, 2020). Given the potential advantages of this modality (especially decreased administration time), additional investigations of preference assessments using electronic picture stimuli are warranted for individuals with and without intellectual and developmental disabilities. We plan to include numerous participants with IDD in the current study, as individuals with less-developed repertoires stand to benefit the most from the refinement of SPA procedures (Morris & Vollmer, 2020).

The reinforcer assessment tasks chosen for use in the current study (i.e., card sorting and button press) were arbitrary responses. Thus, it is unclear whether the results obtained would be similar if a more effortful or socially important response was included. The rationale for including the card sorting task was that it was a developmentally appropriate task that targeted fine motor skills and was arranged on the floor to mimic participants' typical learning environment in an early childhood classroom. However, the button press was an arbitrary response. The rationale for including a button press with older participants is that it was easily presented in a concurrent arrangement such that it could be continuously completed without a lot of materials on a table. Future research should evaluate the reinforcing effects in a reinforcer assessment with socially significant behaviors (e.g., mastered academic tasks or skill acquisition tasks).

An interesting finding is that results differ from previous literature for SPA modalities to include based on the ABLA-R score. It is possible that because the ABLA-R includes physical objects, but the SPA includes pictures, it is possible a P-O/O-P discrimination test would have better prediction about what modalitiy to include. Additionally, research has examined whether an individual's ABLA level may predict performance on three-choice discrimination and found

that individuals performed significantly better with four-choice tasks at their ABLA level than four-choice tasks immediately above their highest passed ABLA level, supporting the predictive validity of the ABLA (e.g., MacPherson et al., 2011; Wacker et al., 1983). That is, it is possible that the concurrent operant arrangement in this study was above Thomas's ABLA-R score. Future research could include a more simple concurrent arrangement to match an inidividuals ABLA-R level. Further, future researchers should directly compare multiple discrimination assessments to to extend knowledge about the role of prerequisite skills required for alternative modality SPAs.

Finally, future researchers should continue to evaluate alternative SPAs with different stimuli. The inclusion of edibles in the present study had less to do with the relevance of an alternative modality (E-Pic MSWO) for assessing preference for edible items and more to do with the possibility of a valid, reliable SPA method for evaluating preference for (a) larger items/activities and (b) protracted and future events (e.g., living situations, vocational activities, exercise environments, etc.), as this information is critical for designing maximally thereapeutic environments for individuals with IDD. Further, it will be important to know whether the E-Pic SPA modality maintains high-predictive validity with different types of stimuli and when assessment stimuli change.

Overall, results of the current study provide some preliminary evidence that an E-pic MSWO has the potential to accurately predict reinforcers in a time-efficient way. However, the limited number of similar studies, together with the results of the current study, suggest that substantial, additional investigations are needed to provide clinicians evidenced-based information about the conditions under which the E-Pic modality would be the best choice of preference assessment method.

References

Ardoin, S. P., Martens, B. K., Wolfe, L. A., Hilt, A. M., & Rosenthal, B. D. (2004). A method for conditioning reinforcer preferences in students with moderate mental retardation. *Journal of Developmental and Physical Disabilities, 16*, 33-51. https://doi.org/10.1023/B:JODD.0000010038.69725.88

Botsch, R. (2011). Chapter 12: Significance and measures of association. http://polisci.usca.edu/apls301/Text/Chapter%2012.%20Significance%20and%20Measures%20of%20Association.htm

Brodhead, M. T., Abel, E. A., Al-Dubayan, M. N., Brouwers, L., Abston, G. W., & Rispoli, M. J. (2016). An evaluation of a brief multiple-stimulus without replacement preference assessment conducted in an electronic pictorial format. *Journal of Behavioral Education, 25*, 417-430. https://doi.org/10.1007/s10864-016-9254-3

Brodhead, M.T., Abston, G.W., Mates, M. and Abel, E.A. (2017). Further refinement of video-based brief multiple-stimulus without replacement preference assessments. *Journal of Applied Behavior Analysis*, 50, 170-175. https://doi.org/10.1002/jaba.358

Brodhead, M. T., Al-Dubayan, M. N., Mates, M., Abel, E. A., & Brouwers, L. (2016). An evaluation of a brief video-based multiple-stimulus without replacement preference assessment. *Behavior Analysis in Practice, 9*, 160-16. https://doi.org/10.1007/s40617-015-0081-0

Brodhead, M.T., Kim, S.Y. & Rispoli, M.J. (2019). Further examination of video-based preference assessments without contingent access. *Journal of Applied Behavior Analysis, 52*, 258-270. https://doi.org/10.1002/jaba.507

Brodhead, M. T., & Rispoli, M. J. (2017) Using videos to assess preference for novel stimuli in children with autism. *Developmental Neurorehabilitation, 20*(8), 560-564. https://doi.org/10.1080/17518423.2016.1237583

Bullock, C. E., Fisher, W. W., & Hagopian, L. P. (2017). Description and validation of a computerized behavioral data program: "bDataPro". *Behavior Analyst, 40,* 275-285. https://doi.org/10.1007/s40614-016-0079-0

Call, N. A., Trosclair-Lasserre, N. M., Findley, A. J., Reavis, A. R., & Shillingsburg, M. A. (2012). Correspondence between single versus daily preference assessment outcomes and reinforcer efficacy under progressive-ratio schedules. *Journal of Applied Behavior Analysis, 45*(4), 763–777. https://doi.org/10.1901/jaba.2012.45-763

Carr, J. E., Nicolson, A. C., & Higbee, T. S. (2000). Evaluation of a brief multiple-stimulus preference assessment in a naturalistic context. *Journal of Applied Behavior Analysis, 33*(3), 353–357. https://doi.org/10.1901/jaba.2000.33-353

Chebli, S. S., & Lanovaz, M. J. (2016). Using Computer Tablets to Assess Preference for Videos in Children with Autism. *Behavior Analysis in Practice, 9*(1), 50–53. https://doi.org/10.1007/s40617-016-0109-0

Clark, D. R., Donaldson, J. M., & Kahng, S. (2015). Are video-based preference assessments without access to selected stimuli effective? *Journal of Applied Behavior Analysis, 48,* 895-900. https://doi.org/10.1002/jaba.246

Clay, C. J., Samaha, A. L., Bloom, S. E., Bogoev, B. K., & Boyle, M. A. (2013). Assessing preference for social interactions. *Research in Developmental Disabilities, 34,* 362–371. https://doi.org/10. 1016/j.ridd.2012.07.028

Clevenger, T. M., & Graff, R. B. (2005). Assessing object-to-picture and picture-to-object

matching as pre-requisite skills for pictorial preference assessments. *Journal of Applied Behavior Analysis, 38,* 543-547. https://doi.org/10.1901/jaba.2005.161-04

Cohen-Almeida, D., Graff, R. B., & Ahearn, W. H. (2000). A comparison of verbal and tangible stimulus preference assessments. *Journal of Applied Behavior Analysis, 33*(3), 329–334. https://doi.org/10.1901/jaba.2000.33-329

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior analysis* (3rd ed.). Pearson. https://doi.org/10.26741/abaespana/2020.cooper3e

Conine, D. E., Morris, S. L., Kronfli, F. R., Slanzi, C. M., Petronelli, A. K., Kalick, L., & Vollmer, T. R. (2021). Comparing the results of one-session, two-session, and three-session MSWO preference assessments. *Journal of Applied Behavior Analysis, 54*(2), 700-712. https://doi.org/10.1002/jaba.808

Conyers, C., Doole, A., Vause, T., Harapiak, S., Yu, C. T., & Martin, G. L. (2002). Predicting the relative efficacy of three presentation methods for assessing preferences of persons with developmental disabilities. *Journal of Applied Behavior Analysis, 35*, 49-58. https://doi.org/10.1901/jaba.2002.35-49

Curiel, H. and Poling, A. (2019), Web-based stimulus preference assessment and reinforcer assessment for videos. *Journal of Applied Behavior Analysis, 52,* 796-803. https://doi.org/10.1002/jaba.593

Davis, C. J., Brock, M. D., McNulty, K., Rosswurm, M. L., Bruneau, B., & Zane, T. (2010). Efficiency of forced choice preference assessment: Comparing multiple presentation techniques. *The Behavior Analyst Today, 10,* 440-455. https://doi.org/10.1037/h0100682

DeLeon, I. G., Fisher, W. W., Rodriguez-Catter, V., Maglieri, K., Herman, K., & Marhefka, J. M. (2001). Examination of relative reinforcement effects of stimuli identified through

pretreatment and daily brief preference assessments. *Journal of Applied Behavior Analysis, 34*(4), 463–473. https://doi.org/10.1901/jaba.2001.34-463

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29*(4), 519–533. https://doi.org/10.1901/jaba.1996.29-519

DeWiele, L., Martin, G. L., Martin, T., Yu, D., & Thomson, K. (2011). The Kerr-Meyerson Assessment of Basic Learning Abilities Revised: A self-instructional manual. Unpublished manuscript, Department of Psychology, University of Manitoba, Winnipeg, Canada. Retrieved from https://stamant.ca/wp-content/uploads/2013/02/ABLA-R-self-instructional-manual-20130301.pdf

de Vries, C., Yu, C. T., Sakko, G., Wirth, K. M., Walters, K. L., Marion, C., & Martin, G. L. (2005). Predicting the relative efficacy of verbal, pictorial, and tangible stimuli for assessing preferences for leisure activities. *American Journal on Mental Retardation, 110*, 145-154. https://doi.org/10.1352/0895-8017(2005)110<145:PTREOV>2.0.CO;2

Fehr, M. J., Trezise, J., Lennon, R., Meyerson, L., & Wacker, D. (1979). Visual, auditory, and vibratory stimulation as reinforcers for profoundly retarded children. *Rehabilitation Psychology, 26*(4), 201–209. https://doi.org/10.1037/h0090947

Fisher, W. W., Piazza, C. C., Bowman, L. G., & Amari, A. (1996). Integrating caregiver report with a systematic choice assessment. *American Journal on Mental Retardation, 101*(1), 15-25. Retrieved from https://pubmed.ncbi.nlm.nih.gov/8827248/

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A

comparison of two approaches for identifying reinforcers for person with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25,* 491-498. https://doi.org/10.1901/jaba.1992.25-491

Francisco, M. T., Borrero, J. C., & Sy, J. R. (2008). Evaluation of absolute and relative reinforcer value using progressive-ratio schedules. *Journal of Applied Behavior Analysis*, *41*(2), 189–202. https://doi.org/10.1901/jaba.2008.41-189

Glover, A. C., Roane, H. S., Kadey, H. J., & Grow, L. L. (2008). Preference for reinforcers under progressive- and fixed-ratio schedules: a comparison of single and concurrent arrangements. *Journal of Applied Behavior Analysis*, *41*(2), 163–176. https://doi.org/10.1901/jaba.2008.41-163

Graff, R. B., & Gibson, L. (2003). Using pictures to assess reinforcers in individuals with developmental disabilities. *Behavior Modification, 27*, 470-483. https://doi.org/10.1177/0145445503255602

Graff, R. B., Gibson, L., & Galiatsatos, G. T. (2006). The impact of high- and low-preference stimuli on vocational and academic performances of youths with severe disabilities. *Journal of Applied Behavior Analysis*, *39*, 131-135. https://doi.org/10.1901/jaba.2006.32-05

Groskreutz, M. P., & Graff, R. B. (2009). Evaluating pictorial preference assessment: The effect of differential outcomes on preference assessment results. *Research in Autism Spectrum Disorders, 3*, 113-128. https://doi.org/10.1016/j.rasd.2008.04.007

Hagopian, L. P., Long E. S., Rush, K. S. (2004). Preference assessment procedures for individuals with developmental disabilities. *Behavior Modification*, *28*(5), 668-77. https://doi.org/10.1177/0145445503259836

Hanley, G. P., Iwata. B. A., & Lindberg, J. S. (1999). Analysis of activity preferences as a function of differential consequences. *Journal of Applied Behavior Analysis, 32,* 419-435. https://doi.org/10.1901/jaba.1999.32-419

Heinicke, M. R., Carr, J. E., Eastridge, D., Kupfer, J., & Mozzoni, M. P. (2013). Assessing preferences of individuals with acquired brain injury using alternative stimulus modalities. *Brain Injury, 27*(1), 48–59. https://doi.org/10.3109/02699052.2012.722250

Heinicke, M. R., Carr, J. E., Pence, S.T., Zias, D. R., Valentino, A. L., & Falligant, J. M. (2016). Assessing the efficacy of pictorial preference assessments for children with developmental disabilities. *Journal of Applied Behavior Analysis, 49*(4), 848-868. https://doi.org/10.1002/jaba.342

Heinicke, M. R., Carr, J. E., & Copsey, C. J. (2019). Assessing preferences of individuals with developmental disabilities using alternative stimulus modalities: A systematic review. *Journal of Applied Behavior Analysis, 52,* 847-869. https://doi.org/10.1002/jaba.565

Higbee, T. S., Carr, J. E., & Harrison, C. D. (1999). The effects of pictorial versus tangible stimuli in stimulus-preference assessments. *Research in Developmental Disabilities, 20,* 63-72. https://doi.org/10.1016/S0891-4222(98)00032-8

Horrocks, E. L., & Morgan, R. L. (2009). Comparison of a video-based assessment and a multiple stimulus assessment to identify preferred jobs for individuals with significant intellectual disabilities. *Research in Developmental Disabilities, 30,* 902-909. https://doi.org/10.1016/j.ridd.2009.01.003

Huntington, R. N., & Higbee, T. S. (2017). The effectiveness of a video based preference assessment in identifying social reinforcers. *European Journal of Behavior Analysis, 19*(1), 1-14. https://doi.org/10.1080/15021149.2017.1404397

Jerome, J., & Sturmey, P. (2008). Reinforcing efficacy of interactions with preferred and nonpreferred staff under progressive-ratio schedules. *Journal of Applied Behavior Analysis, 41*, 221-225. https://doi.org/10. 1901/jaba.2008.41-221

Jerome, J., & Sturmey, P. (2014). The effects of pairing non-preferred staff with preferred stimuli on increasing the reinforcing value of non-preferred staff attention. *Research in Developmental Disabilities, 35*, 849- 860. https://doi.org/10.1016/j.ridd.2014.01.014

Kang, S., O'reilly, M., Lancioni, G., Falcomata, T. S., Sigafoos, J., & Xu, Z. (2013). Comparison of the predictive validity and consistency among preference assessment procedures: A review of the literature. *Research in Developmental Disabilities*, *34*(4), 1125–1133. https://doi.org/10.1016/j.ridd.2012.12.021

Kelly, M. A., Roscoe, E. M., Hanley, G. P., & Schlichenmeyer, K. (2014). Evaluation of assessment methods for identifying social reinforcers. *Journal of Applied Behavior Analysis, 47*, 113-135. https://doi.org/10.1002/jaba.107

Kerr, N., Meyerson, L., Flora, J., Tharinger, D., Schallert, D., Casey, L., & Fehr, M. J. (1977). The measurement of motor, visual and auditory discrimination skills in mentally retarded children and adults and in young normal children. *Rehabilitation Psychology*, *24*(3), 91–206. https://doi.org/10.1037/h0090912

Krus, D., Bart, W. M., & Airasian, P. (1975). Ordering theory and methods. Theta Press.

Lee, M. S., Nguyen, D., Yu, C. T., Thorsteinsson, J. R., Martin, T. L., & Martin, G. L. (2008). Discrimination skills predict effective preference assessment methods for adults with developmental disabilities. *Education and Training in Developmental Disabilities, 43*, 388-396. https://www.jstor.org/stable/23879799

MacPherson, L. F., Sousa, C. G., Thompson, K. M., Martin, T. L., Salem, S., Martin, G. L., &

Yu, C. T. (2011). Does the Assessment of Basic Learning Abilities Predict Four-Choice Discrimination Learning for Persons with Developmental Disabilities? *Journal on Developmental Disabilities, 17*(1), 60-67. Retrieved from https://oadd.org/wp-content/uploads/2011/01/41009_JoDD_17-1_60-67_McPherson_et_al.pdf

Martin, G. L, Thorsteinsson, J. R, Yu, C.T, Martin, T. L, & Vause, T. (2008). The Assessment of Basic Learning Abilities Test for Predicting Learning of Persons With Intellectual Disabilities: A Review. *Behavior Modification*, *32*(2), 228–247. https://doi.org/10.1177/0145445507309022

Matson, J. L., Bielecki, J., Mayville, E. A., Smalls, Y., Bamburg, J. W., & Baglio, C. S. (1999). The development of a reinforcer choice assessment scale for persons with severe and profound mental retardation. *Research in Developmental Disabilities*, *20*(5), 379–384. https://doi.org/10.1016/S0891-4222(99)00018-9

Mechling, L. C., & Moser, S. V. (2010). Video Preference Assessment of Students with Autism for Watching Self, Adults, or Peers. *Focus on Autism and Other Developmental Disabilities*, *25*(2), 76–84. https://doi.org/10.1177/1088357610364392

Michalyshyn, C. A., Lee, M. S. H., Yu, C. T., & Martin, G. L. (2016). Concordance between choice presentation modes and discrimination skills of people with developmental disabilities. *Journal on Developmental Disabilities, 22*(1), 10-16. Retrieved from https://oadd.org/wp-content/uploads/2016/12/41022_JoDD_22-1_v10f_10-16_Michalyshyn_et_al.pdf

Morris, S. L., & Vollmer, T.R. (2020). A comparison of picture and GIF-based preference assessments for social interaction. *Journal of Applied Behavior Analysis, 53*(3), 1452-1465. https://doi.org/10.1002/jaba.680

Mudford, O. C., Martin, N. T., Hui, J. K., & Taylor, S. A. (2009). Assessing observer accuracy in continuous recording of rate and duration: Three algorithms compared. *Journal of Applied Behavior Analysis*, *42*, 527–539. https://doi.org/10.1901/jaba.2009.42-527

Murphy, C., Martin, G. L., & Yu, C. T. (2014). The predictive validity of the assessment of basic learning abilities versus parents' predictions with children with autism. *Education and Training in Autism and Developmental Disabilities, 49*(4), 601-611. Retrieved from http://www.jstor.org/stable/24582355

Nguyen, D. M., Yu, C. T., Martin, T. L., Fregeau, P., Pogorzelec, C., & Martin, G. L. (2009). Teaching object-picture making to improve concordance between object and picture preferences for individuals with developmental disabilities: Pilot study. *Journal on Developmental Disabilities, 15*, 53-64. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3607582/

Northup, J., George, T., Jones, K., Broussard, C. and Vollmer, T.R. (1996). A comparison of reinforcer assessment methods: The utility of verbal and pictorial choice procedures. *Journal of Applied Behavior Analysis*, 29, 201-212. https://doi.org/10.1901/jaba.1996.29-201

Nuernberger, J. E., Smith, C. A., Czapar, K. N., & Klatt, K. P. (2012). Assessing preference for social interaction in children diagnosed with autism. *Behavioral Interventions, 27*, 33–44. https://doi.org/10. 1002/bin.1336

Pace, G. M., Ivancic, M. T., Edwards, G. L., Iwata, B. A., & Page, T. J. (1985). Assessment of stimulus preference and reinforcer value with profoundly retarded individuals. *Journal of Applied Behavior Analysis*, *18*(3), 249–255. https://doi.org/10.1901/jaba.1985.18-249

Paramore, N.W., & Higbee, T.S. (2005). An evaluation of a brief multiple-stimulus preference assessment with adolescents with emotional-behavioral disorders in an educational setting. Journal of Applied Behavior Analysis, 38, 399-403. https://doi.org/10.1901/jaba.2005.76-04

Parsons, M. B., Harper, V. N., Jensen, J. M., & Reid, D. H. (1997). Assisting older adults with severe disabilities in expressing leisure preferences: A protocol for determining choice-making skills. *Research in Developmental Disabilities, 18*, 113-126. https://doi.org/10.1016/S0891-4222(96)00044-3

Reyer, H. S., & Sturmey, P. (2006). The assessment of basic learning abilities (ABLA) test predicts the relative efficacy of task preferences for persons with developmental disabilities. *Journal of Intellectual Disability Research, 50*, 404-409. https://doi.org/10.1111/j.1365-2788.2005.00780.x

Roane, H. S., Lerman, D. C., & Vorndran, C. M. (2001). Assessing reinforcers under progressive schedule requirements. *Journal of applied behavior analysis*, *34*(2), 145–166. https://doi.org/10.1901/jaba.2001.34-145

Roane, H. S., Vollmer, T. R., Ringdahl, J. E., & Marcus, B. A. (1998). Evaluation of a brief stimulus preference assessment. *Journal of Applied Behavior Analysis, 31*(4), 605–620. https://doi.org/10.1901/jaba.1998.31-605

Roscoe, E. M., Iwata, B. A., & Kahng, S. (1999). Relative versus absolute reinforcement effects: implications for preference assessments. *Journal of Applied Behavior Analysis*, *32*(4), 479–493. https://doi.org/10.1901/jaba.1999.32-479

Saini, V., Retzlaff, B., Roane, H.S., & Piazza, C.C. (2021). Identifying and enhancing the effectiveness of positive reinforcement. In W.Fisher, C. Piazza, & H. Roane (Eds.), *Handbook of Applied Behavior Analysis* (pp. 175-192). New York: The Guilford Press.

Schwartzman, L., Yu, C. T., & Martin, G. L. (2003). Choice responding as a function of choice presentation method and level of preference in persons with developmental disabilities. *International Journal of Disability, Community, and Rehabilitation, 1*, 1-7.

Snyder, K., Higbee, T. S., & Dayton, E. (2012). Preliminary investigation of a video-based stimulus preference assessment. *Journal of Applied Behavior Analysis*, *45*(2), 413–418. https://doi.org/10.1901/jaba.2012.45-413

Vause, T., Yu, C.T. and Martin, G.L. (2007), The Assessment of Basic Learning Abilities Test for Persons with Intellectual Disability: A Valuable Clinical Tool. *Journal of Applied Research in Intellectual Disabilities, 20*(5), 483-489. https://doi.org/10.1111/j.1468-3148.2007.00351.x

Wacker, D. P., Steil, D. A., & Greenebaum, F. T. (1983). Assessment of discrimination skills of multiply-handicapped preschoolers and prediction of classroom task performance. *Journal of the Association for the Severely Handicapped, 8*, 65-78. https://doi.org/10.1177/154079698300800207

Windsor, J., Piché, L. M., & Locke, P. A. (1994). Preference testing: A comparison of two presentation methods. *Research in Developmental Disabilities, 15*, 439-455. https://doi.org/10.1016/0891-4222(94)90028-0

Wolfe, K., Kunnavatana, S. S., & Shoemaker, A. M. (2018). An investigation of a video-based preference assessment of social interactions. *Behavior Modification, 42*(5), 729–746. https://doi.org/10.1177/0145445517731062

Figures

Figure 1. Libby's Combined Rank across Session Blocks

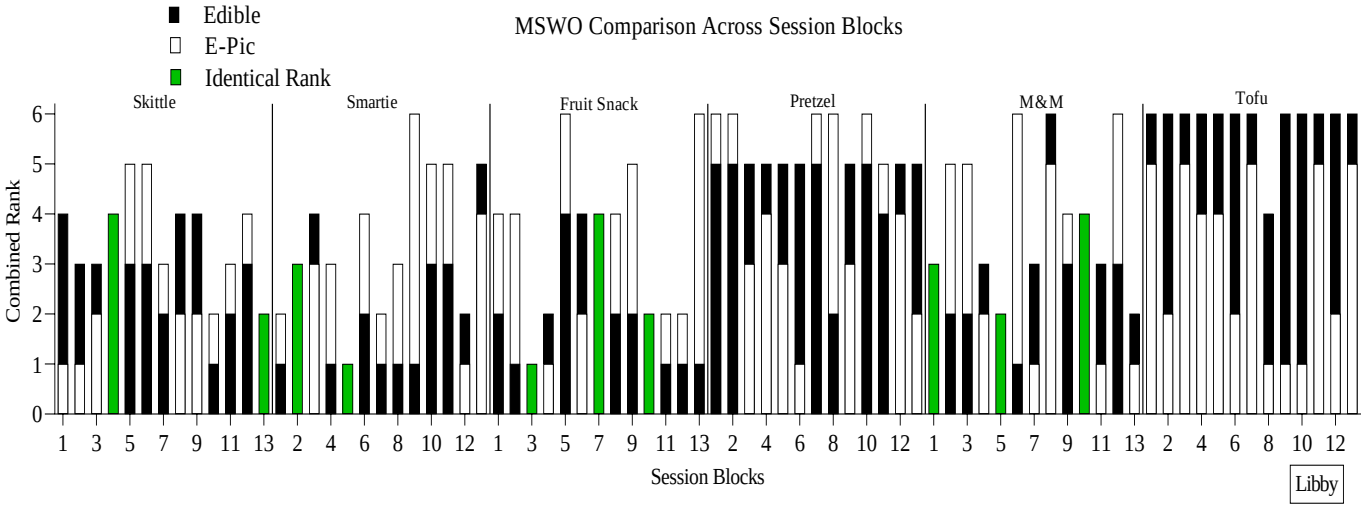

Figure 2. Libby's Aggregate Task Completion across Session Blocks

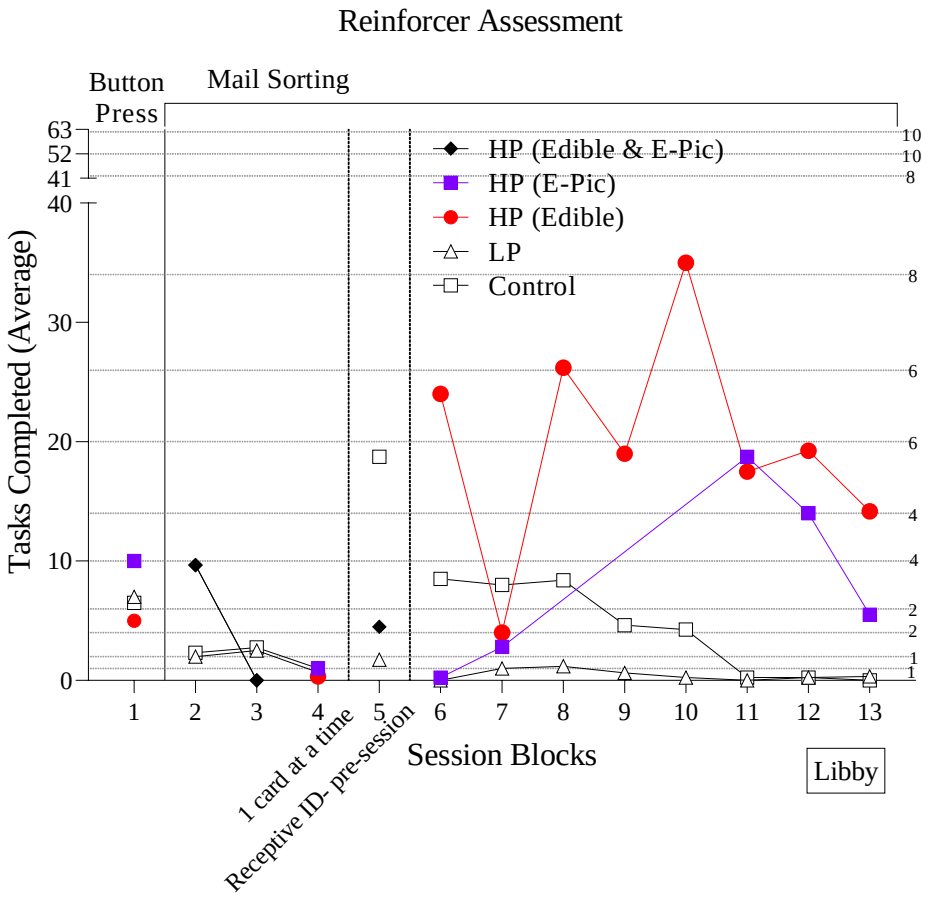

Figure 3. Libby's Results Session Blocks 1-3. (MSWO on Left; RA on Right)

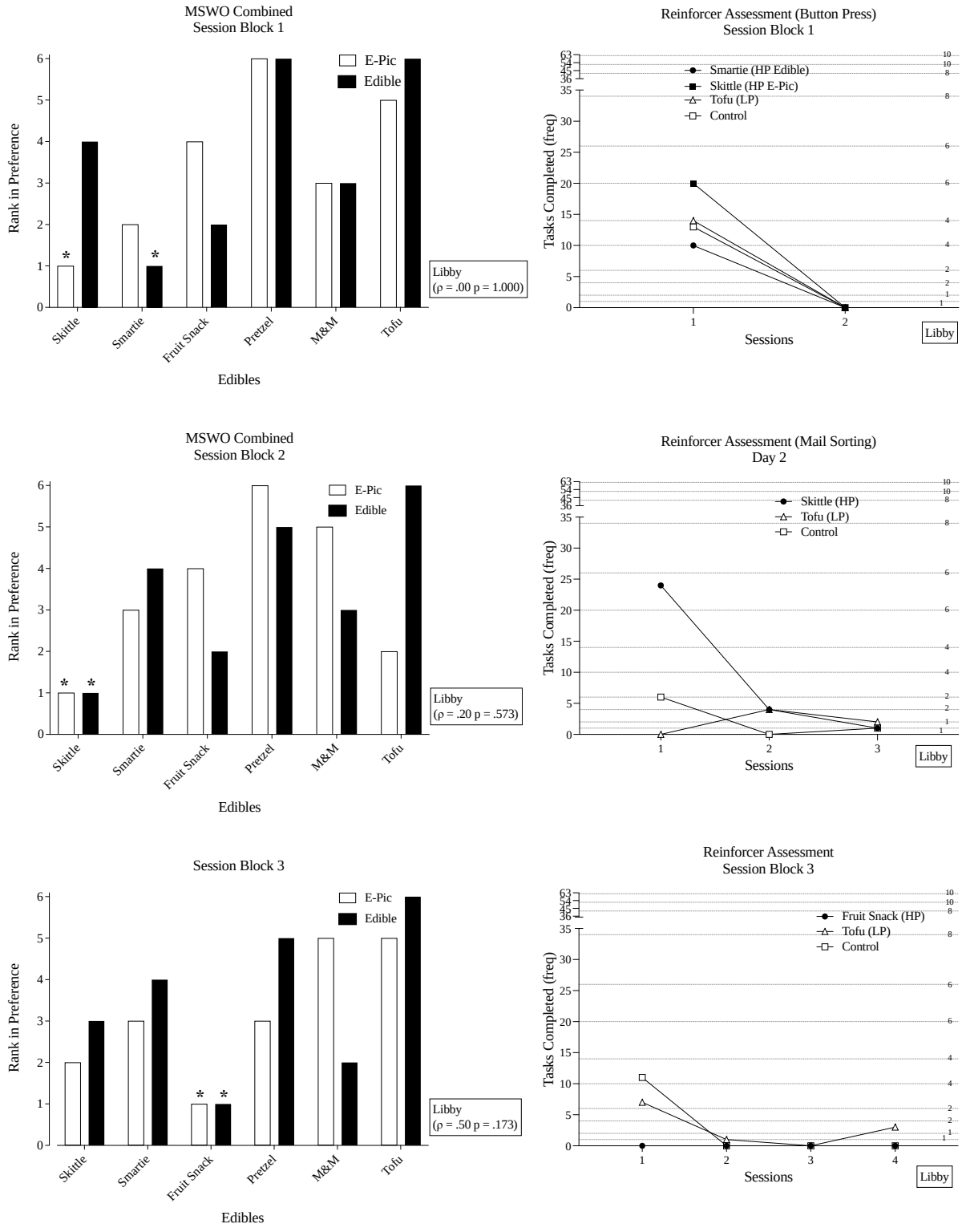

Figure 4. Libby's Results Session Blocks 4-6. (MSWO on Left; RA on Right)

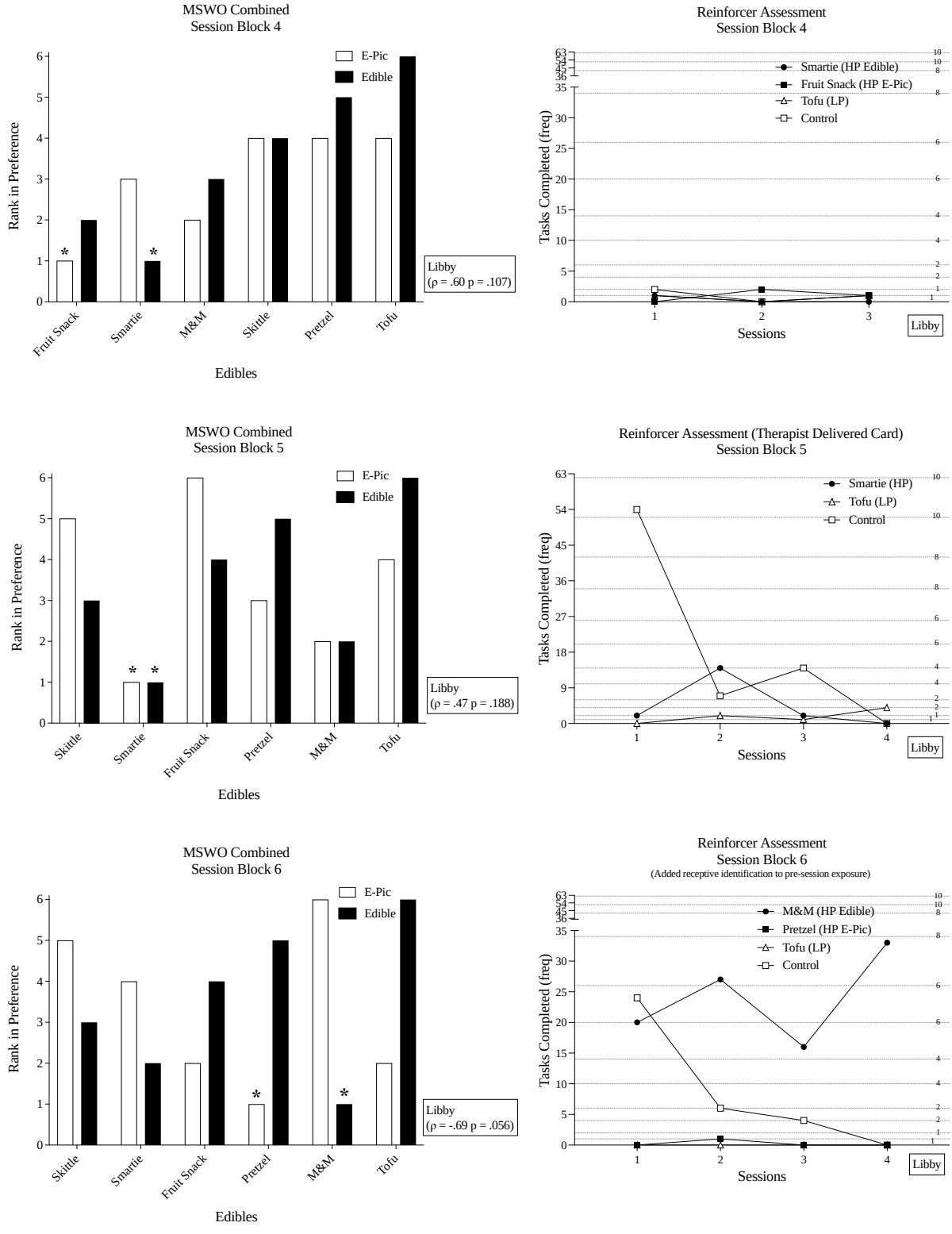

Figure 5. Libby's Results Session Blocks 7-9. (MSWO on Left; RA on Right)

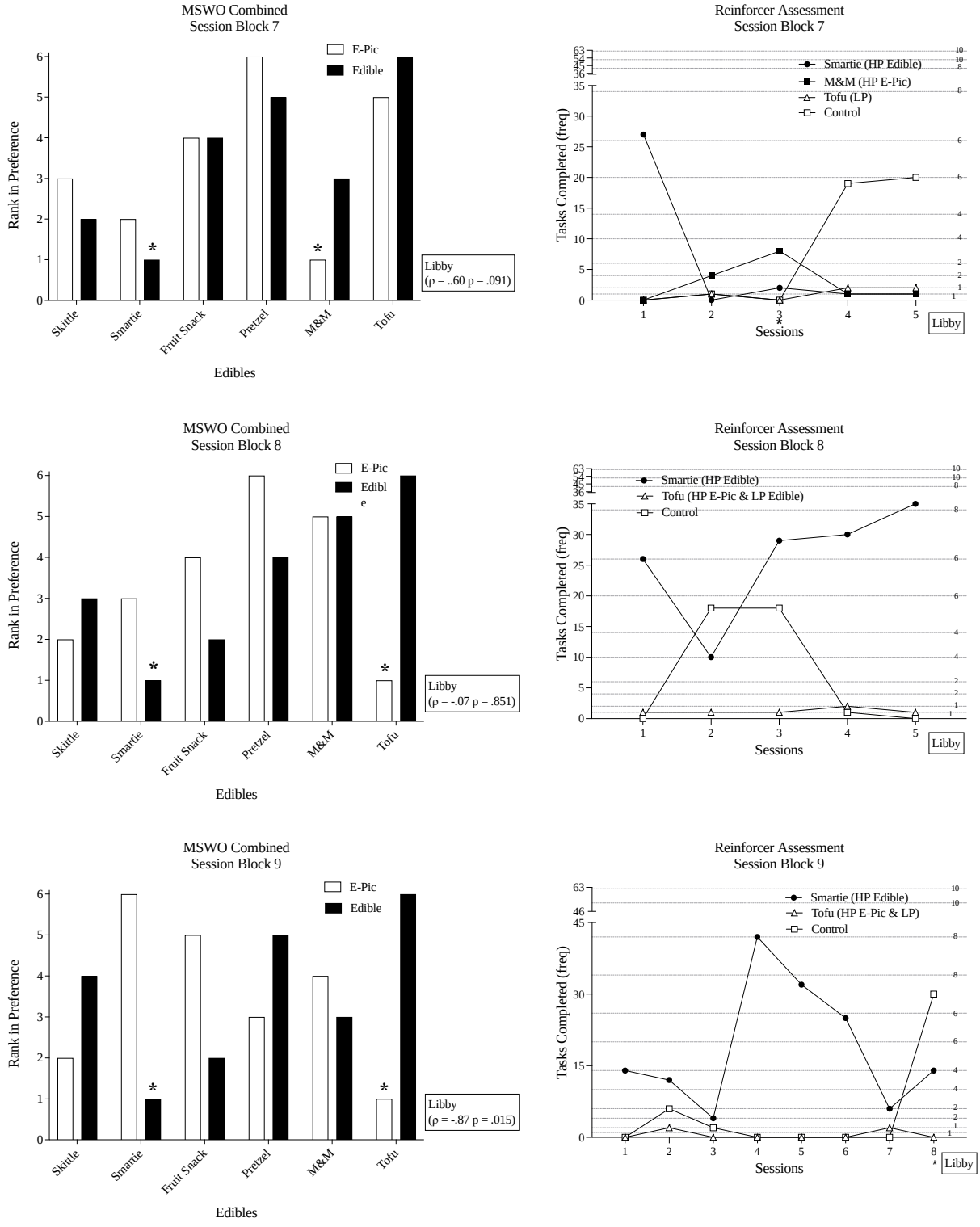

Figure 6. Libby's Results Session Blocks 10-12. (MSWO on Left; RA on Right)

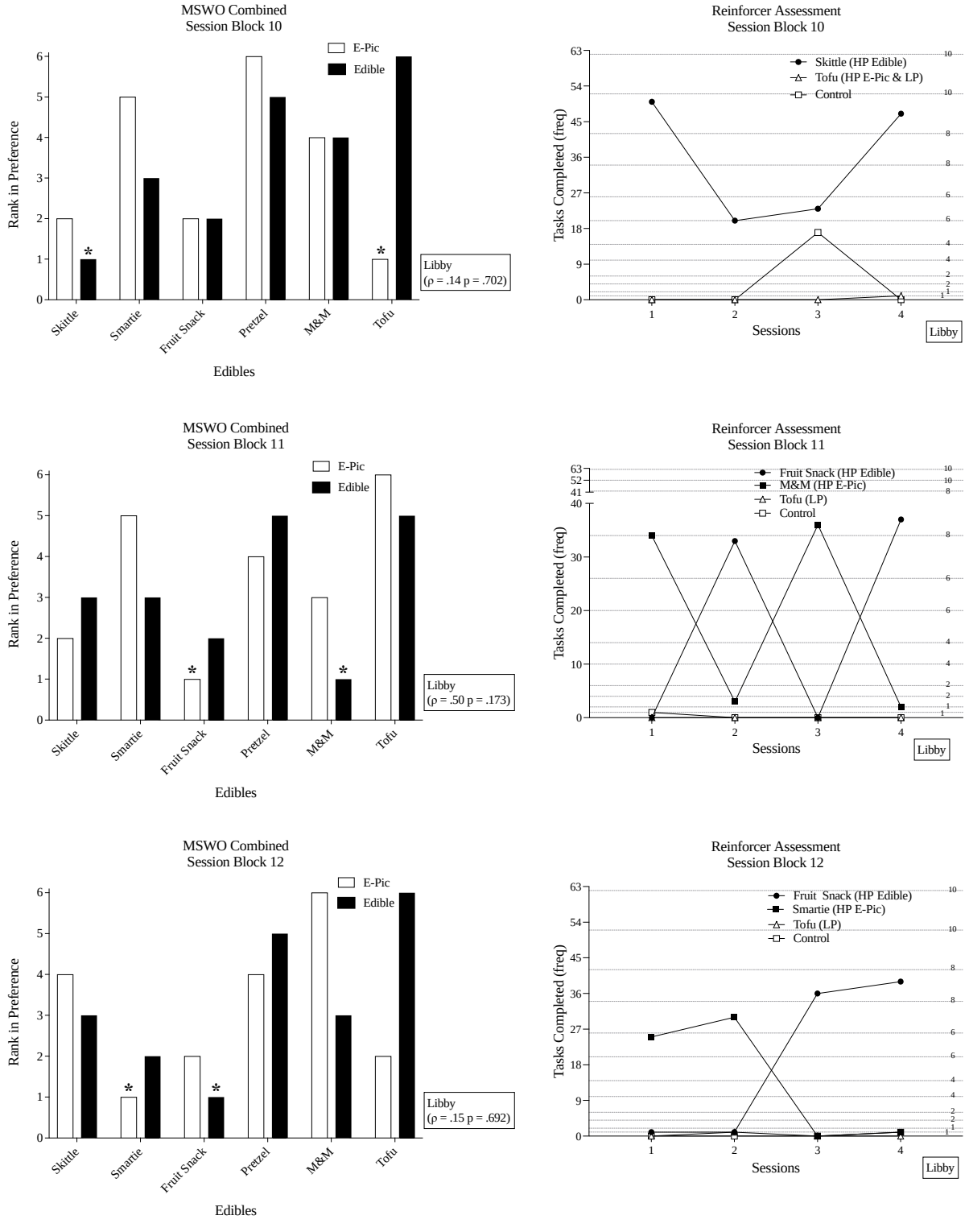

Figure 7. Libby's Results Session Block 13. (MSWO on Left; RA on Right)

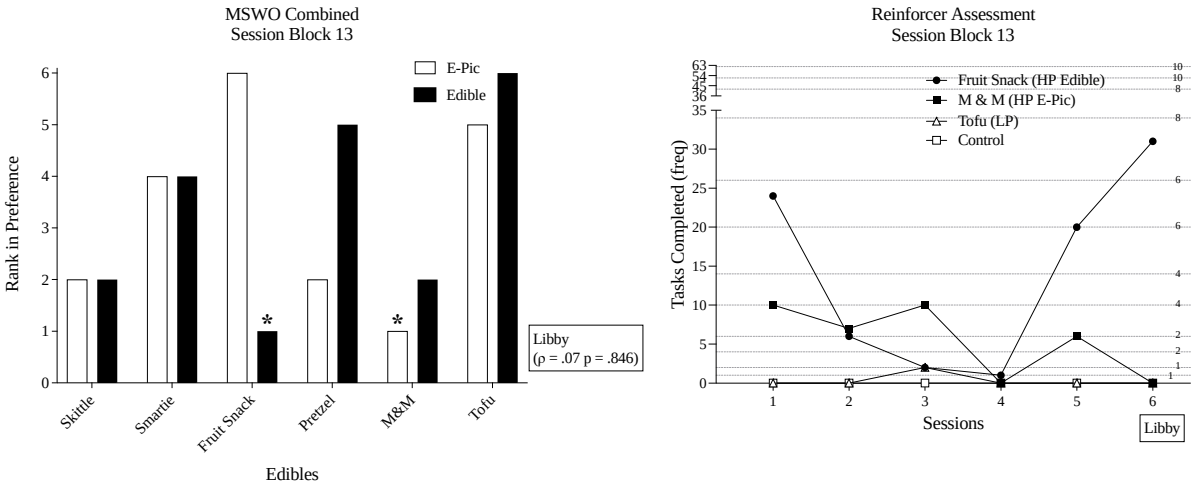

Figure 8. Maddy's Combined Rank across Session Blocks

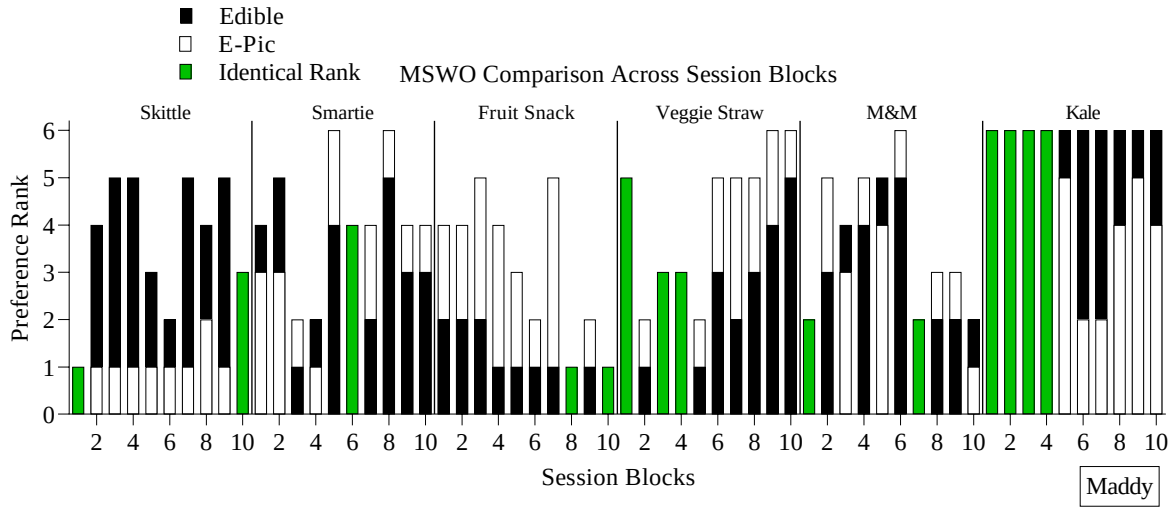

Figure 9. Maddy's Aggregate Task Completion across Session Blocks

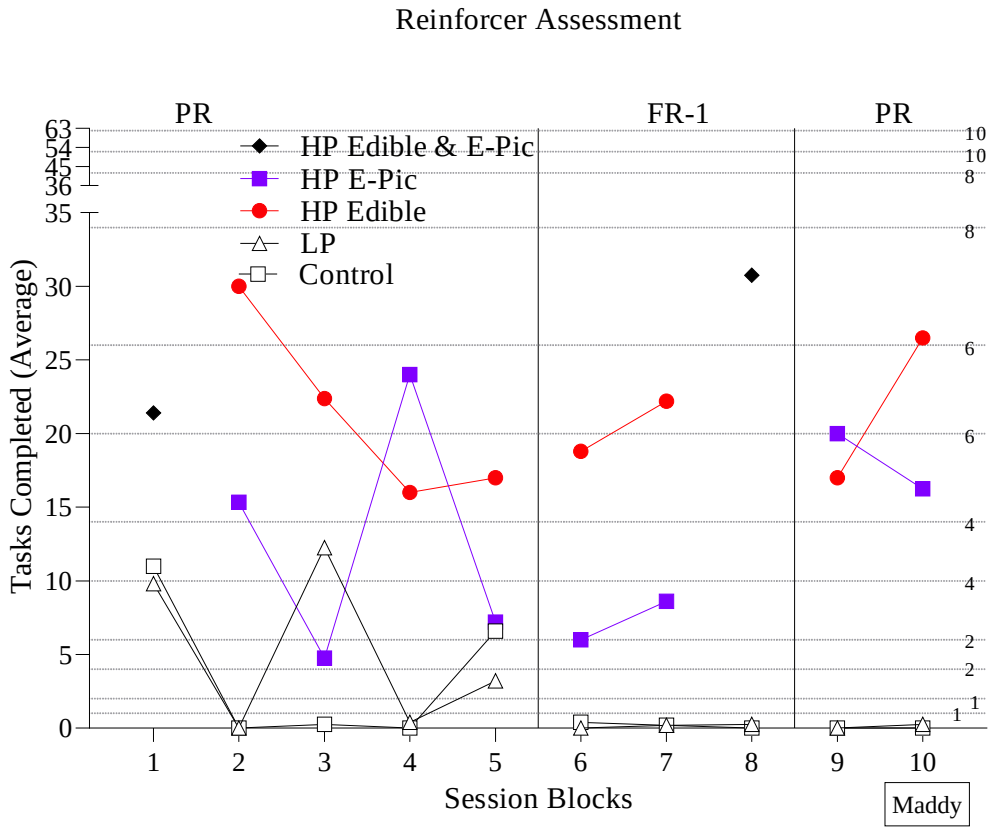

Figure 10. Maddy's Results Session Blocks 1-3. (MSWO on Left; RA on Right)

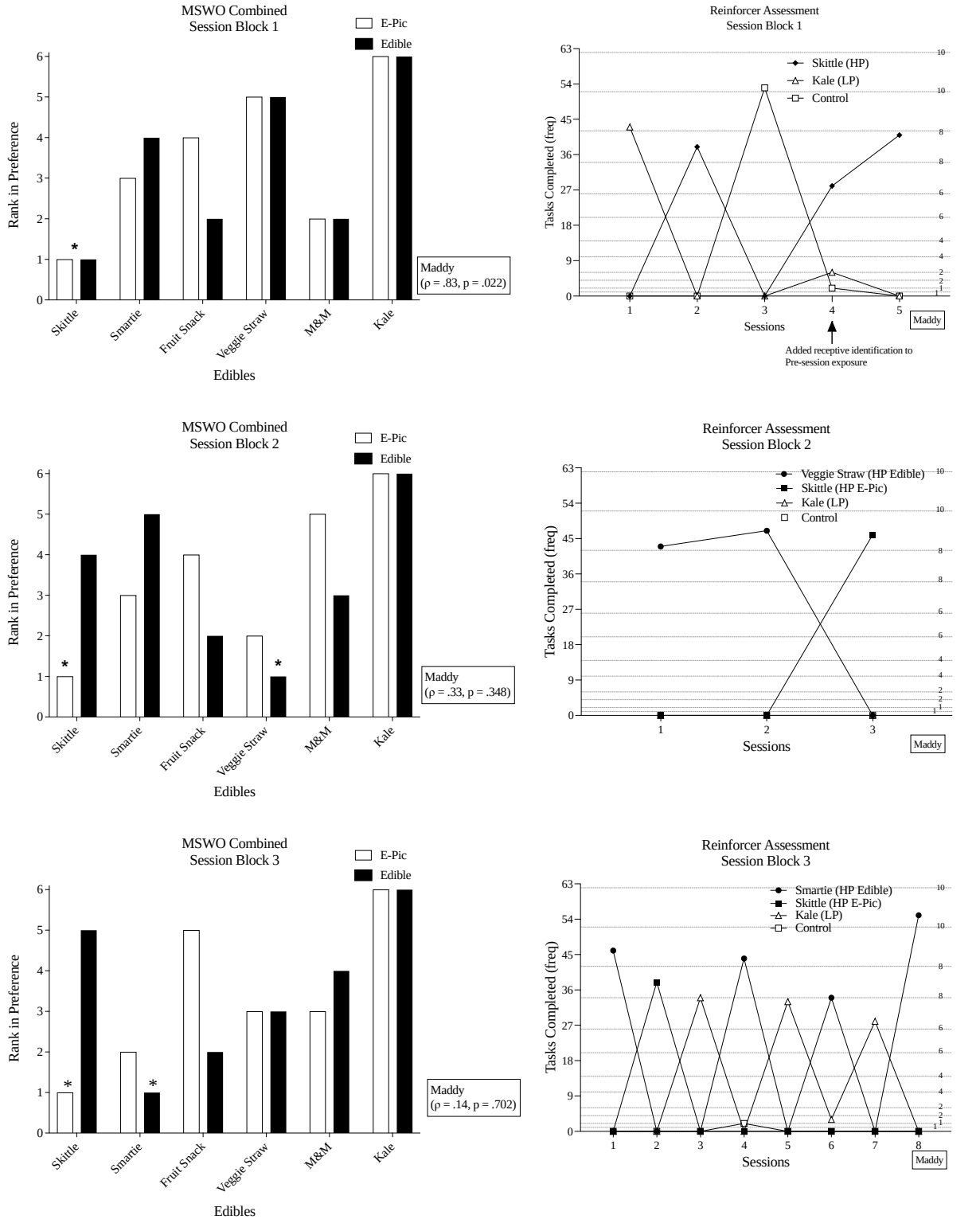

Figure 11. Maddy's Results Session Blocks 4-6. (MSWO on Left; RA on Right)

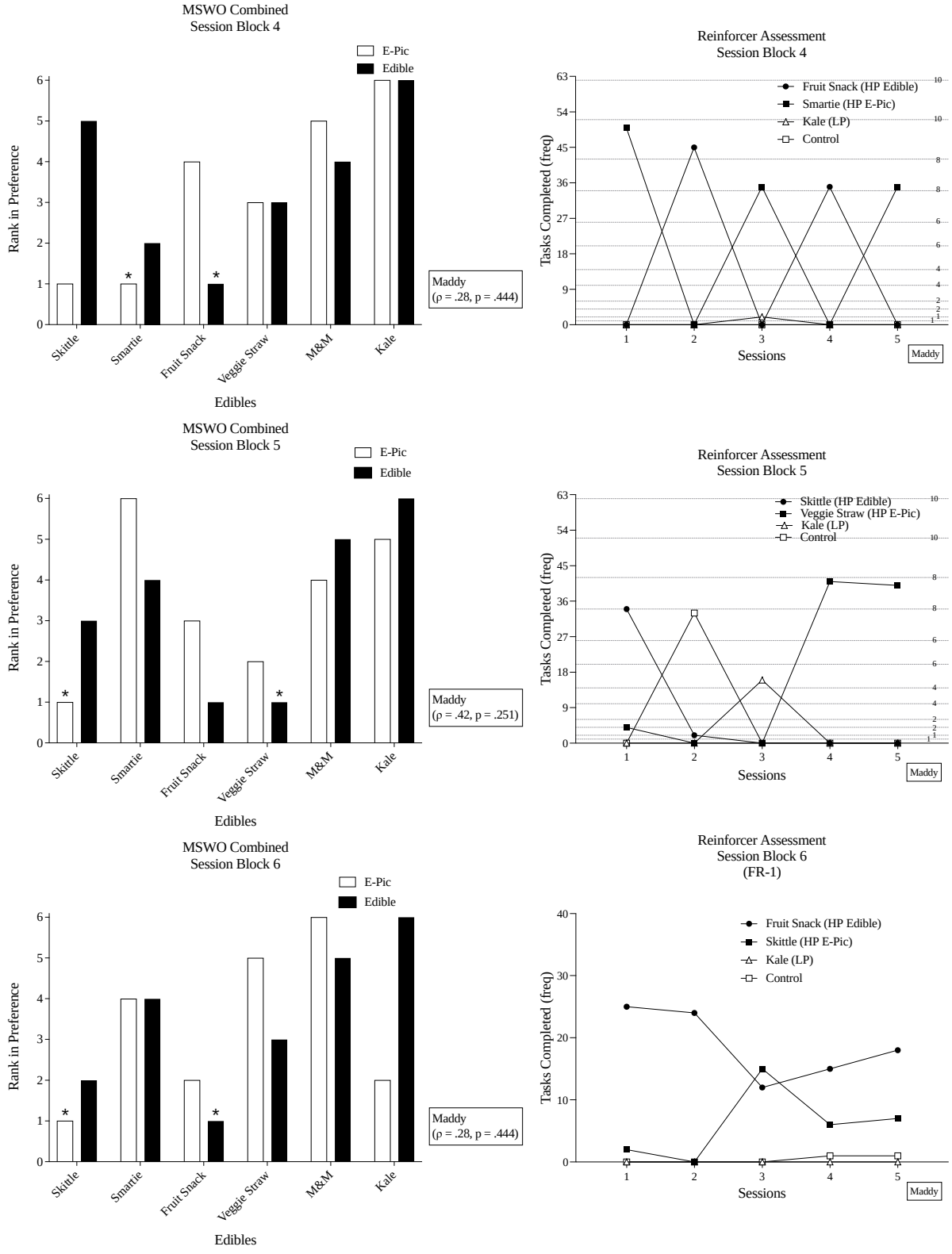

Figure 12. Maddy's Results Session Blocks 7-9. (MSWO on Left; RA on Right)

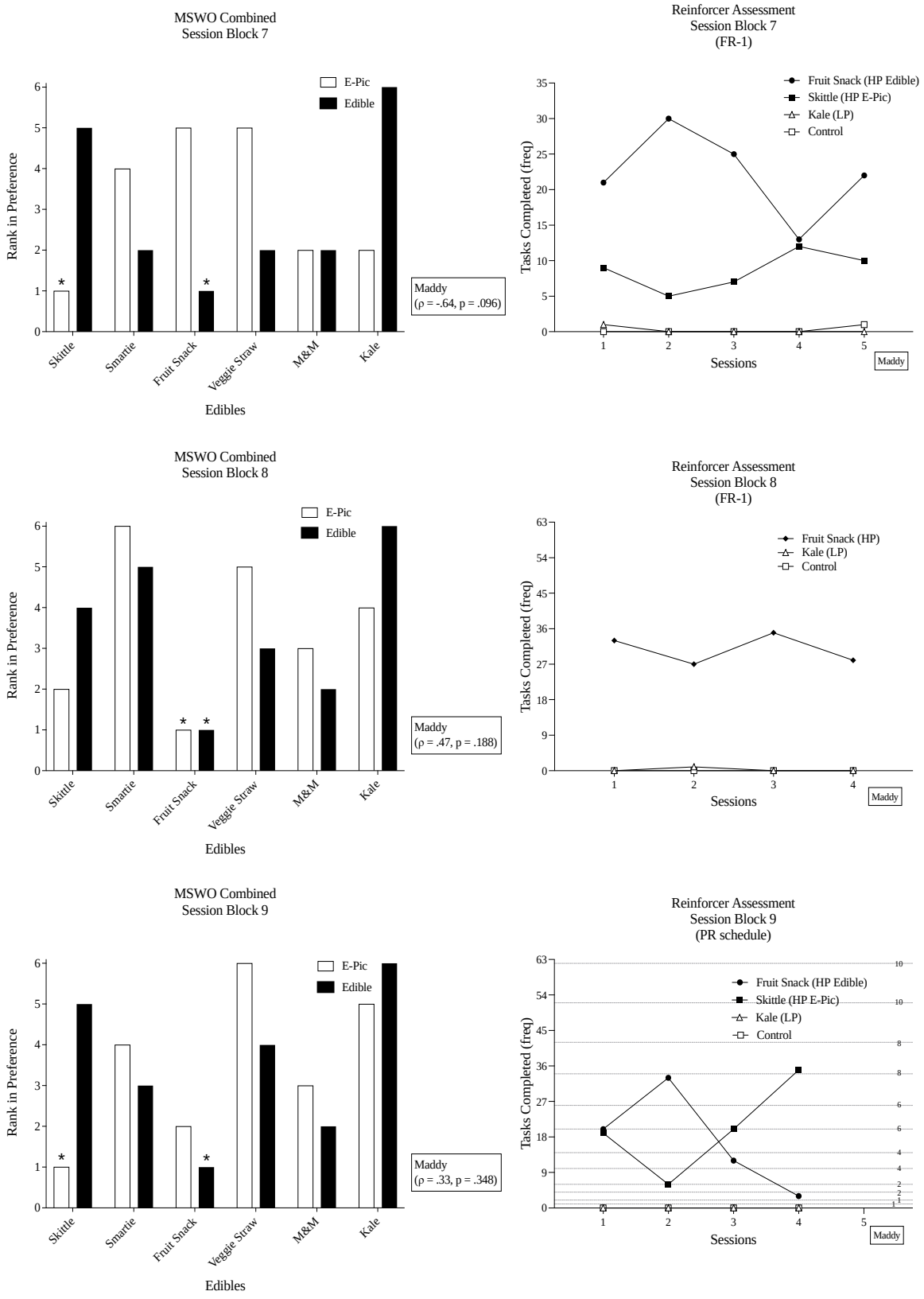

Figure 13. Maddy's Results Session Block 10. (MSWO on Left; RA on Right)

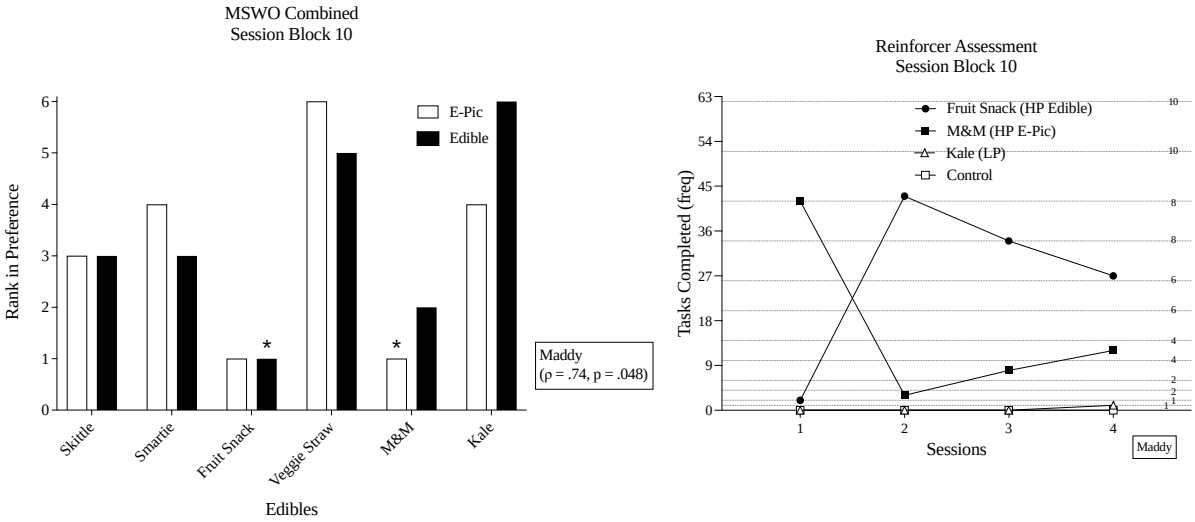

Figure 14. Thomas's Combined Rank across Session Blocks

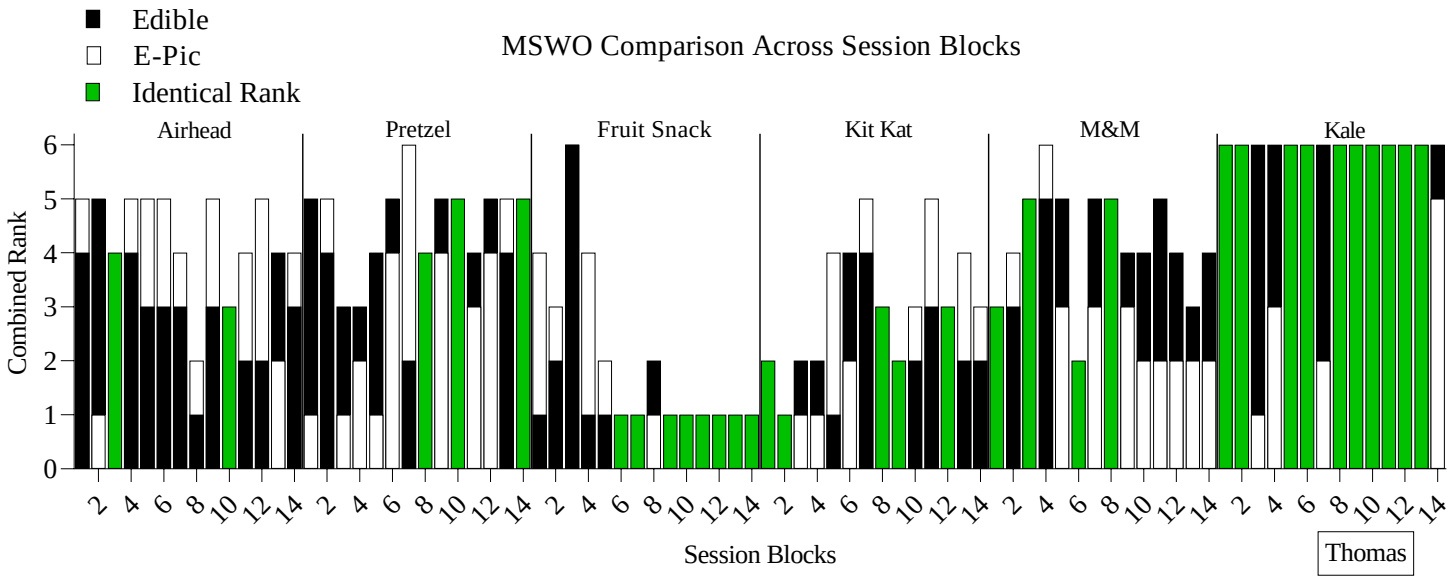

Figure 15. Thomas's Aggregate Task Completion across Session Blocks

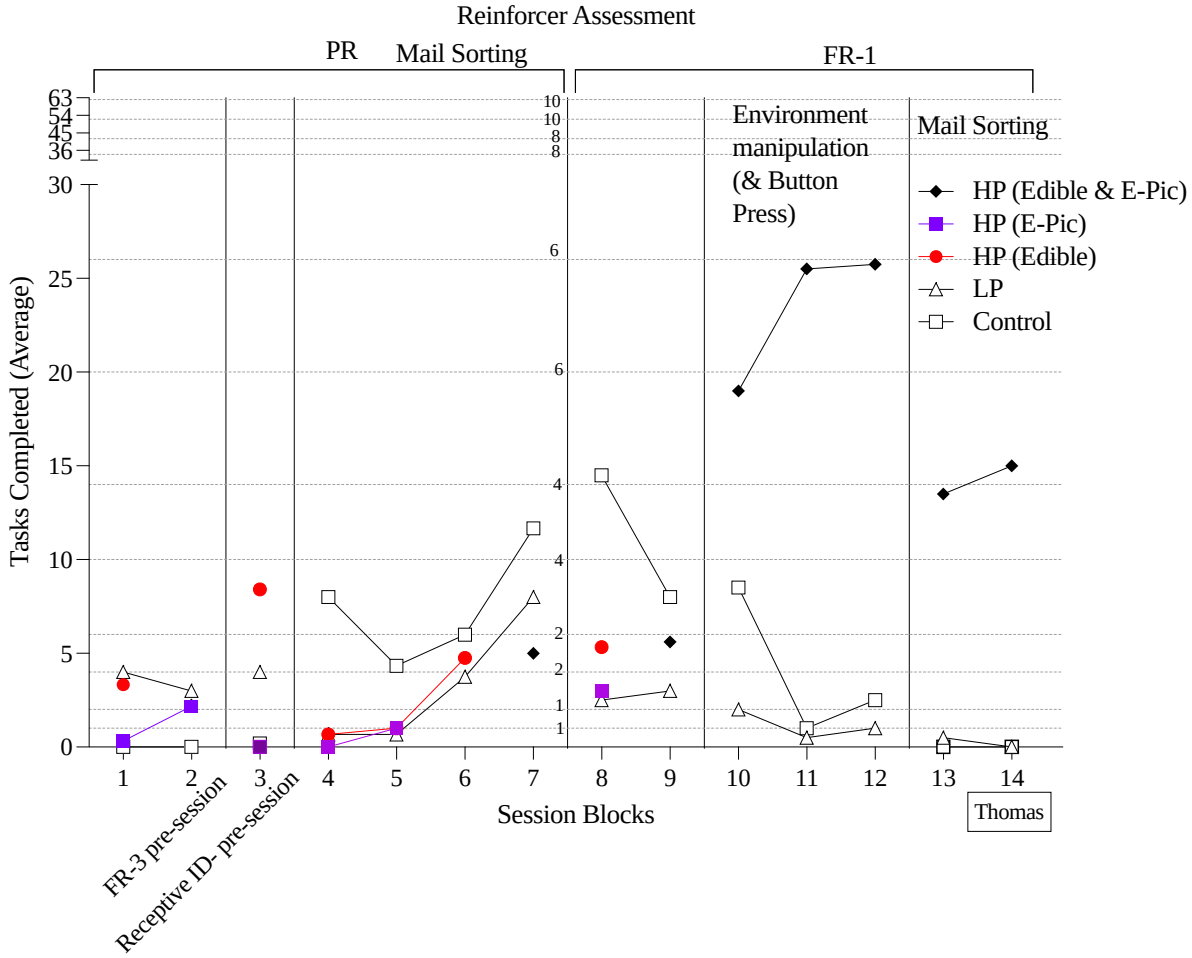

Figure 16. Thomas's Results Session Blocks 1-3. (MSWO on Left; RA on Right)

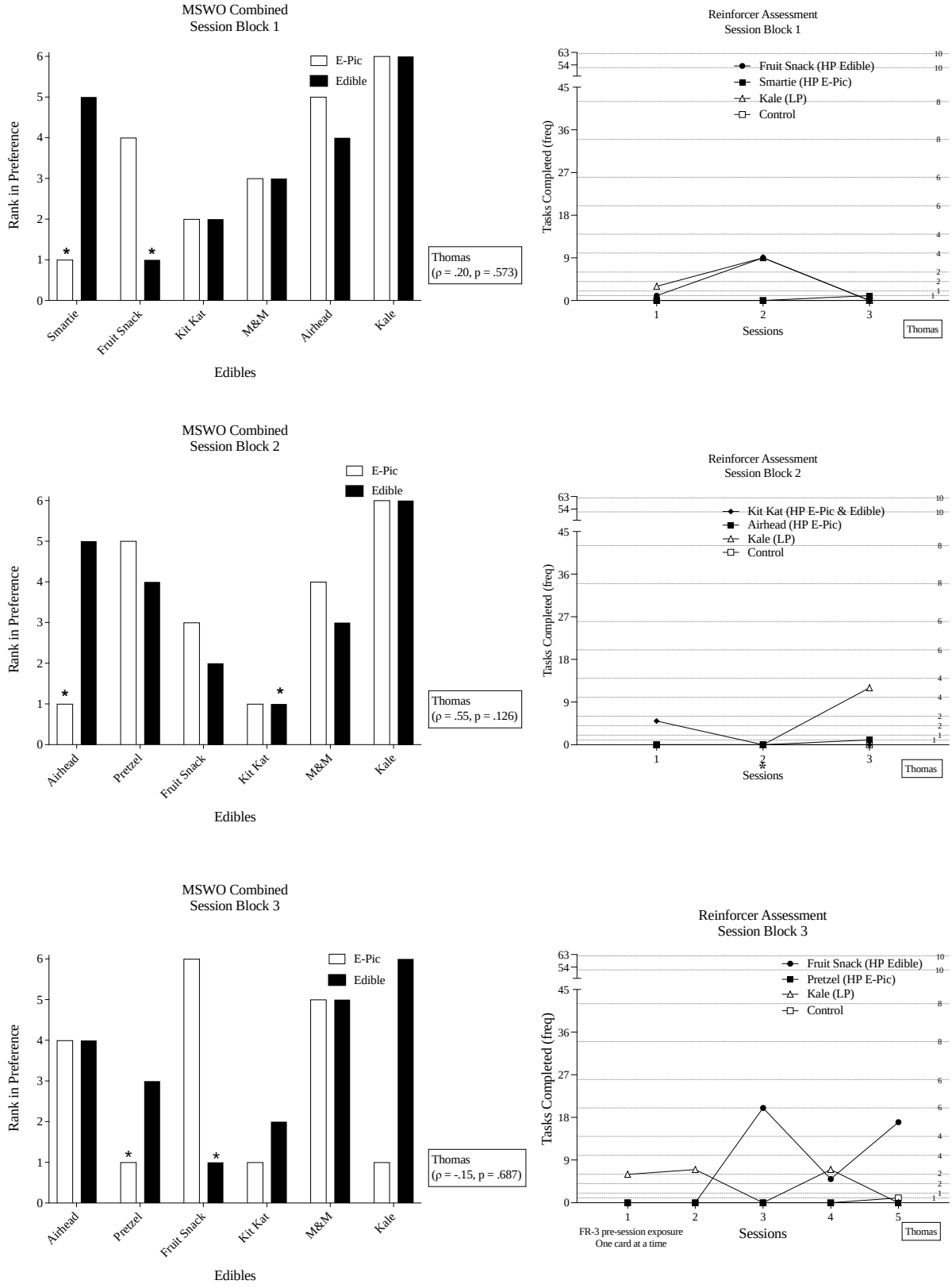

Figure 17. Thomas's Results Session Blocks 4-6. (MSWO on Left; RA on Right)

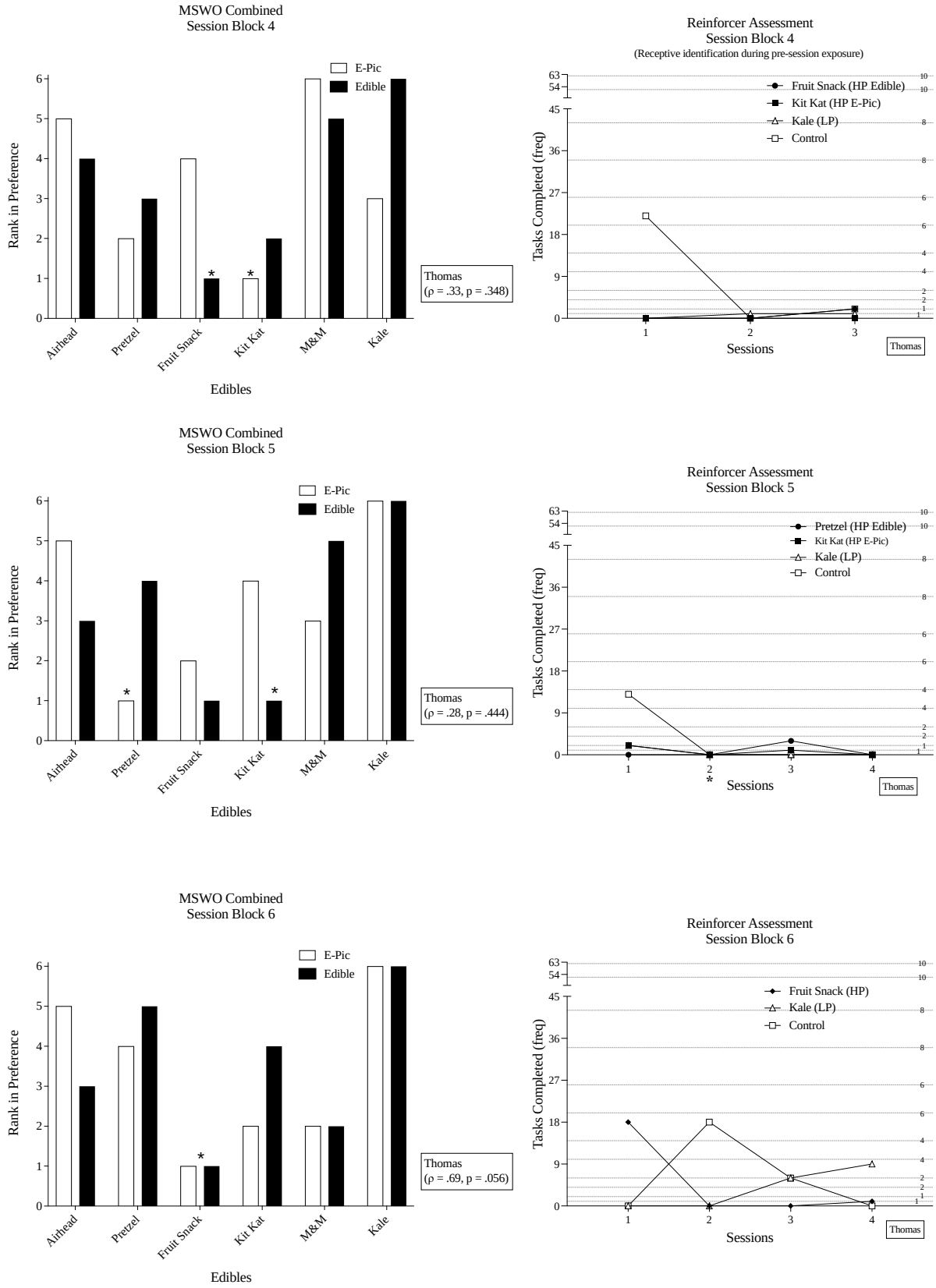

Figure 18. Thomas's Results Session Blocks 7-9. (MSWO on Left; RA on Right)

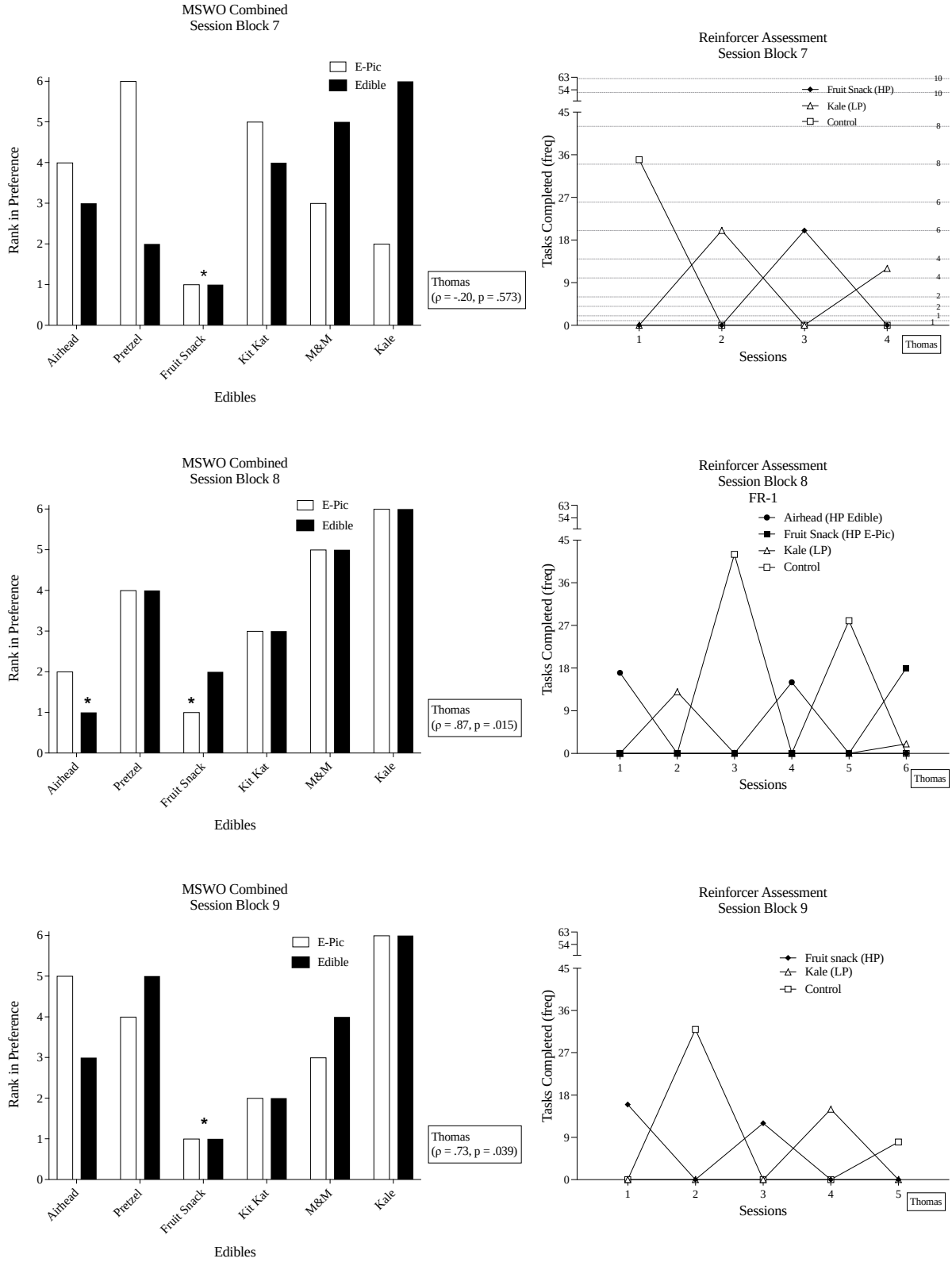

Figure 19. Thomas's Results Session Blocks 10-12. (MSWO on Left; RA on Right)

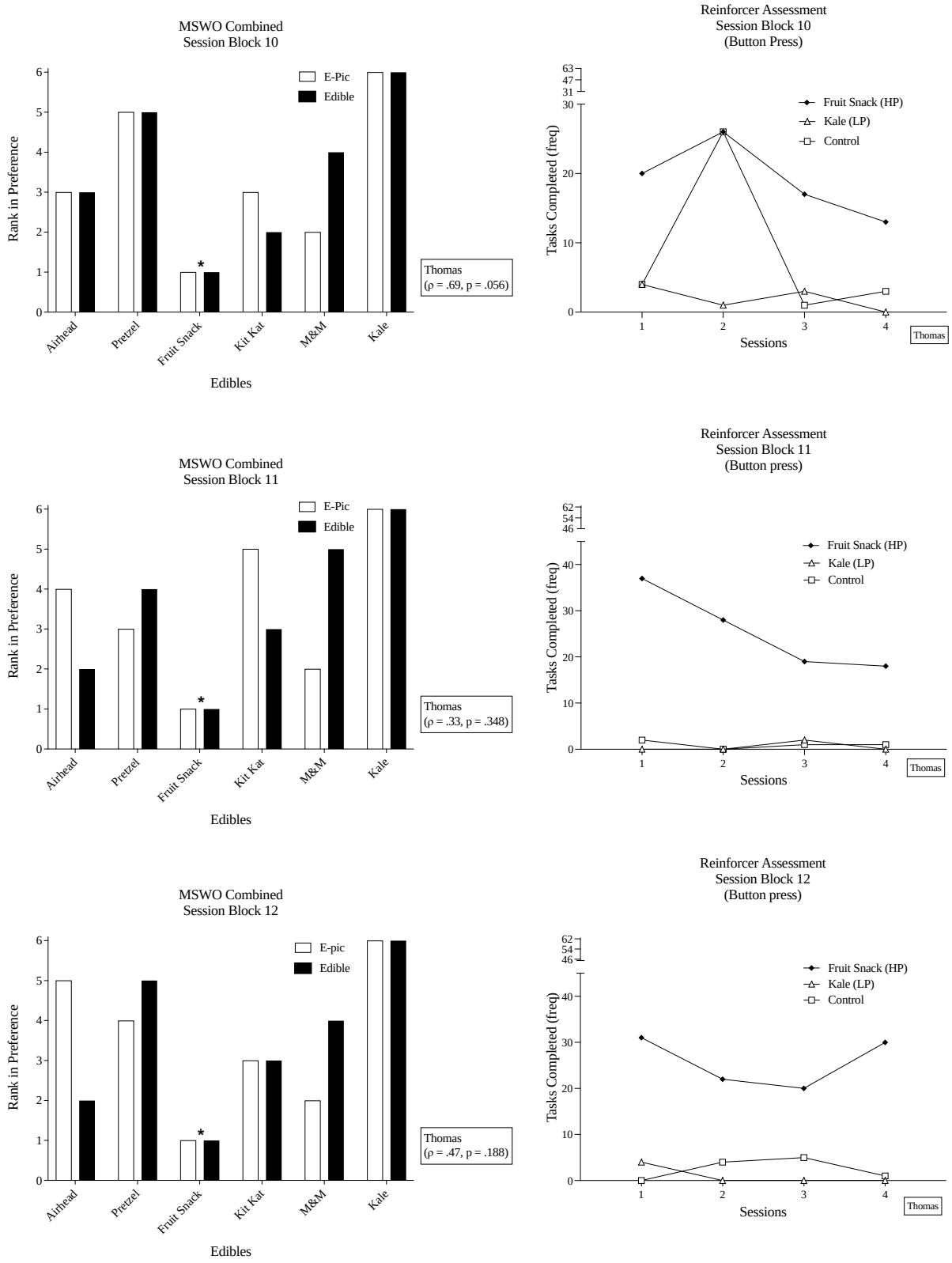

Figure 20. Thomas's Results Session Blocks 13-14. (MSWO on Left; RA on Right)

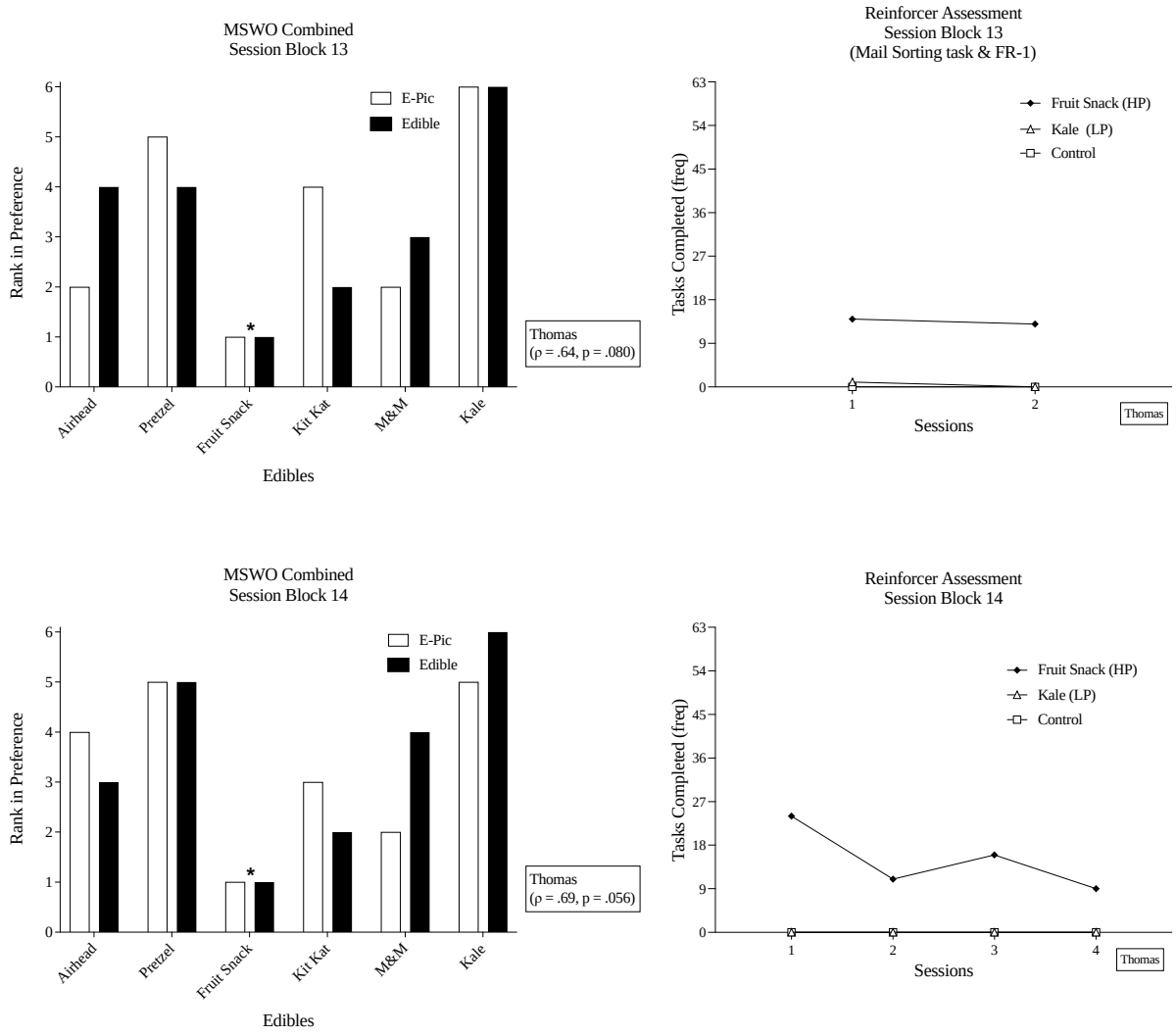

Figure 21. Ellen's Combined Rank across Session Blocks

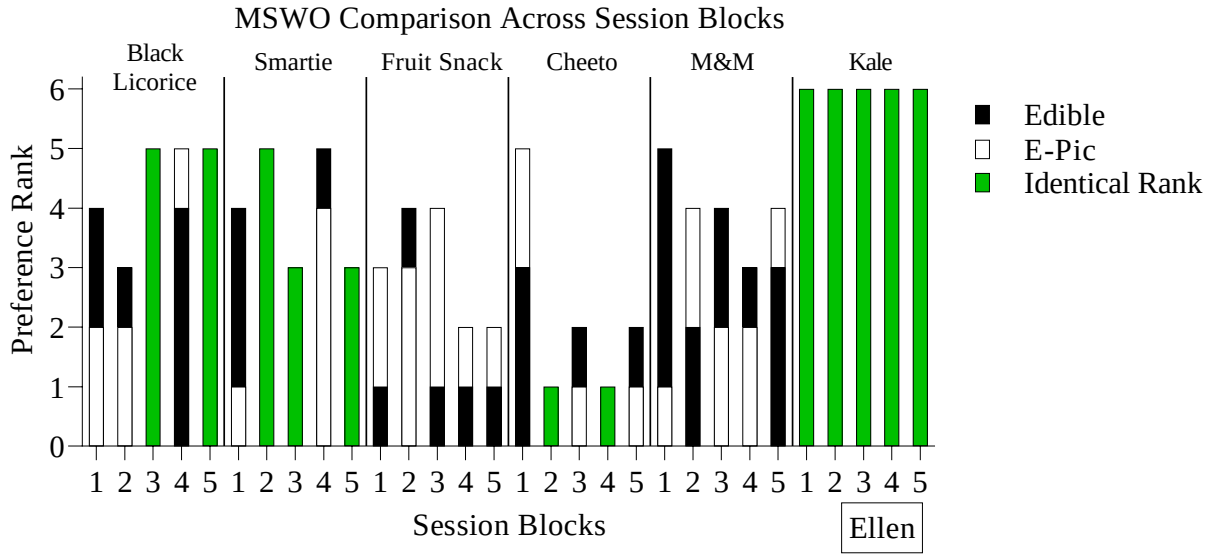

Figure 22. Ellen's Aggregate Task Completion across Session Blocks

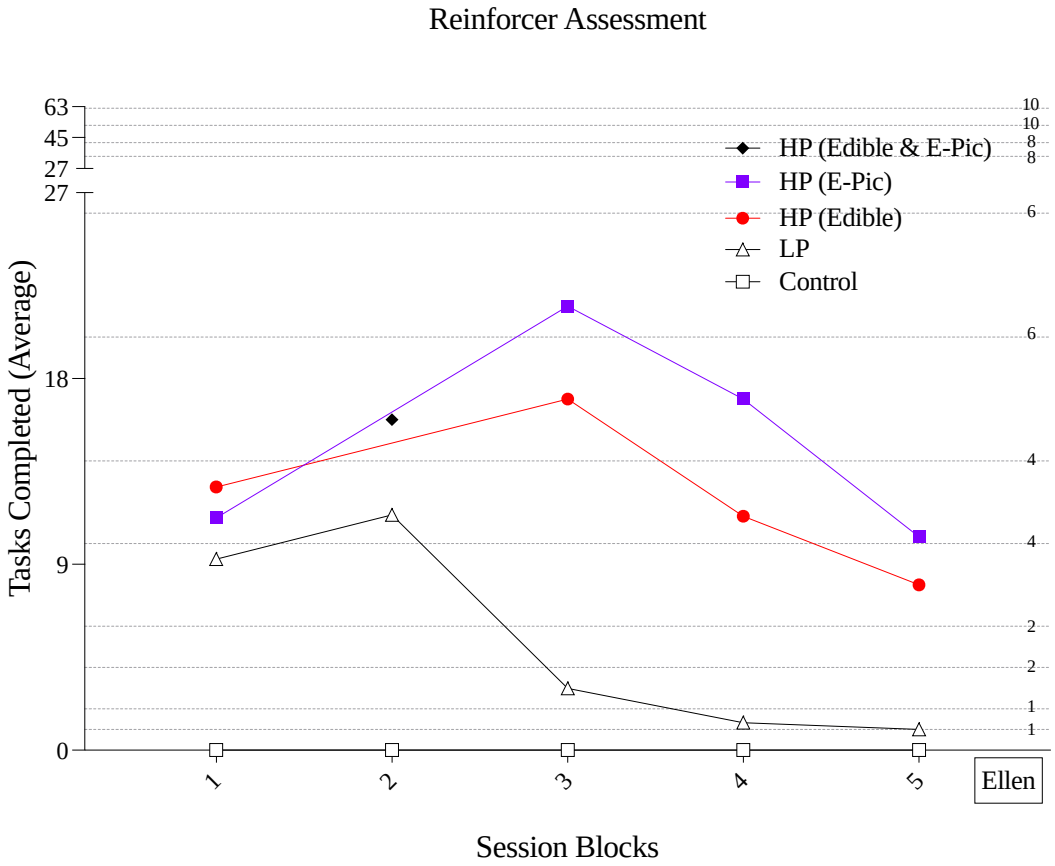

Figure 23. Ellen's Results Session Blocks 1-3. (MSWO on Left; RA on Right)

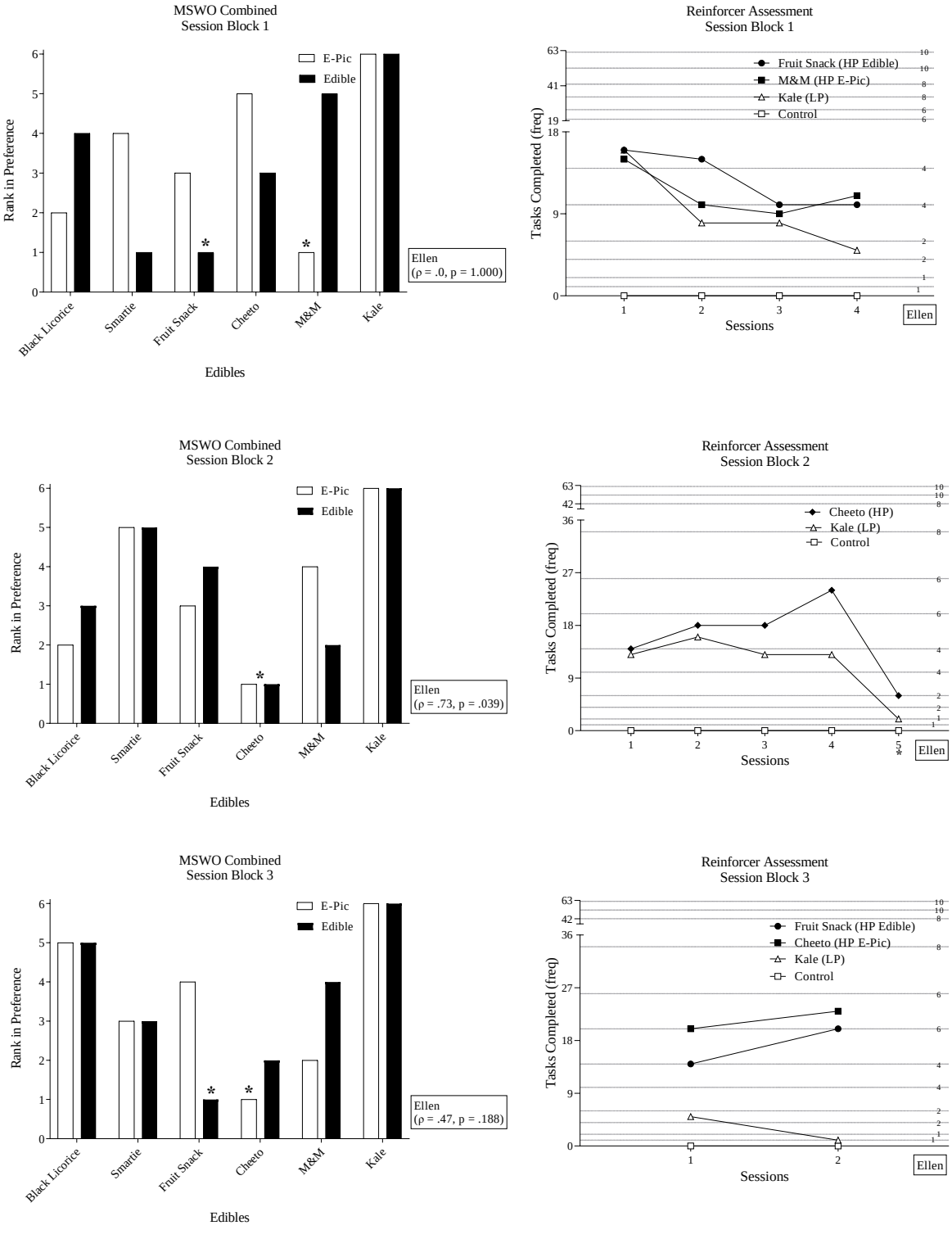

Figure 24. Ellen's Results Session Blocks 4-5. (MSWO on Left; RA on Right)

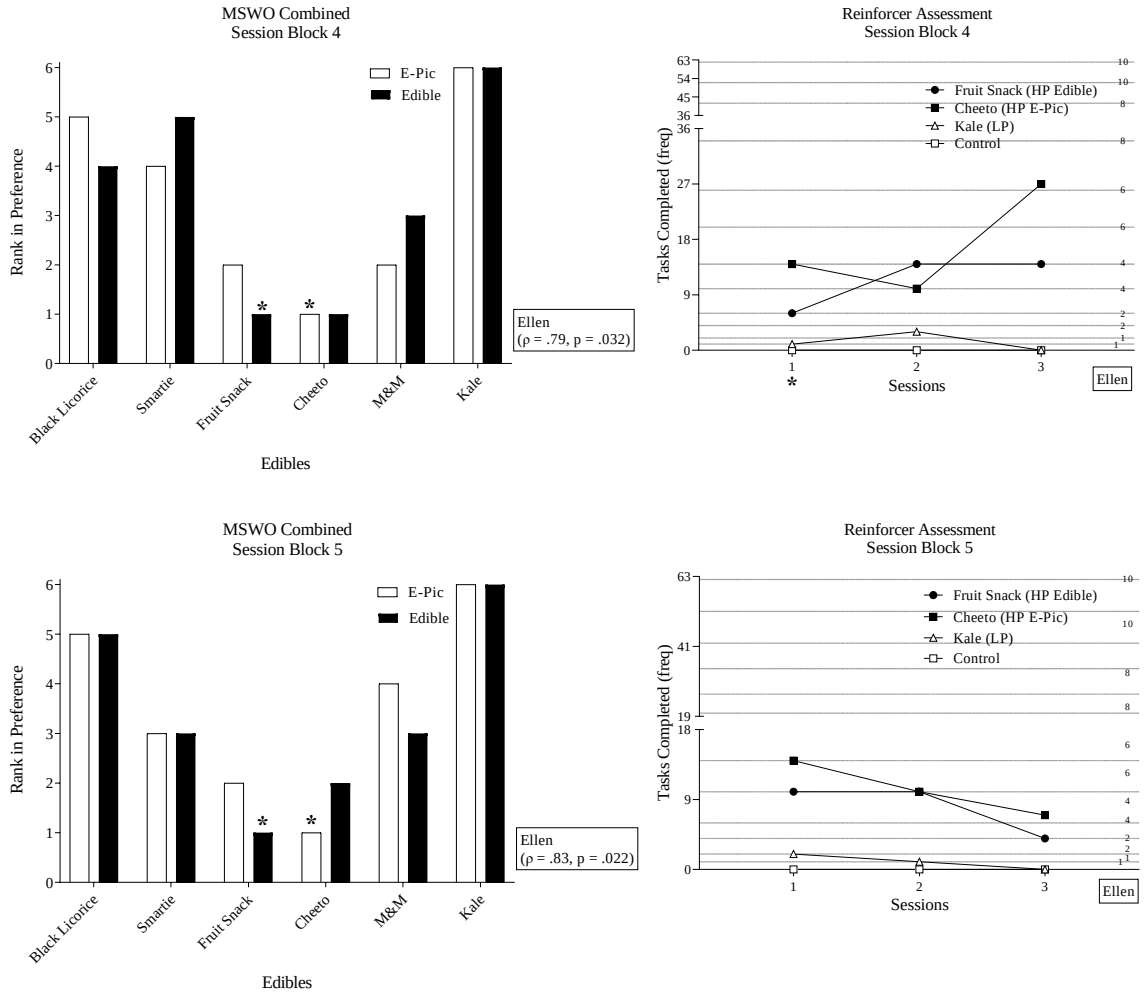

Figure 25. Riley's Combined Rank across Session Blocks

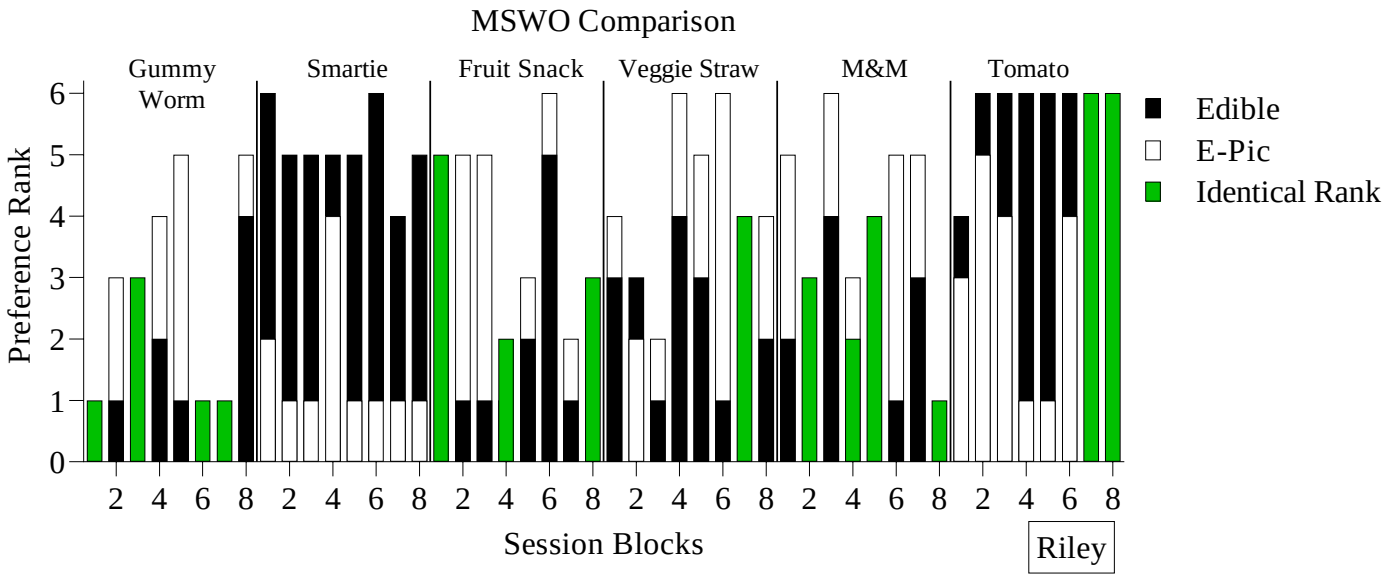

Figure 26. Riley's Aggregate Task Completion across Session Blocks

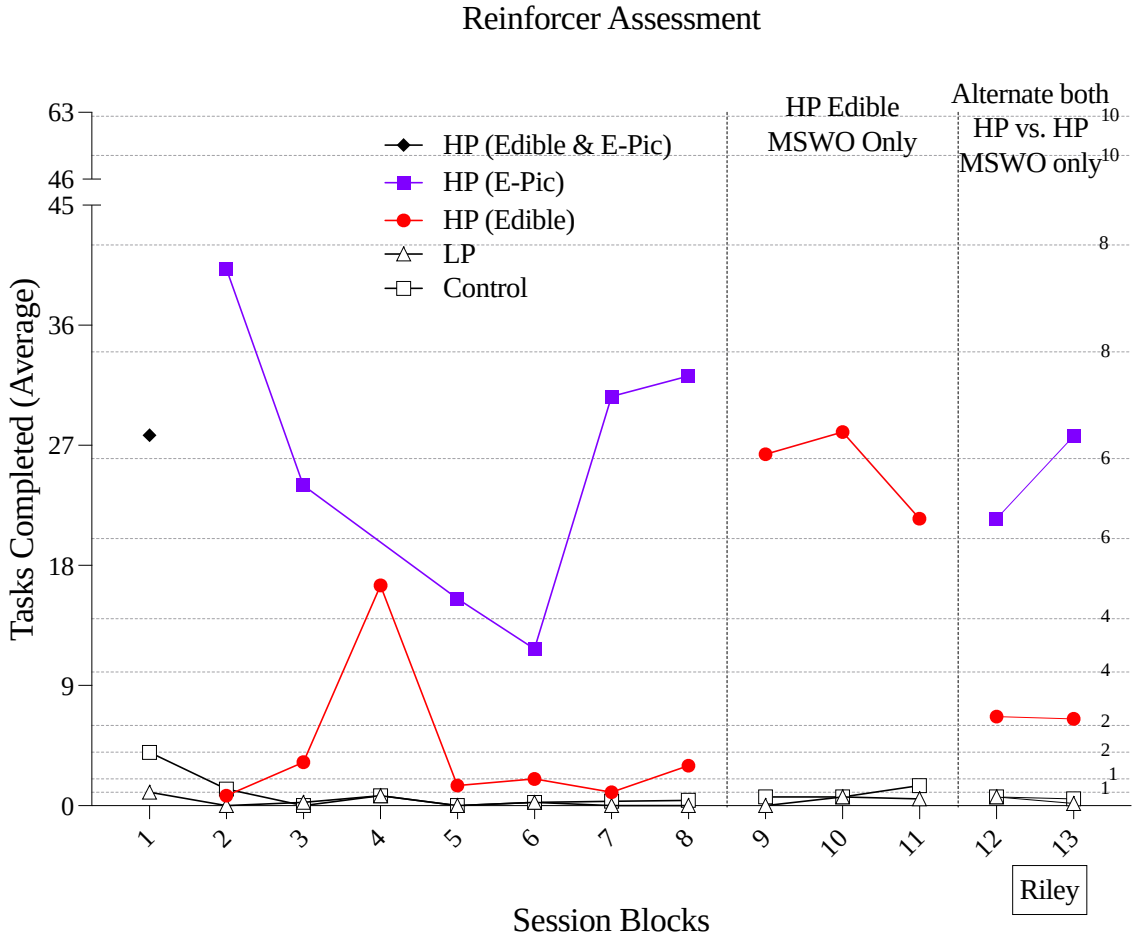

Figure 27. Riley's Results Session Blocks 1-3. (MSWO on Left; RA on Right)

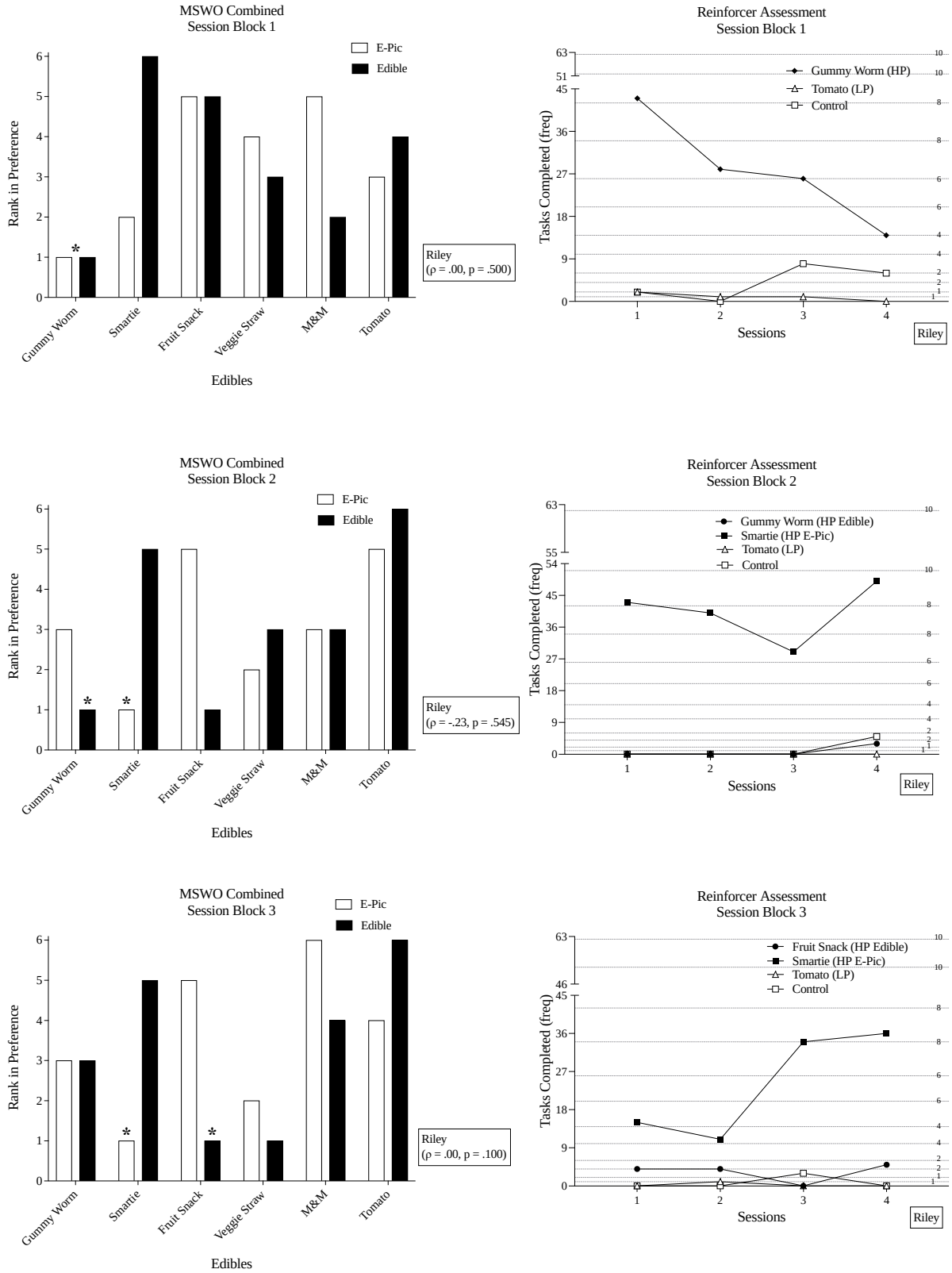

Figure 28. Riley's Results Session Blocks 4-6. (MSWO on Left; RA on Right)

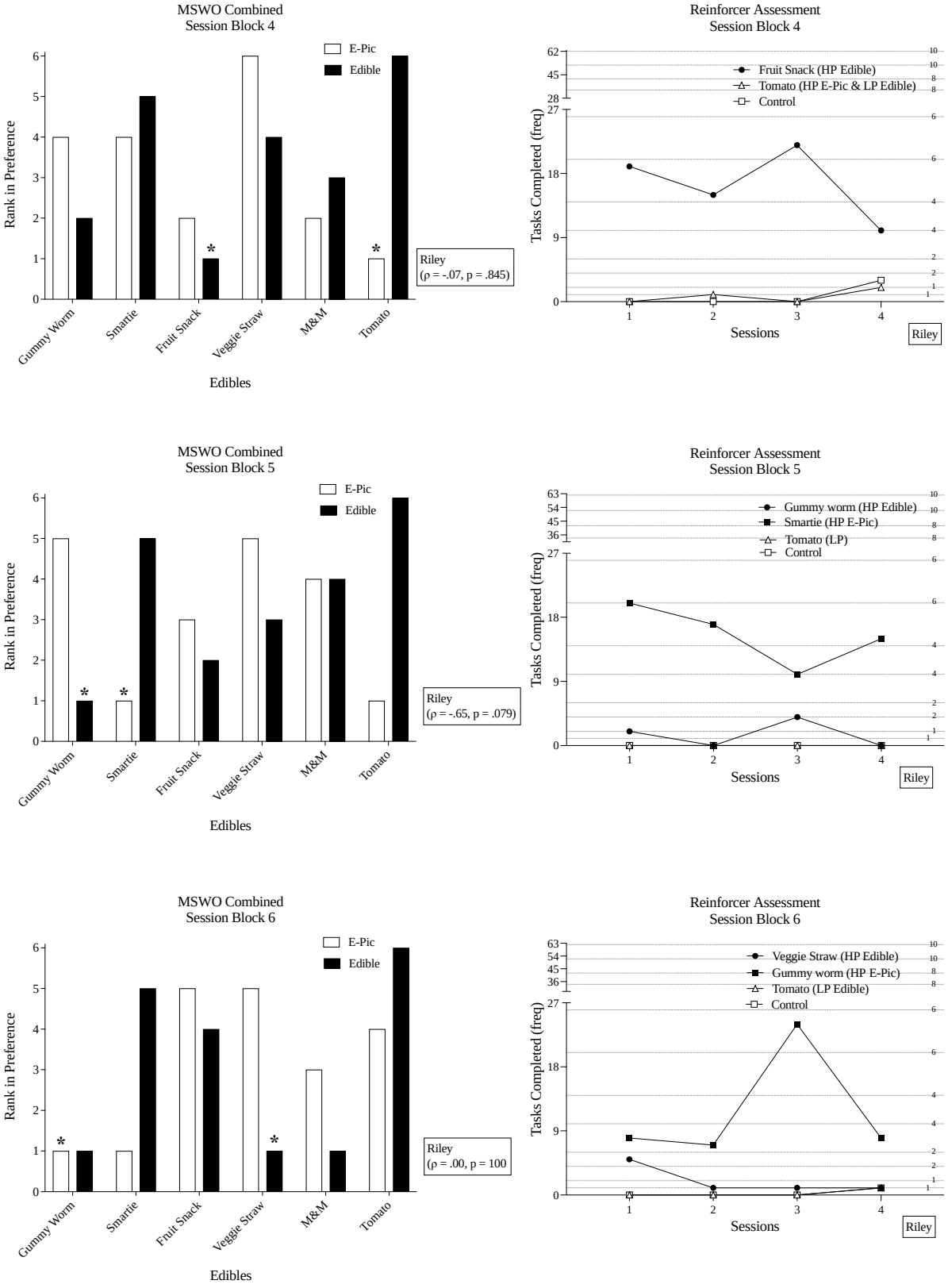

Figure 29. Riley's Results Session Blocks 7-9. (MSWO on Left; RA on Right)

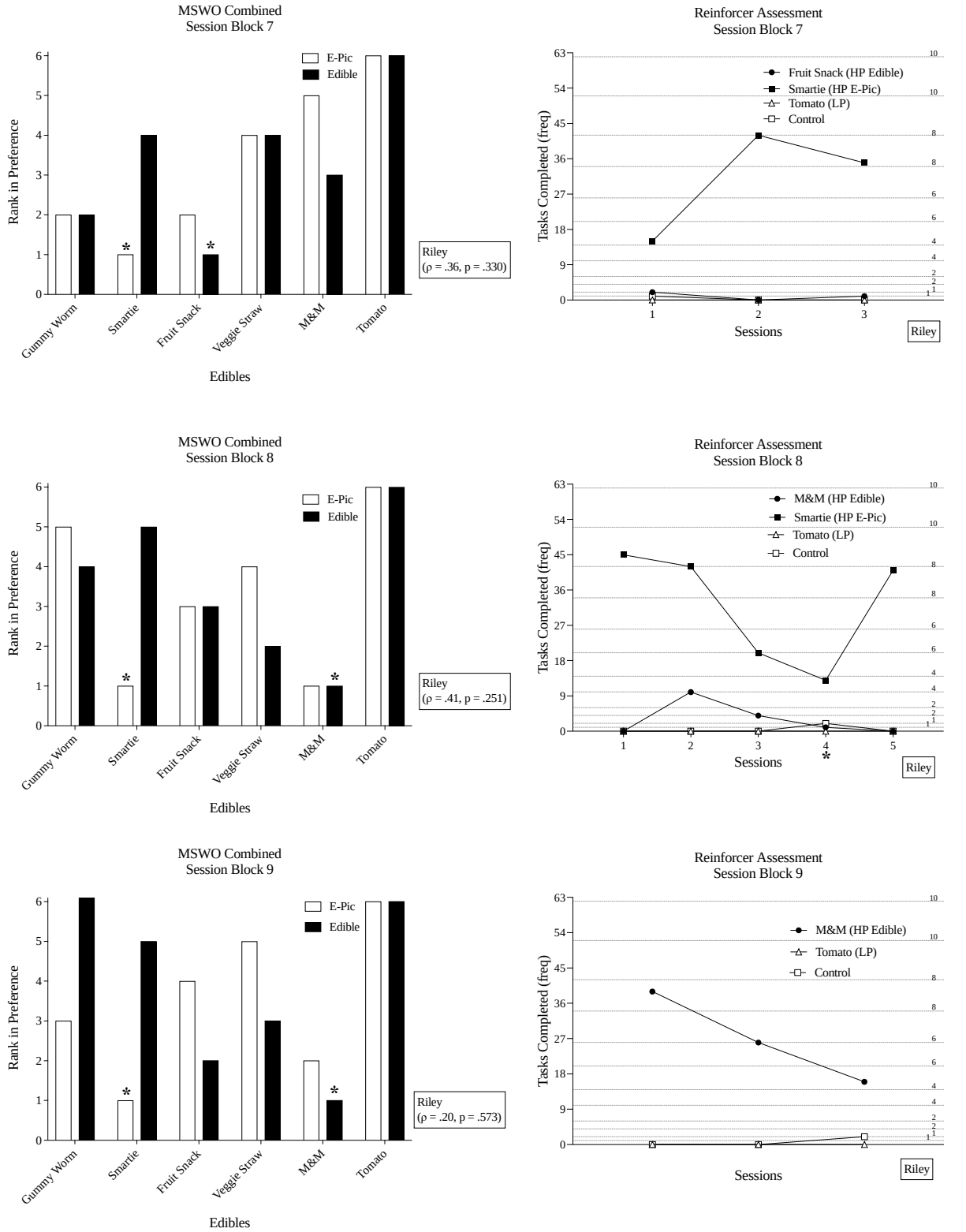

Figure 30. Riley's Results Session Blocks 10-12. (MSWO on Left; RA on Right)

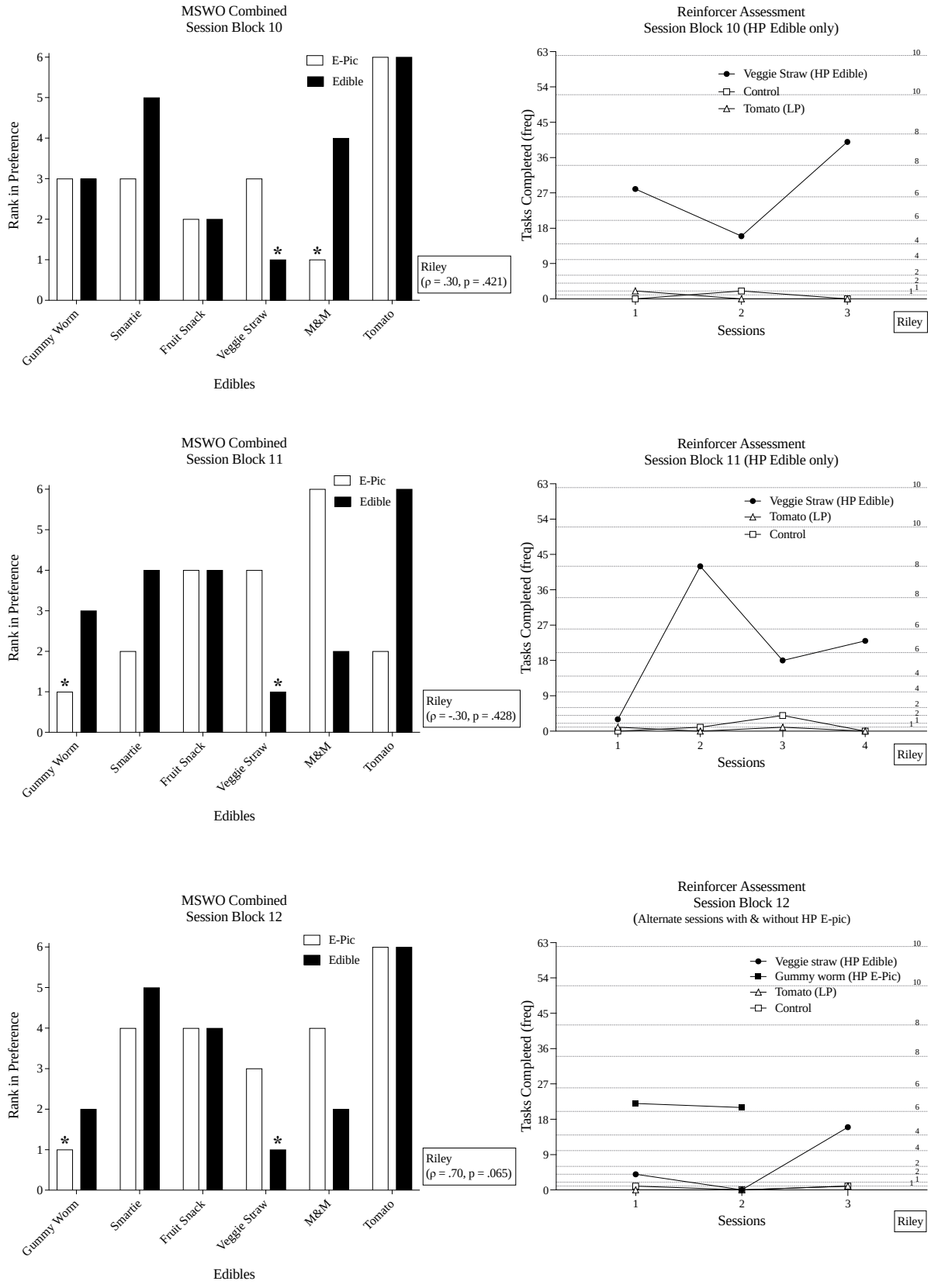

Figure 31. Riley's Results Session Block 13. (MSWO on Left; RA on Right)

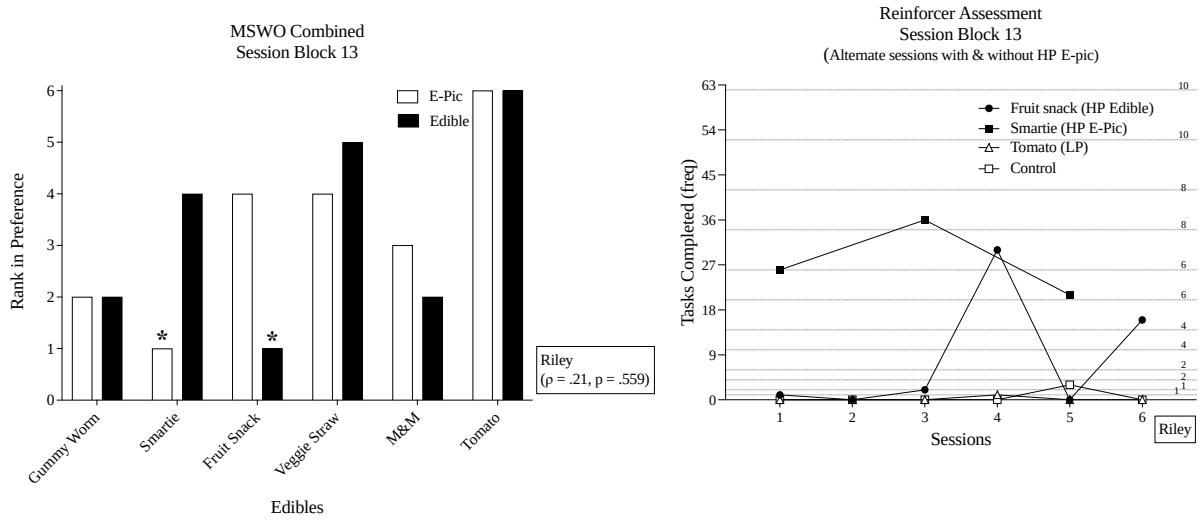

Table 1. Descriptions of the Six ABLA Levels, Discriminations, and Everyday Examples (derived from DeWeile et al., 2011; Heinicke et al., 2013; Martin et al., 2004).

ABLA-R Levels	Types of Discriminations	Everyday Examples
Level 6: Auditory-Visual Discrimination. Consistent placement of a piece of foam into the correct container when instructed to place the foam either in the red box or yellow can when the placement of the two containers are randomly altered	A conditional auditory-visual non-identity discrimination, with pitch, pronunciation, and duration as relevant auditory cues, and with color, shape, and size as relevant visual cues	-Responding appropriately to requests such as, "pass the salt" vs. "pass the pepper" when both the salt and pepper are in different locations on the table from meal to meal -Responding appropriately to instructions "Stop" and "Go"
Level 5: Visual Non-Identity Match-to-Sample Discrimination. Consistent placement of a piece of foam into the correct container when instructed to place the foam either in the red box or yellow can when both containers remain stationary	A conditional visual-visual non-identity discrimination with color, shape, and size as relevant cues	-Matching a shoe to a sock -Matching toothpaste to a toothbrush -Matching the printed word DOG to a picture of a dog
Level 4: Visual Match-To-Sample Discrimination. Consistent placement of a small yellow cylinder into a yellow can and a small red cube into a red box when the placement of the two containers is randomly altered	A conditional visual-visual identity discrimination with color, shape, and size as relevant cues	-Sorting socks into pairs -Restocking a partially emptied salad bar -Filling containers that are partly full
Level 3: Visual Discrimination. Consistent placement of a piece of foam into a yellow can and not a red box when the placement of the two containers are randomly altered	A simultaneous visual discrimination with color, shape, and size as relevant cues	-Locating one's coat in a closet when the location changes each time it is replaced -Locating one's name printed on the whiteboard -Locating the family car in a parking lot when it is parked in different places on different days

Level 2: Position Discrimination. Consistent placement of a piece of foam into a yellow can and not a red box when both containers remain stationary	A simultaneous visual discrimination with position, color, shape, and size as relevant cues	-Turning on the cold (vs. the hot) water tap -Placing a fork on the left side of a plate when setting a table
Level 1: Imitation. Correct imitation of the instructor placing a piece of foam into a yellow can	A simple imitation	-Children playing Follow-the-Leader

Table 2. Summary guidelines E-Pic reliability and validity

			E-Pic MSWO Reliability		Predictive Validity		ABLA Score	E-Pic Efficacy?
Subject	# Session Blocks		HP Item	LP Item	MSWO	E-Pic MSWO		
Libby	13		54%	46%	53%	23%	5	No
**task modifications*	*5*		*80%*	*60%*	*0%*	*0%*		
**pre-ses receptive ID*	*8*		*38%*	*38%*	*88%*	*38%*		
Maddy	10		50%	70%	70%	70%		
**PR*	*5*		*40%*	*80%*	*40%*	*40%*		
**FR*	*3*	*FR-1*	*67%*	*67%*	*100%*	*100%*	4	Yes*
**PR*	*2*		*50%*	*50%*	*100%*	*100%*		
Thomas	11		90%	91%	46%	46%		
**PR*	*4*		*75%*	*75%*	*0%*	*0%*		
**FR*	*2*	*FR-1*	*100%*	*100%*	*0%*	*0%*	3	Yes*
**FR-New Task*	*3*		*100%*	*100%*	*100%*	*100%*		
**FR*	*2*		*100%*	*100%*	*100%*	*100%*		
Ellen	5	PR	80%	100%	100%	100%	6	Yes
Riley	13	PR	8%	46%	54%	90%	6	Yes
	8		*13%*	*25%*	*25%*	*88%*		
MSWO only	*3*		*0%*	*67%*	*100%*	*100%*		
Alt RA w/ E-Pic	*2*		*0%*	*100%*	*100%*	*100%*		

**Required modifications*

Table 3. MSWO time comparison

	Total Session Blocks	Average Time		Total Time		E-Pic Time Savings
		E-Pic	Edible	E-Pic	Edible	
Libby	13	2.6 min	3.2 min	114.8 min	134 min	19.2 min
Maddy	10	2.2 min	3.3 min	66.7 min	98.8 min	32.1 min
Thomas	12	2.9 min	3.8 min	113.3 min	148.3 min	35.0 min
Ellen	5	1.7 min	2.7 min	24.9 min	41.2 min	16.3 min
Riley	13	2.0 min	2.7 min	79.2 min	107.9 min	28.7 min

**2 session blocks not included for Thomas (video malfunction)*

Appendices

Appendix A. Edible MSWO; Right Electronic-Picture MSWO)

Brief MSWO Data Sheet (PRIMARY)

Participant:

Data Collector:__________

A.	B.	C.	D.	E.	F.

Edible MSWO Sessions

SSN#: ___	Date / Initials	Total Time: (min/sec):
Trial #	**Circle item position**	*Item Selected*
1	x x x x x x	
2	x x x x x	
3	x x x x	
4	x x x	
5	x x	
6	x	
SSN#: ___	**Date / Initials**	**Total Time: (min/sec):**
Trial #	**Circle item position**	*Item Selected*
1	x x x x x x	
2	x x x x x	
3	x x x x	
4	x x x	
5	x x	
6	x	
SSN#: ___	**Date / Initials**	**Total Time: (min/sec):**
Trial #	**Circle item position**	*Item Selected*
1	x x x x x x	
2	x x x x x	
3	x x x x	
4	x x x	
5	x x	
6	x	

E-Pic MSWO Sessions

SSN#: ___	Date / Initials	Total Time: (min/sec):
Trial #	**Circle item position**	*Item Selected*
1	x x x x x x	
2	x x x x x	
3	x x x x	
4	x x x	
5	x x	
6	x	
SSN#: ___	**Date / Initials**	**Total Time: (min/sec):**
Trial #	**Circle item position**	*Item Selected*
1	x x x x x x	
2	x x x x x	
3	x x x x	
4	x x x	
5	x x	
6	x	
SSN#: ___	**Date / Initials**	**Total Time: (min/sec):**
Trial #	**Circle item position**	*Item Selected*
1	x x x x x x	
2	x x x x x	
3	x x x x	
4	x x x	
5	x x	
6	x	

Codes: AC = Approach & Consume A = Approach NC = No Choice AV = Avoid E = Expulsion

Appendix B. Summary of Steps to follow for ABLA-R

Note: created by Deweile et al. (2011)

Some Summary Guidelines for Testing Levels 2 Through 6

Levels	2	3	4	5	6
Containers & Positions	Box, Can Stable	Box, Can Randomly Alternate	Box, Can Randomly Alternate	Box, Can Randomly Alternate	Box, Can Randomly Alternate
Test Object Presented	Foam	Foam	Cube and Cylinder Randomly Alternate	*BOX* and *Can* Randomly Alternate	Foam
Verbal Prompt or Question	"Where does it go?"				"Red Box" or "Yellow Can"
Correct Response	Place foam in can on right	Place foam in can independ. of position	Place cube in box, or cylinder in can	Place *BOX* in box or *Can* in can	Place foam in the requested container

Appendix C. Summary of Steps to follow for ABLA-R
Note: Appendices created by DeWiele et al. (2011)

Summary of Level 6 - Auditory-Visual Discrimination

Initial Prompting Sequence - Don't Record Responses

1. Place the can and the box in front of the student.
2. Demonstrate. Say, "When I say, `y-e-l-l-o-w...c-a-n,' it goes in here," while demonstrating putting the foam into the yellow can. Remember to say, "y-e-l-l-o-w...c-a-n" slowly and in a low tone.
3. Guided trial. Say, "Let's try together." Take the student's hand while it grasps the foam, say, "y-e-l-l-o-w...c-a-n," and guide the student to place the foam into the yellow can. Give praise.
4. Opportunity for independent response. Say, "Now you try. y-e-l-l-o-w...c-a-n." Give the foam to the student. If the student places the foam into the yellow can, give praise and an edible. If the student makes an error, repeat the prompting sequence. Do not mark the data sheet.
5. Repeat steps 2, 3, & 4 with the foam and the red box. Remember to say, "REDBOX" rapidly and in a high tone.

If the Student Responds Correctly on the Above Steps, you are Ready to Begin Scoring

6. Look at the data sheet under “Container Position” for two things:
   (a) Should the can be on the right side or the left side?
   (b) Do you say, "REDBOX" or "y-e-l-l-o-w...c-a-n"?

7. Give the foam to the student, and say the correct verbal cue (either "REDBOX" or "y-e-l-l-o-w...c-a-n").

8. If the student places the foam into the correct container:
   - Give praise.
   - Place a T in the test-trials rectangle for that trial.
   - Repeat Steps 6, 7 & 8 until the student gets 8 correct in a row.
   - Reinforce every correct response with praise and an edible.

9. If the student places the foam into the wrong container:
   - Say, "No. That's not where it goes."
   - Shade the test-trials rectangle for that trial.
   - Do the three steps of the error correction procedure.
   - On the opportunity for an independent response, record either a T or shade the error-corrections rectangle for that trial.
   - Continue error correction until a correct response occurs on an opportunity for an independent response.
   - Return to Step 6.

10. Continue until:
    - A pass occurs (8 correct test trials in a row).
    - A fail occurs (8 total errors).

Summary of Testing for Level 5 - Visual Non-Identity Match-to-Sample

Testing of ABLA-R Level 5 is essentially the same as testing of Level 4 except that the Level 5 manipulanda include a silver piece of wood that spells *BOX* and a purple piece of wood that spells *Can* (instead of the little yellow cylinder and little red cube for Level 4).

Initial Prompting Sequence - Don't Record Responses

1. Place the box and the can in front of the student.
2. Demonstrate. Start with the purple word that spells *Can*. Say, "When I say, `Where does it go?' it goes in here," while demonstrating placing the *Can* into the can.
3. Guided trial. Say, "Let's try together." Take the student's hand while it grasps the *Can*, say, "Where does it go?" and guide the student to place the *Can* into the can. Give praise.
4. Opportunity for independent response. Say, "Now you try. Where does it go?" Give the *Can* to the student. If the student places the *Can* into the can, give praise and an edible. If the student makes an error, repeat the prompting sequence. Do not mark the data sheet.
5. Repeat steps 2, 3, and 4 with the silver word that spells *BOX* and the big box.

If the Student Responds Correctly on the Above Steps, you are Ready to Begin Scoring

6. Notice on the ABLA-R Level 5 data sheet whether the can goes on the left or the right (see "Container Position"), and whether to present the *"BOX"* or the *"Can"*(indicated by the location of the dot).
7. Give the object (the purple *Can* or the silver *BOX*) to the student and say, "Where does it go?"
8. If the student places the object into the correct container:
   - Give praise.
   - Place a ✓in the test-trials rectangle on the data sheet for that trial.
   - Repeat Steps 6, 7, & 8 until the student gets 8 correct in a row.
   - Reinforce every correct independent response with praise and an edible.
9. If the student places the object in the wrong container:
   - Say, "No. That's not where it goes."
   - Shade the test-trials rectangle for that trial number.
   - Do the three steps of the error correction procedure.
   - On the opportunity for an independent response of the error correction procedure, place a ✓or shade the error-corrections rectangle for that trial.
   - Continue error correction until a correct response occurs on an opportunity for an independent response.
   - Return to Step 6.
10. Continue until:
   - A pass occurs (8 correct test trials)
   - A fail occurs (8 total errors)

Summary of Testing for Level 4 - Visual Match-to-Sample

Level 4 assesses whether or not a student can learn to consistently place the red cube in the red box, and the yellow cylinder in the yellow can.

Initial Prompting Sequence - Don't Record Responses

1. Place the box and the can in front of the student.

2. Demonstrate. Start with the cylinder. Say, "When I say, `Where does it go?' it goes in here," while demonstrating placing the cylinder into the can.

3. Guided trial. Say, "Let's try together." Take the student's hand while it grasps the cylinder, say, "Where does it go?" and guide the student to place the cylinder into the can. Give praise.

4. Opportunity for independent response. Say, "Now you try. Where does it go?" Give the cylinder to the student. If the student places the cylinder into the can, give praise and an edible. If the student makes an error, repeat the prompting sequence. Do not mark the data sheet.

5. Repeat steps 2, 3, and 4 with the little red cube and the red box.

If the Student Responds Correctly on the Above Steps, you are Ready to Begin Scoring

6. Notice on the ABLA-R Level 4 data sheet whether the can goes on the left or the right (see "Container Position"), and whether to present the cube or the cylinder (indicated by the location of the dot).

7. Give the object (the cylinder or the little red cube) to the student and say, "Where does it go?"

8. If the student places the object into the correct container:
   - Give praise.
   - Place a ✓in the test-trials rectangle on the data sheet for that trial.
   - Repeat Steps 6, 7, & 8 until the student gets 8 correct in a row.
   - Reinforce every correct independent response with praise and an edible.

9. If the student places the object in the wrong container:
   - Say, "No. That's not where it goes."
   - Shade the test-trials rectangle for that trial number.
   - Do the three steps of the error correction procedure.
   - On the opportunity for an independent response of the error correction procedure, place a ✓or shade the error-corrections rectangle for that trial.
   - Continue error correction until a correct response occurs on an opportunity for an independent response.
   - Return to Step 6.

10. Continue until:
    - A pass occurs (8 correct test trials in a row).
    - A fail occurs (8 total errors).

Summary of Level 3 - Visual Discrimination

Initial Prompting Sequence - Don't Record Responses

1. Place the can and box in front of the student.

2. Demonstrate. Say, "When I say, `Where does it go?' it goes in here," while demonstrating placing the foam into the can.

3. Guided trial. Say, "Let's try together." Take the student's hand while it grasps the foam, say, "Where does it go?" and help the student to place the foam into the can. Give praise.

4. Opportunity for independent response. Say, "Now you try. Where does it go?" Give the foam to the student. If the student places the foam into the can, give praise and an edible. If the student makes an error, repeat the prompting sequence. Do not mark the data sheet.

If the Student Responds Correctly on Step 4, you are Ready to Begin Scoring

5. Now look at the data sheet under "Container Position" to see if the can is to be placed on the left or the right side of the box. Place the can on the proper side. (It does not matter if you place the can to your left or to the student's left, as long as you are consistent with who you use as your guide throughout testing.)

6. Give the foam to the student and say, "Where does it go?"

7. If the student places the foam into the can:
   - Give praise.
   - Place a T in the test-trials rectangle for that trial.
   - Repeat Steps 5, 6, & 7 until the student gets 8 correct in a row.
   - Reinforce every correct response with praise and an edible.

8. If the student places the foam into the box:
   - Say, "No. That's not where it goes."
   - Shade the test-trials rectangle for that trail.
   - Do the three steps of the error correction procedure.
   - On the opportunity for an independent response, record either a T or shade an error-correction rectangle for that trial.
   - Continue error correction until a correct response occurs on an opportunity for an independent response.
   - Return to Step 5.

9. Continue until:
   - A pass occurs (8 correct test trials in a row).
   - A fail occurs (8 total errors).

Summary of Level 2 - Position Discrimination

Initial Prompting Sequence - Don't Record Responses

1. Place the can and box in front of the student.

2. Demonstrate. Say, "When I say, `Where does it go?' it goes in here," while demonstrating placing the foam into the can.

3. Guided trial. Say, "Let's try together." Take the student's hand while it grasps the foam, say, "Where does it go?" and help the student to place the foam into the can. Give praise.

4. Opportunity for independent response. Say, "Now you try. Where does it go?" Give the foam to the student. If the student places the foam into the can, give praise and an edible. If the student makes an error, repeat the prompting sequence. Do not mark the data sheet.

If the Student Responds Correctly on Step 4, you are Ready to Begin Scoring

5. Say, "Where does it go?" and give the foam to the student.

6. If the student places the foam into the can:
   - Give praise.
   - Place a T in the test-trials rectangle for that trial.
   - Repeat Steps 5 & 6 until the student gets 8 correct in a row.
   - Reinforce every correct response with praise and an edible.

7. If the student places the foam into the box:
   - Say, "No. That's not where it goes."
   - Shade the test-trials rectangle for that trial.
   - Do the three steps of the error correction procedure.
   - On the opportunity for an independent response, record either a T or shade the error-corrections rectangle for that trial.
   - Continue error correction until a correct response occurs on an opportunity for an independent response.
   - Return to Step 5.

8. Continue until:
   - A pass occurs (8 correct test trials in a row).
   - A fail occurs (8 total errors).

SUMMARY OF STEPS TO FOLLOW WHEN TESTING

Summary of Level 1 - Imitation

Initial Prompting Sequence - Don't Record Responses

1. Place the box in front of the student.
2. Demonstrate. Say, "When I say, `Where does it go?' it goes in here," while demonstrating putting the foam in the box.
3. Guided trial. Say, "Let's try together." Take the student's hand while it grasps the foam, say, "Where does it go?" and help the student to drop the foam into the box. Give praise.
4. Opportunity for Independent Response. Say, "Now you try. Where does it go?" while demonstrating putting the foam in the box. Then say, "Where does it go?" and give the foam to the student. If the student places the foam in the box, give praise and an edible. If the student makes an error, repeat the prompting sequence. Do not mark the data sheet.

If the Student Responds Correctly on Step 4, you are Ready to Begin Scoring

5. Model every time. On each trial, say, "Where does it go?" Then model placing the foam into the box. Then say, "Where does it go?" and give the foam to the student.
6. If the student responds correctly on a trial:
   - Give praise and an edible.
   - Place a ✓ in the appropriate test-trial rectangles.
   - Repeat Steps 5 & 6 until the student gets 4 correct in a row with the box, and 4 correct in a row with the can. (Do not provide the prompting sequence when you switch to the can. Just model the response with the can as you did with the box.)
   - Reinforce every correct response with praise and an edible.
7. If the student places the foam anywhere but in the container:
   - Say, "No. That's not where it goes."
   - Shade in the appropriate test-trial rectangles.
   - Do the error correction.
     * demonstration
     * guided trial
     * opportunity for independent response
   - On the opportunity for the independent response part of error correction, if the response is incorrect, shade in the appropriate error-corrections rectangle, and if the response is correct, place a ✓ in the appropriate error-corrections rectangle.
   - Continue error correction until a correct response occurs on an opportunity for an independent response, then return to Step 5.
8. Continue until:
   - A pass occurs (8 correct total test trials in a row).
   - A fail occurs (8 total errors).

Appendix D. Data sheets for each level in ABLA-R

Note: Data sheets were created by Deweile et al. (2010)

ABLA-R Level 6 Data Sheet 67

Student : _____ Tester : _____ Observer : _____

Test Date : _____ Start Time : _____ End Time : _____ Result : _____

Instructions : Under "container position", the circle represents the can and the square represents the box. The dot shows the correct destination for the manipulandum (and therefore the correct vocal stimulus to present). If a response is correct, place a check in the appropriate Results column rectangle and proceed to the next trial. If response is incorrect, shade in the entire box and proceed to the next error correction (if any).

Trial	Container Position	Results: Test Trial	Results: Error Corrections	Trial	Container Position	Results: Test Trial	Results: Error Corrections
1	□ ⊙	☐	☐☐☐☐☐☐☐	31	⊙ □	☐	☐☐☐☐☐☐☐
2	⊡ ○	☐	☐☐☐☐☐☐☐	32	⊡ ○	☐	☐☐☐☐☐☐☐
3	⊙ □	☐	☐☐☐☐☐☐☐	33	○ ⊡	☐	☐☐☐☐☐☐☐
4	○ ⊡	☐	☐☐☐☐☐☐☐	34	□ ⊙	☐	☐☐☐☐☐☐☐
5	⊙ □	☐	☐☐☐☐☐☐☐	35	⊙ □	☐	☐☐☐☐☐☐☐
6	□ ⊙	☐	☐☐☐☐☐☐☐	36	□ ⊙	☐	☐☐☐☐☐☐☐
7	⊡ ○	☐	☐☐☐☐☐☐☐	37	○ ⊡	☐	☐☐☐☐☐☐☐
8	○ ⊡	☐	☐☐☐☐☐☐☐	38	⊡ ○	☐	☐☐☐☐☐☐☐
9	□ ⊙	☐	☐☐☐☐☐☐☐	39	□ ⊙	☐	☐☐☐☐☐☐☐
10	⊙ □	☐	☐☐☐☐☐☐☐	40	⊡ ○	☐	☐☐☐☐☐☐☐
11	⊡ ○	☐	☐☐☐☐☐☐☐	41	⊙ □	☐	☐☐☐☐☐☐☐
12	□ ⊙	☐	☐☐☐☐☐☐☐	42	○ ⊡	☐	☐☐☐☐☐☐☐
13	○ ⊡	☐	☐☐☐☐☐☐☐	43	⊙ □	☐	☐☐☐☐☐☐☐
14	⊡ ○	☐	☐☐☐☐☐☐☐	44	□ ⊙	☐	☐☐☐☐☐☐☐
15	⊙ □	☐	☐☐☐☐☐☐☐	45	⊡ ○	☐	☐☐☐☐☐☐☐
16	⊡ ○	☐	☐☐☐☐☐☐☐	46	○ ⊡	☐	☐☐☐☐☐☐☐
17	○ ⊡	☐	☐☐☐☐☐☐☐	47	□ ⊙	☐	☐☐☐☐☐☐☐
18	⊙ □	☐	☐☐☐☐☐☐☐	48	⊙ □	☐	☐☐☐☐☐☐☐
19	○ ⊡	☐	☐☐☐☐☐☐☐	49	⊡ ○	☐	☐☐☐☐☐☐☐
20	□ ⊙	☐	☐☐☐☐☐☐☐	50	□ ⊙	☐	☐☐☐☐☐☐☐
21	⊙ □	☐	☐☐☐☐☐☐☐	51	○ ⊡	☐	☐☐☐☐☐☐☐
22	⊡ ○	☐	☐☐☐☐☐☐☐	52	⊡ ○	☐	☐☐☐☐☐☐☐
23	○ ⊡	☐	☐☐☐☐☐☐☐	53	⊙ □	☐	☐☐☐☐☐☐☐
24	⊡ ○	☐	☐☐☐☐☐☐☐	54	⊡ ○	☐	☐☐☐☐☐☐☐
25	□ ⊙	☐	☐☐☐☐☐☐☐	55	○ ⊡	☐	☐☐☐☐☐☐☐
26	⊙ □	☐	☐☐☐☐☐☐☐	56	⊙ □	☐	☐☐☐☐☐☐☐
27	○ ⊡	☐	☐☐☐☐☐☐☐	57	○ ⊡	☐	☐☐☐☐☐☐☐
28	□ ⊙	☐	☐☐☐☐☐☐☐	58	□ ⊙	☐	☐☐☐☐☐☐☐
29	⊡ ○	☐	☐☐☐☐☐☐☐	59	⊙ □	☐	☐☐☐☐☐☐☐
30	⊙ □	☐	☐☐☐☐☐☐☐	60	⊡ ○	☐	☐☐☐☐☐☐☐

Passing criterion: 8 consecutive correct responses on test trials

Failing criterion: 8 cumulative incorrect responses

Student : _____ Tester : _____ Observer : _____

Test Date : _____ Start Time : _____ End Time : _____ Result : _____

Instructions : Under "container position", the circle represents the can and the square represents the box. The dot shows the correct destination for the manipulandum (and therefore whether to present the silver piece of wood that spells *BOX* or the purple piece of wood that spells *Can*). If a response is correct, place a check in the appropriate Results column rectangle and proceed to the next trial. If response is incorrect, shade in the entire box and proceed to the next error correction (if any).

Trial	Container Position	Results		Trial	Container Position	Results	
		Test Trial	Error Corrections			Test Trial	Error Corrections
1	□ ⊙	☐	☐☐☐☐☐☐☐☐	31	⊙ □	☐	☐☐☐☐☐☐☐☐
2	⊡ ○	☐	☐☐☐☐☐☐☐☐	32	⊡ ○	☐	☐☐☐☐☐☐☐☐
3	⊙ □	☐	☐☐☐☐☐☐☐☐	33	○ ⊡	☐	☐☐☐☐☐☐☐☐
4	○ ⊡	☐	☐☐☐☐☐☐☐☐	34	□ ⊙	☐	☐☐☐☐☐☐☐☐
5	⊙ □	☐	☐☐☐☐☐☐☐☐	35	⊙ □	☐	☐☐☐☐☐☐☐☐
6	□ ⊙	☐	☐☐☐☐☐☐☐☐	36	□ ⊙	☐	☐☐☐☐☐☐☐☐
7	⊡ ○	☐	☐☐☐☐☐☐☐☐	37	○ ⊡	☐	☐☐☐☐☐☐☐☐
8	○ ⊡	☐	☐☐☐☐☐☐☐☐	38	⊡ ○	☐	☐☐☐☐☐☐☐☐
9	□ ⊙	☐	☐☐☐☐☐☐☐☐	39	□ ⊙	☐	☐☐☐☐☐☐☐☐
10	⊙ □	☐	☐☐☐☐☐☐☐☐	40	⊡ ○	☐	☐☐☐☐☐☐☐☐
11	⊡ ○	☐	☐☐☐☐☐☐☐☐	41	⊙ □	☐	☐☐☐☐☐☐☐☐
12	□ ⊙	☐	☐☐☐☐☐☐☐☐	42	○ ⊡	☐	☐☐☐☐☐☐☐☐
13	○ ⊡	☐	☐☐☐☐☐☐☐☐	43	⊙ □	☐	☐☐☐☐☐☐☐☐
14	⊡ ○	☐	☐☐☐☐☐☐☐☐	44	□ ⊙	☐	☐☐☐☐☐☐☐☐
15	⊙ □	☐	☐☐☐☐☐☐☐☐	45	⊡ ○	☐	☐☐☐☐☐☐☐☐
16	⊡ ○	☐	☐☐☐☐☐☐☐☐	46	○ ⊡	☐	☐☐☐☐☐☐☐☐
17	○ ⊡	☐	☐☐☐☐☐☐☐☐	47	□ ⊙	☐	☐☐☐☐☐☐☐☐
18	⊙ □	☐	☐☐☐☐☐☐☐☐	48	⊙ □	☐	☐☐☐☐☐☐☐☐
19	○ ⊡	☐	☐☐☐☐☐☐☐☐	49	⊡ ○	☐	☐☐☐☐☐☐☐☐
20	□ ⊙	☐	☐☐☐☐☐☐☐☐	50	□ ⊙	☐	☐☐☐☐☐☐☐☐
21	⊙ □	☐	☐☐☐☐☐☐☐☐	51	○ ⊡	☐	☐☐☐☐☐☐☐☐
22	⊡ ○	☐	☐☐☐☐☐☐☐☐	52	⊡ ○	☐	☐☐☐☐☐☐☐☐
23	○ ⊡	☐	☐☐☐☐☐☐☐☐	53	⊙ □	☐	☐☐☐☐☐☐☐☐
24	⊡ ○	☐	☐☐☐☐☐☐☐☐	54	⊡ ○	☐	☐☐☐☐☐☐☐☐
25	□ ⊙	☐	☐☐☐☐☐☐☐☐	55	○ ⊡	☐	☐☐☐☐☐☐☐☐
26	⊙ □	☐	☐☐☐☐☐☐☐☐	56	⊙ □	☐	☐☐☐☐☐☐☐☐
27	○ ⊡	☐	☐☐☐☐☐☐☐☐	57	○ ⊡	☐	☐☐☐☐☐☐☐☐
28	□ ⊙	☐	☐☐☐☐☐☐☐☐	58	□ ⊙	☐	☐☐☐☐☐☐☐☐
29	⊡ ○	☐	☐☐☐☐☐☐☐☐	59	⊙ □	☐	☐☐☐☐☐☐☐☐
30	⊙ □	☐	☐☐☐☐☐☐☐☐	60	⊡ ○	☐	☐☐☐☐☐☐☐☐

Passing criterion: 8 consecutive correct responses on test trials

Failing criterion: 8 cumulative incorrect responses

Appendix E. Treatment Integrity for MSWO (Edible MSWO; Right Electronic-Picture MSWO)

Participant:________

E-Pic		Edible	
Correct # of stimuli presented for each trial?	Correct consequence on given trial?	Correct # of stimuli presented for each trial?	Correct consequence on given trial?
Data Collector:_______ Date:_______ Session Block:________		Data Collector:_______ Date:_______ Session Block:________	
Session #:_______		Session #:_______	
1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐
Data Collector:_______ Date:_______ Session Block:________		Data Collector:_______ Date:_______ Session Block:________	
Session #:_______		Session #:_______	
1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐
Data Collector:_______ Date:_______ Session Block:________		Data Collector:_______ Date:_______ Session Block:________	
Session #:_______		Session #:_______	
1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐
Data Collector:_______ Date:_______ Session Block:________		Data Collector:_______ Date:_______ Session Block:________	
Session #:_______		Session #:_______	
1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐	1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐

Appendix F. Treatment Integrity Checklist for RA

E-Pic MSWO Comparison – **RA Tx Integrity** Data Sheet

Participant: _______ Date:__________ Session Block:______ Session #: _______ Data Collector:________

HP TASK:__________	**HP TASK:__________**	**CONTROL TASK:**	**LP TASK:______**
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O O O	O O O O	O O O O	O O O O
O O	O O	O O	O O
Errors of Omission		**Errors of Commission**	
SR+ Reinforcer Delivery _____ / _____ = _____	SR+ Correct Reinforcer _____ / _____ = _____	SR+ Reinforcer Delivery _______	SR+ Correct Reinforcer ________

KEY: Task completion = Checkmark reinforcer Delivery = Circle checkmark