Evaluation of Multiple-Stimulus Preference Assessment with Adults with Developmental Disabilities

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Abstract: We compared multiple-stimulus without replacement (MSWO) and paired-stimulus (PS) procedures to assess stimulus preferences of adults with developmental disabilities. Stimulus preference rankings for six food items obtained by the two procedures were positively correlated for all participants (M = .72, range .41 to 1). However, four participants did not select the most-preferred stimuli identified by the PS assessments as their most-preferred stimuli during the MSWO assessments. Preferred-stimulus selection percentages for these participants generally increased during MSWO as the number of stimuli decreased across trials. For participants who selected the same stimuli as their most-preferred in both procedures, their preferred-stimulus selection percentages generally declined during MSWO as the number of stimuli decreased across trials.

Stimulus preference assessment is an important component of many training programs for individuals with developmental disabilities because it can be used to identify reinforcers (Tullis et al., 2011). Stimuli may be presented one at a time across discrete trials in the single-stimulus (SS) procedure (Pace, Ivancic, Edwards, Iwata, & Page, 1985), two at a time in the paired-stimulus (PS) procedure (Fisher et al., 1992), or more than two at a time in the multiple-stimulus with (MSW; Windsor, Piche, & Locke, 1994) or without replacement (MSWO; Leon & Iwata, 1996) procedures. Preference is operationalized as the percentage of trials that a stimulus has been approached or selected when it was available during the assessment.

Preference assessment procedures vary in effectiveness (i.e., the ability to distinguish item preference levels) and efficiency (i.e., the number of trials required). The PS assessment involves pairing each stimulus with every other stimulus and presenting each pair in a random order. The PS procedure is more effective than the SS procedure in establishing a preference hierarchy because individuals tend to approach every stimulus in the latter procedure (Fisher et al., 1992). Multiple-stimulus assessment involves presenting more than two stimuli (typically six to eight, e.g., Windsor et al., 1994) per trial and may be performed with or without replacing items selected on preceding trials. DeLeon and Iwata (1996) compared PS, MSW, and MSWO assessments using seven stimuli. They found that MSWO was more effective than MSW, and that MSWO was as effective as, and more efficient than, PS. The most-preferred stimuli identified by MSWO assessment also functioned as reinforcers.

Since then, several studies have demonstrated the effectiveness of various abbreviated MSWO assessments, for example, by conducting fewer sessions (Higbee, Carr, & Harrison, 2000), by using eight stimuli (Carr, Nicolson, & Higbee, 2000), and by conducting fewer sessions and trials (Graff & Ciccone, 2002). However, DeLeon and Iwata’s study remains the only one that evaluated the effectiveness of MSWO assessment against PS assessments. Therefore, additional research comparing the two procedures would be desirable.

In this study, we sought to partially replicate DeLeon and Iwata’s (1996) study by compar-
ing the effectiveness of MSWO and PS assessments with six stimuli. In addition, we conducted a post hoc analysis of MSWO assessment trials to examine the effects of number of stimuli on responding.

Method

Participants and Setting

Nine adults receiving services for individuals with developmental disabilities participated (see Table 1 for participants’ characteristics). Six of the nine participants were diagnosed with intellectual disability ranging from severe to moderate. Three participants (P2, P5, P7), however, had unknown diagnoses. All participants received the Assessment of Basic Learning Abilities (ABLA; Kerr et al., 1977) at the beginning of the study. The ABLA is a learning-to-learn assessment that measures whether a student is able to learn to perform 2-choice visual and auditory discrimination tasks within a number of trials (Vause, Yu, & Martin, 2007). Participants 1 and 5 passed the simple visual discrimination task (placing a piece of foam into a yellow can independent of its position relative to a red box), but failed the visual matching-to-sample task (placing a yellow cylinder into the yellow can or a red cube into the red box independent of their positions) and the auditory-visual discrimination task (placing a piece of foam into the appropriate container upon hearing the tester’s spoken request to put it in the “yellow can” or “red box”, independent of their positions) on the ABLA. Participants 2, 6, and 7 passed the simple visual discrimination and the visual matching-to-sample tasks, but failed the auditory-visual discrimination task. Participants 3, 4, 8, and 9 passed all three discrimination tasks.

All sessions were conducted individually in an assessment room. The participant and experimenter sat at a table facing each other. An observer was present during some sessions to conduct reliability checks. The study was approved by a Research Ethics Board at our institution and we obtained written informed consent from each participant’s legal decision-maker before the study commenced.

Materials

Various food items were used for each participant. They were selected based on caregivers’ recommendations of items with a range of preferences and on the ease of presentation.

Procedure

PS assessment. Two items were presented on each trial and the participant was asked to “pick one.” An approach response was defined as touching or pointing to an item within 10 s, and the participant received the selected item into the appropriate container upon hearing the tester’s spoken request to put it in the “yellow can” or “red box”, independent of their positions on the ABLA. Participants 2, 6, and 7 passed the simple visual discrimination and the visual matching-to-sample tasks, but failed the auditory-visual discrimination task. Participants 3, 4, 8, and 9 passed all three discrimination tasks.
immediately for consumption. Absence of an approach response within 10 s would have terminated the trial, although this never occurred. Approaching two items simultaneously was blocked gently, although this rarely occurred, and the trial was repeated. Each item was paired with every other item, and each unique pair was presented twice in counterbalanced positions and in random order, totaling 30 trials. The assessment was conducted twice totaling 60 trials. The experimenter recorded the chosen stimulus on each trial.

**MSWO assessment.** The six items used in the PS assessment were used in the MSWO assessment. On the first trial, all stimuli were presented in a row in front of the participant and he/she was asked to “pick one.” Approach response definition and its consequence were the same as in the PS assessment. Selected stimuli were not presented again in subsequent trials of that session. The positions of the stimuli changed randomly across trials. The session ended if no item was chosen on a trial, although this never occurred, or after the last two items were presented on the fifth trial. Five sessions were conducted for a total of 25 trials. The assessment was conducted twice, totaling 50 trials. The experimenter recorded the chosen stimulus on each trial.

**Reliability**

Reliability checks were conducted on 60% of the PS assessment trials and 55% of the MSWO assessment trials. During reliability checks, an observer independently recorded the participant’s response on each trial and the data were compared to the experimenter’s at the end of the session. A trial was scored as an agreement if the recordings were identical and a disagreement if they were not. Percent agreement per session was calculated by dividing the number of agreements by the sum of agreements and disagreements, and expressing the result as a percentage (Martin & Pear, 2011). The mean percent agreement across sessions was 99.9% (range, 99.1%–100%).

The observer also evaluated procedural fidelity by recording whether the experimenter delivered each trial correctly using an 8-item behavior checklist (e.g., securing the participant’s attention, presenting the correct items in the correct positions, allowing up to 10 s for responding, providing the selected item immediately for consumption after an approach response). The mean percentage of steps conducted correctly per session was 99.9% (range, 99.5%–100%).

**Results**

Figure 1 shows the percentage of trials each stimulus was selected during the PS and MSWO assessments for each participant. Stimuli are ordered on the x-axis from the most to the least preferred according to the PS assessment. The mean Kendall’s tau rank correlation coefficient between PS and MSWO was .72 across participants, ranging from .41 to 1. The two procedures identified the same stimuli as the least preferred for all participants and identified the same stimuli as the most-preferred for five participants (P5 through P9, right column in Figure 1). The MSWO procedure identified the stimuli that were ranked second in the PS assessment as the most-preferred for two participants (P1 and P2), and identified the stimuli that were ranked third in the PS assessment as the most-preferred for the remaining two participants (P3 and P4).

To examine how the number of stimuli during MSWO assessments affected responding, we calculated the selection percentages of the most-preferred stimuli, relative to chance, across trials that presented the same number of stimuli (i.e., 10 trials each for 6 choices, 5 choices, 4 choices, 3 choices, and 2 choices; Figure 2). Chance is represented by 0 on the y-axis. Two response patterns emerged. For Participants 1 through 4, who did not select the most-preferred stimuli identified in the PS assessments as their most-preferred stimuli in the MSWO assessments, the selection percentage of the most-preferred stimuli available, relative to chance, generally increased as the number of stimuli decreased (top graph in Figure 2).

For this group, all participants selected the most-preferred stimuli available near or below chance level on 6-choice trials; two participants (P2 and P4) did so above chance on 5-choice trials; three participants (P1, P2, and P3) were well above chance on 4-choice trials; two participants (P1 and P4) were well above chance on 3-choice trials with two participants...
(P2 and P3) slightly above chance; and three participants (P1, P3, and P4) were well above chance on 2-choice trials with one participant (P2) slightly above chance.

Participants 5 through 9, who selected the same stimuli as the most-preferred in both PS and MSWO assessments, displayed a different pattern of responding: the selection percent-
Figure 2. Percentage of trials the most-preferred stimulus available was selected, relative to chance (zero on the y-axis), on multiple-stimulus without replacement (MSWO) trials with 6 choices, 5 choices, 4 choices, 3 choices, and 2 choices, respectively. Top graph shows participants who did not select the same stimulus as the most-preferred in MSWO and paired-stimulus (PS) assessments. Bottom graph shows participants who selected the same stimulus as the most-preferred in MSWO and PS assessments.
age of the most-preferred stimuli available tended to decline, relative to chance, as the number of the choices decreased. For this group, all participants chose the most-preferred stimuli available well above chance on 6-choice and 5-choice trials, followed by a decline in four of the five participants on 4-choice trials. On 3-choice trials, preferred stimulus selections were well above chance for three participants and below chance for two participants. Participants 6 and 9 showed a large improvement in selecting their preferred stimuli on 2-choice trials. Except for this increase, all other participants showed a general decline relative to chance in selecting the most-preferred stimuli available.

**Discussion**

Our results show two main findings. First, food preferences obtained from the MSWO assessments were similar to those found in the PS assessments, with moderate to very high positive correlations across participants. The correlation coefficients found in the present study ($M = .72$, range $$.41$ to $1$) are quite similar to those reported by DeLeon and Iwata (1996) across their seven participants ($M = .72$, range $.52$ to $.86$). This finding supports the effectiveness of the MSWO assessment.

Second, our post hoc analysis suggests that the number of stimuli used in MSWO assessment may influence preferred-stimulus selection rates in one of two ways. For the four participants who did not select the same stimuli as their most-preferred in both PS and MSWO assessments, preferred-stimulus selection rate appeared to increase on MSWO trials with fewer stimuli. This could be due to decreasing difficulties in making reliable discriminations as the number of choices decreased. The discrimination skills measured by the ABLA (Table 1) did not correlate with performance. However, the ABLA measures 2-choice discriminations and data on its predictive validity of many-choice discriminations are limited (Doan, Martin, Yu, & Martin, 2007; MacPherson et al., 2011).

Among the five participants who selected the same stimuli as the most-preferred in both PS and MSWO assessments, everyone chose the most-preferred stimuli available well above chance level during the first two trials of the MSWO assessments with six and five choices, respectively. In general, this group showed a decline, relative to chance, in preferred stimulus selections as the number of choices decreased (except for two participants who showed an increase on 2-choice trials). This general decline might be a result of the decreasing range of preferences among the available stimuli (difference between the most and least preferred stimuli) after more preferred stimuli had been selected on earlier trials. That is, as preferences for the available stimuli became more similar, selection became more varied.

A limitation of this study is that we did not evaluate the reinforcing effectiveness of the preferred stimuli identified by MSWO assessments. Previous research has suggested that stimuli that are slightly less preferred (e.g., ranked second) may also be reinforcers (e.g., Lee, Yu, Martin, & Martin, 2010; Roscoe, Iwata & Kahng, 1999). Therefore, it is possible that the most-preferred stimuli identified by MSWO assessments, even if they do not match those of the PS assessments, may be reinforcers.

Another limitation of the present study is that our analysis of the impact of number of stimuli was post hoc. Therefore, this finding must be treated with caution. In multiple-stimulus preference assessments, the optimal number of stimuli would be the largest number of stimuli that could be used and still yield reliable results based on the individual’s ability, thus achieving maximum efficiency and reliability. Previous studies on MSWO assessment have used seven (DeLeon & Iwata, 1996; Higbee et al., 2000) and eight stimuli (Carr et al., 2000). Future research is needed to determine prospectively whether the number of stimuli will have an impact on preference assessment and whether we can predict the optimal number of items to use in a multiple-stimulus preference assessment.

**References**


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