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Assessing Displacement and Magnitude Effects on Relative Preferences of Edible and High-tech Leisure Items

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on Relative Preferences of Edible and High-tech Leisure Items

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Abstract

Previous studies have shown when edible and leisure items (e.g., toys) are combined in multiple-stimulus-without-replacement (MSWO) preference assessments, edible items are often more preferred than leisure items by individuals with developmental disabilities (Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015). However, how the inclusion of high-tech items (e.g., iPads ®, tablets, computers) affects preferences when compared to edible items is limited in this body of research. More recently, Conine and Vollmer (2019) demonstrated high-tech items might displace edible items; due to the recent influx of high-tech tangible items used as reinforcers in clinical settings, such as iPads, additional research is warranted. In the current evaluation, we compared the preferences for edible items and high-tech items in an assessment to determine if a displacement effect exists. Next, we manipulated the magnitude of both stimulus classes to assess how greater magnitude influences preference. Results showed high-tech leisure items were more preferred over edible items for 2 out of 3 subjects during the combined MSWO. However, regardless of the magnitude across stimuli, edible items were more likely to be selected during the magnitude assessment in the current study. Implications of the findings as well as future research ideas will be discussed in detail.

Keywords: assessment, autism, displacement, edible, high-tech devices, leisure

Introduction

Determining effective reinforcers that can be delivered contingent on the occurrence of an adaptive response is an important component for successful behavior programs. In clinical settings, behavior analysts conduct preference assessments (PAs) to identify top-ranked items; previous research has found top-ranked stimuli tend to function as reinforcers for individuals with intellectual disabilities (ID) and autism spectrum disorder (ASD). Preference assessments can be conducted in several different ways and incorporate different stimuli (e.g., Clay et al., 2013; Hagopian et al., 2004). Additionally, there are specific advantages and disadvantages for each assessment that should be considered prior to assessing preferences, such as the efficiency of the assessment, client characteristics, and the type of items included (Hagopian et al., 2004). The multiple-stimulus-without replacement (MSWO) assessment is one arrangement in which preferences can be assessed efficiently while still producing rank orders of stimuli, compared to other assessment types such as the paired-stimulus PA (Fisher et al., 1992) that require additional time to conduct.

Previous studies have shown when edible and leisure items (e.g., toys) are combined in PAs, edible items are often more preferred than leisure items by individuals with ID and ASD. (Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015). DeLeon et al. (1997) was the first to compare preferences for subjects' highest preferred edible and leisure items in a combined MSWO assessment with individuals with ID. DeLeon et al. found the majority of subjects (i.e., 86%) preferred edible items over their highest preferred leisure items when both stimuli were presented in the combined assessment (partial displacement) and 57% of subjects preferred all edible items over all leisure items (total displacement). These findings indicate a displacement effect, meaning the selection of one item (e.g., an edible) consistently precedes the

selection of another highly preferred item (e.g., a leisure item) in a combined assessment. Bojak and Carr (1999) extended the research on the displacement effect by conducting combined MSWO assessments prior to and after meals to assess the degree to which motivating operations affected preference of four individuals diagnosed with ID. The authors found, even after meal consumption, total displacement of leisure items by edible items still occurred for all subjects. More clearly, even satiation effects did not influence the selection of all edible items over all leisure items during both assessments.

Similar results investigating the displacement effect were achieved in a study conducted by Fahmie et al. (2015) with 12 individuals, both children and adults. The results of the combined MSWO showed, an edible item was the most preferred for 83% of subjects, demonstrating partial displacement, and total displacement was observed for 67% of subjects (i.e., all edible items were selected before all leisure items). Although leisure stimuli might have been displaced by edible stimuli for majority of subjects during PAs, DeLeon et al. (1997) and Fahmie et al. both showed leisure items still functioned as reinforcers and produced similar rates of responding as edible items during skill acquisition programs for individuals in their studies. The authors suggested preferences for edible and leisure stimuli should be assessed in two separate PAs to prevent false negatives of leisure items as potential reinforcers (DeLeon et al., 1997; Fahmie et al., 2015).

Although prior research has supported individuals with ID typically prefer edible items more than leisure items, it is possible the specific types of stimuli being evaluated could affect preferences (Conine & Vollmer, 2019). Due to the development of high-tech devices (e.g., iPads ®) in recent years, none of the previous studies reviewed on displacement mentioned the inclusion of high-tech items. Over the past decade, however, research has found the use of high-

tech items are becoming more popular among individuals with ID (Bouck et al., 2007). These items provide clinicians with a new class of potential reinforcers, which are often used in clinical settings today. Considering the increased accessibility of high-tech devices and the introduction of a new stimulus class, additional evaluations of preferences and displacement effects between edible and high-tech items seem warranted (Conine & Vollmer, 2019; Martin & Scheithauer, 2019).

Researchers have recently begun assessing preference for high-tech items and edible items across different populations. Conine and Vollmer (2019) replicated DeLeon et al. (1997) and directly compared preference for edible and leisure stimuli with 26 children diagnosed with ASD. Contrary to previous studies evaluating displacement, the authors included high-tech devices, such as iPads and computers, in the leisure stimulus class. Although edible items were ranked higher than leisure stimuli on the combined assessment for most subjects, leisure items were selected more often than reported in prior studies. For instance, a leisure item was the most preferred during the combined assessment for 9 out of 26 subjects in Conine and Vollmer, and that most-preferred item was a high-tech device for 8 out of those 9 subjects. The authors did note, however, other leisure items, that were not high-tech, also ranked higher than edibles for these nine subjects. This finding suggests leisure items overall were generally more preferred than edible items for those subjects. Even still, high-tech devices were ranked as the highest-preferred leisure item on the leisure-only assessment for 15 out of 26 children. Conine and Vollmer reported the inclusion of screen-based devices might have influenced the higher selection of leisure items. These findings could reflect the degree to which preferences are influenced by high-tech devices among children diagnosed with ASD today.

Two studies (e.g., Martin & Scheithauer, 2019; Slanzi et al., 2019) recently replicated the work by Conine and Vollmer (2019) to evaluate the external validity of the results achieved by Conine and Vollmer with a different sample of subjects, ranging in age from 4-23 years old. Both studies included high-tech items along with other types of leisure items in the leisure items class. Martin and Scheithauer (2019) only conducted combined MSWO assessments with subjects whose highest-preferred item on the leisure-only MSWO was a high-tech device. Similar to the findings obtained by Conine and Vollmer, edible items were selected more than leisure items for the majority of subjects, although the percentage of subjects with displacement of leisure items by edible items was lower than observed in previous studies. The authors suggest the inclusion of high-tech devices could be contributing to the decrease in displacement effects that has been observed over the years.

Different results were achieved by Slanzi et al. (2019), who extended this line of research in Italy to examine how cultural variations affect displacement. Their findings were consistent with previous studies in that an edible item was the top-ranked item during the combined MSWO for the majority of individuals (56 %). Slanzi et al. also found for 44% of subjects, leisure items were the top-rank item on the combined MSWO. Contrary to Conine and Vollmer (2019) the individuals studied by Slanzi et al. had a higher preference for leisure items that were not high-tech items. The authors indicated cultural differences such as limited availability to technological items and their different learning histories for social contexts could have contributed to their results.

Conine and Vollmer (2019) and Martin and Scheithauer (2019) discussed several variables potentially explaining the differences in displacement observed in their results compared to the findings reported in previous research (e.g., variations in assessment procedures,

types of items included, individual characteristics, and current motivating operations). One qualitative variable of particular interest to this study is access durations. Access durations to leisure items in the displacement literature have primarily been assessed for 30 s (i.e., Bojak & Carr, 1999; Conine & Vollmer, 2019; DeLeon et al., 1997; Slanzi et al., 2019), 15 s (i.e., Fahmie et al., 2015), or 1 min (i.e., Martin & Scheithauer, 2019). However, prior research has demonstrated access durations can influence relative preferences and the reinforcing quality of certain stimuli.

Steinhilber and Johnson (2007) examined preference for stimulus availability by comparing stimulus rank order between brief- (15-s) and long- (15-min) access durations using various tangible stimuli (e.g., compact discs, coloring materials, Gameboys, action figures) with two subjects. The authors found the type of stimulus and its associated duration of access can influence preference; subjects preferred certain stimuli when the access duration was long (15 min), whereas other stimuli were more preferred when the access duration was brief (15 s). Steinhilber and Johnson and DeLeon and Iwata (1996) indicated clinicians should consider providing individuals with the same access durations during preference assessments as those provided for these items in the natural environment.

The effects of magnitude on preference and reinforcer effectiveness has primarily been investigated with different tangible stimuli, such as action figures, coloring books, and handheld gaming devices, like those used by Steinhilber and Johnson (2007). However, Hoffmann et al. (2017) recently updated this line of research by evaluating the preference and reinforcer efficacy with high- and low-tech items. High-tech items included computers, video players, gaming devices, MP3 players, and tablets, whereas low-tech items included dolls, blocks, and books. The authors conducted a magnitude PA to determine the degree to which manipulating the duration

of access would influence subject's preference for high-tech and low-tech stimuli. The access durations included 10 s, 30 s, 60 s, 2.5 min, 5 min, and 10 min. Similar to Steinhilber and Johnson, the authors found preferences were influenced by type of item and its correlated magnitude, with most subjects preferring high-tech items for longer durations. These results further support findings of previous studies in that preferences may vary depending on the type of stimulus and the amount of time the item is provided for consumption (e.g., Steinhilber & Johnson, 2007; Trosclair-Lasserre et al., 2008). It is possible the results of Steinhilber and Johnson and Hoffman et al. could be explained through the notion of preference for accumulated versus distributed reinforcement (DeLeon et al., 2014). DeLeon et al. (2014) suggested individuals with ID tend to prefer accumulated reinforcement arrangements in which consumption of the reinforcer is continuous and less frequently interrupted for items associated with greater *handling cost,* such as playing video games. The authors described *handling cost as* the response effort required to attend to the various stimuli high-tech items produce, as well as the amount of time spent preparing the item for consumption (DeLeon et al., 2014). For example, disrupting an individual's engagement with a game on an iPad after 30 s might result in greater handling costs, as opposed to the ability to extract reinforcement immediately by consuming an edible item. Greater handling cost could potentially decrease preference for high-tech items. However, granting the individual longer access durations may strengthen the reinforcing value and preference for these high-tech devices (DeLeon et al., 2014). Therefore, it is possible short access durations could have increased the handling costs associated with high-tech items, ultimately affecting preference for these items in the recent displacement literature.

Statement of the Problem

Inclusion of high-tech devices as a leisure item to compare preference for edible and leisure stimuli has appeared in three studies to date (i.e., Conine & Vollmer, 2019; Martin & Scheithauer, 2019; Slanzi et al., 2019). It is apparent from recent research, displacement of leisure items by edible items decreases when high-tech devices are included in the array. However, the degree to which magnitude influences individual preferences for edible and high-tech leisure items remains unclear and is an important variable worth investigating for two reasons. First, although Conine and Vollmer (2019), Martin and Scheithauer (2019) and Slanzi et al. (2019) examined how the introduction of a new stimulus class (i.e., high-tech devices) affects displacement of edible and leisure items, the electronic devices were only offered for 30 s or 1 min during PAs. The extent to which brief-access and long-access durations to high-tech items affects relative preferences to edible items should be evaluated empirically. Secondly, clinicians should not may the mistake of assuming items with higher relative preferences can be the only effective reinforcers in practice (Roscoe et al., 1999). Previous research has shown items with lower relative preferences can still have absolute reinforcing effects. Roscoe et al. (1999), found subjects' top-preferred stimuli to have higher relative reinforcing effects, however, the lower-preferred items identified in the PAs, still had absolute reinforcing effects. The authors discuss the importance of identifying and increasing the reinforcing value of stimuli in order to achieve treatment goals efficiently. Moreover, it is important for clinicians to identify competing items, as there are several variables that may influence the items that are included in preference assessments, such as practicality, context, availability, and the effectiveness of a reinforcer (Steinhilber & Johnson, 2007; Hoffmann et al., 2017). For example, providing five small edible items contingent on appropriate responding may be more practical in environments that only

allow brief access to the preferred item. Conversely, using edible items as reinforcers in some settings can often be viewed as not socially or ethically appropriate. Manipulating the magnitude of both edible and high-tech items could provide useful information to practitioners of ways to identify competing stimuli by increasing the reinforcing value of these items during preference assessments. It is possible the findings from our study could provide practitioners with a guideline on which relevant magnitudes to include in preference assessments when evaluating preference for high-tech items relative to edible items. Therefore, the purpose of this study is two-fold: 1) to extend the work of Conine and Vollmer and assess displacement effects between edible and high-tech items and 2) to manipulate the magnitude of both stimulus classes to assess how greater magnitude influences preferences.

Method

Subjects, Setting, and Materials

Three subjects, all diagnosed with ASD, were selected to participate in this study. The subjects ranged in age from 4 to 7 years old. All subjects communicated using single words, short phrases, or full sentences. Subjects were included if they did not have a current history of food refusal and were reported to have had some exposure to high-tech media devices (e.g., an iPad) to control for the novelty of these items influencing preferences. All assessments were conducted at ABA clinics that subjects regularly attended. Sessions took place in therapy rooms and were conducted up to three times per week, and each session lasted approximately 20 to 60 min.

Sixteen stimuli (eight edible items and eight high-tech applications on a screen-based device such as an iPad) were selected for the PAs for each subject. To determine which stimuli to include in subject's assessments, the experimenter asked each subject's primary caregivers and

therapists or teachers to complete a tailored version of the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD; Fisher et al., 1996). The RAISD only contained questions relevant to edible and high-tech leisure items. The final section of the RAISD form required subject's caregivers and therapists to list at least eight preferred edible and eight preferred high-tech leisure activities they perceived to be preferred items for the child.

If at least eight items were not identified for each stimulus class, additional items were included based on caregiver and therapist report, and direct observation. The results obtained from the indirect interviews and the RAISD for each subject were used to create a list of stimuli to include in the MSWO assessments, which were conducted with each subject to determine their top-ranked four items from each stimulus class to be included in the combined MSWO assessment. Pictorial representations were used for all relevant edible and high-tech leisure activities for each assessment (Heinicke et al., 2016). Previous research has shown by providing access to the actual item selected during pictorial preference assessments, helps with the identification of reinforcing effects for stimuli (Heinicke et al., 2016). The subject's highest preferred edible and high-tech leisure activity identified from the combined MSWO assessment as described by DeLeon and Iwata (1997) were used for the magnitude PAs.

Response Measurement and Interobserver Agreement

For the MSWO and magnitude assessments, the primary dependent variable was selection. Selection was defined as the subject making physical contact with a picture representation of the item within 5 s of its presentation. For all MSWO and magnitude preference assessments, trained graduate students collected paper and pencil data on the percentage of trials by dividing the total number of trials the item was selected by the total number of trials the item

was presented and multiplying to 100%. Preferences for each item will be ranked in order such that the item with the highest percentage of selections will be scored as the top-preferred item.

A second observer collected reliability data for a mean of 58% of all the MSWO assessments and 55% of magnitude assessment sessions across all subjects. Interobserver agreement was calculated by dividing the number of trials in which there was an agreement by the total number of trials in the session. Interobserver agreement scores were 100% for all subjects for both the MSWO and magnitude assessments. A second observer also collected procedural integrity data for 38% of sessions on the latency of stimulus delivery and the magnitude provided for each item during the magnitude assessment, which was defined as the experimenter delivering the item with the correct magnitude within 5 s of selection. Procedural integrity data were collected on 38% of sessions, and scores were 100%.

Phase 1: MSWO Preference Assessments

Procedure

Three different MSWO assessments (Conine & Vollmer, 2019; DeLeon & Iwata, 1997) were conducted with each subject to identify each subject's top-preferred edible and high-tech items. Each MSWO consisted of at least three sessions and two additional sessions were conducted if a clear hierarchy of preferences was not identified. This only occurred for one subject (i.e., Meredith) whose preferences appeared to be unstable during the first edible MSWO assessment. All items used were identified from the preassessment sessions (i.e., RAISD, caregiver and therapist rapport, and direct observation). During each MSWO, the experimenter was seated directly across from the subject at a therapy table and eight pictorial representations of all relevant stimuli were presented in an array to the subject. A clipboard was used to block access to item selection prior to the start of the trial. The order of edible MSWO and high-tech

MSWO assessments was consistent across subjects and both were always completed prior to the combined MSWO assessment.

The first assessment was the edible MSWO and consisted of an array of pictorial representations (each approximately 3 in. x 3 in.) of eight edible items. The second assessment was the high-tech leisure MSWO and contained an array of pictorial representations showing eight high-tech iPad leisure activities. The third assessment was a combined MSWO, which included the subject's top-four edible and top-four high-tech leisure activities identified from the edible and high-tech MSWO assessments. For all high-tech leisure stimuli, the relevant iPad applications were downloaded and opened prior to conducting assessments to ensure the item was delivered immediately following a selection. We allowed subjects to sample the high-tech stimuli associated with the pictorial representations prior to the high-tech and combined MSWOs because of the various stimuli these items could be associated with in each subject's natural environment.

Additionally, the guided access feature was activated on the iPad, limiting the access to one application at a time while using the device. This was done to ensure subjects only gained access to the application they selected during the PA. During each assessment, all pictorial representations of items were displayed randomly in an array and the subject was instructed to "pick one." After a selection was made, the subject was allowed to consume the edible item or access to the high-tech item for 30 s. An orange-colored visual timer displayed on an iPhone was present during the high-tech item consumption interval to signal the duration of access provided (i.e., 30 s). After consuming the edible item or the 30-s access duration to the high-tech application elapsed, the item was removed. The pictorial representations of the remaining items were presented in the array and the next trial began. This process was repeated until all items

were selected, or no selection was made for 30 s. These same procedures were conducted three times for each of the three preference assessments or until preferences were consistent.

Results

Table 1 displays the items included in each assessment for each subject. Figures 1-3 shows results for all three subjects (only the top-four ranked items are displayed for both edible and high-tech leisure MSWOs). Figure 1 shows results for Derek, who preferred all high-tech items over all edible items on the combined MSWO (total displacement of edible items by high-tech items). Figure 2 shows results for Cristina, who selected a high-tech item as her highest-preferred item on the combined assessment, but the high-tech items did not totally displace edible items; therefore, only partial displacement of edible items by high-tech items occurred. For Cristina, however, 3 out of 4 high-tech items ranked in the top-four choices on the combined MSWO. Figure 3 shows results for Meredith, edible items were ranked higher than all high-tech items (i.e., total displacement of high-tech items by edible items occurred). Overall, high-tech applications mainly appeared in the top-four ranks on the combined MSWO for 2 out of 3 subjects (66%), and an edible item was only the highest-preferred item for 1 out of 3 subjects (33%).

Phase II: Magnitude Preference Assessment

The purpose of this assessment was to evaluate the degree to which magnitude influences preference between subjects' highest-preferred edible and high-tech items. The magnitude PA included each subject's highest-preferred edible and highest-preferred high-tech application identified from the combined MSWO. Similar to the procedures described by Hoffman et al. (2017) and Fisher et al. (1992) we compared preferences for short durations (30 s), long

durations (5 min), small quantities of edible items (1/2 or 1/4), and large quantities of edible items (five small edible items, or one large whole edible item) in a paired-stimulus PA.

Magnitude Cards

The same pictorial representations used during the MSWO assessments were used during the magnitude assessments, with the size of the pictures being the only procedural difference. That is, large pictures (approximately 9 in. x 7 in.) of each item were used to represent either five edibles (or one large whole edible item) and 5 min of access duration to the high-tech item. Small pictures (approximately 3 in. x 3 in.) of each item were used to represent ½ (or ¼) of an edible item and 30 s of access duration to the high-tech item. Color-coded visual timers were also paired with both large and small access durations to help subjects discriminate between different amounts of time (i.e., 30 s and 5 min). The experimenter paired an orange visual timer with the high-tech items to signal 30 s of access duration throughout all assessments, and a purple timer was used to signal 5 min of access duration during the magnitude PA.

Procedure

The magnitude PA took place at least one day after completing the combined MSWO to control for satiation effects. If the edible item had to be delivered in large quantities (i.e., one full cookie), exposure sessions were also conducted at least one day prior to the magnitude PA to control for satiation and caloric intake. For each session, the subject was seated at a therapy table across from the experimenter. Prior to each magnitude PA, exposure sessions were conducted to ensure subjects experienced the contingencies between the large and small pictorial representations and their corresponding magnitudes. Once the experimenter prompted the subject to touch the card, access to the item was provided for the specified magnitude. This process was completed before every session to ensure subjects accessed the items with the corresponding

magnitudes. The magnitude PA was conducted similar to the procedures of Hoffman et al. (2017). We used the top-preferred high-tech item at differing magnitudes (i.e., 30-s and 5-min) and top-preferred edible at differing magnitudes (i.e., ½ or ¼ edible) and (five edibles or one large edible item) and paired them each with the other for a total of six possible combinations. For each trial, the experimenter presented pictorial representations of the items on the table in front of the subject. A clipboard was used to block access to item selection prior to the start of the trial. We conducted each session three times to counterbalance stimulus combinations across trials and avoid side biases. The therapist presented pictorial representations of subject's highly preferred edible and high-tech item and the subject was instructed to "pick one". For example, "Do you want a lot of Nick Jr. or a little cookie? Pick one." Any attempts to select more than one item were blocked, and the experimenter repeated the verbal instruction. If no choice was made after 5 s, the therapist represented the verbal instruction "You can pick one if you want", items were removed after 30 s if no selection was made or the subject said "no". Contingent on selection of an item, the subject was then provided the item(s) for consumption (i.e., to eat, or to access the high-tech activity for the specific duration).

Results

Figure 5 shows results for the magnitude assessment for each subject. Overall, 2 out of the 3 subjects (Cristina and Meredith) selected edible items more often than high-tech items for both large (i.e., five edibles or one whole edible) and small magnitudes (i.e., ½ or ¼ edible). This finding is noteworthy given Cristina preferred high-tech items more than edible items in the combined MSWO. For Derek, whom total displacement of edible items by high-items was observed in the combined MSWO, high-tech still remained the most preferred, and was selected 77% of the time regardless if it was available for 30 s or 5 min. Meredith's preference for edible

items remained consistent across the MSWO and magnitude assessments in that edible items were always most preferred. That is, regardless if the choice trial consisted of 5 min of access duration to her top-ranked high-tech item and ¼ of a sugar cookie, she reliably approached the small edible item. However, Cristina, who's combined MSWO showed partial displacement of edible items by high-tech items, chose edible items for 66% of opportunities. Cristina also chose 30 s of access duration (44%) more than 5 min of access duration (22%) across presentations.

Overall Discussion

Generally, we found high-tech items were more preferred during the combined MSWO assessments for 2 out of 3 subjects (66%). Total displacement of high-tech items by edible items was only observed for one subject in the current study, which differs from the results reported in previous research. Although we found mixed results for all three subjects, a leisure item (i.e., high-tech) was the top-ranked item more frequently than an edible item between our three subjects. Figure 4 shows the results of the current study compared to previous studies evaluating preference between edible and leisure items over the years (i.e., Bojak & Carr, 1999; Conine & Vollmer, 2019; DeLeon et al., 1997; Fahmie et al., 2015; Martin & Scheithauer, 2019; Slanzi et al., 2019).

As shown in the top panel of Figure 4, an edible item was the top-ranked item on the combined assessment for 1 out of 3 subjects in the current study (33%); this percentage is lower than the results reported in all previous mentioned studies. Moreover, the top-ranked stimulus on the combined assessment in the current study was reliably a high-tech item (66%), which is higher than the 35% of subjects in Conine and Vollmer (2019) and the 30% of subjects in Martin and Scheithauer (2019). Interestingly, studies conducted prior to 2015 (i.e., Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015), in which high-tech devices were not included in the

leisure items class, found a leisure item was the highest-preferred item on the combined MSWO for no more than 17% of subjects. However, leisure items are occupying top ranks more frequently since the inclusion of high-tech devices.

It appears high-tech leisure items (e.g., iPad) might compete with edible items more than the typical tangible items (e.g., toys) used in previous research. Our results further support the indications made by Connie and Vollmer (2019) and Martin and Scheithauer (2019) who mentioned displacement of leisure by edible items has been decreasing over the years, possibly due to the recent influx of high-tech tangible items. It is possible this new stimulus class (i.e., high-tech devices) is so preferred amongst individuals with autism that it often displaces edible items when both are presented simultaneously in assessments.

The only procedural difference from Conine and Vollmer (2019) and Phase I of our study was the inclusion of only high-tech items in the leisure stimulus class. While most subjects in Conine and Vollmer preferred high-tech devices among other leisure items, the other leisure items were still selected over edible items for those subjects. Although assessing displacement effects between non-technological leisure items to edible items was not the purpose of this study, it is possible some of the current subjects might have preferred other toys that are not electronic devices over edible items. Regardless of the type of leisure items we included in the MSWO assessments, high-tech items were still more preferred than edible items for 2 out of 3 subjects. This suggests the handling cost associated with these types of electronic devices did not seem to affect preferences for those subjects during the combined MSWO when the access duration was brief (i.e., 30 s).

Several factors may have contributed to preferences throughout Phase I and Phase II. First, due to limited resources provided at the current clinic in which sessions were conducted,

several iPad applications failed to load due to poor internet connection, requiring subjects to wait to access the high-tech item. The temporal delay subjects experienced between selections and item consumption with high-tech devices may have influenced preferences during Phase I and Phase II. Second, it is possible the top-four items from each stimulus class used in the combined assessment did not accurately represent true preference hierarchies for each subject. For example, Meredith's highest-preferred edible item was a 'mini cupcake' for the first three edible-only MSWO assessments. Because preferences appeared to be unstable for the initial three edible MSWO assessments for Meredith, we conducted two additional assessments. Unlike the first round, the 'mini cupcake' was selected last on both trials for the two additional assessments and was ranked 5th overall. Therefore the 'mini cupcake' was not included during the combined MSWO for Meredith. One potential explanation for this finding is the "saving the best for last" phenomenon. Some current research indicates saving the most preferred item for last is a variable to consider because it could affect rank orders during MSWO assessments (Ngur et al., 2019). On the other hand, total displacement of high-tech by edible items was still observed for Meredith, even without the inclusion of the 'mini cupcake', suggesting highly preferred edible items were nevertheless included in the array during the combined MSWO.

Third, the top-ranked items on the combined MSWO from each stimulus class were included in the magnitude PA for each subject. We decided to only use subject's most preferred items identified from the combined MSWO to keep the stimulus rankings for each item consistent throughout the magnitude assessment. While this procedure modification was done to include highly preferred stimuli from each stimulus class in the magnitude PA, item rank orders for each subject were not entirely consistent across the individual MSWO and combined MSWO assessments in our study. It is possible subjects' preferences for the stimuli used in the

magnitude PA may have changed for one or both items. This could have influenced selections during the magnitude assessment as past research has demonstrated preferences should be examined frequently because preferences change over time (Bowman et al., 1997). Future research should consider allowing subjects to select their highest-preferred items immediately prior to evaluating magnitude between these two stimulus classes.

Fourth, we were not able to control for access to food and high-tech items prior to conducting assessments and current motivating operations might have influenced selections for items across assessments. Additionally, pre-session exposure followed by repeated presentations to both stimuli possibly decreased preference for these items during the magnitude PA. It is also a possibility that satiation effects occurred sooner in our study because subjects were only allowed access to one specific application on the high-tech device. Subjects studied by Hoffmann et al. (2017) were able to change applications on the high-tech device during their access durations. This procedure modification is important to consider because previous researchers suggest satiation effects may take longer to occur with high-tech items because of the various stimuli they produce (e.g., Hoffmann et al., 2017; McSweeney, 2004). Therefore, future research should compare magnitude between high-tech and edible items, without limiting high-tech items to a single application.

Lastly, within-session data from the magnitude PA suggests 2 out of 3 subjects in our study were unable to discriminate between the varying magnitudes. For example, when small and large magnitudes were presented simultaneously for the same item (i.e., ½ M&M or five M&Ms) both subjects selected the stimulus associated with the smaller magnitude majority of the time. It is unknown if subjects were discriminating between “a lot” versus “a little” because only the choice presentations that included the same item with large and small magnitudes served

as discrimination tests during each magnitude assessment. It is also difficult to completely rule out current motiving operations influencing selections for items with smaller magnitudes. Although we used color coded timers to help with discriminating between small and long access durations, we only conducted one exposure session before each magnitude assessment with our subjects; future researchers should consider conducting additional teaching trials as well as testing subjects' correct identification of "less" versus "more". For subjects who have the prerequisite skills to discriminate between different magnitudes, researchers should continue to examine which magnitudes of the displaced item competes with subject's most-preferred item on the combined MSWO. For example, assessing how many edible items are needed to produce the same preference and reinforcing value as 30 s of access to high-tech items (or, conversely, how many minutes on an iPad will be equivalent to consuming one edible item for subjects who typically prefer edibles to high-tech). Future research should consider conducting reinforcer assessments with high-tech and edible items to evaluate how magnitude influences reinforcer effectiveness for electronic and edible items because this still remains unknown.

Our study opens up many possible avenues to continue to explore this line of research. Future research should examine how magnitude can influence preferences for subject's who's combined MSWO shows total displacement of edible by high-tech items by systematically increasing the number of edible items to examine at which point there is a switch in preference if any at all. From a clinical perspective, practitioners should critically evaluate access durations and handling costs associated with the types of stimuli they are assessing in assessments and providing as reinforcers to increase socially significant behaviors. Practitioners should note reinforcement can be extracted immediately following the consumption of an edible item; however, other stimuli (i.e., games on an iPad) may take longer than 30 s to adequately function

as reinforcers (DeLeon et al., 2014). The results of our study show some children prefer all high-tech items over edible items, some prefer all edible items over all high-tech and some have a mixed preference for either. As behavior analyst working in applied settings, we must not assume edible items will always be the most preferred among the clients we work with. Because while edible items might have absolute reinforcer effectiveness, other stimuli such as high-tech, might have higher relative reinforcing effects; when the two are compared responding could be greater for high-tech items (Roscoe et al., 1999).

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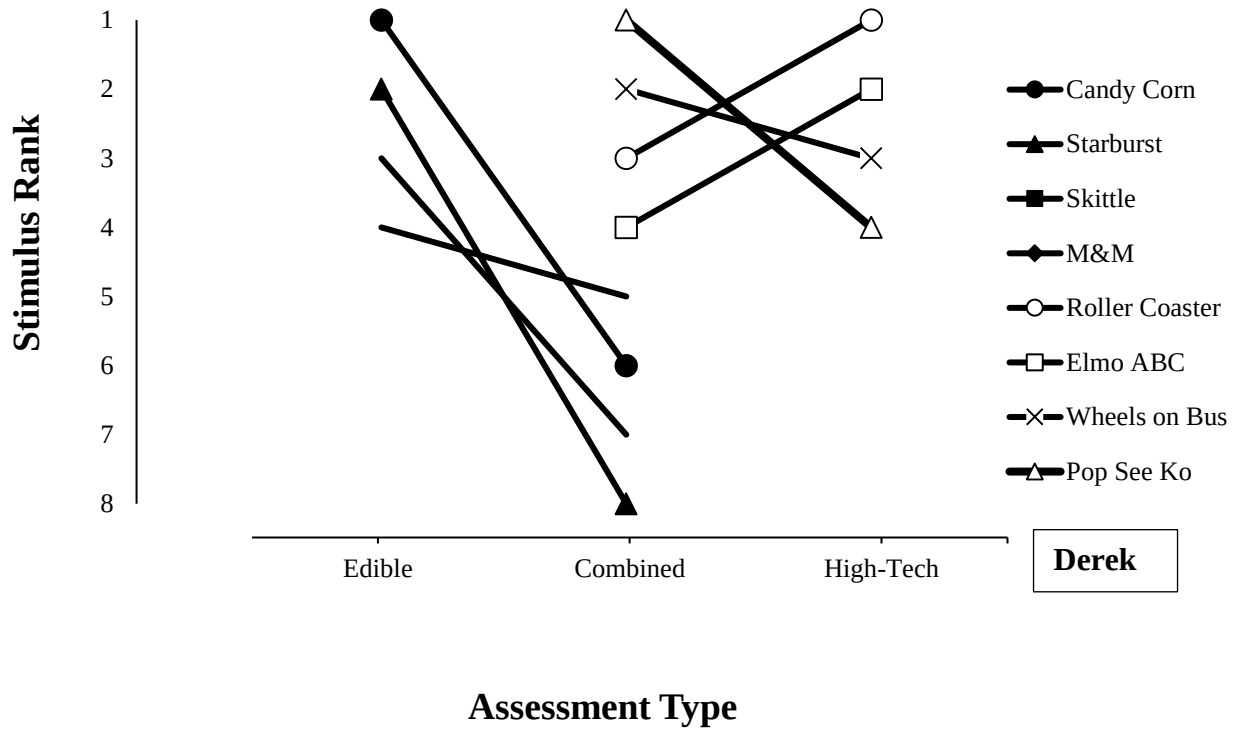
Table 1

Edible and High-Tech Leisure Items in Average Rank Order

Participant	Age	Edible Stimuli	High-Tech Stimuli
Derek	7	Candy Corn, Starburst, Skittle, M&M, gummy worm, Ritz Crackers, pretzels, Goldfish	Roller Coaster; Go Noodle, Elmo ABC, wheels on the Bus, Pop See Ko;go noodle, Nick Jr., Storybots, Brain Pop, Starfall
Meredith	6	Goldfish, Dorritos, pickle, sprinkle cookie, mini cupcake, grape, strawberry, Ritz Crackers,	Barbie Dress up game, Nick Jr., PBS videos, Ninja Turtles, Peppa Pig videos, PBS Games, tToll videos, Brain Pop
Cristinia	4	Sprinkle Cookie, gummy bear, M&M, Oreo, Kettle Cooked Potato chip, chocolate chip cookie, Snapea, Honey Vanilla Crunch cereal	Villancicos album, Itsy Bitsy Spider video, We are the Dinosaurs music video, Christmas album, Nick Jr., ABC song, Jump music video, Goldfish music video

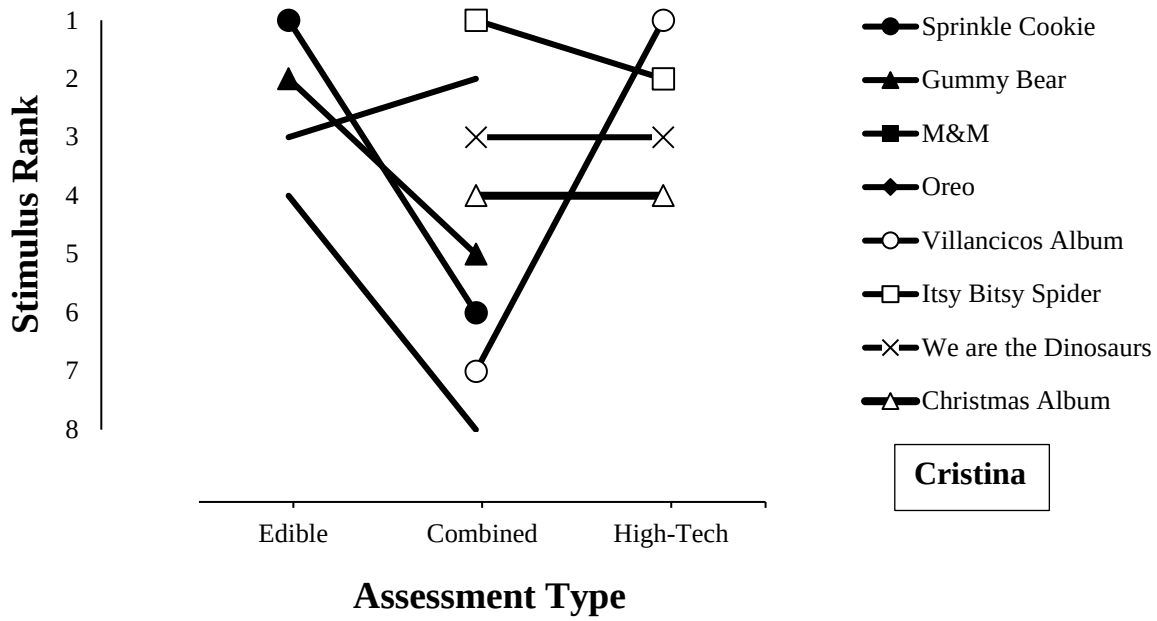
Note. Items within each stimulus class are listed in rank order from subject's highest-preferred to least-preferred.

Figure 1



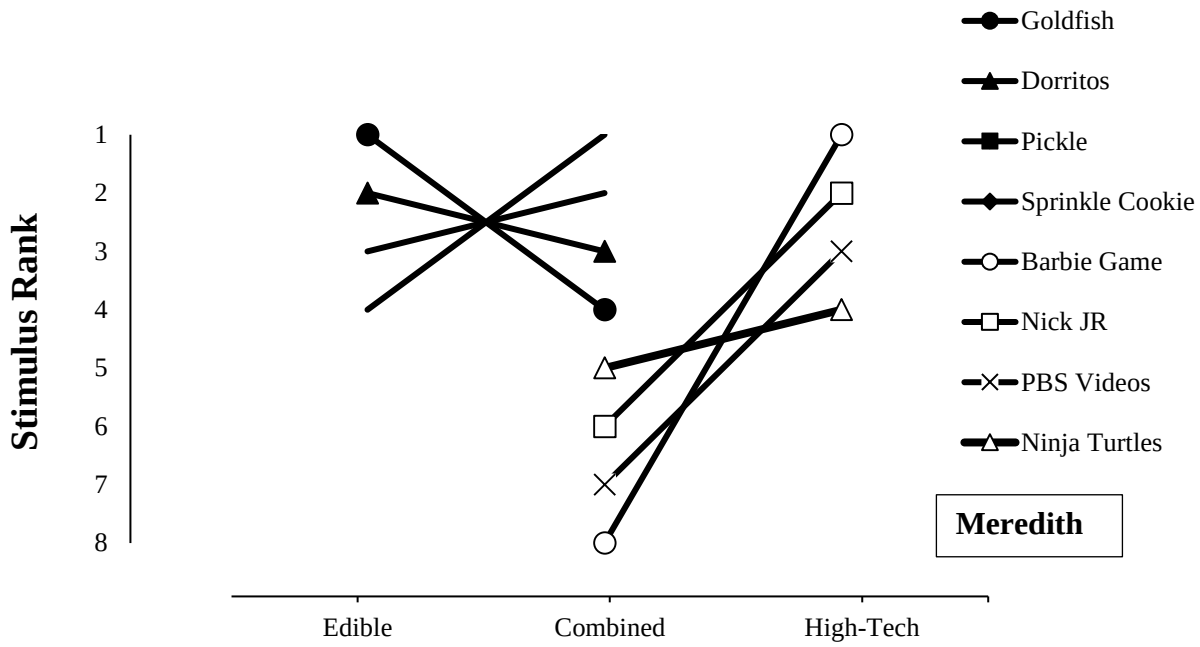
*Note. S*timulus rankings from the edible-only, leisure-only, and combined MSWO preference assessments for Derek, in which total displacement of edible items by high-tech items occurred (i.e., high-tech items were selected before all edible items).

Figure 2



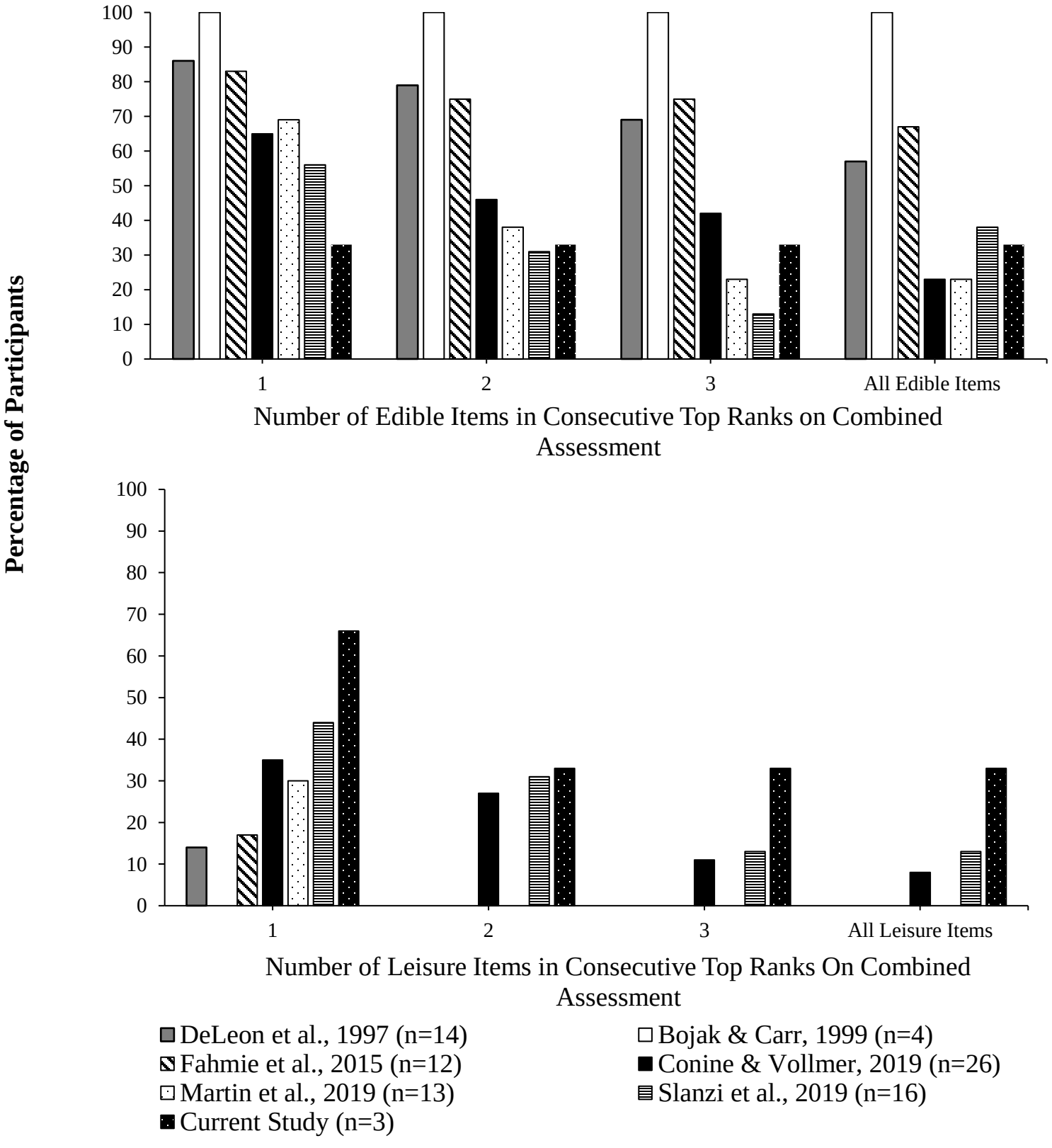
Note. Stimulus rankings from the edible-only, leisure only, and combined MSWO preference assessments for Cristina, in which partial displacement of edible items by high-tech items occurred; all but one high-tech item was selected in the top four (i.e., before edible items).

Figure 3



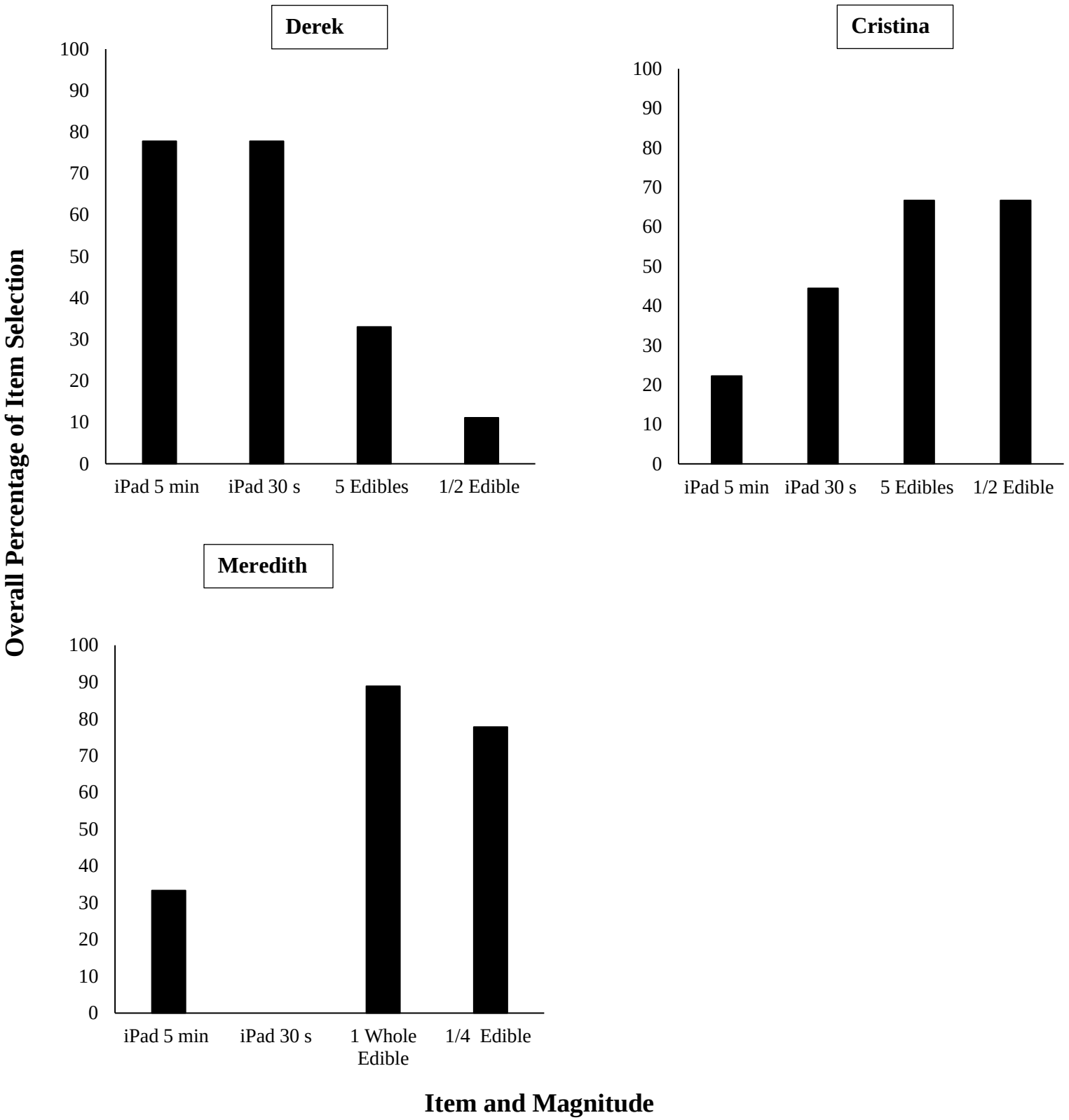
Note. Stimulus rankings from the edible-only, leisure-only, and combined MSWO preference assessments for Meredith, in which total displacement of high-tech items by edible items occurred (i.e., edible items were selected before all high-tech items).

Figure 4



Note. The percentage of subjects for whom edible items (top panel) or leisure items (bottom panel) were selected in the top three ranks on the combined MSWO assessments across studies.

Figure 5



Note. The overall percentage of item selections made for each subject during the paired-stimulus preference assessment conducted in Phase II. The magnitudes being assessed in this assessment included high-tech long duration (iPad 5 min), high-tech short duration (iPad 30 s), five edibles (or one large whole edible) and ½ (or ¼) edible.