AN EVALUATION OF THE EFFECTS OF REINFORCER MAGNITUDE ON PREFERENCE AND ON-TASK BEHAVIOR

BY

Brooke A. Jones

Submitted to the graduate degree program in Applied Behavioral Science
and the Graduate Faculty of the University of Kansas
in partial fulfillment of the requirements for the degree of
Master's of Arts.

_____
Chairperson

_____

_____

Date defended:_____

The Thesis Committee for Brooke Ashley Jones certifies
that this is the approved Version of the following thesis:

AN EVALUATION OF THE EFFECTS OF REINFORCER MAGNITUDE ON

PREFERENCE AND ON-TASK BEHAVIOR

Committee:

_____
Chairperson

_____

_____

Date approved:_____

Abstract

Stimulus preference assessments (SPAs) are conducted to identify reinforcers. Among the variables that affect preference and reinforcer efficacy is magnitude of reinforcement. The purposes of the current studies were to (a) evaluate the extent to which magnitude (i.e., short vs long durations of item access) affects preferences of typically developing preschool-age children and (b) compare levels of on-task behavior when different magnitudes of reinforcement were provided. Study 1 results demonstrated that rankings for high-preferred items remained relatively stable across magnitudes. However, some items were shown to have disparate rankings across magnitudes. Study 2 results demonstrated that some participants (5/9) did not display increased levels of on-task behavior for either magnitude of reinforcement. However, some participants (4/9) showed that both magnitudes of reinforcement maintained the same level of on-task behavior when the work requirement was relatively small, but a larger magnitude maintained more on-task behavior as the work requirement was increased.

An Evaluation of the Effects of Reinforcer Magnitude on Preference and On-Task Behavior

The determination of stimuli that can be used as reinforcers in teaching or treatment programs is important for learning and habilitation of individuals with (Wacker, Berg, Wiggins, Muldoon, & Cavanaugh, 1985) and without (Resetar & Noell, 2008) developmental disabilities. Stimulus preference assessments (SPA) have been shown to be relatively accurate predictors of stimuli (e.g., edibles, leisure items, and activities) that can be used as reinforcers (Hagopian, Long, & Rush, 2004). In general, SPAs involve presenting one or more stimuli to a participant and measuring some aspect of participant behavior to determine preference. Stimuli that are found to be highly preferred are then used as reinforcers in teaching and treatment programs.

Over the last 20 years, many different SPA methods have been used to determine preferred stimuli for both individuals with developmental disabilities (see Cannella et al., 2005 for a review) and typically developing individuals (Cote, Thompson, Hanley, & McKerchar, 2007; Layer, Hanley, Heal, & Tiger, 2008; Resetar & Noell, 2008). The major methodological differences between different SPAs are the presentation format and measurement used to assess preference. Different presentation formats include presenting items singly (DeLeon, Iwata, Conners, & Wallace, 1999; Hagopian, Rush, Lewin, & Long, 2001; Pace, Ivancic, Edwards, Iwata, & Page, 1985), in pairs (Fisher et al., 1992), or in a group (DeLeon & Iwata, 1996; Roane, Vollmer, Ringdahl, & Marcus; 1998). Across these different presentation formats, two different dependent measures have been used to determine preference, which include approach or selection responding

(Pace et al.; DeLeon et al., 1996; Fisher et al.) or manipulation of the stimuli (DeLeon et al., 1999; Hagopian et al.; Roane et al.).

There are various factors that may affect preference for particular stimuli, including history effects (i.e., what happens between or prior to assessments) and assessment arrangement (i.e., what happens during the assessment). With respect to history effects, time between assessments (Hanley, Iwata, & Roscoe, 2006; Zhou, Iwata, Goff, & Shore, 2001), establishing operations (Gottschalk, Libby, & Graff, 2000), and histories of reinforcement associated with particular stimuli (Hanley, Iwata, Roscoe, Thompson, & Lindberg, 2003) have been shown to result in shifts in preference. With respect to assessment arrangement, the type of stimuli used in the array (Bojak & Carr, 1999; DeLeon, Iwata, & Roscoe, 1997) and magnitude or duration of access during the preference assessment (Steinhilber & Johnson, 2007; Trosclair-Lasserre, Lerman, Call, Addison, & Kodak, 2008) have also been shown to result in shifts in preference.

As mentioned above, one variable that may affect preference (and possibly subsequent reinforcing efficacy) of a stimulus is magnitude. Magnitude of a reinforcer can be defined as the amount (i.e., intensity, number, or duration) of the reinforcer delivered (Hoch, McComas, Johnson, Faranda, & Guenther, 2002). Magnitude of an edible reinforcer might be manipulated by providing different amounts of food (e.g., one piece for a small magnitude and five pieces for a larger magnitude). Magnitude of a leisure item might be manipulated by providing different durations of access time (e.g., a few seconds for a small magnitude and a few minutes for a larger magnitude). In the SPA literature, different magnitudes (i.e., access times) have been provided within different assessments. For example, participants were provided 5-s item access to each

chosen leisure item in the paired-stimulus (PS) procedure described by Fisher et al. (1992), whereas participants were provided 30-s access to each chosen leisure item in the multiple-stimulus-without-replacement (MSWO) procedure described by DeLeon et al. (1996).

Basic research has suggested that magnitude of reinforcement may affect choice or preference (Catania, 1963; Neuringer, 1967; Schmitt, 1974; Schwartz, 1969; Shimoff & Matthews, 1975). For example, Catania and Neuringer both demonstrated that the rate of responding exhibited by pigeons matched the magnitude (i.e., duration of access to grain) of reinforcement provided under concurrent-operant arrangements but not under single-operant arrangements. Applied research has suggested that magnitude (i.e., duration of item access time) of reinforcement has been shown to affect preference for certain items or activities (Hoch et al., 2002; Steinhilber & Johnson, 2007). For example, Hoch and colleagues altered magnitude and quality of reinforcement to shift the response allocation of three boys diagnosed with autism. Two areas were available concurrently: one area was associated with solitary play and one area was associated with social play. In an evaluation of the effects of reinforcer magnitude, two conditions were conducted. In the equal magnitude condition, choice of either area (i.e., social or solitary) resulted in the same magnitude (i.e., 50-s access to a high-preferred item) of reinforcement. In the unequal magnitude condition, choice of the social area resulted in a larger magnitude (i.e., 90-s access to the high-preferred item) of reinforcement and choice of the solitary area resulted in a smaller magnitude (i.e., 10-s access to the high-preferred item). With respect to magnitude, results demonstrated that no responding was allocated to the social area when magnitude was equal. However, when a higher magnitude of reinforcement

was available for choice of the social area, more responding was allocated to the social area.

Steinhilber and Johnson (2007) conducted preference assessments with highly disparate magnitudes (15-s access vs 15-min access) to determine whether duration of item access time would affect preference for leisure items. The authors conducted two different multiple-stimulus-without-replacement (MSWO; DeLeon & Iwata, 1996) preference assessments; both preference assessments were associated with the same items, but one was associated with 15-s access (short-access assessment) to the selected item and the other was associated with 15-min access (long-access assessment) to the selected item. Results showed that, for both participants, some items were more highly preferred when available for 15 seconds than 15 minutes, whereas other items were more preferred when available for 15 min than 15 seconds. Additionally, the authors conducted reinforcer assessments to determine levels of responding associated with high-preferred stimuli when provided for preferred and non-preferred durations of item access. The authors determined two high-preferred items from the preference assessment: one that was preferred when available for a short duration of item access (short high preferred [SHP]) and one that was preferred when available for a long duration of item access (long high preferred [LHP]). The authors then compared responding for these items when available for both short and long durations. Using a concurrent-operant arrangement, the authors showed that rankings from the short-access and long-access preference assessments were predictive of response allocation during the reinforcer assessment. Specifically, one participant allocated more responding to the SHP when a short duration

of access was provided for both items and both participants allocated more responding to the LHP when a long duration of access was provided for both items.

Reinforcer assessments have shown that stimuli found to be more preferred during SPAs may maintain higher levels of responding than stimuli found to be less preferred (Roscoe, Iwata, & Kahng, 1999). One procedure for evaluating the reinforcing efficacy of stimuli involves the use of progressive-ratio schedules in which a reinforcer is provided after progressively increasing work requirements until a point of no responding is reached. This point is referred to as the breaking point (Hodos, 1961) or, more commonly, break point. Low break points occur when little work is completed before responding ceases. High break points occur when a high level of work is completed before responding ceases. Reinforcers that result in lower break points are conceptualized as less potent than reinforcers that result in higher break points. Jarmolowicz and Lattal (2010) outlined three variations of progressive-ratio (PR) schedules. In one variation, the response requirement is increased after every reinforcer delivery within session (e.g., FR1, FR2, FR3, etc.). In another variation, the response requirement is increased intermittently (e.g., FR1 FR1, FR2 FR2, FR3 FR3, etc.) within session In the third variation, the response requirement is increased between sessions (e.g., one session at FR1, the next session at FR2, the next session at FR3, etc.).

Basic research has shown that magnitude may affect reinforcer efficacy as examined by performance under progressive-ratio schedules (Rickard, Body, Zhang, Bradshaw, & Szabadi, 2009; Spear & Katz, 1991). For example, Spear and Katz arranged an experiment in which rats first completed different FR schedules to access either different cocaine doses or amounts of food, depending on the rat. The rats also

completed second-order progressive-ratio schedules to earn access to different magnitudes of the same reinforcer. Data were analyzed for each phase and fitted to different equations to examine the effects of reinforcer magnitude on three typically used measures within progressive-ratio schedules (e.g., response rate, post-reinforcement pause, and running response rate). Overall, different results were demonstrated for the reinforcing effects of different cocaine doses versus different durations of access to food. For cocaine dose, break points were generally higher given a higher magnitude of reinforcement. For food, break points were relatively high for 1-, 3-, and 10-s access to grain, but lower for 30-s access to grain. Overall, these results suggest that reinforcer value of a particular type of reinforcer (e.g., cocaine dose) increased as a function of increases in reinforcer magnitude.

Recent work on the applied utility of progressive-ratio schedules (Roane, 2008) has shown that stimuli ranked high, medium, and low in preference hierarchies can maintain high, medium, and low levels of responding, respectively (DeLeon, Frank, Gregory, & Allman, 2009; Francisco, Borrero, & Sy, 2008; Glover, Roane, Kadey, & Grow, 2008; Penrod, Wallace, & Dyer, 2008). In a study evaluating the relationship between preference and reinforcer efficacy, Trosclair-Lasserre et al. (2008) examined the effects of different magnitudes of social reinforcement on preference and appropriate target behavior exhibited by four children who engaged in problem behavior maintained by social positive reinforcement. The authors first evaluated participants' preferences for different magnitudes of social reinforcement using a concurrent-operant arrangement. Results showed that a large magnitude of social reinforcement was more preferred than a smaller magnitude of social reinforcement for three of four participants. Then, the

authors arranged a reinforcer assessment using progressive-ratio schedules in which participants engaged in target responses to access different magnitudes of social reinforcement. The authors compared levels of responding across conditions of 10-s access, 60-s access, and 120-s access within a multielement design. Within each session, a PR schedule involving two exposures to each requirement was used to determine levels of responding for each magnitude of social reinforcement. For two participants, more responses were emitted in sessions in which a 120 s of social reinforcement was available than when a 10 s or 60 s of social reinforcement was available.

The utility of preference assessments and subsequent use of high-preferred items as reinforcers in a classroom-type setting has been evaluated. Daly et al. (2009) evaluated activities that were acceptable and feasible for teachers to deliver during a school day by way of a MSWO preference assessment. The reinforcing efficacy of high-, medium-, and low-preferred stimuli was then determined by providing access contingent upon completion of a criterion number of math problems. In this and many types of reinforcer assessments, including those using progressive-ratio schedules, reinforcement is delivered contingent upon completion of a particular number of discrete responses (i.e., for ratio-based responding). However, investigation of the effects of reinforcers on duration-based responding might also be important. First, the *duration* of behavior is an important dimension to measure and change in various environments. For example, in preschool and kindergarten environments, it is often important to begin teaching children to engage in a task for extended periods for time (e.g., work on a pre-academic worksheet while seated at a table). Second, ratio schedules of reinforcement might be difficult to implement in some applied environments. For example, a high student-to-teacher ratio

may impede teachers accurately determining whether ratios have been met, resulting in less than optional integrity of reinforcer delivery. The occurrence of target behavior as measured via discontinuous sampling (e.g., momentary time sampling; Powell, Martindale, & Kulp, 1975) may be more efficient than measurement requiring continuous monitoring of a behavior because observers can monitor one student while attending to other responsibilities or simultaneously monitor multiple students (Hanley, Cammilleri, Tiger, & Ingvarsson, 2007).

The purpose of the current study was to extend previous research on the effects of magnitude of stimuli (i.e., item access) on preference and reinforcer efficacy. The purpose of Study 1 was to replicate and extend previous research by comparing preferences for items given relatively short vs long access times with a large number of young children (Study 1) to determine the effects of magnitude on preference. The purpose of Study 2 was to determine the extent to which young children would engage in on-task behavior to earn access to high-preferred items for short or long access times.

Method: Study 1 (Preference Assessments)

Participants and Setting

Thirty (18 female and 12 male) typically developing children, ranging in age from 2 to 5 years, participated. Each child was able to sit appropriately for at least 40 min without exhibiting problem behavior that might impede continuation of the assessment. Preference assessments were conducted in a quiet area of the child's classroom, large motor room, or session room; the session area was equipped with a table, chairs, and relevant session stimuli. Assessments were conducted 3 to 5 days per week. Sessions were 30-60 min in length, and at least 4 hrs elapsed between each assessment.

Data Collection and Measurement

Trained observers recorded participant behavior on data sheets. The dependent variable was item selection, defined as placing a hand on one of the presented items. The independent variable was duration of item access time (e.g., 30 s or 5 min), defined as the time that elapsed from stimulus presentation to stimulus removal. Data were also collected on participant termination of item interaction (i.e., if the participant stopped interacting with an item, the therapist denoted the amount of time remaining in the access period). This issue was reported to occur relatively infrequently (i.e., 9/30 participants) and only during access times for items with ranks of 3 through 7 (i.e., lower-preferred items). Interobserver agreement (IOA) for item selection was assessed during a minimum of 28% of preference assessment trials across participants. Interobserver agreement for item selection was calculated by dividing the number of trials with agreement by the number of trials with agreement plus the number of trials with disagreement and multiplying by 100 to yield a percentage. Agreement across all assessments for all participants was 100%.

Procedure

Stimuli included in preference assessments were novel leisure items (e.g., handheld video game, a toy play set, a DVD movie, etc.) to which access was restricted throughout the school day. Researchers attempted to choose items that they hypothesized might yield differentiated preference hierarchies (i.e., items that might be more likely to be preferred for long access times over short access times and vice versa).

Each assessment consisted of seven trials and was associated with a colored poster board placed on the table to aid in discrimination across assessments. Prior to the

start of each assessment, the therapist provided exposure to each stimulus by vocally labeling each item, describing the length of access time (i.e., short or long), and prompting the participant to label each item (e.g., "What's this?"). All assessments began with the participant seated at a table or on the floor with the therapist. All seven leisure items were presented equidistant from each other and the participant. To begin a trial, the experimenter delivered the prompt, "Pick your favorite." Contingent upon item selection, the therapist provided access to the selected item, a timer that counted down access time was placed in front of the participant and started, and the other items were removed. Attempts to select multiple items simultaneously were blocked. When access time elapsed, the therapist removed the item and re-presented all unselected items from the array. For each array presentation, the items were rotated such that the same item was not in the same position for successive array presentations. During the first six trials, if the child made no selection within 30 s, the therapist prompted him/her again to pick his/her favorite item. During the last trial, if the child made no selection within 30 s or said, "No, thanks," the assessment was terminated. This procedure was repeated until an opportunity to select each item had been presented. Item access time was predetermined for each condition as described below.

Generally, researchers studying characteristics of preference via SPAs conduct multiple assessments with each participant. However, our pilot data suggested that conducting multiple assessments for each of two access times (i.e., three SPAs with 30-s item access time and three SPAs with 5-min item access time) yielded similar outcomes within access times. That is, for 11 participants, the same highly preferred items appeared in the top three across at least two of the three assessments within an access

time. Based on these data, only one MSWO preference assessment was conducted for each of two access times with participants. The order of these two SPAs was counterbalanced across participants.

MSWO (30-s access). Contingent upon item selection, the therapist provided 30-s access to the item. After 30 s elapsed, the therapist removed the item from the participant and presented the array of remaining items. This condition was associated with a yellow poster board placed on the table and a timer set for 30 s.

MSWO (5-min access). This assessment was identical to the MSWO (30-s access) but with 5-min access time provided contingent upon item selection. This condition was associated with a blue poster board placed on the table and a timer set for 5 min.

Results: Study 1 (Preference Assessments)

Across all participants, several patterns of responding were seen with respect to both stability and disparity in preferences across access times. Stability was examined based on similarity in rankings for high-preferred items across assessments. Disparity was examined based on the displacement of an item ranked in the top two in one assessment to a ranking in the bottom two in the other assessment.

Figure 1 depicts the number of participants (n=30) in which there was stability in rankings for high-preferred items across access times (i.e., 30-s access and 5-min access). Stability was defined as an item ranked as one of the top three across access times. The data in Figure 1 depict how many participants had one or more items in the top three across access times, one or more items in the top two across access times, and the same top (number one) item across access times. The results suggested that 8 participants had

at least one item in the top three across access times, 27 participants had at least one item in the top two across access times, and 14 participants had the same highest-preferred item across access times. Overall, these data suggest that preferences for highly preferred items were not greatly affected by duration of item access time.

Figure 2 depicts the number of participants (n=30) in which there was disparity in rankings for at least one item across access times. Disparity was defined as the displacement of an item ranked in the top two in one assessment to a ranking in the bottom two in the other assessment. Figure 2 shows that 11 of 30 participants had at least one item with disparate rankings across access times. Figure 3 depicts the number of participants who had disparities with different numbers of highly preferred items (of the four possible). Results demonstrate that zero participants showed disparate rankings across access times for four items, zero participants showed disparate rankings across access times for three items, one participant showed disparate rankings across access times for two items, and 10 participants showed disparate rankings across access times for one items. Although one participant had two items with disparate rankings, the majority (10/11) of participants had only one item with disparate rankings across access times. Taken together, results from Figures 2 and 3 suggest that, although there was relative stability in rankings for highly preferred items, some items, for some participants, had disparate rankings. Figure 4 depicts the number of items, out of the 12 items for which there were disparate rankings, that had better rankings (i.e., were more highly preferred) for each access time. Of these 12 items, two items were more preferred for 30-s access and 10 items were more preferred for 5-min access. These results suggest that

the majority of disparities were due to items being more preferred for a long item access time rather than a short item access time.

Several general patterns of responding were displayed across individual participants. Representative data are depicted in Figures 5-9 for each of these patterns of responding. Figure 5 shows Alyssa's data, which represent participants' data in which the top two items were the same across assessments and no items had disparate rankings. Nine participants demonstrated this pattern of responding. For Alyssa, the 30-s assessment was conducted first. Her results show that item rankings were identical regardless of access time. For example, the play foam was ranked first in the 30-s and 5-min access assessments, the magnet set was ranked second in the 30-s and 5-min access assessments, and so on. No ranking is reported for the Zube Tube® in the 5-min assessment because Alyssa did not select that item in that assessment. Figure 6 shows Frank's data, which represent participants' data in which one item was in the top two across access times and no items had disparate rankings. Ten participants demonstrated this general pattern of responding. For Frank, the 30-s access assessment was conducted first. His results show that item rankings for high-preferred items were relatively stable with the Leapster® being ranked in the top two regardless of item access time. In addition, item rankings were identical across item access times for moderate- and low-preferred items. Figure 7 shows Kaitlin's data, which represent participants' data in which one item was in the top two across access times and one item had a disparate ranking with the item being more preferred for a short access time. Two participants showed this pattern of responding. For Kaitlin, the 30-s access assessment was conducted first. Her results show that the helicopter was ranked in the top two regardless

of item access time; however, item rankings were relatively variable for other items, with rankings for pony meeting the definition of disparity and having a lower ranking in the 30-s access assessment than the 5-min access assessment. Figure 8 shows Ophelia's data, which represent participants' data in which one item was in the top two across access times and one item had a disparate ranking with the item being more preferred for a long access time. Seven participants showed this pattern of responding. For Ophelia, the 30-s access assessment was conducted first. Similar to Kaitlin, Ophelia's results show that the play foam was ranked in the top two regardless of item access time; however, item rankings were relatively variable for other items, with rankings for snake meeting the definition of disparity and having a lower ranking in the 5-min access assessment than the 30-s access assessment. Figure 9 shows Chelsea's data, which represent participants' data in which zero items were in the top two across access times and one or two items had disparate rankings with the item(s) being more preferred for a long access time. Two participants showed this pattern of responding. For Chelsea, the 30-s access assessment was conducted first. Her results show that item rankings were relatively variable for most items, with rankings for the magnets and sound machine meeting the definition of disparity and having a lower ranking in the 5-min access assessment than the 30-s access assessment.

Method: Study 2 (Reinforcer Assessment)

Participants and Setting

Nine participants for whom the same item was highly preferred during both the 30-s access and the 5-min access MSWO preference assessments in Study 1 participated in Study 2. Items used in Study 2 were either equally highly preferred (i.e., both items

ranked first [Jill, Alyssa, Therese, Carlie, Ewan] or second [Bailey]) or had the highest average ranking (Sibyl, Marvin, Connor). Sessions were conducted 3 to 5 days per week and were 1 min 15 s to 8 min in length. Sessions were conducted in a session room equipped with a table, chairs, and relevant session stimuli. Relevant session stimuli included the target task, discriminative stimuli, and an alternative activity that consisted of one to three items that were low preferred (i.e., ranked 5, 6, or 7) across both access times in Study 1.

Data Collection and Measurement

For most participants, a free-operant preference assessment (Roane, Vollmer, Ringdahl, & Marcus, 1998) was conducted prior to each phase to determine whether participants would allocate more time to the highest-preferred item than the lowest-preferred items. For free-operant preference assessment sessions, the dependent variable was interaction with each item, defined as hand-to-item contact. These sessions were 5 min in length, and partial-interval recording within 5-s intervals was used to measure levels of item interaction. Item interaction was not mutually exclusive (i.e., participants could interact with more than one item simultaneously).

For reinforcer assessment sessions, the dependent variable was on-task behavior, defined as continuous and appropriate manipulation of task materials; non-examples included inappropriate manipulation (e.g., scribbling on table, ripping materials, etc.), the absence of engagement with task materials (e.g., staring at the wall), or engagement with the alternative activities. Partial-interval recording within 5-s intervals was used to measure levels of on-task behavior. Target tasks included tracing shapes (Jill, Alyssa, Therese, Carlie, Marvin, Ewan, Jason) and matching colored letters and numbers to

squares on a multi-colored board (Bailey, Sibyl); these skills were targeted in each child's preschool curriculum. The independent variable was duration of item access time (e.g., 30 s or 5 min) as defined in Study 1. Data were collected on stimulus delivery, defined as the therapist placing the item in front of the participant, and stimulus removal, defined as the therapist removing the item from the participant. Duration of item access was calculated by subtracting the time at which the stimulus was delivered from the time at which the stimulus was removed and converting the resulting duration to a number of seconds.

Trained observers recorded both participant and therapist behaviors on handheld computers**.** Interobserver agreement (IOA) was assessed during a minimum of 52% of all sessions across phases. Interobserver agreement for on-task behavior and item interaction was calculated by comparing response frequencies within 5-s intervals. To calculate the percentage agreement for on-task behavior and item interaction, the number of intervals with disagreement was subtracted from the total number of intervals; that number was divided by the total number of intervals and multiplied by 100 to yield a percentage. Interobserver agreement for reinforcer duration was calculated using the total agreement method. To calculate the percentage agreement for reinforcer duration, the smaller duration was divided by the larger duration, and the quotient was multiplied by 100 to yield a percentage. For Alyssa, mean agreement coefficients for on-task behavior were 98.9% (range, 80%-100%) and mean agreement coefficients for reinforcer duration were 98.4% (range, 74%-100%). For Sibyl, mean agreement coefficients for on-task behavior were 98.1% (range, 93%-100%) and mean agreement coefficients for reinforcer duration were 100%. For Therese, mean agreement coefficients for on-task

behavior were 99.6% (range, 95.8%-100%) and mean agreement coefficients for reinforcer duration were 100%. For Marvin, mean agreement coefficients for on-task behavior were 98.3% (range, 80%-100%) and mean agreement coefficients for reinforcer duration were 99.4% (range, 93.9%-100%). For Carlie, mean agreement coefficients for on-task behavior were 96.8% (range, 69%-100%) and mean agreement coefficients for reinforcer duration were 99.6% (range, 97%-100%). For Ewan, mean agreement coefficients for on-task behavior were 98.4% (range, 88.3%-100%) and mean agreement coefficients for reinforcer duration were 97.4% (range, 91%-100%). For Jason, mean agreement coefficients for on-task behavior were 94.6% (range, 65%-100%) and mean agreement coefficients for reinforcer duration were 98.8% (range, 96.9%-100%). For Bailey, mean agreement coefficients for on-task behavior were 94.1% (range, 62%-100%) and mean agreement coefficients for reinforcer duration were 99.9% (range, 80%-100%). For Jill, mean agreement coefficients for on-task behavior were 94.2% (range, 78.3%-100%) and mean agreement coefficients for reinforcer duration were 97.3% (range, 25%-100%).

Procedure

As mentioned above, a free-operant preference assessment was conducted during each phase to ensure that the high-preferred item from the preference assessments resulted in high levels of item interaction. Prior to the start of each free-operant preference assessment session, the therapist stated the rules for the session (e.g., "Here are some toys; you can play with whatever you want"), and the items were placed on the floor in front of the participant. After 5 min elapsed, the items were removed. If the

high-preferred item continued to evoke high levels of item interaction from the participant, the reinforcer assessment continued.

For all participants (except Jill), three forced-exposure training sessions were conducted prior to each condition (i.e., Baseline, 30-s access, 5-min access, Progressive-duration schedule) of the reinforcer assessment. Prior to the progressive-duration schedule phase, training sessions were conducted for only the initial work requirement. Training sessions were not conducted for subsequent work requirements to avoid the potential for a premature break point in responding due to repeated exposures to a particular schedule. The purpose of these training sessions was to ensure that the participant's behavior contacted the contingencies associated with each phase prior to beginning data collection. The criterion for reinforcement during the 30-s access, 5-min access, and beginning of the progressive-duration phases was a 20% increase over the average number of on-task intervals in the last three sessions of the initial baseline phase. During each training session, the therapist prompted the participant using progressive verbal, model, and physical prompts (as necessary) to engage in on-task behavior for the required number of intervals (i.e., until the reinforcement criterion had been reached). Then, the appropriate consequence was delivered immediately (i.e., no programmed consequences during baseline, 30 s of access to the item during the 30-s access phase, 5 min of access to the item during the 5-min access phase, 30 s or 5 min of access [depending on the condition] during the Progressive-duration schedule phase).

Prior to the start of each reinforcer-assessment session, the therapist stated the contingencies for the session and prompted the participant to repeat the correct

contingencies. Additionally, the participant was prompted to emit examples and non-examples of on-task behavior.

Delay procedure. Initially, all work periods were 5 min in length regardless of the reinforcement criterion. The purpose of this extended work period was to avoid a ceiling effect (i.e., a cap on the level of on-task behavior that could occur). Each condition (i.e., Baseline, 30-s access, 5-min access) was associated with a different-colored poster board to aid in discrimination of contingencies across conditions. Each session began with the participant standing in the middle of the session room. Task materials, a timer, the specified reinforcer, and the alternative activity were present. The appropriate task materials were placed on a table on one side of the room and the alternative activities were placed on the floor on the other side of the room. The therapist delivered the prompt, "You can work over here to earn *appropriate consequence*, you can play over here, and you can switch back and forth if you want." A timer was visible to the participant, and the therapist started and stopped the timer when the participant was and was not engaging in on-task behavior, respectively. Throughout the session, the therapist delivered a statement regarding the number of minutes remaining in session approximately once every minute. When 5 min elapsed, the therapist either (a) delivered the specified reinforcer if the participant had engaged in on-task behavior at or above criterion level or (b) ended the session if the participant did not meet the criterion for reinforcement.

Baseline. During this phase, task materials and the alternative activity were available. No programmed consequences were provided for on-task behavior.

30-s access. During this phase, sessions were similar to baseline; however,

participants were required to engage in on-task behavior at criterion levels (i.e., 20% increase over the last three Baseline sessions) to gain access to the highly preferred item for a period of 30 s. If participants engaged in on-task behavior at the criterion, 30-s access to the HP item was provided after session. If participants did not meet the criterion, the session was ended.

5-min access. During this phase, sessions were similar to 30-s access sessions with the exception that engaging in on-task behavior at the criterion level resulted in 5-min access to the same HP item after session.

No-delay procedure. If no reinforcement effect was shown with the initial procedure, it was hypothesized that this effect may have been due to a potential delay to reinforcement. That is, if the participant met the response requirement early in the session, (s)he was required to wait until the entire 5-min session elapsed prior to earning the reinforcer. To attempt to mitigate this delay, a no-delay procedure was conducted. For the no-delay procedure, initial baseline sessions were 5 min in length. The length of sessions in subsequent phases was determined in the same way as the reinforcement criterion was determined during the delay procedure (i.e., 20% increase over average number of on-task intervals in last 3 sessions of the initial baseline condition). Each session began with the participant seated at the table in front of the task materials. The criterion for reinforcement was engaging in on-task behavior for 100% of intervals (i.e., the entire session). That is, the participant had to engage in on-task behavior during every interval to earn reinforcement at the end of that session. When the session elapsed, the therapist either (a) delivered the specified reinforcer if the participant was engaged in on-task behavior at criterion level or (b) ended the session if the participant did not meet

the criterion for reinforcement.

30-s access (no delay). During this phase, as described above, session length was decreased to match the reinforcement criterion. That is, participants were required to engage in on-task behavior for the entire session, and session length was set at approximately a 20% increase over the average level of responding during the last three baseline sessions. If participants engaged in on-task behavior for the entire session, 30-s access to the HP item was provided immediately. If participants did not meet the criterion, the session was ended.

5-min access (no delay). During this phase, sessions were similar to 30-s access (no delay) sessions with the exception that engaging in on-task behavior at the criterion level resulted in 5-min access to the same HP item immediately.

Progressive-duration schedule. During progressive-duration schedule (PDS) phase, the work requirement was increased by either 30 s (Bailey) or 1 min (Jill) after at least 2 consecutive sessions at or above the reinforcement criterion. The schedules operated independently across conditions. That is, the work requirements in each condition (i.e., PDS 30-s access or PDS 5-min access) were based on levels of responding in that condition only. Prior to each session in which the criterion for reinforcement had increased, the therapist told the participant the new schedule (e.g., "you have to work for 1 minute and 45 seconds instead of 1 minute and 15 seconds this time") and set the timer at the appropriate criterion.

PDS 30 s. During this condition, the criterion for reinforcement was progressively increased across sessions. If participants engaged in on-task behavior at the criterion level, 30-s access to the HP item was provided after session. If participants

did not meet the criterion, the session was ended.

PDS 5 min. This condition was identical to the PDS-30-s phase with the exception that engaging in on-task behavior at the criterion level resulted in 5-min access to the HP item after session. If the participants did not meet the criterion, the session was ended.

Experimental Design

In the initial reinforcer assessment, a reversal design was used to compare percentage of intervals with on-task behavior with contingent short or long access time. In the progressive-duration schedule (PDS) phase, the PDS 30-s access condition (PDS 30 s) and the PDS 5-min access condition (PDS 5 min) were alternated using a multielement design to determine whether different break points existed for the same item given either short or long access times.

Results: Study 2 (Reinforcer Assessment)

In all reinforcer assessment graphs, closed circles denote on-task behavior, open symbols without connecting lines denote engagement during free-operant preference assessments, the dashed line denotes the reinforcement criterion, and the vertical bars denote session length. For the PDS phase, the triangles denote levels of responding during the PDS 30 s condition, the squares denote levels of responding during the PDS 5 min condition, the "x" symbols denote a schedule increase in the PDS 30 s condition and the "+" symbols denote a schedule increase in the PDS 5 min access condition.

Figure 10 depicts the results for three participants for whom a reinforcement effect was not shown under either access time with or without delay. Alyssa's data are depicted in the top panel. Alyssa's highest-preferred item was Play Foam® and her

lowest-preferred items were the Gigglator® and a pony. For Alyssa, results of an initial free-operant preference assessment showed that more responding was allocated to the highly preferred item than the low-preferred items. Low to zero levels of responding were seen during baseline. In the 30-s access phase, moderate and variable levels of responding were seen initially, but a decreasing trend was evident throughout the remainder of the phase. Results of another free-operant preference assessment conducted prior to the 5-min access phase suggested that Alyssa's highest-preferred item continued to evoke high levels of engagement, suggesting that it continued to be preferred. In the 5-min access phase, Alyssa only earned the reinforcer during two sessions. When the delay was removed, Alyssa continued to engage in low to zero levels of on-task behavior in both 30-s access and 5-min access phases despite high levels of engagement with the HP item in the free-operant preference assessment. Sibyl's data are depicted in the middle panel. Sibyl's highest-preferred item was a baby doll and stroller and her lowest-preferred items were a pop-up book and a puzzle. For Sibyl, high levels of engagement with the HP item occurred during both free-operant preference assessment sessions. During baseline, low to zero levels of on-task behavior were seen. During the 30-s access phase, low levels of on-task behavior continued to be observed. During the 5-min access phase, Sibyl engaged in near-criterion levels of on-task behavior for two sessions and met criterion levels during two sessions, but levels of responding decreased throughout the phase. When the 5-min phase was conducted without a delay, zero levels of on-task behavior continued to occur. Therese's data are depicted in the bottom panel. Therese's highest-preferred item was the Leapster® and her lowest-preferred items were the Gigglator® and the snake. High levels of engagement with the HP item occurred

during her only free-operant preference assessment session. For Therese, zero levels of on-task behavior were observed during baseline, 30-s access, and 5-min access phases. The criterion for reinforcement was reduced to seven intervals at session 12 and then to one interval at session 14 with no effect on on-task behavior. Although criterion levels of on-task behavior were initially observed when the delay was removed during the 30-s access phase, levels eventually decreased. Levels of on-task behavior during the 5-min phase with no delay were all below reinforcement criterion.

Figure 11 depicts the results for two additional participants for whom a reinforcement effect was not shown. Marvin's data are depicted in the top panel. Marvin's highest-preferred item was a Goob Tube and his lowest-preferred items were a ball game and a superhero toy. High levels of engagement with the HP item occurred during each free-operant preference assessment session; although overall level of engagement was lower during the final free-operant preference assessment session, Marvin continued to engage in exclusive responding with the HP item. For Marvin, a reinforcement effect was initially seen in the 30-s access phase, but the effect was not replicated. The delay was removed, and Marvin did not engage in stable, maintained levels of on-task behavior during the 30-s or 5-min phase. Carlie's data are depicted in the middle panel. Carlie's highest-preferred item was the Leapster® and her lowest-preferred items were a Magnadoodle® and a puzzle. Carlie only participated in the no-delay procedure. High levels of engagement with the HP item occurred during all free-operant preference assessment sessions. During the 30-s access phase, Carlie's levels of on-task behavior were initially high; however, throughout the phase, levels became more variable and eventually decreased to zero. When the 5-min phase was implemented,

levels of on-task behavior remained low. The results observed across all participants and all phases suggest that each participant's highest-preferred item did not function as a reinforcer in this arrangement despite high levels of response allocation during all free-operant preference assessment sessions and removal of the potential delay to reinforcement.

Figure 12 depicts data for participants for whom the same reinforcement effect was shown across access times. Ewan's data are depicted in the top panel. Ewan's highest-preferred item was the Leapster® and his lowest-preferred items were a doll and a toy truck. High levels of engagement with the HP item occurred across all free-operant preference assessment sessions. For Ewan, zero levels of on-task behavior were seen across all baseline phases. During the initial 30-s access phase and the replication of this phase, Ewan engaged in stable levels of on-task behavior at criterion. During the initial 5-min access phase, levels of on-task behavior were initially variable. It was hypothesized that satiation to a single Leapster® game was occurring, so Ewan was provided with an array of Leapster® games from which to choose prior to session. When this choice was offered, stable levels of on-task behavior at the criterion level occurred throughout the remainder of the phase and the replication. Jason's data are depicted in the bottom panel. Jason's highest-preferred item was the Nintendo DS® and his lowest-preferred items were a puzzle and a superhero toy. High levels of engagement with the HP item occurred across all free-operant preference assessment sessions. During the initial baseline, Jason engaged in high levels of on-task behavior that decreased to near-zero levels throughout the phase; a similar pattern of responding was also seen during the second and third baseline phases. During both 30-s access and 5-min access conditions, Jason engaged in

stable levels of on-task behavior at criterion levels after the first few sessions. Overall, these results suggest that both 30-s access and 5-min access to the same highest-preferred item (that was equally preferred across access times in the preference assessments) maintained the same level of on-task behavior.

Figure 13 shows results for participants for whom a reinforcement effect was shown under both access times. Bailey's data are depicted in the top panel. Bailey's highest-preferred item was a superhero toy and his lowest-preferred items were a Barrel of Monkeys® and a puppet. High levels of engagement with the HP item occurred across all free-operant preference assessment sessions. Bailey engaged in either initially moderate but decreasing or low levels of on-task behavior throughout all baseline phases. Steady levels of on-task behavior were observed at criterion levels for the remainder of phases. That is, Bailey engaged in only as much on-task behavior as was necessary to earn reinforcement throughout the majority of sessions in the 30-s access and 5-min access phases. During the progressive-duration schedule phase, Bailey engaged in similar levels of on-task behavior across 30-s and 5-min access conditions at a reinforcement criterion of 15 intervals, 21 intervals, 27 intervals, and 33 intervals. At a reinforcement criterion of 39 intervals, levels of responding failed to reach reinforcement criterion in the 30-s access condition for 5 consecutive sessions. The criterion for reinforcement was eventually increased in the 30-s access condition and on-task behavior occurred at high levels until a criterion of 57 intervals was reached. Zero levels of responding occurred during all 30-s access condition sessions at this criterion for reinforcement. At a reinforcement criterion of 39 intervals, responding in the 5-min access condition continued to occur at steady levels until a reinforcement criterion of 63

intervals was reached. Levels of responding remained high, though below reinforcement criterion, for several sessions and then decreased to zero levels for several sessions. Jill's data are depicted in the bottom panel. Jill's highest-preferred item was the Leapster® and her lowest-preferred items were a doll and a kaleidoscope. High levels of engagement with the HP item occurred Jill's only free-operant preference assessment session. Jill engaged in variable levels of on-task behavior during baseline phases. She engaged in high, stable levels of on-task behavior during the 30-s and 5-min access phases. During the progressive-duration schedule phase, Jill engaged in similar levels of on-task behavior across the 30-s and 5-min access conditions at the 48-interval criterion. When the criterion for reinforcement was increased to 57 intervals in the 30-s access phase, responding decreased to zero levels over the course of 5 sessions. When the criterion for reinforcement was increased to 57 intervals in the 5-min access phase, responding continued to occur at high levels through the next schedule increase. When the 84-interval criterion was reached, levels of responding decreased below the criterion for reinforcement. Overall, data for Bailey and Jill suggest that although 30-s and 5-min access to a high-preferred item maintained similar levels of on-task behavior when the work requirement was relatively small, 5-min access to the high-preferred item maintained more on-task behavior than 30-s access as the work requirement was increased.

Discussion

The purpose of Study 1 in which we conducted MSWO preference assessments with short and long access times was to compare preferences for items given these different access times. Our study represents a systematic replication of Steinhilber &

Johnson (2007) in which preferences across item access times were compared in two participants. A surprising finding of our study was that the vast majority of participants ranked items within the top two or three regardless of access time suggesting that highly preferred items remain similar regardless of item access time. The implication of these data is that conducting a preference assessment with a short access time may be sufficient when attempting to identify highly preferred items that might then later be used as reinforcers.

However, as seen in Steinhilber and Johnson (2007), participants in our study ranked some items disparately when available for a short access time versus a long access time. That is, some items were ranked higher when provided for 30 s as compared to 5 min and vice versa. It is important to note, though, that more items were preferred when available for a long access time than a short access time. Although we examined relatively large differences in rankings (i.e., items ranked in the top 2 in one assessment and the bottom 2 in the other assessment), these results suggest that preference for some leisure items may be affected by the duration for which the items are available. That is, certain items (e.g., watching television, completing a puzzle, etc.) may be more preferred when available for an extended period of time, whereas other items (e.g., novel sensory toys, limited-function activities, etc.) may more preferred when available for a short period of time. These results suggest that conducting preference assessments with different access times might yield a different hierarchy of preferred items, depending on the items. Therefore, it is possible that access times during preference assessments should match the access time for which an individual will earn a particular item. Based on these results, an evaluation of levels of responding under conditions of preferred and

less-preferred durations of access to items with disparate rankings is warranted. That is, it would be important to determine whether disparate preferences predict disparate levels of behavior given contingent access to preferred or less-preferred durations of reinforcement.

The purpose of Study 2 was to determine the extent to which young children would engage in on-task behavior to earn access to the same high-preferred item when available for short or long access times. That is, we attempted to determine whether items that were equally preferred during a preference assessment would maintain equal levels of target behavior during a reinforcer assessment. For five of the participants in Study 2, the stimulus identified as highly preferred across both assessments in Study 1 did not function as a reinforcer for a brief work period given either access time. These results may suggest that the utility of preference assessments may be limited for identifying potent reinforcers for on-task behavior exhibited by typically developing children.

However, our results may have been due to procedural differences in our study as compared to other studies. That is, most reinforcer assessments are arranged such that an individual responds to a ratio requirement and earns reinforcement immediately following completion of the required ratio. In the current study, we utilized a duration-based requirement in an attempt to more closely approximate a typical classroom environment. However, it may be more difficult for participants to discriminate duration requirements as compared to ratio requirements. For example, ratio-based schedules often start at a low value, such as an FR1; whereas, in the current study, the initial work requirement was 1 min 15 s, which would likely approximate a much higher ratio value

than FR1. Although the work requirement was relatively small (i.e., based on individual participants' levels of responding in baseline), relatively continuous on-task behavior (e.g., tracing shapes for 1 min 15 s) had to occur as opposed to completing discrete tasks [e.g., tracing one shape]). Although duration of on-task behavior (as opposed to number of tasks completed) was our dependent variable of interest, future researchers might compare both ratio- and duration-based schedule requirements to determine differences in responding when measuring one dependent variable versus the other.

For four of the participants in Study 2, the stimulus identified as highly preferred under both access times in Study 1 functioned as a reinforcer given both short and long access time. These results demonstrate that different durations of item access maintain similar levels of on-task behavior when the work requirement is relatively small. These results suggest that preference assessments with brief access times can identify items that will function as reinforcers for some preschool-age, typically developing children. That is, a preference assessment with short access times is relatively likely to identify a reinforcer for which a child will engage in a small amount of a target behavior, regardless of the duration for which the item will be provided as a reinforcer. These results suggest that a preference assessment with brief access times may be sufficient when attempting to identify a reinforcer for a small work requirement.

During the progressive-duration schedule phase, different levels of on-task behavior under short and long access times were demonstrated for the same two participants. These results suggest that, regardless of similarities in preference, a longer duration of access to a reinforcer maintains a longer duration of behavior than a shorter duration of access to a reinforcer for progressively increasing work requirements. As

mentioned previously, short and long access times both maintained the same amount of target behavior when the work requirement was relatively small. However, as the requirement was increased, a longer duration of access was required to maintain a longer duration of work. These results suggest that it may be necessary to provide a longer duration of item access when requiring more than a brief duration of target behavior.

There are some limitations of these studies. In Study 1, 30 s and 5 min were selected as the short and long item access time, respectively, because they are relatively common access times. However, it is possible that 30 s and 5 min do not represent a large enough disparity for a magnitude effect to be demonstrated. Steinhilber and Johnson (2007) used 15 s and 15 min as disparate access times for their participants (adolescents with autism spectrum disorder); however, the participants in the current study were typically developing 3-to-5 year old children and, with respect to clinical application, it is unlikely that a child of this age would earn access to a reinforcer for longer than 5 min. Another possible limitation of Study 1 is that anecdotal information suggested that nine of 30 participants did not interact with at least one lesser-preferred item for the entire programmed access time (e.g., for only 2 out of 5 minutes). However, in the absence of objective data, conclusions cannot be made regarding this issue. Future researchers could record data on item interaction during access times to ensure that the programmed magnitudes of reinforcement are being evaluated.

A possible limitation of Study 2 is that the session length was initially set at 5 minutes to avoid a ceiling effect for on-task behavior. Given this arrangement, it was possible for the participant to experience a delay to reinforcement, which may have reduced the efficacy of the highly preferred item as a reinforcer for on-task behavior. For

example, if a participant's reinforcement criterion was 15 intervals (1 min 15 s) of on-task behavior within a 60-interval (5-min) session and the participant completed the response requirement immediately (i.e., within the first 15 intervals of the session), (s)he was required to wait 45 intervals (3 min 45 s) to the end of session before earning reinforcement. Several participants in the current study would engage in this pattern of responding; participants would complete their work requirement at the beginning of the session and then experience a delay. We hypothesized that this delay-to-reinforcement arrangement was decreasing the efficacy of the preferred items as reinforcers because the items were not being delivered immediately following completion of the response requirement. To mitigate this issue, we removed the possibility for a delay to reinforcement by decreasing session time to equal the reinforcement criterion. When this delay was removed, though, a reinforcement effect was still not seen. It may be possible that a history of a delay to reinforcement decreased the reinforcing efficacy of the stimulus despite the stimulus remaining highly preferred. Future researchers could ensure participants do not contact a delay to reinforcement by evaluating the effects in the absence of delay to determine whether the highly preferred item functions as a reinforcer in this arrangement. In the current study, though, Carlie experienced only the no-delay procedure and a maintained reinforcement effect was still not demonstrated.

Another possible limitation of Study 2 involves the methods by which sessions were conducted and schedule requirements were progressively changed during the progressive-duration schedule phase. First, because the conditions in that phase were rapidly alternated within a multielement design, it is possible that there were carryover effects from one condition to another. For example, less responding may have been

maintained in the 30-s access phase when immediately following a 5-min access phase due to satiation. Additionally, only short breaks were provided between sessions during this phase. Kodak, Lerman, and Call (2007) found that progressive-ratio breakpoints were much lower when the same reinforcer provided in session was also provided immediately after session. In our study, consecutive opportunities to earn the reinforcer might have functioned as an abolishing operation for the value of the reinforcer during subsequent sessions. That is, if the participant just earned 5 min access to a highly preferred item, motivation to engage in the target behavior to earn access to that item in a subsequent session may have been decreased. Similarly, participants might be less likely to engage in on-task behavior in the 30-s access condition if they have previously learned that a 5-min access condition will immediately follow the 30-s access condition. To avoid this issue, future researchers could ensure that a long period of time (e.g., several hours) elapses between sessions when conducting this evaluation using a multielement design. Future researchers could also evaluate break points for each access time in isolation (i.e., first determine break point in responding for 30-s access and then determine break point in responding for 5-min access) to avoid the possibility of carryover effects due to rapid alternation of conditions. Second, during this phase, requirements for increasing the reinforcement criterion (i.e., increasing the schedule requirement) operated independently across conditions (i.e., access times). That is, once criterion was met to increase the schedule requirement for one access time, the schedule requirement was changed for only that access time regardless of whether criterion was met for the other access time. Although this procedure allowed for examination of whether a particular work requirement would eventually be maintained given a particular access time (i.e., whether

the participant would eventually earn a reinforcer at a particular schedule requirement), the independent schedule increases may have evoked a higher level of behavior for a longer period of time (i.e., responding was allowed to continue to occur because the schedule requirement was not increased). Future researchers could increase the schedule requirement simultaneously across access times to facilitate the efficient determination of the break point.

An additional limitation of Study 2 was that a timer was used to aid in discrimination of the duration of the work requirement across sessions. It is possible that this extraneous variable exerted some control over behavior. For example, consider Bailey's baseline patterns of responding in Figure 13. Specifically, in the third and fourth baseline phases, levels of on-task behavior remained at the criterion level initially, despite the absence of reinforcement delivery. This maintenance might have been due to the presence of the timer within session. The timer was used during all conditions (including baseline) to ensure that levels of responding in the 30-s and 5-min access phase weren't due to the presence of the timer alone. It is possible, though, that the sound of the timer became a conditioned reinforcer through repeated pairings with the delivery of reinforcement after session. A conditioned reinforcement effect would explain the maintenance of criterion levels of on-task behavior initially in baseline, followed by a decrease in levels of the behavior because the timer was no longer being paired with the delivery of reinforcement.

Finally, the reinforcing efficacy of those items with disparate rankings across access times in Study 1 has not yet been evaluated. That is, despite being highly preferred for one access time and lower preferred for another access time, we did not

evaluate whether an item with disparate rankings would function as a reinforcer when provided for either the preferred or less-preferred item access time. Future researchers should determine whether items that are highly preferred for one access time but low preferred for another access time will function as reinforcers when delivered for the access time for which they were preferred. Researchers might determine that items with disparate rankings function as reinforcers regardless of duration for which it was preferred and duration for which it is provided. These results would suggest that a highly preferred item will function as a reinforcer, regardless of the duration of access time for which it is delivered. Researchers might also determine that items with disparate rankings only function as reinforcers when provided for the duration for which they were preferred. These results would support previous research (Steinhilber & Johnson, 2007) that showed that the reinforcing efficacy of some items is predicted by preference for different durations of access to those stimuli.

Additionally, this study introduces a new type of progressive schedule arrangement, termed here a progressive-duration schedule, that differs from those outlined by Jarmolowicz & Lattal (2010). To create this schedule, aspects of other progressive ratio schedules were combined. For example, Johnson and Bickel (2006) used a progressive-ratio schedule that increased across sessions and compared levels of responding under both single- and concurrent-operant arrangements. In the single-operant arrangement, the same FR value was in place during a given session, and that value was increased during each subsequent session until no reinforcers were earned at a particular FR value. In the concurrent-operant arrangement, the same FR value was in place for each concurrently available reinforcer during session. The FR value increased

equally for both reinforcers across sessions until neither reinforcer was earned at a particular FR value. Tustin (1994) also used a progressive-ratio schedule in which the FR requirement increased across, rather than within, session to examine preference for different types (e.g., sensory, attention) of reinforcers. In these schedules described, reinforcement is delivered contingent upon completion of a particular number of discrete responses within a ratio schedule. Time-based progressive schedules, which involve the availability of reinforcement after a particular period of time has elapsed, have also been described (e.g., progressive-interval schedules; Dougherty, Cherek, & Roache, 1994). Similar to any interval schedule, progressive-interval schedules involve the delivery of reinforcement for the first response that occurs after a specified period of time elapses. As discussed previously, though, with respect to applied application (e.g., classrooms) of reinforcement schedules, ratio-based responding may not be the only variable of interest; using duration-based responding, a more teacher-friendly dependent variable, rather than ratio-based responding may be easier for teachers to measure due to typical classroom variables (e.g., large student-to-teacher ratio). In the current study, we were able to identify items that functioned as reinforcers for a duration-based reinforcement criterion for two participants. Future researchers could continue this line of research, focusing on feasible dependent variables for use in the applied setting, such that more individuals may be likely to utilize effective and efficient preference and reinforcer assessment strategies.

References

Bojak, S. L., & Carr, J. E. (1999). On the displacement of leisure items by food during multiple-stimulus preference assessments. *Journal of Applied Behavior Analysis, 32*, 515-518.

Cannella, H. I., O'Reilly, M. F., & Lancioni, G. E. (2005). Choice and preference assessment research with people with severe to profound developmental disabilities: A review of the literature. *Research in Developmental Disabilities, 26*, 1-15.

Catania, A. C. (1963). Concurrent performances: A baseline for the study of reinforcement magnitude. *Journal of the Experimental Analysis of Behavior, 6*, 299-300.

Cote, C. A., Thompson, R. H., Hanley, G. P., & McKerchar, P. M. (2007). Teacher report and direct assessment of preferences for identifying reinforcers for young children. *Journal of Applied Behavior Analysis, 40*, 157-166.

Daly, E. J., Wells, N. J., Swanger-Gagne, M. S., Carr, J. E., Kunz, G. M., & Taylor, A. M. (2009). Evaluation of the multiple-stimulus without replacement preference assessment method using activities as stimuli. *Journal of Applied Behavior Analysis*, *42*, 563-574.

DeLeon, I. G., Frank, M. A., Gregory, M. K., & Allman, M. J. (2009) On the

correspondence between preference assessment outcomes and progressive-ratio schedule assessments of stimulus value. *Journal of Applied Behavior Analysis, 42*, 729-733.

DeLeon, I. G. & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29*, 519-533.

DeLeon, I. G., Iwata, B. A., Conners, J., & Wallace, M. D. (1999). Examination of ambiguous stimulus preferences with duration-based measures. *Journal of Applied Behavior Analysis, 32*, 111-114.

DeLeon, I. G., Iwata, B. A., & Roscoe, E. M. (1997). Displacement of leisure reinforcers by food during preference assessments. *Journal of Applied Behavior Analysis, 30*, 475-484.

Dougherty, D. M., Cherek, D. R., & Roache, J. D. (1994). The effects of smoked marijuana on progressive-interval schedule performance in humans. *Journal of the Experimental Analysis of Behavior, 62*, 73-87.

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 persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*, 491-498.

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*, 189-202.

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*, 163 -176.

Gottschalk, J. M., Libby, M. E., & Graff, R. B. (2000). The effects of establishing operations on preference assessment outcomes. *Journal of Applied Behavior Analysis, 33*, 85-88.

Hagopian, L. P., Long, E. S., & Rush, K. S. (2004). Preference assessment procedures for individuals with developmental disabilities. *Behavior Modification, 28*, 668-677.

Hagopian, L. P., Rush, K. S., Lewin, A. B., & Long, E. S. (2001). Evaluating the predictive validity of a single stimulus engagement preference assessment. *Journal of Applied Behavior Analysis, 34,* 475-485.

Hanley, G. P., Cammilleri, A. P., Tiger, J. H., & Ingvarsson, E. T. (2007). A method for describing preschoolers' activity preferences. *Journal of Applied Behavior Analysis, 40,* 603-618.

Hanley, G. P., Iwata, B. A., & Roscoe, E. M. (2006). Some determinants of changes in preference over time. *Journal of Applied Behavior Analysis*, *39*, 189-202.

Hanley, G. P., Iwata, B. A., Roscoe, E. M., Thompson, R. H., & Lindberg, J. S. (2003). Response-restriction analysis: II. Alteration of activity preferences. *Journal of Applied Behavior Analysis, 36*, 59-76.

Hoch, H., McComas, J. J., Johnson, L., Faranda, N., & Guenther, S. L. (2002). The effects of magnitude and quality of reinforcement on choice responding during play activities. *Journal of Applied Behavior Analysis, 35,* 171-181.

Hodos, W. (1961). Progressive ratio as a measure of reward strength. *Science, 134*, 943-944.

Jarmolowicz, D. P. & Lattal, K. A. (2010). On distinguishing progressively increasing response requirements for reinforcement. *The Behavior Analyst, 33*, 119-125.

Johnson, M. W. & Bickel, W. K. (2006). Replacing relative reinforcing efficacy with behavioral economic demand curves. *Journal of Applied Behavior Analysis*, *85*, 73-93.

Kodak, T., Lerman, D. C., & Call, N. (2007). Evaluating the influence of postsession reinforcement on choice of reinforcers. *Journal of Applied Behavior Analysis, 40*, 515-527.

Layer, S. A., Hanley, G. P., Heal, N. A., & Tiger, J. H. (2008). Determining individual preschoolers' preferences in a group arrangement. *Journal of Applied Behavior Analysis, 41*, 25-37.

Neuringer, A. J. (1967). Effects of reinforcement magnitude on choice and rate of responding. *Journal of the Experimental Analysis of Behavior, 10*, 417-424.

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*, 249-255.

Penrod, B., Wallace, M. D., & Dyer, E. J. (2008). Assessing potency of high-and low-preference reinforcers with respect to response rate and response patterns. *Journal of Applied Behavior Analysis*, *41*, 177-188.

Powell, J., Martindale, A., & Kulp, S. (1975). An evaluation of time-sample measures of behavior. *Journal of Applied Behavior Analysis, 10*, 325-332.

Resetar, J. L., & Noell, G. H. (2008). Evaluating preference assessments for use in the general education population. *Journal of Applied Behavior Analysis, 41*, 447-451.

Rickard, J. F., Body, S., Zhang, Z., Bradshaw, C. M., & Szabadi, E. (2009). Effect of reinforcer magnitude on performance maintained by progressive-ratio schedules. *Journal of the Experimental Analysis of Behavior, 91*, 75-87.

Roane, H. S. (2008). On the applied use of progressive-ratio schedules. *Journal of Applied Behavior Analysis, 41*, 155-161.

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,* 605-620.

Roscoe, E. M., Iwata, B. A., & Kahng, S. (1999). Relative versus absolute reinforcement effects: Implications for preference assessments. *Journal of Applied Behavior Analysis, 32*, 479-493.

Schmitt, D. R. (1974). Effects of reinforcement rate and reinforcer magnitude on choice behavior of humans. *Journal of the Experimental Analysis of Behavior, 21*, 409-419.

Schwartz, B. (1969). Effects of reinforcement magnitude on pigeons' preference for different fixed-ratio schedules of reinforcement. *Journal of the Experimental Analysis of Behavior, 12*, 253-259.

Shimoff, E., & Matthews, B. A. (1975). Unequal reinforcer magnitudes and relative preference for cooperation in the dyad. *Journal of the Experimental Analysis of Behavior, 24*, 1-16.

Spear, D. J., & Katz, J. L. (1991). Cocaine and food as reinforcers: Effects of reinforcer magnitude and response requirement under second-order fixed-ratio and progressive-ratio schedules. *Journal of the Experimental Analysis of Behavior, 56*, 261-275.

Steinhilber, J. & Johnson, C. (2007). The effects of brief and extended stimulus availability on preference. *Journal of Applied Behavior Analysis, 40*, 767-772.

Trosclair-Lasserre, N. M., Lerman, D. C., Call, N. A., Addison, L. R., & Kodak, T. (2008). Reinforcement magnitude: An evaluation of preference and reinforcer efficacy. *Journal of Applied Behavior Analysis*, *41*, 203-220.

Tustin, R. D. (1994). Preference for reinforcers under varying schedule arrangements: A behavioral economic analysis. *Journal of Applied Behavior Analysis, 27*, 597-606.

Wacker, D. P., Berg, W. K., Wiggins, B., Muldoon, M., & Cavanaugh, J. (1985). Evaluation of reinforcer preferences for profoundly handicapped students. *Journal of Applied Behavior Analysis, 18*, 173-178.

Zhou, L., Iwata, B. A., Goff, G. A., & Shore, B. A. (2001). Longitudinal analysis of leisure-item preferences. *Journal of Applied Behavior Analysis*, *34*, 179-184.

Figure 1. This figure depicts the number of participants who showed stable preferences for high-preferred (HP) items across access times (30 s vs 5 min).

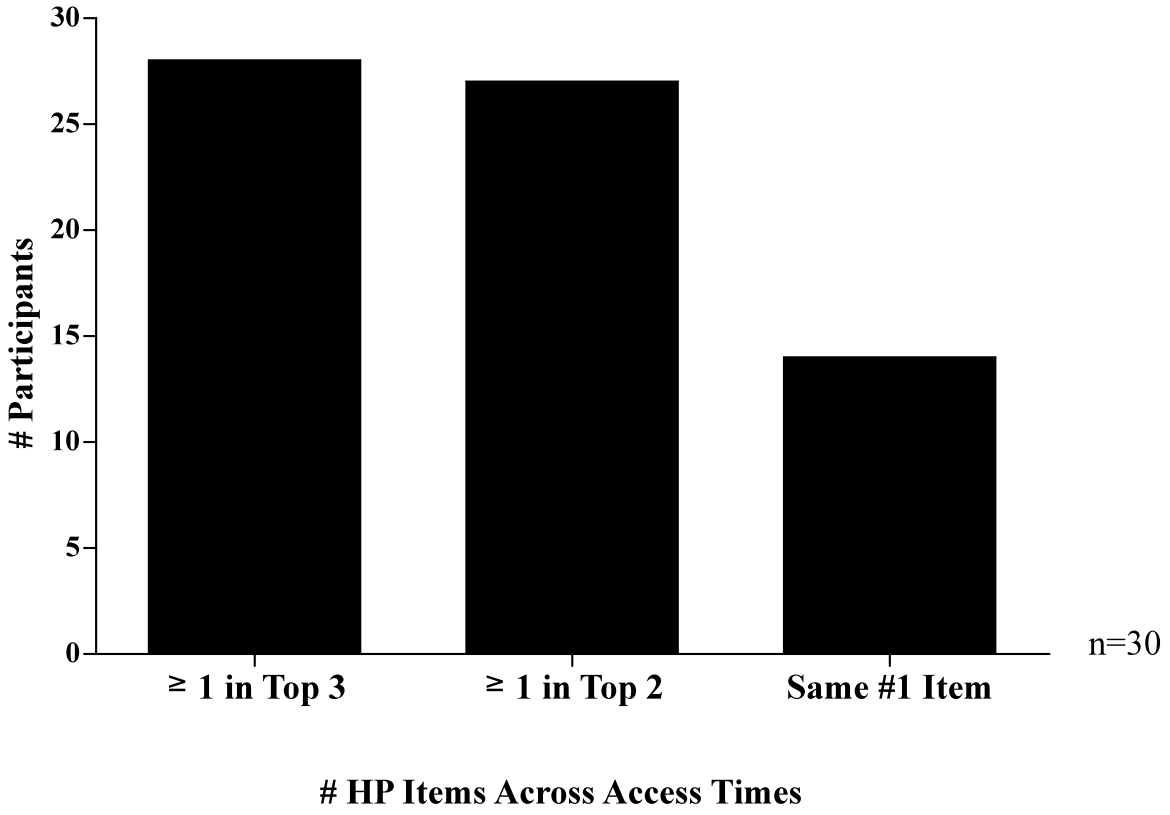

Figure 2. This figure depicts the number of participants who had at least one item with disparate rankings across access times (30 s vs 5 min).

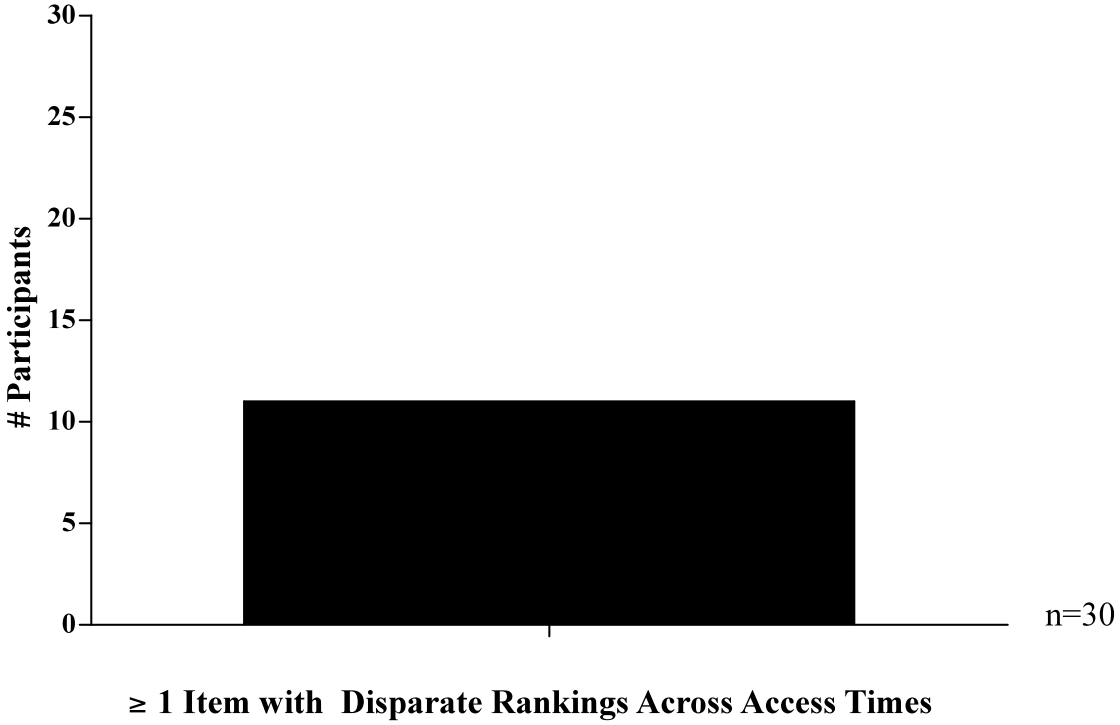

Figure 3. This figure depicts the number of participants who had 4, 3, 2, or 1 item(s) with disparate rankings.

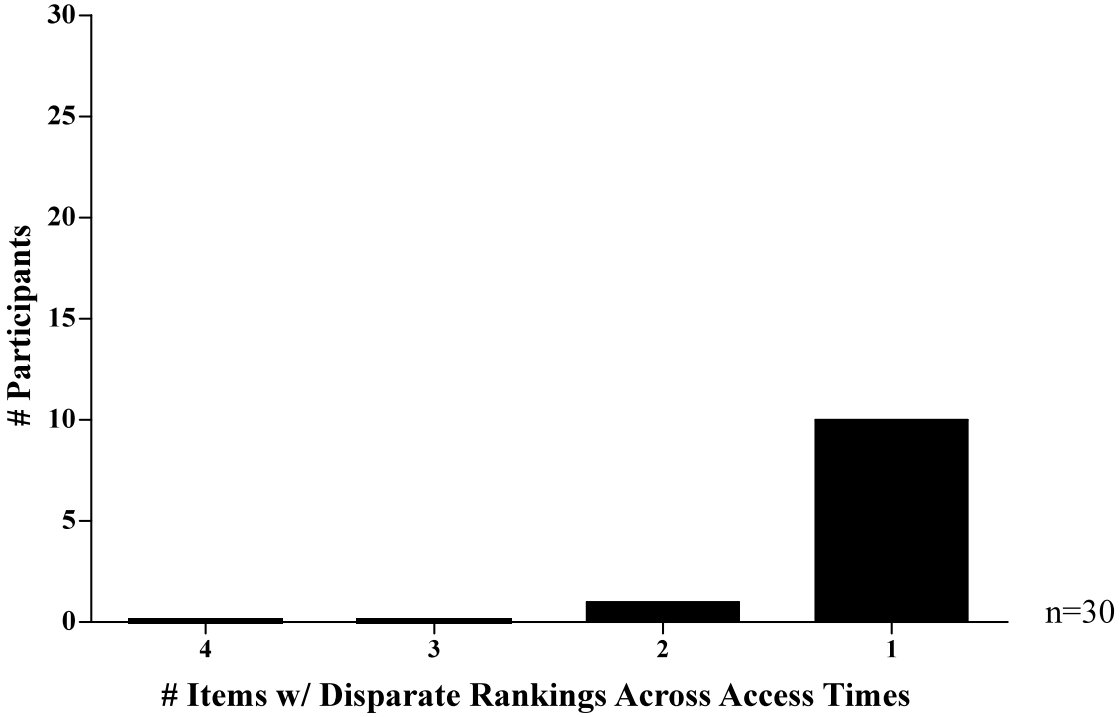

Figure 4. This figure depicts the number of items that were more highly preferred for each of the access times.

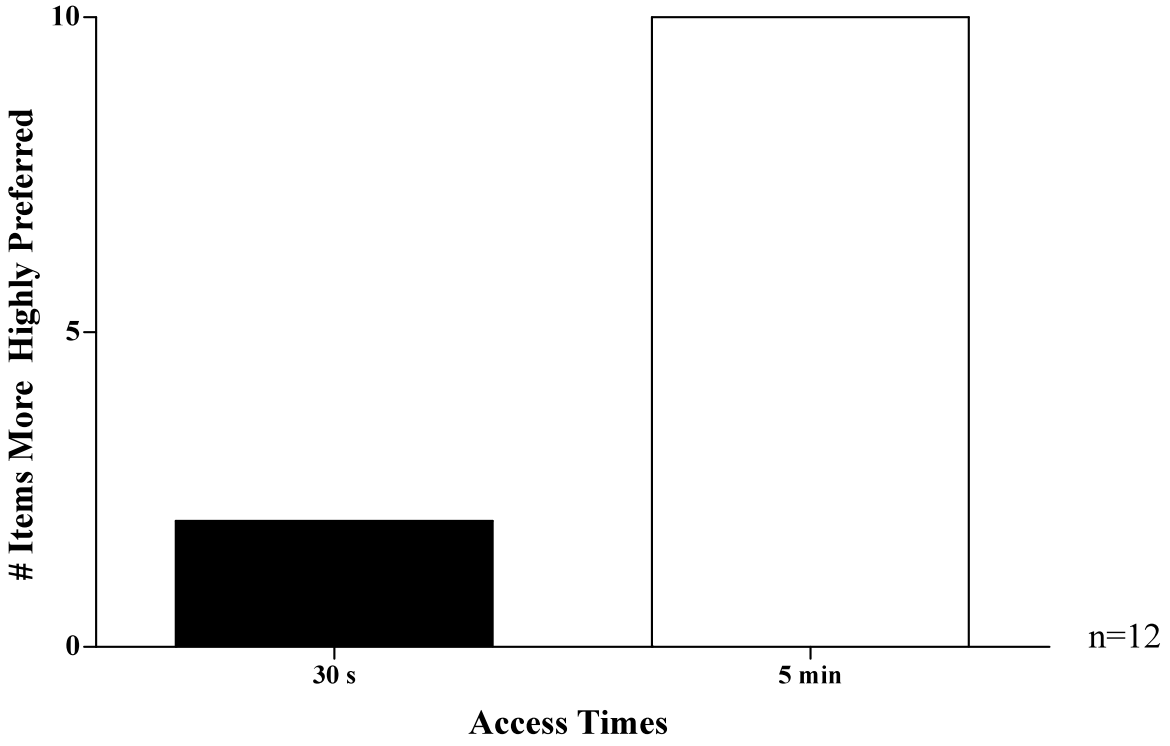

Figure 5. This figure depicts representative data for participants who ranked the same (S) items within the top two and had zero items with disparate (D) rankings.

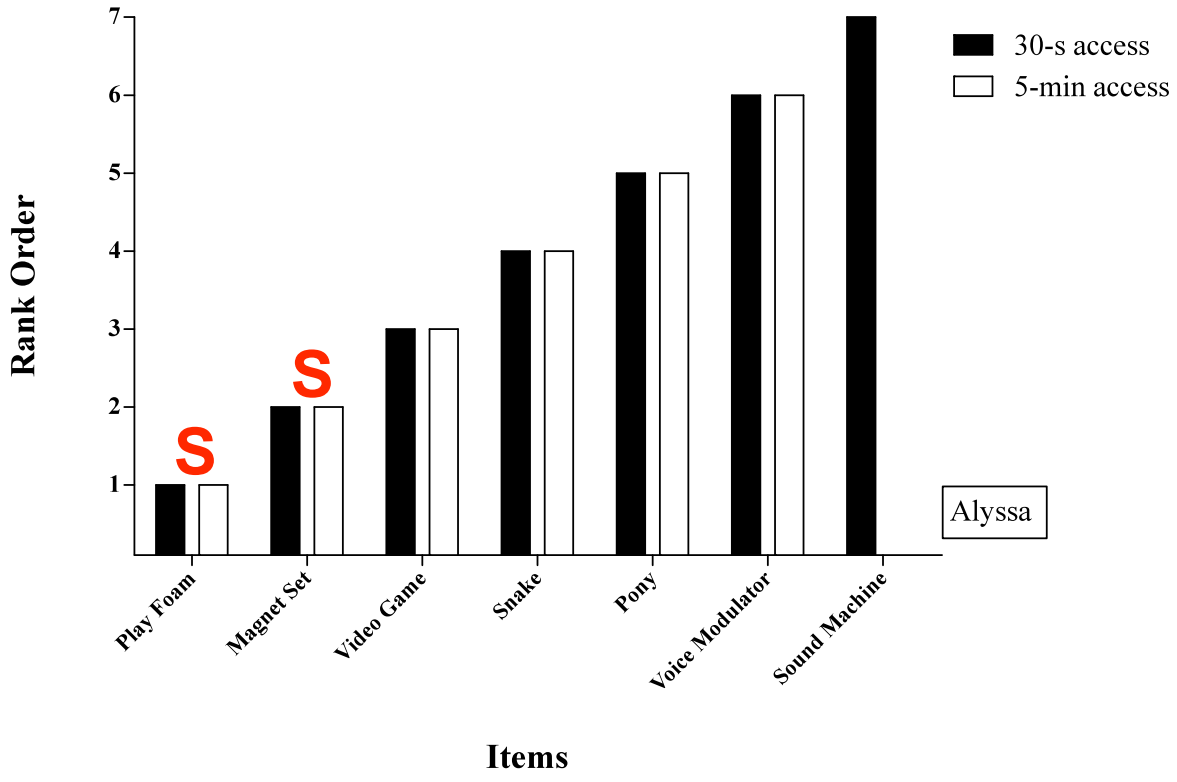

Figure 6. This figure depicts representative data for participants who ranked one item within the top two (S) across assessments and had zero items with disparate (D) rankings.

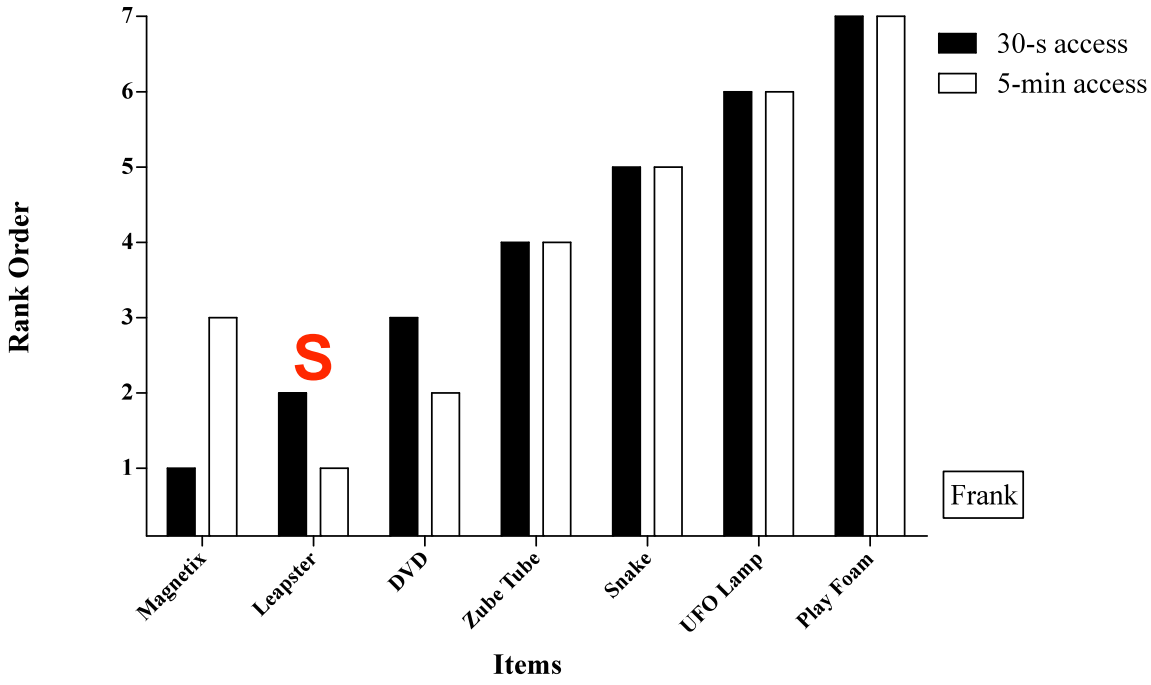

Figure 7. This figure depicts representative data for participants who ranked one item within the top two (S) across access times and had one item with disparate (D) rankings that was more highly preferred for a short access time.

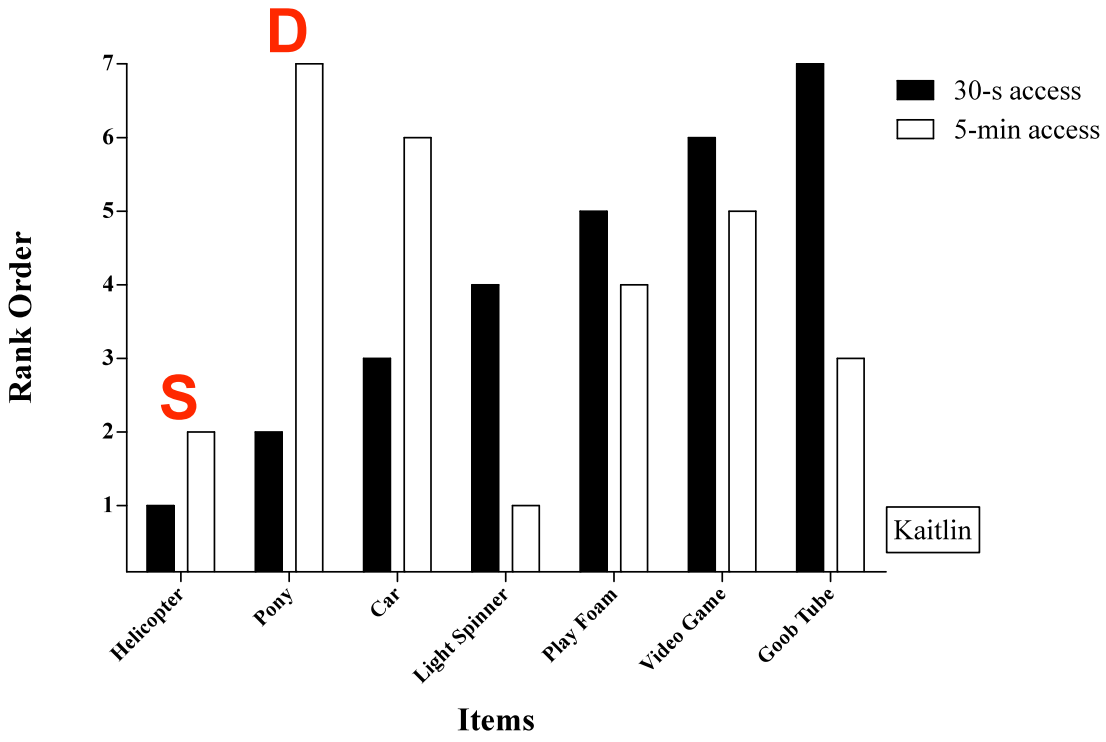

Figure 8. This figure depicts representative data for participants who ranked one item within the top two (S) across access times and had one item with disparate (D) rankings that was more highly preferred for a long access time.

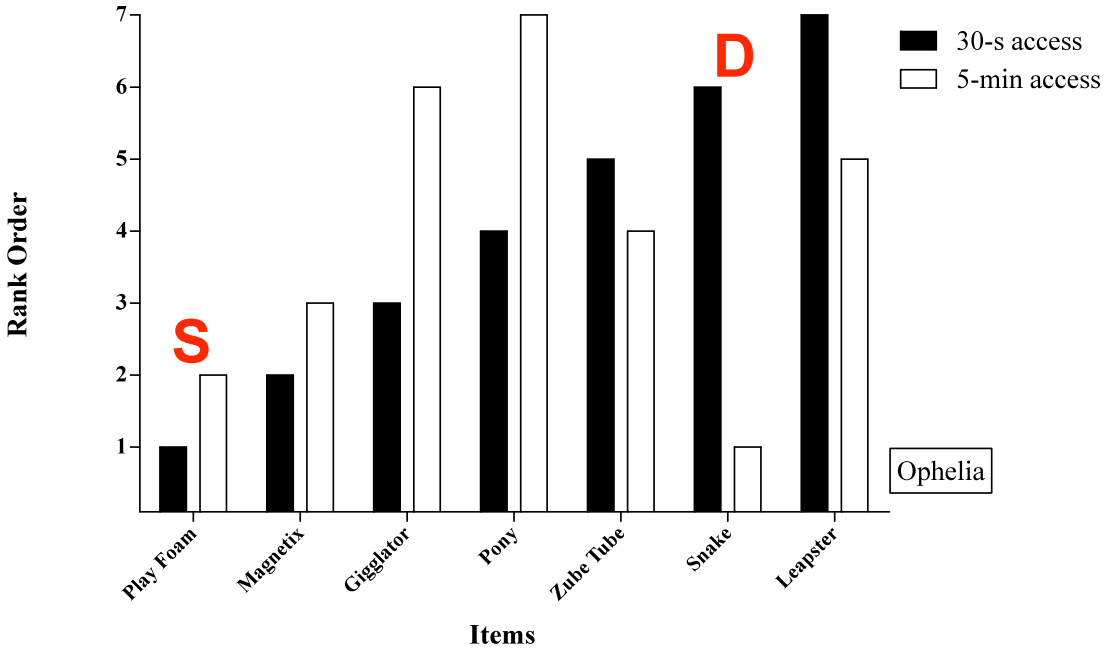

Figure 9. This figure depicts representative data for participants who ranked zero items within the top two (S) across access times and had one or two items with disparate (D) rankings that was/were more highly preferred for a long access time.

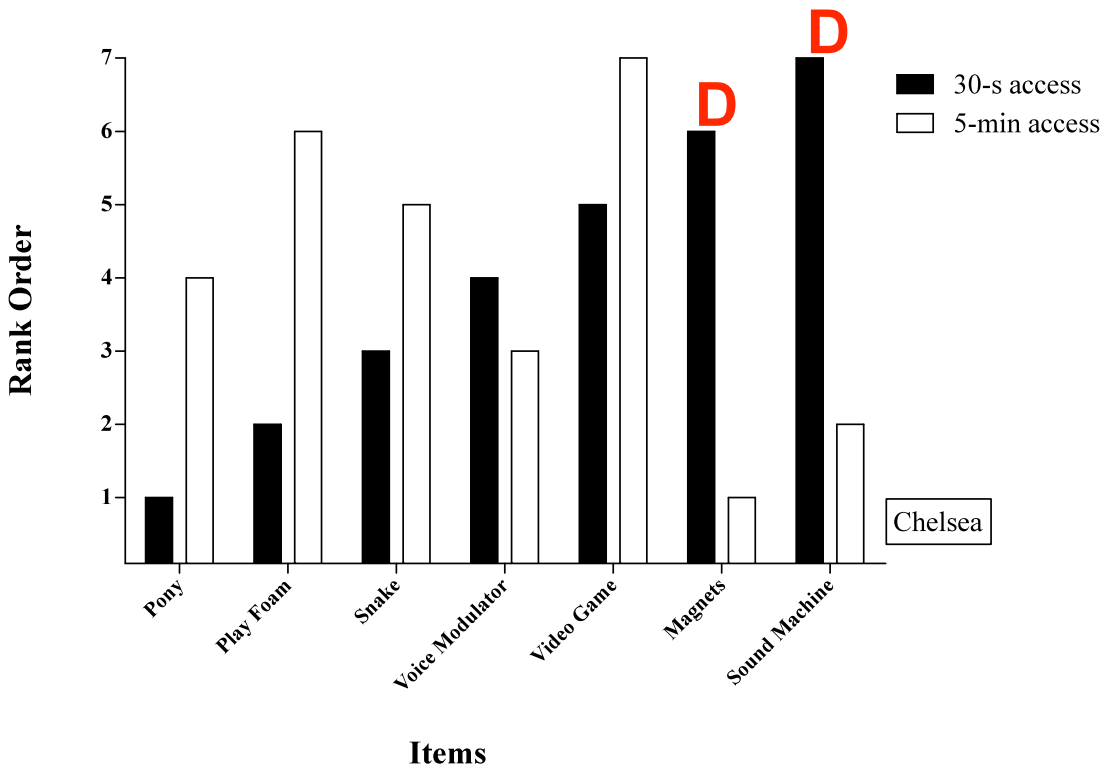

Figure 10. This figure depicts data for three participants for whom no reinforcement effect was shown regardless of whether there was a possible delay to reinforcement.

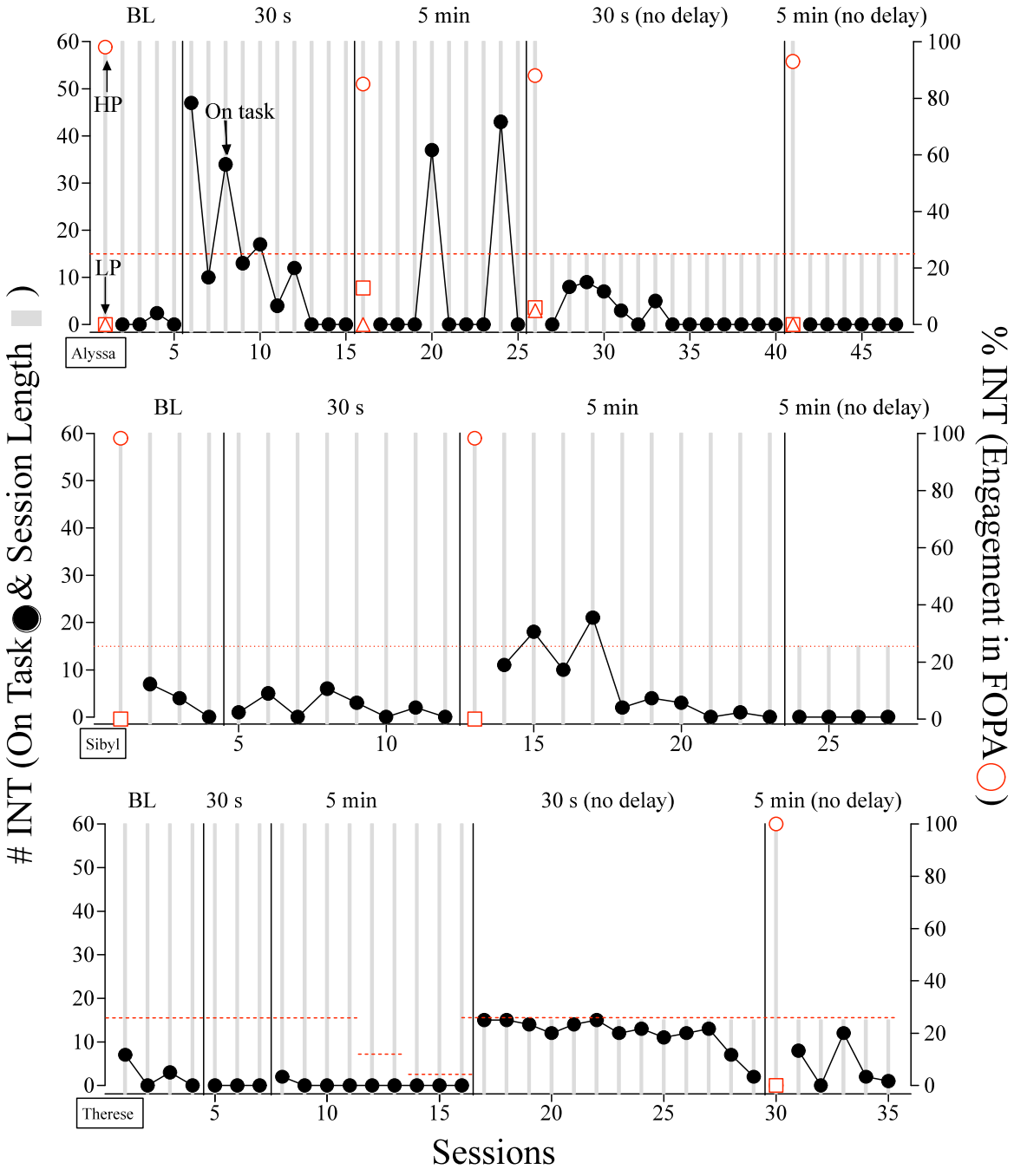

Figure 11. This figure depicts data for two participants for whom no reinforcement effect was shown regardless of whether there was a possible delay to reinforcement (Marvin) or there was no delay to reinforcement (Carlie).

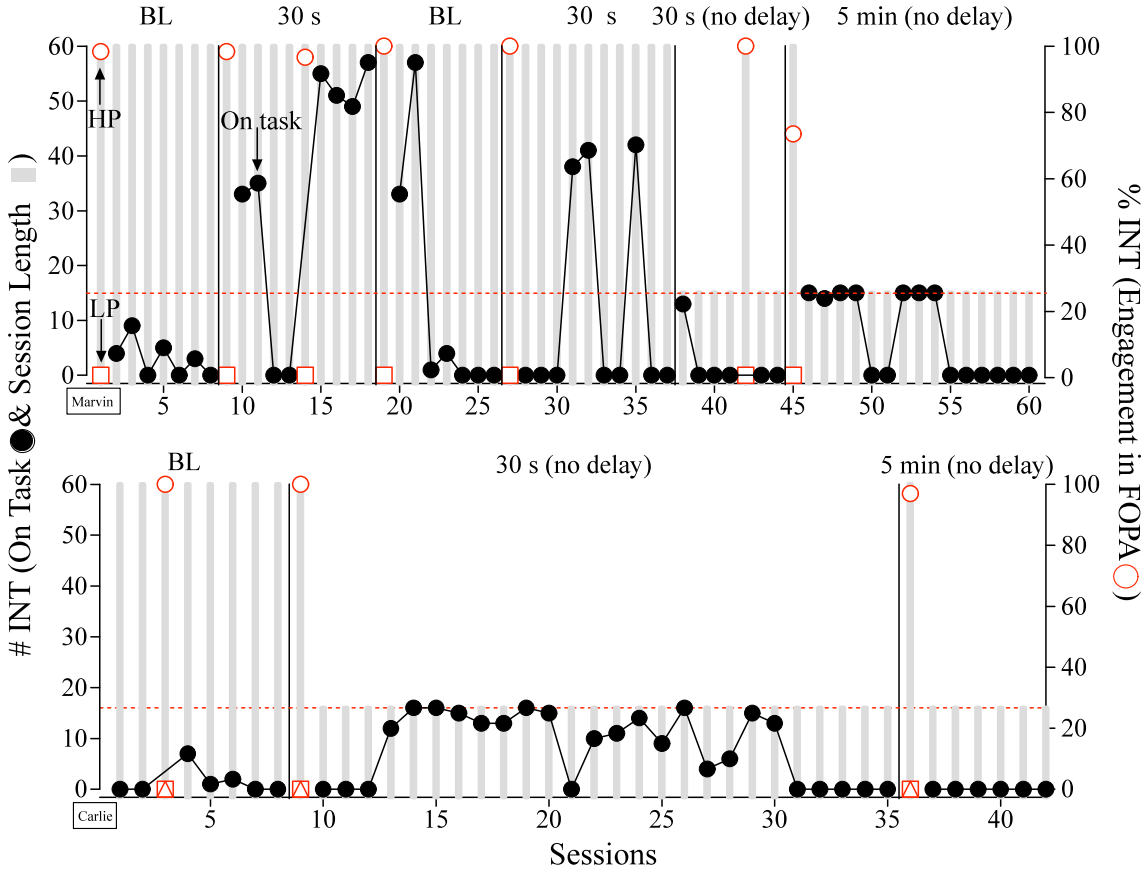

Figure 12. This figure depicts data for participants for whom the same reinforcement effect was shown across access times.

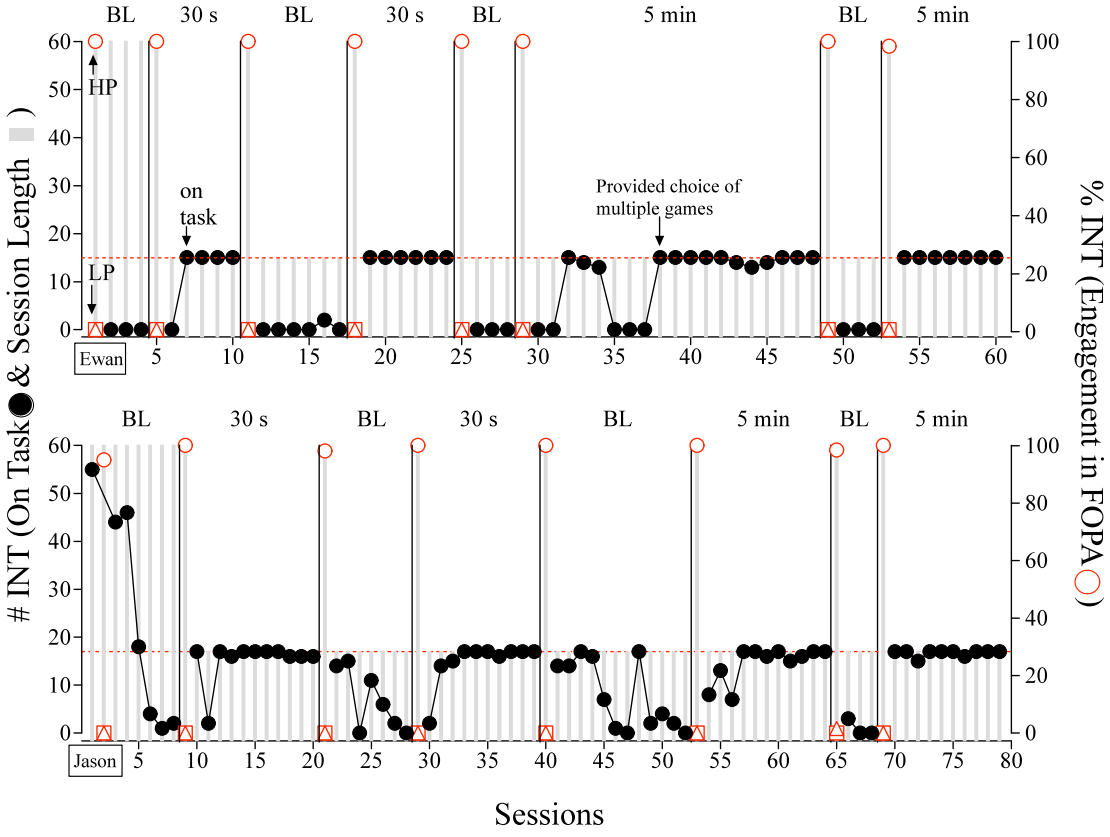

Figure 13. This figure depicts data for participants for whom the same reinforcement effect was shown across access times and the progressive-duration schedule (PDS) phase was conducted.