Displacement of One Stimulus Class Over Another Stimulus Class: A Systematic Replication

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Abstract

Previous researchers have found that individuals with intellectual and developmental disabilities tend to prefer edible over leisure stimuli and that leisure stimuli generally function as less effective reinforcers than edible stimuli, regardless of the preference patterns observed during a combined-class multiple-stimulus without replacement (MSWO) assessment. However, researchers have often arbitrarily selected items to include in these preference assessments and have not investigated this phenomenon with typically developing children. In Study 1, we evaluated the preference for leisure and edible stimuli in a combined-class MSWO assessment with 15 typically developing children. Five of 15 participants preferred edible stimuli over leisure stimuli, 3 of 15 participants preferred leisure stimuli over edible stimuli, and the remaining seven of 15 participants did not prefer one stimulus class over another. In Study 2, we compared the reinforcer potency of displaced stimuli and the stimuli that displaced them with 7 of 8 participants who showed displacement of one stimulus class over the other. Four of 7 participants allocated more responding to the free-operant task associated with the top-ranked stimulus identified in the combined-class MSWO, while 3 of 7 participants showed no differences in responding to the free-operant task regardless of ranking of the reinforcer delivered.

Keywords: multiple-stimulus without replacement, preference assessment, reinforcer assessment, displacement

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Not only can reinforcement-based interventions produce large improvements in the quality of one's life, but the effectiveness of many behavioural interventions relies on the use of reinforcement (Killu, 2008); therefore, accurately identifying powerful reinforcers is critical when developing behavioural interventions. Reinforcement-based interventions have been used to teach a wide range of skills, such as social skills (e.g., Leaf, Dotson, Oppenheim-Leaf, Sherman, & Sheldon, 2012), academic skills (e.g., Leaf, Sheldon, & Sherman, 2010), language skills (e.g., Ingvarsson & Hollobaugh, 2011), daily living skills (e.g., Phillips, 1968), and technological skills (e.g., Pachis & Zonneveld, in press; Walker, 2000).

A common misconception is that some stimuli (e.g., M & M's) or stimulus classes (e.g., candy) inherently function as reinforcers (Fisher, Piazza, & Roane, 2011). For example, if chocolate functions as a reinforcer for an individual, one may erroneously assume that topographically similar stimuli (e.g., candy) will also function as a reinforcer for that individual – or that chocolate will function as a reinforcer for other individuals. However, the effect a stimulus has on behaviour determines the function, or lack thereof, of that stimulus; not the topography. That is, if the delivery of a stimulus following a specific behaviour increases the frequency of that behaviour under similar conditions in the future, that stimulus is said to be a reinforcer (Pierce & Cheney, 2017). Given the important role reinforcement plays in the success of behavioural interventions – and that reinforcers cannot be identified topographically – it is not surprising that behaviour analysts have devoted over 30 years to the study and refinement of methods used to identify reinforcers.

Preference Assessments

A preference assessment is a tool used to directly assess an individual's preference for stimuli and to systematically identify potentially reinforcing stimuli for an individual (Hagopian, Long, & Rush, 2004). Preference assessments were originally designed for individuals with severe disabilities but have since been adapted to address the needs of individuals with less-severe or no disabilities (Rech, 2012). Researchers have used preference assessments to identify preferred stimuli for: (a) individuals with autism spectrum disorders (ASD; e.g., Brodhead, Al-Dubayan, Mates, Abel, & Brouwers, 2016; Carr, Nicolson, & Higbee, 2000; Ciccone, Graff, & Ahearn, 2015; Falcomata & Gainey, 2014; Frewing, Rapp, & Pastrana, 2015; Penrod, Gardella, & Fernand, 2012; Penrod, Wallace, & Dyer, 2008; Snyder, Higbee, & Dayton, 2012), (b) individuals with attention deficit hyperactivity disorder (ADHD; e.g., Cohem-Almeida, Graff, & Ahearn, 2000; Penrod et al., 2008), (c) individuals with developmental disorders (e.g., DeLeon, Iwata, Conners, & Wallace, 1999; Kodak, Fisher, Kelley, & Kisamore, 2009; Roane, Vollmer, Ringdahl, & Marcus, 1998; Roscoe, Iwata, & Kahng, 1999), (d) older adults with dementia (e.g., Ortega, Iwata, Nogales-González, & Frades, 2012), (e) older adults without dementia (e.g., van der Melj, Wijnhoven, Finlayson, Oosten, & Visser, 2015), and (f) typically developing children (e.g., Haynes, Derby, McLaughlin, & Weber, 2002; Sautter, LeBlanc, & Gillet, 2008).

Researchers have demonstrated a lack of correspondence between child-reported preference assessments and the direct assessment of children's preference via preference assessments (e.g., Northup, 2000; Northup, George, Jones, Broussard, & Vollmer, 1996). While some researchers have shown that caregiver-reported preference assessments can predict a child's preference for stimuli (e.g., Mata, Scheibehenne, & Todd, 2008), others have found a lack of correspondence between caregiver-reported preference assessments and the direct assessment of preference in: typically developing children (e.g., Fantuzzo, Rohrbeck, Hightower,

& Work, 1991), adolescents with an intellectual disability (e.g., Green, Rein, Canipe, & Gardiner, 1991), and adults with an intellectual disability (e.g., Parsons & Reid, 1990). Given that indirect (child- and caregiver-reported) procedures may not correspond with preference assessment outcomes, researchers and practitioners alike should conduct preference assessments to reliably determine the potential reinforcer potency of stimuli.

Preference assessments determine individuals' preferences for stimuli by measuring their responses to stimuli during brief presentations (e.g., 30 s) of stimuli (Hagopian, Rush, Lewin, & Long, 2001; Piazza, Fisher, Hagopian, Bowman, & Toole, 1996). Researchers have used either *approach-based* or *engagement-based* procedures to: (a) measure an individual's responses to stimuli during a preference assessment and (b) analyze these responses to derive a preference hierarchy (Hagopian et al., 2004). A preference hierarchy ranks stimuli in order from most preferred to least preferred based on the number of trials in which an individual approaches an item or the duration in which the individual engages with the item. The greater the number of approaches or duration of engagement, the higher the ranking, and the more preferred the stimulus (Hagopian et al., 2004).

Approach-based Procedures. During these procedures, a researcher exposes an individual to one or more stimulus and measures whether the individual approaches a stimulus (Pace et al., 1985). Researchers have defined approach or selection responses as an individual (a) making physical contact with a stimulus (DeLeon & Iwata, 1996), (b) pointing to a stimulus (Davies, Chand, Yu, Martin, & Martin, 2013), or (c) verbally requesting a stimulus (Paramore & Higbee, 2005). To date, all approach-based preference assessments have been trial-based (Hagopian et al., 2004). During trial-based preference assessments, the researcher delivers one or more stimulus for a brief period (e.g., 30 s), records the individual's approach or selection response, then derives a preference hierarchy by ranking stimuli based on the frequency of approaches or selections (Roane et al., 1998).

Single-Stimulus Preference Assessment. During this procedure, the researcher presents an individual with each stimulus individually. The researcher delivers the stimulus for a brief period (e.g., 30 s) if the individual approaches the stimulus or terminates the trial if the individual does not approach the stimulus (Pace et al., 1985). The researcher then presents another stimulus to the individual and continues this process until he or she has presented all stimulus (in a quasi-random order) at least once. Researchers have established the predictive validity of this procedure for identifying stimuli that will function as reinforcers (e.g., Roscoe et al., 1999). That is, researchers have found that highly preferred stimuli function as potent reinforcers (e.g., Roscoe et al., 1999). An advantage of this procedure is its ease of implementation and usefulness for individuals who have difficulty making a choice between two or more stimuli (Fisher et al., 1992). However, this procedure may not always yield a preference hierarchy because individuals can approach all or most of the stimuli across trials (Fisher et al., 1992). When this occurs, it is unclear if individuals approached each stimulus because it is highly preferred or because they typically approach any stimulus placed in front of them. Therefore, single stimulus procedures are susceptible to producing false positive outcomes (i.e., incorrectly identifying stimuli as highly preferred; Fisher et al., 1992)

Paired-Stimulus Preference Assessment. During this procedure, the researcher presents stimuli in pairs (Fisher et al., 1992). The researcher delivers a stimulus for a brief period (e.g., 30 s) if the individual approaches that stimulus and removes the other stimulus from the array (Fisher et al., 1992). If the individual attempts to approach both stimuli, the researcher blocks that response and provides a prompt to select *one* stimulus (Fisher et al., 1992). The researcher terminates the trial if the individual does not approach either stimulus and presents another pair of stimuli (Fisher et al., 1992). This procedure is complete once the researcher has presented all possible pairs of stimuli at least once. An advantage of this procedure is that it accurately identifies the relative preference of potential reinforcers (Fisher et al., 1992). That is, this procedure yields a preference hierarchy that ranks stimuli from the individual's most preferred to least preferred; stimuli that the individual approaches more frequently are higher-preferred and stimuli that the individual approaches less frequently are less-preferred (Piazza et al., 1996). Researchers have established the predictive validity and the correspondence between the relative reinforcing value and relative preference rankings of stimuli obtained by this procedure. That is, researchers have found that stimuli ranked higher in a preference hierarchy function as more potent reinforcers than stimuli ranked lower in a preference hierarchy (e.g., Piazza et al., 1996). A limitation of this procedure is that it may not be appropriate for individuals who have difficulty making a choice between two stimuli (Fisher et al., 1992). Further, this procedure is time-consuming (DeLeon & Iwata, 1996).

Multiple-Stimulus With Replacement Preference Assessment. During this procedure, the researcher simultaneously presents multiple stimuli that are equally spaced apart and equally accessible to the individual (Windsor, Piché, & Locke, 1994). The researcher delivers a stimulus for a brief period (e.g., 30 s) if the individual approaches a stimulus and removes all other stimuli from the array (Windsor et al., 1994). The researcher then re-arranges and re-presents the entire array to the individual (Windsor et al., 1994). The researcher blocks an approach to multiple stimuli and provides a prompt to select *one* stimulus (DeLeon & Iwata, 1996). The researcher terminates the session if the individual does not approach a stimulus within 30 s of the second prompt. This procedure is complete once the researcher has presented all stimuli a pre-determined number of times (e.g., 10 trials; Windsor et al., 1994). Researchers have established the predictive validity of the MSW for identifying stimuli that will function as reinforcers (e.g., Kodak et al., 2009). However, because the researcher presents all stimuli during each trial, this procedure may not yield a preference hierarchy (DeLeon & Iwata, 1996); the individual could potentially select the same stimulus on each trial to the neglect of all other stimuli. Last, the preference hierarchy derived from this procedure may not be stable across sessions (i.e., individuals may rank stimuli inconsistently across several administrations of this preference assessments; DeLeon & Iwata, 1996). Therefore, several administrations of this procedure may be necessary to determine clear and stable preferences (DeLeon & Iwata, 1996).

Multiple-Stimulus Without Replacement (MSWO) Preference Assessment. During this procedure, the researcher presents stimuli in a similar format to the multiple stimulus with replacement preference assessment (DeLeon & Iwata, 1996). That is, the researcher simultaneously presents multiple stimuli that are equally spaced apart and equally accessible to the individual (DeLeon & Iwata, 1996). The researcher delivers a stimulus for a brief period (e.g., 30 s) if the individual approaches a stimulus and removes all other stimuli from the array (DeLeon & Iwata, 1996). The researcher does not replace the selected item in the array, re-arranges the remaining stimuli, and presents the new array to the individual (DeLeon & Iwata, 1996). The researcher blocks an approach to multiple stimuli and provides a prompt to select *one* stimulus (DeLeon & Iwata, 1996). The researcher terminates the session if the individual does not approach a stimulus within 30 s of the second prompt. This procedure is complete once the researcher presents all stimuli (DeLeon & Iwata, 1996). This procedure is efficient and is useful to compare the relative preference of many stimuli (DeLeon & Iwata, 1996). Further, it produces an easy-to-interpret preference hierarchy (i.e., the researcher ranks the first stimulus selected as the most preferred and the last stimulus selected as the least preferred; DeLeon & Iwata, 1996). Researchers have established the predictive validity and the correspondence between the relative reinforcing value and relative preference rankings of stimuli obtained by this procedure (e.g., Carr et al., 2000).

Engagement-Based Procedures. These procedures involve exposing individuals to one or more stimuli and measuring the duration of engagement with a stimulus. (Hagopian et al., 2004). Researchers have typically defined engagement as individuals: (a) approaching and interacting with a stimulus with one or both hands (Roane et al., 1998), (b) consuming the stimulus (Hagopian et al., 2001), (c) engaging in the activity (e.g., playing catch; Hagopian et al., 2001), or (d) orienting towards the stimulus (Hanley, Cammilleri, Tiger, & Ingvarsson, 2007). Researchers have used (a) whole-interval (e.g., Hagopian et al., 2001), (b) partial-interval (e.g., Roane et al., 1998), or (c) momentary time sampling (Hanley et al., 2007) recording methods to measure engagement with a stimulus. Researchers consider those stimuli with which individuals engage for a longer duration as more preferred than those stimuli with which individuals engage for a shorter duration (Roane et al., 1998).

Single-Stimulus Engagement Preference Assessment. This trial-based procedure is identical to the single-stimulus procedure except the researcher measures the duration of engagement with stimuli, rather than the frequency of approaches (Hagopian et al., 2001). The researcher delivers each stimulus individually for a set duration (e.g., 2 min) if the individual approaches the stimulus then measures the duration with which the individual engages with the selected stimulus (Hagopian et al., 2001). After a set duration has lapsed, the researcher removes the stimulus and presents a new stimulus (Hagopian et al., 2001). This procedure is complete once the researcher presents all stimuli to the individual a pre-determined number of times

(Hagopian et al., 2001). Researchers have established the predictive validity and the correspondence between the relative reinforcing value and relative preference rankings of stimuli obtained by this procedure (Hagopian et al., 2001). An advantage of this procedure is that it allows researchers to evaluate the preference for activities that may not be possible to assess in an array (e.g., dancing, going for a walk; Hagopian et al., 2001). Similar to the single-stimulus procedure, this procedure is useful to assess preference for stimuli with individuals that have difficulty making a choice between two or more stimuli (e.g., DeLeon et al., 1999). A limitation of this procedure is that it may not be appropriate to assess preference for edible stimuli (Hagopian et al., 2001); providing free access to edible stimuli (even for a relatively brief period; e.g., 2 min) may be undesirable or even harmful from a nutritional standpoint. Second, this procedure is susceptible to false positives as individuals may show similar levels of engagement with many or all stimuli (Hagopian et al., 2001). Finally, this procedure may produce unstable preference hierarchies across multiple presentations (Hagopian et al., 2001). Therefore, researchers may need to conduct more frequent assessments to capture current motivating operations.

Free-Operant Preference Assessment. For this procedure, multiple stimuli are concurrently available, and the researcher does not impose any restrictions on the stimuli with which the individual engages or the duration with which the individual engages with stimuli (Roane et al., 1998). The researcher does not block engagement with multiple stimuli and does not provide a consequence for no engagement (Roane et al., 1998). The procedure is complete once a pre-determined amount of time (e.g., 5 min) has lapsed (Roane et al., 1998). Researchers have established the predictive validity and the correspondence between the relative reinforcing value and relative preference rankings of stimuli obtained by this procedure (e.g., Roane et al., 1998). An advantage of this procedure is that it useful for determining preference for stimuli that require a longer engagement period (e.g., video games, videos on an iPad; Hagopian et al., 2004). In addition, researchers have observed lower levels of problem behaviour maintained by access to tangible stimuli during this procedure relative to the paired-stimulus and MSWO procedures because stimuli are not removed from the individual during the free-operant procedure (Kang et al., 2010). A limitation of this procedure is that it may not be appropriate to use to evaluate preference for edible stimuli because providing unlimited access (even for a relatively brief period) to certain edibles (e.g., foods high in sugar, sodium, saturated fats) may have negative effects on one's health (Hagopian et al., 2004). In addition, this procedure does not always produce a discrete preference hierarchy (Roane et al., 1998); therefore, one may not be able to determine the relative potential reinforcer potency of stimuli.

Reinforcer Assessments

Although researchers have demonstrated the predictive validity of preference assessments (DeLeon & Iwata, 1996; Hagopian et al., 2001; Kodak et al., 2009; Roane et al., 1998; Roscoe et al., 1999; Wilder et al., 2008), preference assessments do not directly assess the efficacy of these stimuli as reinforcers. Therefore, researchers must conduct reinforcer assessments to determine whether a stimulus will function as a reinforcer for an individual. Reinforcer assessments can take many formats, but generally involve the researcher systematically providing and withholding the putative reinforcer contingent on a target response. If the presentation of a stimulus contingent on target responding produces higher levels of responding relative to those observed when that stimulus is not presented, that stimulus is said to function as a reinforcer (Pace et al., 1985). However, one should exercise caution when conducting – and interpreting the results of – reinforcer assessments because researchers have found several factors that may influence the outcomes of a reinforcer assessment.

Factors that Influence Reinforcer Assessment Outcomes.

Task Difficulty. Researchers have used simple or complex tasks in reinforcer assessments. The difficulty of a task is determined on an individual basis during a pre-test; researchers consider tasks associated with higher rates of accurate responding as simple tasks for that individual and those associated with low rates of responding or high rates of inaccurate responding as complex tasks for that individual (Neef et al., 2005). Examples of simple tasks that have been used in reinforcer assessments include: (a) touching a card (Call, Trosclair-Lasserre, Findley, Reavis, & Shillingsburg, 2012), (b) button-pressing (Call et al., 2012), (c) placing a block in a bucket (DeLeon, Frank, Gregory, & Allman, 2009), (d) placing a peg on a peg board (DeLeon et al., 2009), (e) printing on a pad of paper (Roscoe et al., 1999), and (f) pressing a microswitch (Lee, Yu, Martin, & Martin, 2010; Roscoe et al., 1999). Researchers administered these tasks in a free-operant arrangement, such that the individual could freely engage in the task without any restrictions (Roscoe et al., 1999). One advantage of using simple free-operant tasks is that individuals can easily discriminate the contingencies between responding and the delivery of reinforcement, which may allow researchers to identify putative reinforcers in a shorter amount of time (Piazza et al., 1996). Another advantage of using simple free-operant tasks is that these assessments measure the potency of a reinforcer, rather than the individual's ability to complete a task (Piazza et al., 1996). Despite these benefits, the results of a reinforcer assessment conducted with a simple free-operant task may not generalize to the natural environment where the individual is often required to complete more complex tasks (Fisher et al., 2011). For example, a reinforcer assessment involving button pressing may identify that music reinforces an individual's button pressing behavior, but this outcome does not guarantee that music will function as a reinforcer for a more complex task (e.g., setting the dinner table).

Researchers have also evaluated the reinforcer potency of stimuli using complex tasks such as: (a) on-task behaviour (e.g., sitting appropriately; Paramore & Higbee, 2005) and (b) completing a task analysis (e.g., building a block structure; Fahmie, Iwata, & Jann, 2015). One advantage to using complex tasks during a reinforcer assessment is that these tasks may make the reinforcer assessment more ecologically valid because complex tasks tend to be more representative of those in the natural environment and in typical training settings (Paramore & Higbee, 2005). A limitation of using complex tasks is that if an individual fails to engage in the complex task, researchers cannot determine if the item is not an effective reinforcer or if the skill is not in the individual's repertoire (Piazza et al., 1996). Therefore, using complex tasks during a reinforcer assessment may mask the reinforcing effects of a stimulus simply because the individual is not capable of completing the task.

Experimental Arrangement. Researchers have used single-operant and concurrent-operants arrangements to determine the reinforcer potency of stimuli. In a single-operant arrangement, the researcher presents one target task to the individual. If the individual engages in the target task, the researcher delivers the putative reinforcer (e.g., Call et al., 2012; Glover, Roane, Kadey, & Grow, 2008; Lee et al., 2010; Roscoe et al., 1999). This arrangement measures the *absolute* reinforcer potency of a stimulus (i.e., whether the stimulus functions as a reinforcer; Roscoe et al., 1999). According to DeLeon et al. (2009), one advantage of the single-operant arrangement is that it closely resembles typical teaching or treatment arrangements. However, the single-operant arrangement does not provide information on the relative reinforcing potency of two or more stimuli (i.e., whether one stimulus is a more potent reinforcer than another stimulus; Roscoe et al., 1999). To determine the relative reinforcing potency of two or more stimuli, researchers must use a concurrent-operants arrangement.

In a concurrent-operants arrangement, the researcher presents two or more identical target tasks to the individual, each of which is associated with a different putative reinforcer (e.g., DeLeon et al., 2001; Fisher et al., 1992; Roscoe et al., 1999). For example, button-pushing (Task A) may be associated with grapes and button-pushing (Task B) may be associated with strawberries. When the individual completes Task A, the researcher gives him or her a grape and when the individual completes Task B, the researcher gives him or her a strawberry. This arrangement measures the *relative* reinforcer potency of stimuli (Roscoe et al., 1999). Continuing with this example, if the individual allocated more responding to Task A than to Task B, one would conclude that grapes are more reinforcing than strawberries for this individual. One advantage of a concurrent-operants arrangement is its efficiency (Fisher et al., 1992); it is quicker to conduct than a single-operant arrangement because it measures the reinforcer potency of multiple stimuli within a single session. Further, a concurrent-operants arrangement is ecologically valid as it more closely resembles the simultaneous availability of stimuli in the natural environment (Fisher et al., 1992). That is, individuals typically have multiple options of stimuli or activities from which they can choose in the natural environment. However, this arrangement may yield false negatives (Roscoe et al., 1999). That is, in a concurrent-operants arrangement, it may be the case that an individual allocates exclusive or more responding to the task associated with the most potent reinforcer even if the other stimulus functions as reinforcer, albeit to a lesser extent.

Schedule of Reinforcement. A schedule of reinforcement specifies the contingencies for the delivery of a reinforcer (Ferster & Skinner, 1957). A dense schedule of reinforcement delivers the reinforcer after every occurrence, or close to every occurrence, of the target response (Fisher, et al., 2011). A dense schedule of reinforcement may also involve the delivery of the reinforcer in short intervals (e.g., every 10 s; Hagopian, Fisher, & Legacy, 1994). Dense schedules are useful to teach the contingency between a response and a reinforcer (Vollmer et al., 2001). Teaching the contingency between a response and a reinforcer is important to ensure that the level of responding observed during the assessment is a function of the delivery of the reinforcer and not an extraneous variable (e.g., the difficulty of the task). A limitation to using a dense schedule of reinforcement is that individuals may not vary in levels of responding between reinforcers of varying potencies (DeLeon, Iwata, Goh, & Worsdell, 1997). That is, the low response requirement to contact reinforcement under a dense schedule of reinforcement may not be sufficient to produce differentiated levels of responding across reinforcers of varying potencies. Therefore, reinforcer assessments using dense schedules of reinforcement may identify stimuli as potent reinforcers even though they may not function as reinforcers under leaner schedules of reinforcement.

A lean schedule of reinforcement requires more responses or longer intervals between responses for an individual to contact reinforcement than does a dense schedule (Fisher & Mazur, 1997). That is, the number of responses the individual must perform to contact reinforcement is larger under lean schedules of reinforcement than under dense schedules of reinforcement. This difference in response ratio between dense and lean schedules of reinforcement may lead to differences in response allocation during reinforcement assessments under differing schedules of reinforcement (Fisher & Mazur, 1997). For example, under a dense schedule of reinforcement (e.g., FR 1), an individual may engage in an equal number of responses toward two identical response alternatives when responding to one alternative results in a strawberry and responding to the other results in a grape. However, under a leaner schedule of reinforcement (e.g., VR 25), the individual may engage in more responses toward the response alternative that results in a strawberry compared to the alternative that results in a grape. Based on these findings, we would conclude that, under a dense schedule of reinforcement, both strawberries and grapes functioned as reinforcers. However, under the leaner schedule, strawberries emerged as more potent reinforces than grapes. Therefore, an advantage of using a lean schedule of reinforcement is that it may more accurately identify stimuli that will function as potent reinforcers in the natural environment than dense schedules of reinforcement, as individuals are more likely to contact lean schedules of reinforcement in the natural environment than dense schedules of reinforcement (Francisco et al., 2008). A limitation to using a lean schedule of reinforcement is that if the schedule is too lean, the individual may not engage in the task at all – irrespective of the potency of the reinforcer. If the individual does not engage in the task, the results of the reinforcer assessment may determine that a stimulus is not a reinforcer, even though it may function as a potent reinforcer (Fisher & Mazur, 1997).

One type of schedule of reinforcement that allows for the rapid identification of reinforcer potency is the progressive-ratio (PR) schedule. For example, under a PR 1 schedule of reinforcement, the researcher delivers a reinforcer following the first response completed by the individual, at which point the response requirement systematically increases to two responses; the schedule continues to increase by 1 response within the session until the individual stops responding (Hodos, 1961). The point at which the individual stops responding is referred to as the break point and is reported as the highest completed schedule value (Hodos, 1961). Researchers classify stimuli with larger break points (e.g., Hodos, 1961) or quicker rate of responses (e.g., Penrod et al., 2008) as more potent reinforcers than stimuli with smaller break points or slower rate of responses. Researchers have compared the breakpoints of various stimuli in single-operant (e.g., Call et al., 2012; DeLeon et al., 2009; Glover et al., 2008; Penrod et al., 2008; Roane, Call, & Falcomata, 2005; Roane et al., 2001) and concurrent-operants arrangements (e.g., Francisco et al., 2008; Kodak et al., 2007; Moore, 2015; Tiger et al., 2010) to determine which stimuli are the most potent reinforcers. Researchers have used PR schedules of reinforcement to assess the reinforcer potency of tangible stimuli for non-humans (e.g., Donny et al., 2012; Lynch, Kiraly, Caldarone, Picciotto, & Taylor, 2007; Shahbazi, Moffett, Williams, & Frantz, 2008), tangible stimuli for humans (e.g., Call et al., 2012; Fisher & Mazur, 1997; Glover et al., 2008; Roane et al., 2001), and social attention for humans (e.g., Jerome & Sturmey, 2008; 2014). Further, researchers have arranged progressive-ratio schedules to increase the response requirement in several ways, including: (a) additively (i.e., increasing the number of responses required by a constant amount [e.g., Kodak, Lerman, & Call, 2007]); (b) multiplicatively (i.e., increasing the number of responses required by a constant factor [e.g., DeLeon, Fisher, Herman, & Crosland, 2000]); (c) a combination of additive and multiplicative additions (e.g., Roane et al., 2001); (d) after the individual fulfills the response requirement once (e.g., Kodak et al., 2007), twice (e.g., Roane et al., 2001), and three times (e.g., DeLeon et al., 2000).

Combined-Reinforcer Class Comparisons. Researchers have reported mixed results when comparing the reinforcing efficacy of edible (e.g., food) and leisure (e.g., toys) stimuli (e.g., Ferrari & Harris, 1981; Rincover & Newsom, 1985). Rincover and Newsome (1985) compared the potency of edible and leisure stimuli for three children with ASD. All three participants engaged in higher levels and more accurate responding when the researcher delivered a leisure stimulus following correct responding relative to an edible stimulus. However, other researchers have found idiosyncratic results regarding the relative potency of edible and leisure stimuli as reinforcers. For example, Ferrari and Harris (1981) found that leisure stimuli were the most potent reinforcers for two of four participants with ASD and that edible stimuli were the most potent reinforcers for the remaining two participants. Leaf et al. (2014) also reported idiosyncratic results regarding the potency of edible and leisure stimuli as reinforcers for completing an expressive language task with three children with ASD. Given these mixed findings, researchers should conduct systematic preference assessments with each participant when attempting to identify stimuli that may function as potent reinforcers. That said, researchers should exercise caution when conducting preference assessments that combine edible and leisure stimuli. Some researchers have reported that preference hierarchies derived from preference assessments that contain edible and leisure stimuli (hereafter referred to as *combined-class assessments)* may not accurately predict the relative reinforcing potency of these stimuli (DeLeon et al., 1997; Fahmie et al., 2015).

Combined-Class Multiple-Stimulus Without Replacement Preference Assessments.

When edible and leisure stimuli are presented together in a combined-class MSWO assessment, some individuals may show a preference for one stimulus class over the other (e.g., DeLeon et al., 1997); this phenomenon is called displacement. Researchers have characterized different preference patterns as displacement, such as when an individual selects: (a) all stimuli from one stimulus class prior to selecting all stimuli from another stimulus class (Andakyan et al., 2016; Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015), (b) two stimuli from one stimulus class prior to selecting all stimuli from another stimulus class (Andakyan et al., 2016; DeLeon et al., 1997), and (c) all stimuli from a stimulus class prior to selecting all but one stimulus from another stimulus class (Andakyan et al., 2016; Fahmie et al., 2015). However, the inclusion of three separate criterion for displacement seems to broaden the definition of displacement to include preference patterns that may be more accurately characterized as partial displacement. Whether this broad definition is impractical or leads to erroneous conclusions is presently unknown and remains an empirical question.

DeLeon et al. (1997) were the first to evaluate the displacement of one stimulus class over another in a combined-class MSWO assessment. They first conducted 10 single-class MSWO assessments with 14 adults with intellectual disabilities; five of which consisted of seven edible stimuli that the researchers arbitrarily selected and five of which consisted of seven leisure stimuli that the researchers arbitrarily selected. The researchers then conducted five combined-class MSWO assessment in which they included the top-three-ranked-edible stimuli and the top-four-ranked-leisure stimuli from each of the single-class MSWO assessments. The researchers found that edible stimuli displaced leisure stimuli for 11 of 14 participants. For eight of these 11 participants, all edible stimuli displaced all leisure stimuli. For three of these 11 participants, two of the three edible stimuli displaced all leisure stimuli. The remaining three of 14 participants showed no displacement of one stimulus class over the other. Next, the authors conducted a single-operant arrangement reinforcer assessment to evaluate the reinforcing efficacy of the top-ranked-leisure stimulus for two of the 11 participants for whom edible stimuli were found to displace leisure stimuli under a dense fixed-ratio schedule of reinforcement. For both participants, the leisure stimulus functioned as a reinforcer despite being ranked lower than all or most edible stimuli in the combined-class MSWO assessments. This finding suggests that combined-class MSWO assessments may mask the potential reinforcer efficacy of displaced stimuli. However, the finding that the displaced leisure stimuli functioned as reinforcers for both participants is not surprising given that previous research has demonstrated that low-preference stimuli may function as reinforcers (e.g., Francisco et al., 2008; Roscoe et al., 1999). Further, DeLeon et al. (2007) did not compare the reinforcer potency of the edible and leisure stimuli with these two participants; therefore, we have no information on the relative reinforcing potency between the displaced leisure stimuli and the edible stimuli that displaced them.

DeLeon et al. (1997) purported that 11 of 14 participants may have chosen edible stimuli over leisure stimuli because the response effort to consume the edible stimuli may have been lower than that of the leisure stimuli. The authors also posited that an establishing operation (i.e., food deprivation) may have been in effect that momentarily increased the value and selection of the edible stimuli. To evaluate the possible influence of motivating operations on the results of combined-class MSWO assessments, Bojak and Carr (1999) conducted single-class and combined-class MSWO assessments with four adults with intellectual disabilities between 29 to 44 years of age both before and after dinner. The authors included edible and leisure stimuli in the MSWO assessments based on the results of a modified Reinforcer Assessment for Individuals with Severe Disabilities (Fisher et al., 1996). The combined-class MSWO assessments contained the top-four-ranked stimuli from the edible and leisure single-class MSWO assessments. All four participants showed an exclusive preference for edible stimuli (i.e., all edible stimuli displaced all leisure stimuli) and this preference for edible stimuli did not shift before and after meals. These findings lend support to the DeLeon et al. (1997) finding that participants showed a preference for edible stimuli over leisure stimuli and also extended DeLeon et al. by demonstrating that motivating operations did not influence the displacement of one stimulus class over the other.

Bojak and Carr (1999) stated that participants may have showed a preference for edible stimuli because they had a longer history with the edible stimuli relative to that of the leisure stimuli used in their study. That is, the authors hypothesized that participants' previous exposure to the edible stimuli used in the study may have been more extensive than their previous exposure to the leisure stimuli used in the study. Therefore, it could be the case that controlling for an individual’s past history with stimuli may influence the occurrence of displacement in combined-class MSWO assessments. The authors also stated that participants may not have showed different preference patterns during pre- and post-meal assessments because the magnitude of food used in their study may not have been sufficient to produce satiation with respect to food. As such, the authors suggested that varying the magnitude of food presented in a meal prior to and following a combined-class MSWO assessment may create a sufficient abolishing operation for the selection of edible stimuli. Andakyan, Fryling, and Benjamin (2016) attempted to create a sufficient abolishing operation for the selection of edible stimuli by conducting combined-class MSWO assessments before and after multiple meals throughout the day. The authors conducted single- and combined-class MSWO assessments with four children with ASD between 4 to 7 years of age. The authors included items based on the results of the Reinforcer Assessment for Individuals with Severe Disabilities (Fisher et al., 1996). Unlike the results obtained by DeLeon et al. (1997) and Bojak and Carr (1999), the authors found that edible stimuli displaced leisure stimuli for only two of four participants. For one of these two participants, all edible stimuli displaced all leisure stimuli. For the other participant, the top-two-ranked stimuli were edible stimuli. Leisure items displaced edible items with one participant and no displacement was observed with one participant. Similar to the results obtained by Bojak and Carr (1999), the timing of the combined-class MSWO assessment (before or after a meal) did not influence the displacement of one stimulus class over the other; however, the authors noted that although preference across stimulus class did not shift before and after a meal, preference within a stimulus class did shift. That is, although the consumption of meals prior to the combined-class

MSWO assessments did not serve as a sufficient abolishing operation for the consumption of edible stimuli over leisure stimuli, it did serve as a sufficient abolishing operation for the consumption of *certain* edible stimuli over other edible stimuli. For example, one participant (Ian) selected edible stimuli in the order of: ice cream, mac n cheese, blackberry, and Doritos during the combined-class MSWO assessment before a meal, and he selected edible stimuli in the order of: ice cream, Doritos, mac n cheese, and blackberry during the combined-class MSWO assessment after a meal.

Finally, Fahmie et al. (2015) extended previous research on the displacement of leisure stimuli by edible stimuli and the reinforcer potency of these stimuli on the acquisition and maintenance of tasks with 12 individuals with: (a) ASD, (b) an intellectual disability, or (c) Dandy Walker syndrome and Klinefelter syndrome between 5 to 22 years of age. In Study 1, the authors conducted single- and combined-class MSWO assessments with arbitrarily selected stimuli to determine each participant’s preferences for edible and leisure stimuli and found that edible stimuli displaced leisure stimuli for 10 of 12 participants. For nine of these 10 participants, all edible stimuli displaced all leisure stimuli. For one of these 10 participants, all edible stimuli were ranked higher than all but one leisure stimulus. Two of 12 participants showed no displacement for one stimulus class over the other. In Study 2, the compared the reinforcer efficacy of four high-preference edible and four high-preference leisure stimuli on the acquisition of a six-step response chain (building a Lego structure) with four participants. Two of these participants showed a displacement of edible stimuli over leisure stimuli and the other two participants showed no displacement for one stimulus class over the other in Study 1. For all participants, the researchers found no difference in the accuracy of task completion when an edible or leisure stimulus was delivered as reinforcement on a fixed-ratio schedule, suggesting that both stimuli functioned as equally effective reinforcers. In Study 3, the authors compared the reinforcer potency of edible and leisure stimuli on the maintenance of a simple-free operant task over a 15-min period using a FR 10 schedule of reinforcement with six participants. Four of these participants showed a displacement of edible stimuli over leisure stimuli and the other two participants showed no displacement for one stimulus class over the other in Study 1. For five out of these six participants, edible stimuli functioned as more potent reinforcers than leisure stimuli. For one out of these six participants, edible and leisure stimuli functioned as equally potent reinforcers despite this participant showing exclusive preference for edible stimuli over leisure stimuli in Study 1. While all previous researchers (Andakyan et al., 2015; Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015) have found that the majority of participants prefer edible stimuli over leisure stimuli, there is some evidence to suggest that leisure stimuli may not function as a less potent reinforcer than edible stimuli (DeLeon et al., 1997; Fahmie et al., 2015).

Significance of Research

Several gaps and limitations in this literature warrant further investigation. For all four studies, the participants were diagnosed with an intellectual disability (Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015), an intellectual disability with attention deficit hyperactivity disorder and microcephaly (Fahmie et al., 2015), ASD (Andakyan et al., 2016; Fahmie et al., 2015), Dandy Walker syndrome (Fahmie et al., 2015), or Dandy Walker syndrome with Klinefelter syndrome (Fahmie et al., 2015). Because this phenomenon has not be evaluated with typically developing participants, it seems prudent to determine if typically developing participants generally prefer one stimulus class over another. Second, researchers have not provided a clear definition on what constitutes displacement of one stimulus class over another during a combined-class MSWO assessment. Rather, researchers have loosely defined displacement as a *general preference for one stimulus class over the othe*r and have simply reported various preference patterns – some of which they used inconsistently within their study (Andakyan et al., 2016). A clear definition of displacement would allow researchers to clearly identify whether specific preference hierarchies constitute displacement and to evaluate the implications of these hierarchies. Third, not all studies to date used caregiver report to inform the stimuli included in the single-class MSWO assessments (DeLeon et al., 1997; Fahmie et al., 2015). Therefore, it is possible that these authors did not assess the preference of the participant's most preferred edible and leisure stimuli in the single-class MSWO assessments. Fifth, all four studies included a relatively small number of participants, which may limit the confidence that the outcomes are reliable (Hackshaw, 2008). Therefore, it seems important to determine if displacement is prevalent among a large sample of participants to increase the confidence that edible items do reliably displace leisure items. Sixth, all four studies measured the selection – rather than consumption – of stimuli during all MSWO assessments; considering only the selection of stimuli may lead to false positive outcomes as individuals may not subsequently consume or engage with the item selected. Finally, previous researchers have conducted reinforcer assessments with denser (DeLeon et al., 1997) and leaner (Fahmie et al., 2015) fixed-ratio schedules of reinforcement. However, fixed-ratio schedules of reinforcement do not allow for the identification of the potency of a reinforcer. Given that behavior analysts rely on potent reinforcers to implement effective behavioral interventions (Killu, 2008), it seems important to evaluate the potency of displaced stimuli and the stimuli that displaced them.

Therefore, the purpose of Study 1 was to determine if the displacement of leisure stimuli by edible stimuli typically observed in previous studies is consistent in a sample of 15 typically developing children. We conducted 10 single-class and five combined-class MSWO assessments with caregiver-informed stimuli and measured each participant's consumption of stimuli to determine if these participants showed a general preference for one stimulus class over another. The purpose of Study 2 was to extend the work of DeLeon et al. (1997) and determine the predictive validity of combined-class MSWO assessments under increasing response requirements. We conducted a single-operant reinforcer assessment with a progressive-ratio schedule of reinforcement with seven of eight participants who showed one pattern of displacement to determine if (a) displaced stimuli functioned as reinforcers and (b) if any differences in reinforcer potency existed between displaced stimuli and the stimuli that displaced them.

Study 1: Preference Assessments

We assessed each participant's preference for edible and leisure stimuli. First, we conducted 10 single-class MSWO assessments; five of which contained eight edible stimuli (edible-MSWO assessment) and five of which contained eight leisure stimuli (leisure-MSWO assessment). Next, we conducted five combined-class MSWO assessments that contained each participant's top-four ranked-edible and top-four ranked-leisure stimuli from the single-class edible- and leisure-MSWO assessments, respectively.

Method

Participants and Setting

We recruited fifteen participants aged 5 to 9 years from two elementary schools in the Greater Hamilton Area (see Appendix A for the certificate of ethics clearance for human participant research and Appendix B for the informed consent form). We conducted sessions in a separate room near each participant's classroom. In one school, the room contained a table, two chairs, several filing cabinets, and a book shelf. The room in the second school contained a table and two chairs. We conducted two sessions per day, three to five days per week. Sessions lasted 3 to 6 min.

Materials

For each participant, we included eight edible and eight leisure stimuli based on the results of a caregiver-informed survey (see Table 1 for a list of all items included in these assessments).

Response Measurement, Reliability, and Procedural Integrity

Trained observers collected trial-by-trial data using paper and pencil on the occurrence of consumption during all preference assessments (see Appendix C for a sample data sheet). For edible stimuli, we recorded *consumption* when the participant selected (touched, picked up, or asked for) one stimulus within 5 s of its presentation, placed the stimulus in his or her mouth, *and* did not expel the stimulus. For leisure stimuli, we recorded *consumption* when the participant selected (touched, picked up, or asked for) one stimulus within 5 s of its presentation *and* interacted with the stimulus with his or her hands or held an eye gaze towards the stimulus for at least 3 s. We summarized these data by calculating the percentage of trials with consumption by dividing the number of times a participant consumed a stimulus by the number of times we presented the stimulus as a choice in the array. We then ranked stimuli based on these consumption percentages – we ranked stimuli consumed on a greater percentage of trials higher than stimuli consumed on a smaller percentage of trials. If a participant consumed two or more stimuli on an equal percentage of trials, we calculated and ranked consumption percentages for the final three (of five) MSWO assessments.

A second independent observer collected data during 40% (range, 0% to 87%) of all sessions. We calculated trial-by-trial interobserver agreement by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100%. We defined an agreement as both observers scoring the same response within a given trial. We defined a disagreement as both observers scoring a different response within a given trial. Mean agreement for the consumption of stimuli was 99% (range, 88% to 100%) and was 97% (range, 75% to 100%) for the placement of consumed stimuli in the array across all preference assessments.

We calculated procedural integrity on a trial-by-trial basis during 40% (range, 0% to 87%) of all sessions. Trained observers collected data on the accuracy with which the primary experimenter delivered the stimulus, delivered the prompt, and terminated the session. We defined *correct stimulus delivery* as the experimenter placing the correct stimulus directly in front of the participant. We defined *correct prompt delivery* as the experimenter re-administering the correct prompt (i.e., “Pick one”) while pointing to all stimuli in the array. We defined *correct session termination* as the experimenter ending the session if the participant: (a) did not approach a stimulus after 30 s on two consecutive prompts, (b) consumed all stimuli, or (c) engaged in problem behaviour. We calculated procedural integrity by dividing the number of experimenter accuracies by the number of experimenter accuracies plus inaccuracies and multiplying by 100%. Mean procedural integrity was 100% for correct stimulus delivery, 99% (range, 75% to 100%) for correct prompt delivery, and 100% for correct session termination across all preference assessments.

Procedure

We conducted two pre-tests prior to Study 1. First, we asked each caregiver to fill out a survey (see Appendix D) about their child's preferred edible and leisure stimuli. We distributed copies of the survey in person and asked caregivers to return a completed copy in-person within one week. The survey asked caregivers to list their child's: (a) 10 most-preferred edible stimuli, (b) 10 most-preferred leisure stimuli, (c) food allergies, and (d) and any items they did not want us to use in this study. Although we only included eight stimuli in each single-class assessment, we asked caregivers to list additional stimuli in the survey in the event that we could not use a stimulus that caregivers reported (e.g., we could not find or obtain a stimulus or other individuals' allergies in the area prohibited inclusion of certain stimuli).

We conducted a second pre-test to determine if participants could make a selection among eight stimuli. The experimenter placed eight equally spaced stimuli in front of the participant and asked the participant to select a stimulus by saying, "Pick one" or "Pick your favourite." If the participant selected a stimulus within 30 s of the prompt, we included him or her in the study. If the participant did not select a stimulus within 30 s of the prompt, we regained the participant's attention by asking him or her to look at all stimuli and prompted him or her to select a stimulus by saying, "Pick one" or "Pick your favourite." If the participant selected a stimulus within 30 s of the prompt, we included him or her in the study. If the participant did not select a stimulus within 30 s of the prompt, we did not include him or her in the study. Because all participants selected a stimulus within 30 s of the prompt, we did not exclude any participants based on this criterion.

We conducted all preference assessments using an MSWO-presentation format similar to that described by DeLeon and Iwata (1996). We conducted one MSWO assessment per session. We conducted two sessions per day until the participant completed five edible-MSWO and five leisure-MSWO assessments. The edible-MSWO assessment contained eight edible stimuli and leisure-MSWO assessment contained eight leisure stimuli. The experimenter quasi-randomly determined the order of these MSWO assessments each day such that he or she did not conduct the same type of single-class MSWO assessment first on more than two consecutive days. Next, the experimenter included the top-four stimuli from each class in the combined-class MSWO assessment. If a participant consumed two stimuli for the same percentage of trials during either single-class MSWO assessments, the experimenter ranked these stimuli based on their consumption percentage for the final three preference assessments. The experimenter conducted the combined-class MSWO once per day for five days.

Prior to conducting all MSWO assessments, the experimenter provided participants with pre-session exposure to each stimulus included in the upcoming assessment. Pre-session exposure consisted of the experimenter presenting the participant with a dime-sized piece of an edible stimulus or a leisure stimulus, labeling the stimulus, and asking the participant to try the stimulus. If the participant agreed to try an edible stimulus, the experimenter gave him or her a dime-sized piece of the edible stimulus. If the participant agreed to try a leisure stimulus, the experimenter gave him or her free access to the stimulus for 30 s. The experimenter did not prompt the participant to eat the edible stimulus or interact with the leisure stimulus and did not arrange any programmed consequences if the participant refused to try an edible or leisure stimulus.

During all MSWO assessments, the experimenter presented all eight stimuli to the individual. The experimenter placed each stimulus equally spaced apart and prompted the participant to select a stimulus (e.g., “Pick your favourite”). If the participant selected one stimulus within 5 s of the prompt, the experimenter gave him or her 30 s access to the stimulus and removed all other stimuli. The experimenter re-presented the array of remaining stimuli after 30 s lapsed. We included this 30 s inter-trial interval to equate session duration across all MSWO assessments. If the participant did not make a selection within 30 s of the prompt, the experimenter provided a second prompt to select a stimulus. The experimenter blocked attempts to approach two or more stimuli at a time and re-administered the prompt to select one stimulus. This process continued until the participant chose all stimuli or did not approach a stimulus within 30 s following two consecutive prompts.

Study 2: Reinforcer Assessment

We conducted single-operant arrangement reinforcer assessments using a multielement design to compare the reinforcer potency of edible and leisure stimuli. For all reinforcer assessments, we terminated the session if the participant did not respond for 1 min or 30 min lapsed, whichever occurred first. We conducted one to three sessions per day, two to four days per week.

Method

Participants and Setting

We selected seven participants from Study 1 to participate in Study 2 because they (a) showed displacement of one stimulus class over the other and (b) were available for participation. All sessions in took place in a research room located near the participant’s classroom.

Materials

We assigned each participant one of four free-operant tasks (i.e., cleaning up popsicle sticks, lining up popsicle sticks, cleaning up playing cards, or flipping playing cards) that was in the participant’s repertoire but did not occur at high rates in the absence of reinforcement.

Depending on the assigned free-operant task, sessions included popsicle sticks or playing cards. We included each participant's top-ranked-edible and top-ranked-leisure stimulus from the combined-class MSWO assessments in Study 1 in these reinforcer assessments.

Response Measurement, Reliability, Procedural Integrity

Trained observers collected frequency data using Countee™ software on Apple iPhones™ or Samsung Galaxy ™ smartphones (see Appendix E for a screenshot of Countee™ display screen). Observers recorded the frequency of independent responding of the individually assigned free-operant task. We assigned *cleaning up popsicle sticks* to Morgan and Eric and defined it as placing a popsicle stick one at a time inside a plastic bag with one's hands. We assigned *lining up popsicle sticks* to Levi and defined it as placing two popsicle sticks on the table such that the tip of one popsicle stick contacted the tip of the other popsicle stick. We assigned *cleaning up playing cards* to Richard and defined it as placing a playing card one at a time inside a rectangular box. We assigned *flipping playing cards over* to Brittany, Cristobal, and Kyle and defined it as picking up a card one at a time faced down and flipping it over such that the back of card contacted the table. We analyzed these data as responses per minute by dividing the total number of target responses by the total duration of task presentation.

A second, independent observer collected data during 33% (range, 0% to 42.3%) of session. We divided sessions into 10-s intervals and compared observers' records within each 10-s interval. We calculated proportional IOA by dividing the smallest recorded number of independent target responses by the largest recorded number for each 10-s second interval. We summed all fractions and added this summation to the difference between the total number of intervals and the number of intervals for which there was a disagreement. We divided this integer by the total number of intervals and multiplied by 100%. Mean proportional agreement across participants was 97.8% (range, 93.8% to 100%) for the rate of responses.

Trained observers scored the accuracy with which the experimenter delivered the stimulus and terminated the session. We defined *correct stimulus delivery* as the experimenter placing the correct stimulus directly in front of the participant. We defined *correct termination of the session* as the experimenter ending the session if the participant: (a) did not complete a target response within 1 min, (b) 30 min lapsed, or (c) engaged in problem behaviour. We calculated procedural integrity by dividing the number of accuracies by the number of accuracies plus inaccuracies and multiplying by 100%. Mean procedural integrity across participants was 100% for correct stimulus delivery and 100% correct termination of the session.

Procedures

We used a single-operant arrangement within a multielement design to compare the reinforcer potency of the top-ranked-edible and the top-ranked-leisure stimulus from the combined-class MSWO assessments. Prior to each session, the experimenter provided a brief instruction, prompted the participant to complete one response, and provided 30 s access to the stimulus, if any. During all sessions, the experimenter placed a free-operant task in front of the participant and said, “You can start when you are ready.” The experimenter did not provide any other prompts to the participant. The experimenter terminated the session if: (a) 30 min lapsed or (b) the participant did not engage in the target task for 1 min.

During baseline, the experimenter did not provide a programmed consequence for engaging in the free-operant task. During the reinforcement phase, we arranged identical additive PR schedules in which the response requirement to contact reinforcement increased by two following two completions of the schedule requirement (e.g., PR 1, PR 1, PR 3, PR 3, PR 5, PR

5 and so on). The experimenter provided 30 s access to the stimulus evaluated in that condition after the participant completed each PR requirement. If the participant consumed the stimulus before 30 s lapsed (e.g., the participant consumed the edible within 10 s), the experimenter did not re-present the free-operant task until 30 s lapsed. This 30 s inter-trial interval equated the reinforcer-access period across all sessions and conditions.

If the participant engaged in the free-operant task for 30 min across two consecutive edible and two consecutive leisure sessions, we arranged a multiplicative PR schedule (i.e., the response requirement doubled following one completion of the schedule requirement). If the participant engaged in the free-operant task for 30 min across the following two consecutive sessions, we arranged a more stringent PR schedule – the response requirement increased by four-fold following one completion of the schedule requirement. If the participant engaged in the free-operant task for 30 min across the following two consecutive sessions, we again arranged a more stringent PR schedule for the following sessions – the response requirement increased by eight-fold following one completion of the schedule requirement. We determined the order of the conditions quasi-randomly such that we did not conduct more than two consecutive sessions of the same condition.

Results

Study 1: Preference Assessment

Table 2 shows the percentage of trials with consumption and preference rankings for stimuli included in the single-class MSWO assessments for all participants. We included each participant's top-four-ranked-edible and top-four-ranked-leisure stimuli in the combined-class MSWO assessment. Figure 1 shows the consumption percentages for these stimuli during the single-class and combined-class MSWO assessments. We categorized each participant's consumption into one of three displacement patterns: the percentage of trials with consumption for (a) all stimuli from one stimulus class was greater than all stimuli from the other stimulus class, (b) two stimuli from one stimulus class was greater than all stimuli from the other stimulus class, and (c) for all stimuli from one stimulus class was greater than all but one stimulus from the other stimulus class. If a participant's consumption behaviour did not meet one of these three criteria, we determined that the participant did not display displacement of one stimulus class over the other.

Overall, eight of 15 participants (53.3%) showed one of these three patterns of displacement. Five (33.3%) participants showed a general preference for edible over leisure stimuli and three (20.0%) participants showed a general preference for leisure over edible stimuli. Of the eight participants who showed a preference for one stimulus class over another, three showed the first pattern (a) of displacement: Brittany and Morgan ranked all edible stimuli higher than all leisure stimuli in the combined-class MSWO assessment, and Cristobal ranked all leisure stimuli higher than all edible stimuli. Four participants showed the second pattern (b) of displacement: Richard and Levi ranked two edible stimuli higher than all other stimuli, and Eric and Kyle ranked two leisure stimuli higher than all other stimuli. One participant (Sammy) showed the third pattern of (c) of displacement. Sammy ranked all edible stimuli higher than all but one leisure stimulus. The remaining seven participants (Auston, Katrina, Marcus, Tanya, Elliott, Curtis, and Stewart; 46.7% of participants) showed mixed preferences for edible and leisure stimuli.

To determine if the difference in mean ranking for edible and leisure stimuli during the combined-class MSWO assessments was statistically significant for each participant, we conducted Pillai's trace. That is, we used Pillai's trace to determine if each participant showed a statistically significant preference for one stimulus class over the other during the five combined-class MSWO assessments. Pillai's trace produces a number between 0 and 1 that represents the magnitude to which other factors contribute to the difference between two independent variables (i.e., the magnitude to which random factors contribute to the difference between a participant's mean ranking of edible and leisure stimuli in a combined-class MSWO assessment). The value produced from Pillai's trace converts to an F-statistic that one compares to an *F*-ratio distribution table to determine if the value is statistically significant (i.e., if the probability of the difference score that is less than or greater than zero is less than 5%). The results of Pillai's trace showed that the difference in mean ranking between edible and leisure stimuli was statistically significant for all participants who showed the first pattern (a) of displacement: Brittany (F = 4.404, p = 0.004; M edible = 2.500, 95% CI [2.500, 2.500]; M leisure = 6.500, 95% CI [6.500, 6.500]) and Morgan (F = 4.545, p = 0.003; M edible = 2.650, 95% CI [2.372, 2.928]; M leisure = 6.350, 95% CI [6.072, 6.628]) ranked all edible stimuli higher than all leisure stimuli in the combined-class MSWO assessments, and Cristobal (F = 58.500, p = 0.000; M edible = 6.500, 95% CI [6.500, 6.500]; M leisure = 2.500, 95% CI [2.500, 2.500]) ranked all leisure stimuli higher than all edible stimuli in the combined-class MSWO assessments. The results of Pillai's trace showed that the difference in mean ranking between edible and leisure stimuli to be statistically significant for all participants who showed the second pattern (b) of displacement: Richard (F = 7.654, p = 0.000; M edible = 3.200, 95% CI [2.527, 3.873]; M leisure = 5.850, 95% CI [5.245, 6.455]) and Levi (F = 8.690, p = 0.000; M edible = 3.750, 95% CI [2.819, 4.681]; M leisure = 5.250, 95% CI [4.319, 6.181]) ranked two edible stimuli higher than all leisure stimuli in the combined-class MSWO assessments, and Eric (F = 7.445, p = 0.000; M edible = 4.750, 95% CI [3.470, 6.030]; M leisure = 4.250, 95% CI [2.970, 5.530]) and Kyle (F = 3.481, p =

0.013; *M* edible = 5.250, 95% CI [3.794, 6.706]; *M* leisure = 3.750, 95% CI [2.294, 5.206]) ranked two leisure stimuli higher than all edible stimuli in the combined-class MSWO assessments. Pillai's trace also showed that the difference in mean ranking between edible and leisure stimuli was statistically significant for the only participant who showed the third (c) pattern of displacement: Sammy ($F = 3.448$, $p = 0.013$; *M* edible = 3.750, 95% CI [2.768, 4.732]; *M* leisure = 5.250, 95% CI [4.268, 6.232]) ranked all edible stimuli higher than all but one leisure stimulus in the combined-class MSWO assessments. Further, the results of Pillai's trace showed that the difference in mean ranking between edible and leisure stimuli was statistically significant for five of seven participants who did not show a pattern of displacement: Auston ($F = 5.639$, $p = 0.001$; *M* edible = 4.700, 95% CI [4.207, 5.373]; *M* leisure = 4.300, 95% CI [3.627, 4.973]), Katrina ($F = 13.889$, $p = 0.000$; *M* edible = 4.400, 95% CI [3.685, 5.115]; *M* leisure = 3.885, 95% CI [3.885, 5.315]), Matt ($F = 8.674$, $p = 0.000$; *M* edible = 4.350, 95% CI [3.786, 4.914]; *M* leisure = 4.650, 95% CI [4.086, 5.214]), Curtis ($F = 8.586$, $p = 0.000$; *M* edible = 5.050, 95% CI [3.840, 6.260]; *M* leisure = 3.950, 95% CI [2.740, 5.160]), and Stewart ($F = 9.698$, $p = 0.000$; *M* edible = 4.550, 95% CI [4.040, 5.060]; *M* leisure = 4.450, 95% CI [3.940, 4.960]). Finally, the results of Pillai's trace showed that the difference in mean ranking between edible and leisure stimuli was not statistically significant for two of seven participants that did not show a pattern of displacement: Tanya ($F = 2.384$, $p = 0.060$; *M* edible = 5.000, 95% CI [3.994, 6.006]; *M* leisure = 4.000, 95% CI [2.994, 5.006]) and Elliott ($F = 1.409$, $p = 0.252$; *M* edible = 4.500, 95% CI [3.220, 5.780]; *M* leisure = 4.500, 95% CI [3.220, 5.780]).

Study 2: Reinforcer Assessment

Figures 2 and 3 depict the rate of responding and last completed breakpoint for all participants included in Study 2. All participants showed little to no responding in baseline and higher levels of responding in the PR schedule of reinforcement assessment phase, suggesting that both stimuli functioned as reinforcers for all participants (except for Eric, whose top-ranked-displaced stimulus did not function as a reinforcer during the last two sessions). We observed congruent results between the combined-class MSWO assessments and PR reinforcer assessments for four (Brittany, Eric, Kyle, and Richard) of seven participants (Figure 2). That is, these participants allocated more responding to the task when responding resulted in the top-ranked stimulus identified in the combined-class MSWO assessment relative to the top-ranked-displaced stimulus. For two (Brittany and Richard) of these four participants, we found that the edible stimulus was a more potent reinforcer. Brittany engaged in a higher rate of responding in the edible condition (*M* = 10.6; range, 5.7 to 20.1) relative to the leisure condition (*M* = 6.2; range, 1.7 to 10.1). Brittany's break point data corresponded to her response rate data; that is, we observed higher break points in the edible condition (*M* = 14; range, 5 to 25) relative to the leisure condition (*M* = 7; range, 3 to 11). Richard also engaged in a higher rate of responding in the edible condition (*M* = 20.6; range, 15.6 to 24.3) relative to the leisure condition (*M* = 15.2; range, 4.6 to 18.0). Richard's break point data also corresponded to his response rate data; we observed higher break points in the edible condition (*M* = 21.7; range, 11.0 to 27.0) relative to the leisure condition (*M* = 14.3; range, 5.0 to 23.0). For the remaining two (Eric and Kyle) of these four participants, we found that the leisure stimulus was the more potent reinforcer. During the PR schedule of reinforcement phase, we observed similar rates of responding across both conditions during the first 14 sessions for Eric and the first 27 sessions for Kyle, after which the leisure stimulus emerged as the more potent reinforcer for both participants. Despite this initial undifferentiated responding, Eric engaged in a higher mean rate of responding in the leisure condition (*M* = 10.7; range, 3.3 to 16.0) relative to the edible condition (*M* = 8.2; range, 1.3 to

16.9). Eric's break point data corresponded to his response rate data; that is, we observed higher break points in the leisure condition (*M* = 14.2; range, 3.0 to 23.0) relative to the edible condition (*M* = 10.2; range, 1.0 to 23.0). Similarly, Kyle's mean rate of responding was higher in the leisure condition (*M* = 14.3; range, 0.8 to 28.3) relative to the edible condition (*M* = 9.9; range, 0.8 to 26.9). Kyle's break point data corresponded to his response rate data; that is, we observed higher break points in the leisure condition (*M* = 9.1; range, 1.0 to 17.0) relative to the edible condition (*M* = 6.0; range, 1.0 to 15.0).

We observed incongruent results between the combined-class MSWO assessments and PR reinforcer assessment for the remaining three (Cristobal, Morgan, and Levi) of seven participants (Figure 3). That is, these participants allocated similar levels of responding to the task when responding resulted in the top-ranked stimulus and the top-ranked-displaced stimulus identified in the combined-class MSWO assessment. Under the additive PR schedule in which the response requirement increased by two after Cristobal completed the schedule requirement twice, Cristobal engaged in similar response rates in the edible condition (*M* = 37.6; range, 30.7 to 44.5) and leisure condition (*M* = 38.4; range, 36.4 to 40.4) and identical break points for the maximum session duration (i.e., 30 min) for two consecutive edible and two consecutive leisure sessions (*M* = 32.0; range, 31.0 to 33.0); therefore, we implemented a multiplicative progressive-ratio schedule of reinforcement in which the response requirement doubled after he met each response requirement. Under this schedule arrangement, Cristobal engaged in a similar rate of responding in the edible condition (*M* = 46.9; range, 40.4 to 51.8) and the leisure condition (*M* = 46.7; range, 39.3 to 51.0). Cristobal's break point data corresponded to his response rate data; that is, we observed similar break points in the edible condition (*M* = 128.0; range, 128.0 to 128.0) and the leisure condition (*M* = 128.0; range, 128.0 to 128.0). Under the additive PR schedule in which the response requirement increased by two after Morgan completed the schedule requirement twice Morgan engaged in the task with similar response rates in the edible condition (*M* = 11.3; range, 11.1 to 11.6) and leisure condition (12.0; range, 10.8 to 13.2) and identical break points for the maximum session duration for two consecutive edible and two consecutive leisure sessions (*M* = 20.0; range, 19.0 to 21.0); therefore, we implemented a multiplicative PR schedule of reinforcement where the response requirement doubled after he met each response requirement. During the first two sessions under this PR schedule, Morgan engaged in a higher rate of responding in the leisure condition (18.5) relative to the edible condition (13.8). However, Morgan's break point data did not correspond to his response rate data; we observed identical break points during the edible and leisure conditions (*M* = 128.0; range, 128.0 to 128.0). Because Morgan's break points were identical, and he engaged in the task for the maximum session duration for these two sessions, we modified the schedule such that the response requirement quadrupled after he met each response requirement. During the first two sessions under this PR schedule, Morgan engaged in a higher rate of responding in the leisure condition (20.5) relative to the edible condition (13.2). However, Morgan's break point data did not correspond to his response rate data; we observed identical break points during the edible and leisure conditions (*M* = 256.0; range, 256.0 to 256.0). Because Morgan's break points were identical, and he engaged in the task for the maximum session duration for these two sessions, we modified the schedule again such that the response requirement increased by a factor of eight after he met each response requirement. Under this schedule arrangement, Morgan engaged in a similar rate of responding in the edible condition (*M* = 14.1; range, 8.2 to 19.7) and the leisure condition (*M* = 14.7; range, 8.9 to 19.2). Morgan's break point data corresponded to his response rate data; that is, we observed similar break points in the edible condition (*M* = 64.0; range, 64.0

to 64.0) and the leisure condition (*M* = 64.0; range, 64.0 to 64.0). Levi engaged in a similar rate of responding in the edible condition (*M* = 16.9; range, 14.6 to 18.3) and the leisure condition (*M* = 16.3; range, 15.4 to 18.8). Levi's break point data corresponded to his response rate data; that is, we observed similar break points in the edible condition (*M* = 20.7; range, 17.0 to 25.0) and the leisure condition (*M* = 20.3; range, 17.0 to 23.0).

Discussion

This study is the first to investigate the displacement of one stimulus class over another with typically developing children. Based on the three patterns of displacement reported by previous researchers (Andakyan et al., 2016; Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015), we found that eight of 15 participants showed a general preference for one stimulus class over the other in the combined-class MSWO assessments. Of these eight participants, five showed a preference for edible stimuli and three showed a preference for leisure stimuli. We then investigated the predictive validity of the combined-class MSWO assessments with seven of the eight children who showed a general preference for one stimulus class over the other and found that the results of this assessment accurately predicted the relative reinforcer potency of the top-ranked and the top-ranked-displaced stimuli for four of seven participants.

We found two noteworthy findings in Study 1. First, we found the order that the majority of participants ranked stimuli changed from the single-class to the combined-class MSWO assessments, suggesting that the presence of items from a different stimulus class may shift preference for edible and leisure stimuli. For example, when considering only the rank order of edible stimuli, we found that 12 of 15 participants ranked 14 of 60 edible stimuli lower in the combined-class MSWO assessment relative to their rankings in the edible-MSWO assessment, suggesting that preference for these 14 stimuli decreased when we introduced highly preferred leisure stimuli in the array. We found that 12 of 15 participants ranked 17 of 60 edible stimuli higher in the combined-class MSWO assessment, suggesting that preference for these stimuli increased when we introduced highly preferred leisure stimuli in the array. Finally, we found that the ranking of 29 of 60 edible stimuli did not change for 11 of 15 participants, suggesting that preference for these stimuli remained the same when we introduced highly preferred leisure stimuli in the array. We found similar results when considering only the rank order of leisure stimuli. We found that 13 of 15 participants ranked 15 of 60 leisure stimuli lower in the combined-class MSWO assessment relative to the leisure- MSWO assessment, suggesting that preference for these stimuli decreased when we introduced highly preferred edible stimuli in the array. We found that 13 of 15 participants ranked 31 of 60 leisure stimuli higher in the combined-class MSWO assessments, suggesting that preference for these stimuli increased when we introduced highly preferred edible stimuli in the array. Finally, we found that the ranking of 24 of 60 leisure stimuli did not change for 11 of 15 participants, suggesting that preference for these stimuli remained the same when we introduced highly preferred edible stimuli in the array. The finding that the majority of participants' preference for some edible and leisure stimuli shifted dependent on the other stimuli included in the array may lend some support for the use of combined-class MSWO assessments for typically developing children. That is, including highly preferred edible and leisure stimuli in one array may more accurately identify the *relative* preference for these stimuli than comparing consumption percentages from separate edible- and leisure-MSWO assessments.

Second, when we analyzed the results of the combined-class MSWO assessments in Study 1, we found that a smaller proportion of participants (53%) showed a preference for one stimulus class over the other stimulus class relative to the results found by previous researchers

(*M* = 86%; range, 75% to 100%; Andakyan et al., 2016; Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015). Further, of those participants who showed a preference for one stimulus class over the other, we found that a smaller proportion of participants (623%) showed a preference for edible stimuli over leisure stimuli relative to the results of previous researchers (*M* = 92%; range, 67% to 100%; Andakyan et al., 2016; Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015). However, of those participants who showed a preference for one stimulus class over the other, we found that a larger proportion of our participants (38%) showed a preference for leisure stimuli over edible stimuli relative to the results of previous researchers (*M* = 8%; range, 0% to 33%; Andakyan et al., 2016; Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015).

These findings seem to suggest – at least initially - that typically developing children's preferences for edible and leisure stimuli may be different than those of individuals with intellectual and developmental disabilities. One possible rationale for these disparate findings may be the pre-existing differences in these participant's characteristics. For example, while play skills develop without the use of explicit instruction in typically developing children, they often require explicit instruction to emerge in children with an intellectual or developmental disability (Morrison, Sainato, Benchaaban, & Endo, 2002). Therefore, it is possible that play may function as an automatic reinforcer for typically developing children, but not for children diagnosed with an intellectual or developmental disability. If this is the case, it is not surprising that we observed that a higher proportion of our participants showed a general preference for leisure stimuli relative to previous studies' findings – where all participants had a diagnosis of an intellectual or developmental disability. Therefore, it may be important for behavior analysts to consider participant characteristics when deciding which preference assessment format to use. For example, if an individual does not have a large play-skill repertoire, it seems likely that he or she would select edible stimuli over leisure stimuli in a combined-class preference assessment. In this case, behavior analysts should conduct a single-class preference assessment with each stimulus class to obtain the most accurate and complete picture of the individuals' preference for both stimulus classes.

It is also possible that the discrepancies between the results of our study and those of previous studies are due, at least in part, to: (a) the method by which researchers selected stimuli for inclusion in the MSWO assessments and (b) the dependent variable researchers used to capture participants' preference for stimuli. First, only two (Andakayan et al., 2016; Bojak & Carr, 1999) of four studies used a caregiver-informed survey to select stimuli to include in the MSWO assessments. Fahmie et al. (2015) and DeLeon et al. (1997) arbitrarily selected edible stimuli that sampled a variety of tastes and leisure stimuli that sampled a variety of sense modes. While DeLeon et al. selected leisure stimuli for some participants based on staff opinion, they did not have a formalized system for incorporating staff opinion for all participants. Therefore, it is possible that these researchers did not include their participants' (a) highly preferred edible and leisure stimuli or (b) highly preferred unique combinations or arrangements of these stimuli, inclusion of which may have produced different results for some participants. In fact, in one (Andakayan et al., 2016) of the two studies in which researchers used a caregiver-informed survey to identify stimuli to include in the MSWO assessments, two of four participants showed a general preference for leisure over edible stimuli. It should be noted that the authors of this study concluded that only one participant showed a preference for leisure over edible stimuli (this participant's top-two stimuli were leisure items); however, when we analyzed the data based on the three patterns of displacement reported in the literature, we found that two of four participants showed this pattern of displacement.

Second, whereas all four previous studies (Andakyan et al., 2016; Bojak & Carr, 1999; DeLeon et al., 1997; Fahmie et al., 2015) measured and analyzed participants' *selection* patterns, we measured and analyzed participants' *consumption* patterns. This distinction is important to consider because it is possible that a participant may select a stimulus during an MSWO assessment but may not subsequently consume that stimulus – in full or in part. During the single-class MSWO assessments, we found that Stewart selected gum on a high percentage of trials; however, he never subsequently consumed the gum. Had we only considered the selection of stimuli, we would have concluded that gum was a high-preference stimulus for Stewart and included gum in the subsequent combined-class MSWO assessments, which may have influenced the results of the combined-class MSWO assessments. Therefore, it is possible that only measuring the selection of stimuli could lead to false positive outcomes. Whereas measuring the consumption of stimuli seems to provide a more stringent criterion by which to determine a participant's preference for stimuli compared to selection alone.

One overarching issue we noticed when reviewing the displacement literature was that previous researchers did not explicitly define what constitutes displacement. For example, DeLeon et al. (1997) vaguely defined displacements as a "general preference" (p. 475), "strong preference" (p. 479), or "selective preference for one class of reinforcers" (p. 481). When considering that researchers defined displacement as a *general* or *strong* preference for one stimulus class over the other, we found it interesting that two of three (Andakyan et al., 2016; DeLeon et al., 1997) previous studies used the second (b) pattern of displacement (i.e., selecting two stimuli from one stimulus class prior to selecting all stimuli from another class). Therefore, we considered the number of stimuli per stimulus class reported in both studies. Whereas Andakyan et al. (2016) included four edible and four leisure stimuli, DeLeon et al. (1997) only included three edible stimuli and four leisure stimuli. It is also worth noting that DeLeon et al. only observed the second (b) pattern of displacement with edible stimuli. That is, for the two of 14 participants who selected two edible stimuli before selecting all leisure stimuli, the participants did in fact select the majority (two of three) edible stimuli before selecting leisure stimuli. Therefore, this second (b) pattern of displacement may only be relevant for MSWO arrays that include three stimuli per stimulus class. Reporting that a participant ranked a majority of edible stimuli over leisure stimuli seems to be a more stringent criterion of displacement than reporting that a participant ranked half of the edible stimuli over leisure stimuli.

Nevertheless, all three patterns of displacement focused on the ranking of the top-four-ranked stimuli for each participant. That is, no authors mentioned or formally considered the order of the bottom-four-ranked stimuli. Therefore, we conducted Pillai's trace to identify any patterns of displacement within our sample of participants when we considered the ranking of all stimuli included in the array. Pillai's trace compares the mean ranking of edible and leisure stimuli for each participant to determine any differences. When we considered the ranking of all stimuli, we found that 13 of 15 participants (i.e., all participants except Tanya and Elliott) showed a preference for one stimulus class over another. However, we must proceed with caution when interpreting the results of Pillai's trace because the 95% confidence intervals regarding the mean ranking of edible and leisure stimuli overlapped for nine of 13 participants who showed a preference for one stimulus class over another, suggesting that these participants may not have shown a clinically significant difference in the mean ranking of edible and leisure stimuli. That is, we found: (a) a general preference for one stimulus class over another and (b) non-overlapping confidence intervals for four of 15 participants (Brittany, Cristobal, Morgan, and Richard), suggesting that these participants may have shown a clinically significant difference in the mean ranking of edible and leisure stimuli. Given that these analyses revealed that some participants who showed a preference for one stimulus class over another when considering only the top-four-ranked stimuli may not have showed a preference for one stimulus class over another when considering the ranking of all stimuli, future researchers should evaluate the utility of considering the ranking of all stimuli to determine a participant's general preference for one stimulus class over another.

In Study 2, we extended the work by DeLeon et al. (1997) who found that the top-ranked-displaced leisure stimulus functioned as a reinforcer for both participants for whom this was assessed. Because DeLeon et al. did not also assess the reinforcing potency of the top-ranked-edible stimulus, we have no information on the relative reinforcer potency of displaced stimuli and the stimuli that displaced them. When we compared the reinforcer potency of displaced stimuli and the stimuli that displaced them, we found two noteworthy findings. First, we found that the top-ranked stimulus (i.e., the stimulus that displaced the other stimulus) identified in the combined-class MSWO assessment functioned as the most potent reinforcer for four of seven participants. For the other three participants, both stimuli functioned as equally potent reinforcers. Therefore, for all seven participants, we found that the top-ranked stimulus was either the most potent reinforcer (for four of seven participants) or was an equally potent reinforcer (for three of seven participants) relative to the top-ranked-displaced stimulus. Given that the top-ranked stimulus never functioned as the less potent reinforcer relative to the top-ranked-displaced stimulus, it seems reasonable to conclude that conducting combined-class

MSWO assessments with typically developing children to predict the reinforcing efficacy of stimuli is a viable option.

Second, for the three participants who showed a preference for leisure over edible stimuli in Study 1, we found that the edible stimulus functioned as an equally potent reinforcer as the leisure stimuli for the entire assessment (one [Cristobal] of three participants) or for a majority of the assessment (two [Eric and Kyle] of three participants). This finding is interesting because we did not observe this same pattern for the two of four participants who showed a preference of edible stimuli over leisure stimuli. It is possible that edible stimuli functioned as equally potent reinforcers as leisure stimuli for these participants because edible stimuli are unconditioned reinforcers. Therefore, despite leisure stimuli displacing edible stimuli for these participants, the value of the unconditioned reinforcers was sufficiently high to match that of the leisure stimuli that displaced them in the combined-class MSWO assessment. That said, leisure stimuli displaced edible stimuli for only three participants; therefore, researchers may consider comparing the reinforcing potency of edible and leisure stimuli for a greater number of participants who show a general preference for leisure stimuli over edible stimuli.

There are three potential noteworthy limitations of our study. First, our preference assessment procedures may not have accurately captured participants' preference for leisure stimuli. Specifically, we provided participants with 30 s access to the selected leisure stimulus. It could be the case that certain leisure stimuli are not valuable for short (e.g., 30 s) durations but are valuable at longer durations (e.g., Kodak et al., 2009; Steinhilber & Johnson, 2007). For example, Steinhilber and Johnson (2007) found different preference hierarchies for both participants when researchers manipulated duration of access to these stimuli in an MSWO assessment; for both participants, some items were more preferred at shorter (15 s) durations and some were more preferred at longer (15 min) durations. Conversely, Jones, Dozier, and Neidert (2014) found that eight of 11 participants showed no difference in their top-ranked stimulus when they had access to the stimuli for shorter (30 s) or longer (5 min) durations in an MSWO assessment. It is possible that the longer duration (5 min) in the Jones et al. study was not a large enough difference from the small duration (30 s) to produce a change in preference. It is also possible that varying the duration of access for stimuli in an MSWO assessment may only shift participants' preference towards *certain* stimuli. Thus, it may be fruitful for future researchers to identify characteristics of stimuli that influence preference for shorter or longer duration of access.

Second, we conducted our study with a relatively small number of participants (N = 15) within a small age range (M = 7; range 5 to 9). Given that we only assessed the displacement and reinforcer potency of edible and leisure stimuli with 15 typically developing children aged 5 to 9 years, we cannot definitively conclude that typically developing individuals outside of this age range would show the same pattern of responding we observed. Therefore, future researchers should investigate the displacement and relative reinforcer potency of edible and leisure stimuli with: (a) a larger number of participants and (b) participants of a wide range of ages.

Third, we did not directly compare the preference and reinforcer potency of edible and leisure stimuli for typically developing individuals and individuals with an intellectual or developmental disability. Comparing the preference and reinforcer potency of edible and leisure stimuli for these two populations within one study may increase the confidence with which one can report any observed differences between these two populations. It is possible that methodological differences across studies (e.g., use of a caregiver-informed survey, schedule of reinforcement during a reinforcer assessment), rather than participant characteristics (i.e., participant diagnoses), could account for observed differences between the results of our study and past studies. Therefore, future researchers should consider systematically replicating this study with typically developing individuals and individuals with an intellectual or developmental disability to explicitly compare preference profiles and reinforcer potency of edible and leisure stimuli for these two populations.

Our findings indicate that the combined-class MSWO assessment may have some utility with typically developing children. We reported congruent results between the combined-class MSWO assessment and PR reinforcer assessment for a majority (four of seven) participants included in Study 2. Further, our finding that the majority of participants' preferences shifted when we combined stimulus classes in the combined-class MSWO assessments suggest that including highly preferred edible and leisure stimuli in an array may more accurately identify the relative preference of these stimuli relative to including only stimuli from one stimulus class. This is particularly useful given that combined-class MSWO assessments may reduce the amount of time researchers and practitioners need to devote to assessing a participant's preference for edible and leisure stimuli, which may subsequently increase the amount of time they can devote to other activities (e.g., teaching social skills). The reduced time devoted to conducting a combined-class MSWO assessment relative to single-class MSWO assessments is particularly useful given that Moore (2015) found that typically developing children may show unstable preferences when conducting an MSWO assessment once per week. Thus, it may be useful for researchers and practitioners to conduct several iterations of an MSWO assessment, highlighting the utility of an efficient, accurate MSWO assessment arrangement.

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Table 1

Stimuli Included in the Single-Class MSWO Assessments

Subject	Edible Stimuli	Leisure Stimuli
Auston	Raspberries, chocolate ice cream, vanilla ice cream, cheese pizza, pepperoni pizza, strawberry ice cream, Kit-Kat, lettuce	Basketball, Minecraft game, fidget spinner, blue car, black car, tan car, helicopter, football
Brittany	Cheddar popcorn, white cheese, red apples, cheddar cheese, caramel popcorn, plain popcorn, Smarties, marble cheese	Minecraft video, doctor Barbie, crayons, Shopkins, Littlest Pet Shop video, blue Play-Doh, painting, pink Play-Doh
Cristobal	White cheese, all-dressed chips, cheddar cheese, Kit-Kat, ketchup chips, plain chips, Smarties, marble cheese	Stranger Things video, WWE figure, Star Wars figure, Spiderman figure, Ninja Turtle figure, soccer ball, hockey stick and puck, football
Katrina	Salt and vinegar chips, Kit-Kat, Smarties, red peppers, cucumbers, oranges, waffles, chocolate chip cookies	Doctor Barbie, airplane Barbie, tennis Barbie, skating Barbie, chef Barbie, crayons, Smelly Bellyons video, Craft for Kids video
Marcus	Oreos, Goldfish, plain chips, plain popcorn, all-dressed chips, caramel popcorn, cheddar popcorn, ketchup chips	Pokemon book, Pokemon video, blocks, Lego, Yu-Gi-Oh video, stuffed toy, blue car, black car
Morgan	Oreos, Goldfish, plain chips, plain popcorn, all-dressed chips, ketchup chips, cheddar popcorn, caramel popcorn	Pokemon book, Pokemon video, blue car, tan car, stuffed toy, fidget spinner, Yu-Gi-Oh video, Lego
Sammy	Cheerios, grapes, Kit-Kat, Oreo, plain chips, strawberries, ketchup chips, all-dressed chips	Minecraft game, Connect 4, fidget spinner, purple Hatchimal, red Hatchimal, green Hatchimal, playing cards, Minecraft video
Tanya	Cheese pizza, pepperoni pizza, red apples, granola bar, Kit-Kat, plain chips, Nibs, plain popcorn	Crayons, chef Barbie, pink Play-Doh, blue Play-Doh, Cookie Swirl video, Littlest Pet Shop video, painting, doctor Barbie
Eric	Green sucker, orange sucker, yellow sucker, red apples, green apples, grapes, white cheese, cheddar cheese	Blue car, Lego, tennis ball, Spiderman figure, blue Play-Doh, pink Play-Doh, Mario video, Kizi video
Elliott	Cheese pizza, french fries, strawberries, blueberries, peppeorni pizza, pears, Cheerios, Smarties	Soccer video, Nerf gun, painting, crayons, Lego, soccer ball, blue car, tan car
Kyle	Pepperoni pizza, cheese pizza, strawberries, oranges, Cheerios, Fruit Loops, french fries, Smarties	Lego, Beyblades, blue car, tan car, soccer ball, stuffed animal, Stixbot, Star Wars video
Richard	Pineapples, Cheerios, red apples, corn, broccoli, carrots, green apples, blueberries	Minecraft book, Lucky Blocks video, Minecraft video, football, hockey stick and puck, basketball, painting, crayons
Levi	Aero, Kit-Kat, Smarties, plain chips, barbecue chips, broccoli, corn, ketchup chips	Roblox video, Teen Titans video, Pokemon book, Lego, playing cards, blue car, blocks, stuffed animal
Curtis	Aero, rice, oranges, Fruit Loops, plain chips, Nibs, Cheerios, gum	Dude Perfect video, hockey stick and puck, basketball, hockey cards, blue car, WWE figure, football, soccer ball
Stewart	Gum, Rockets, Fruit Roll-up, Nerds, chocolate chip cookies, lady fingers, french fries, Tostitos	Minecraft book, Teen Titans video, Stampy video, Star Wars figure, Lego, crayons, painting, blocks

Table 2

Percentage of Trials With Consumption During the Single-Class MSWO Assessments

Subject	Edible Stimuli	Percentage of Trials With Consumption	Ranking	Leisure Stimuli	Percentage of Trials With Consumption	Ranking
Auston	Raspberries	100%	1	Minecraft Game	100%	1
	Lettuce	38.5%	2	Fidget Spinner	50.0%	2
	Cheese Pizza	29.4%	3	Helicopter	29.4%	3
	Kit-Kat	21.7%	4	Football	23.8%	4
	Meat Pizza	21.7%	5	Basketball	20.8%	5
	Pink Ice Cream	15.2%	6	Blue Car	16.7%	6
	Chocolate Ice Cream	14.7%	7	Tan Car	13.9%	7
	Vanilla Ice Cream	14.7%	8	Black Car	13.0%	8
Brittany	White Cheese	41.7%	1	Blue Play-Doh	41.7%	1
	Apples	26.3%	2	Painting	31.3%	2
	Cheddar Popcorn	23.8%	3	Doctor Barbie	27.8%	3
	Caramel Popcorn	21.7%	4	Crayons	21.7%	4
	Smarties	20.8%	5	Shopkins	17.2%	5
	Plain Popcorn	19.2%	6	Littlest Pet Shop Video	16.7%	6
	Cheddar Cheese	17.9%	7	Minecraft Video	16.7%	7
	Marble Cheese	16.1%	8	Pink Play-Doh	15.2%	8
Cristobal	Kit-Kat	100%	1	Stranger Things	100%	1
	Smarties	50.0%	2	Hockey Stick + Puck	50.0%	2
	Cheddar Cheese	31.3%	3	WWE Figure	33.3%	3
	Plain Chips	23.8%	4	Football	23.8%	4
	Marble Cheese	20.8%	5	Star Wars Figure	18.5%	5
	White Cheese	16.1%	6	Soccer Ball	18.5%	6
	Ketchup Chips	13.9%	7	Spiderman Figure	14.2%	7
	All-dressed Chips	13.5%	8	Ninja Turtle Figure	12.5%	8
Curtis	Gum	100%	1	Hockey Stick + Puck	100%	1
	Oreo	29.4%	2	Dude Perfect Video	41.7%	2
	Aero	29.4%	3	Basketball	20.8%	3
	Rice	27.8%	4	Football	20.8%	4
	Nibs	19.2%	5	Soccer Ball	19.2%	5
	Plain Chips	17.9%	6	WWE Figure	18.5%	6
	Fruit Loops	16.7%	7	Blue Car	17.9%	7
	Cheerios	13.2%	8	Hockey Cards	14.7%	8
Elliott	Pears	71.4%	1	Nerf Gun	83.3%	1
	Strawberries	45.5%	2	Crayons	45.5%	2
	Blueberries	41.7%	3	Painting	27.8%	3
	Kit-Kat	23.8%	4	Soccer Ball	25.0%	4
	Smarties	20.8%	5	Lego	20.0%	5
	Aero	16.7%	6	Soccer Video	18.5%	6
	Cheese Pizza	14.2%	7	Blue Car	14.2%	7
	Pepperoni Pizza	12.5%	8	Tan Car	13.1%	8
Eric	Green Sucker	50.0%	1	Mario Video	71.4%	1
	Red Sucker	45.5%	2	Kizi Video	41.7%	2
	Yellow Sucker	38.5%	3	Blue Play-Doh	31.3%	3
	Green Apple	25.0%	4	Spiderman Figure	20.8%	4
	Red Apple	20.0%	5	Pink Play-Doh	17.9%	5
	Grapes	17.2%	6	Lego	17.2%	6
	Cheddar Cheese	9.4%	7	Blue Car	15.6%	7
	White Cheese	5.6%	8	Tennis Ball	15.6%	8

Subject	Edible Stimuli	Percentage of Trials With Consumption	Ranking	Leisure Stimuli	Percentage of Trials With Consumption	Ranking
Katrina	Chocolate Chip Cookies	33.3%	1	Skating Barbie	100%	1
	Kit-Kat	31.3%	2	Doctor Barbie	33.3%	2
	Smarties	29.4%	3	Airplane Barbie	33.3%	3
	Waffles	23.8%	4	Chef Barbie	26.3%	4
	Salt & Vinegar Chips	22.7%	5	Crayons	19.2%	5
	Red Peppers	19.0%	6	Craft for Kids Video	15.6%	6
	Cucumbers	14.8%	7	Smelly Bellyons	13.2%	7
	Oranges	8.3%	8	Tennis Barbie	13.2%	8
Kyle	Cheese Pizza	50.0%	1	Lego	100%	1
	Pepperoni Pizza	35.7%	2	Beyblade	38.5%	2
	Fruit Loops	21.7%	3	Stixbot	38.5%	3
	French Fries	20.0%	4	Soccer Ball	21.7%	4
	Oranges	19.2%	5	Star Wars Video	20.8%	5
	Strawberries	18.5%	6	Stuffed Animal	16.1%	6
	Cheerios	17.2%	7	Tan Car	14.7%	7
	Smarties	15.6%	8	Blue Car	12.5%	8
Levi	Corn	71.4%	1	Roblox Video	83.3%	1
	Broccoli	38.5%	2	Pokemon Handbook	55.6%	2
	Aero	31.3%	3	Teen Titans Video	27.8%	3
	Kit-Kat	25.0%	4	Blocks	20.0%	4
	Ketchup Chips	22.7%	5	Playing Cards	19.2%	5
	Plain Chips	17.2%	6	Lego	18.5%	6
	BBQ Chips	14.7%	7	Stuffed Animal	17.2%	7
	Smarties	12.8%	8	Blue Car	12.5%	8
Marcus	Oreo	50.0%	1	Blocks	62.5%	1
	Plain Chips	31.3%	2	Pokemon Video	45.5%	2
	Goldfish	29.4%	3	Pokemon Book	29.4%	3
	Plain Popcorn	22.2%	4	Lego	19.0%	4
	Cheddar Popcorn	7.1%	5	Yu-Gi-Oh Video	18.1%	5
	All-dressed Chips	3.4%	6	Stuffed Toy	6.9%	6
	Ketchup Chips	3.3%	7	Black Car	3.4%	7
	Caramel Popcorn	0.0%	8	Blue Car	3.2%	8
Morgan	Caramel Popcorn	100%	1	Pokemon Video	71.4%	1
	Oreo	41.7%	2	Pokemon Book	31.3%	2
	Plain Popcorn	31.3%	3	Yu-Gi-Oh Video	26.3%	3
	Cheddar Popcorn	21.7%	4	Lego	25.0%	4
	Goldfish	18.5%	5	Fidget Spinner	25.0%	5
	All-dressed Chips	16.1%	6	Blue Car	14.8%	6
	Plain Chips	15.1%	7	Stuffed Toy	13.5%	7
	Ketchup Chips	15.1%	8	Tan Car	11.8%	8
Richard	Green Apple	71.4%	1	Crayons	45.5%	1
	Pineapples	31.3%	2	Painting	41.7%	2
	Broccoli	27.8%	3	Lucky Blocks Video	31.3%	3
	Blueberries	27.8%	4	Basketball	31.3%	4
	Red Apple	20.8%	5	Hockey Stick + Puck	23.8%	5
	Corn	18.5%	6	Minecraft Video	16.1%	6
	Carrots	16.1%	7	Minecraft Book	15.2%	7
	Cheerios	5.0%	8	Football	12.5%	8
Sammy	Kit-Kat	45.5%	1	Minecraft Game	50.0%	1
	Cheerios	29.4%	2	Connect 4	45.5%	2
	Plain Chips	27.8%	3	Fidget Spinner	29.4%	3
	Strawberries	27.8%	4	Playing Cards	29.4%	4
	Ketchup Chips	19.2%	5	Minecraft Video	25.0%	5
	Grapes	19.2%	6	Purple Hatchimal	15.2%	6
	All-dressed Chips	18.5%	7	Green Hatchimal	14.2%	7
	Oreo	13.5%	8	Red Hatchimal	13.5%	8

Subject	Edible Stimuli	Percentage of Trials With Consumption	Ranking	Leisure Stimuli	Percentage of Trials With Consumption	Ranking
Stewart	Chocolate Chip Cookies	100%	1	Stampy Video	83.3%	1
	Lady Finger Cookies	45.5%	2	Teen Titans Video	35.7%	2
	Tostitos	29.4%	3	Lego	33.3%	3
	French Fries	26.3%	4	Blocks	27.8%	4
	Fruit Roll-up	16.7%	5	Star Wars Figure	22.7%	5
	Nerds	14.3%	6	Crayons	15.6%	6
	Rockets	8.1%	7	Painting	14.2%	7
	Gum	0.0%	8	Minecraft Book	13.2%	8
Tanya	Nibs	26.3%	1	Painting	55.6%	1
	Cheese Pizza	23.5%	2	Pink Play-Doh	35.7%	2
	Granola Bar	23.5%	3	Blue Play-Doh	31.3%	3
	Apples	20.0%	4	Crayons	25.0%	4
	Plain Chips	20.0%	5	Littlest Pet Shop Video	18.5%	5
	Plain Popcorn	20.0%	6	Cookie Swirl Video	16.1%	6
	Kit-Kat	19.2%	7	Chef Barbie	15.6%	7
	Pepperoni Pizza	17.4%	8	Doctor Barbie	15.2%	8

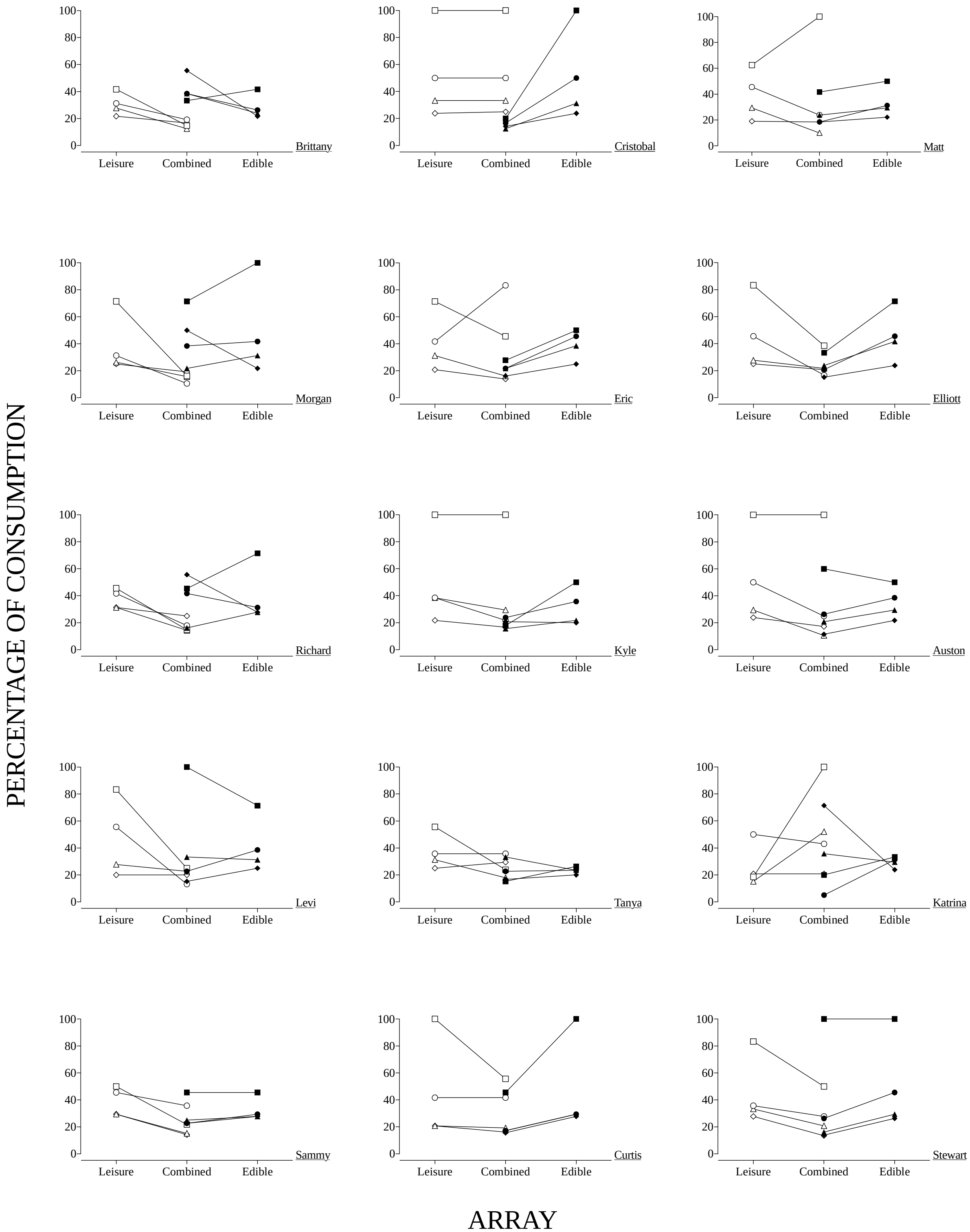


Figure 1. Percentage of consumption for each participant’s top-four-ranked-edible and top-four-ranked-leisure stimuli in the single-class and combined-class MSWO assessments.

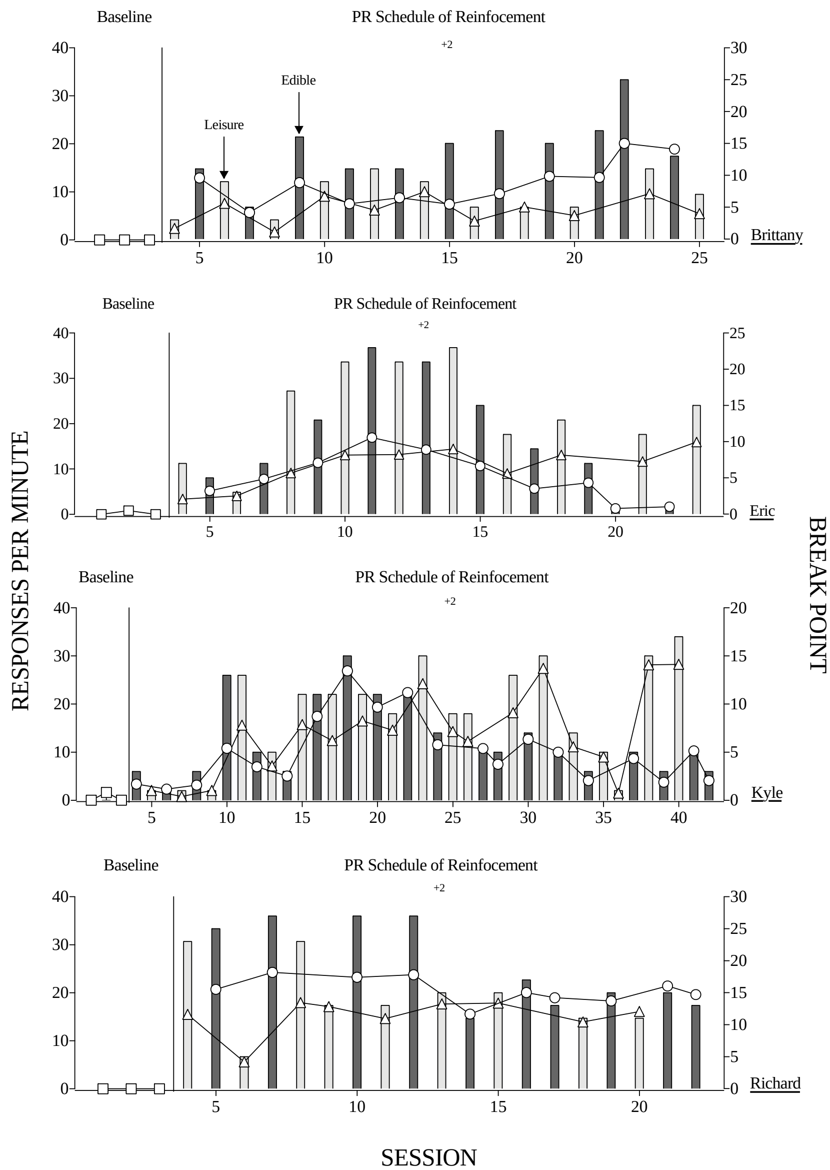


Figure 2. Responses per minute and last completed break points during the progressive-ratio reinforcer assessment for four participants whose top-ranked stimulus from the combined-class MSWO assessment functioned as the most potent reinforcer. Squares denote response rates during baseline. For the edible condition, circles denote response rates and dark grey bars denote break points. For the leisure condition, triangles denote response rates and light grey bars denote break points. Mathematical symbols and values (e.g., +2) indicate the manner in which the PR schedule increased.

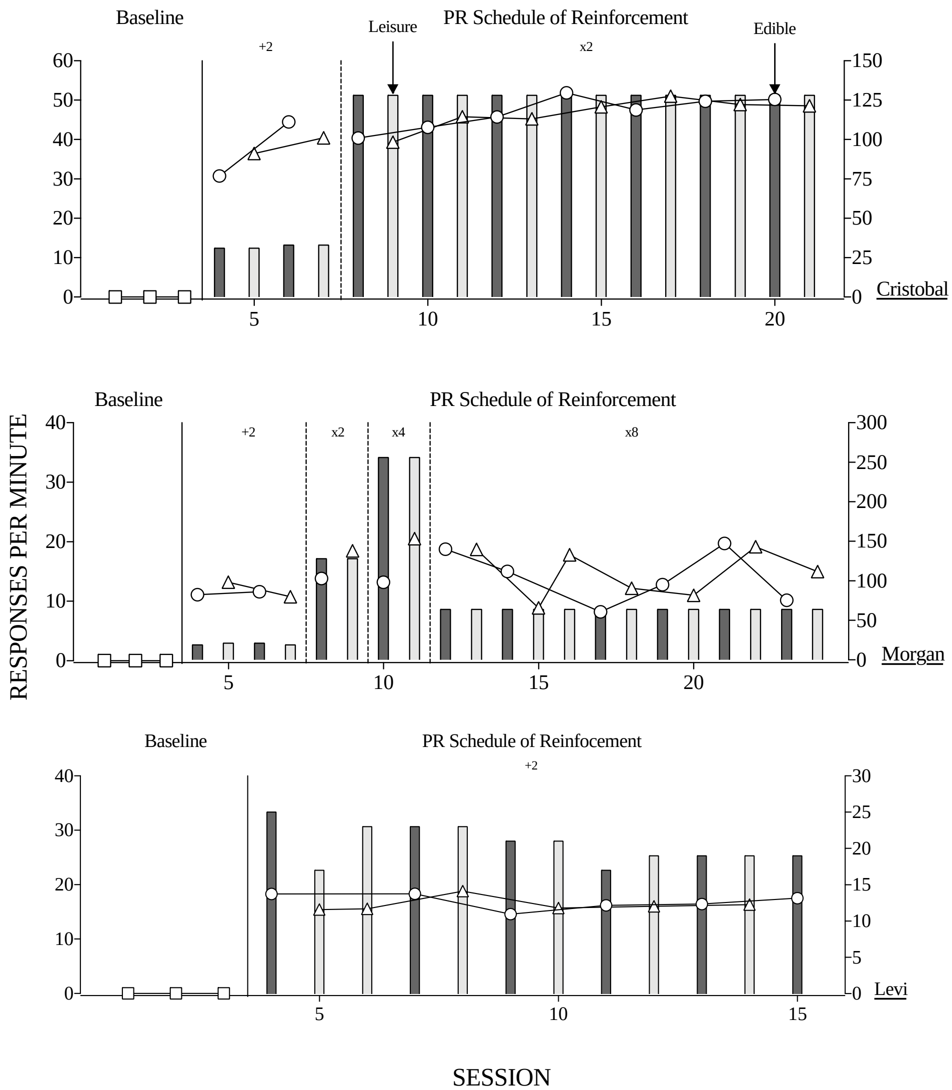


Figure 3. Responses per minute and last completed break points during the progressive-ratio reinforcer assessment for three participants whose top-ranked stimulus from the combined-class MSWO assessment functioned as an equally potent reinforcer as the top-ranked-displaced stimulus from the combined-class MSWO assessment. Squares denote response rates during baseline. For the edible condition, circles denote response rates and dark grey bars denote break points. For the leisure condition, triangles denote response rates and light grey bars denote break points. Mathematical symbols and values (e.g., +2) indicate the manner in which the PR schedule increased.

Appendix A

Brock University
Research Ethics Office
Tel: 905-688-5550 ext. 3035
Email: reb@brocku.ca

Social Science Research Ethics Board

Certificate of Ethics Clearance for Human Participant Research

DATE:	6/26/2017		
PRINCIPAL INVESTIGATOR:	ZONNEVELD, Kimberley - Centre for Applied Disability Studies		
FILE:	16-316 - ZONNEVELD		
TYPE:	Masters Thesis/Project	STUDENT: SUPERVISOR:	Adam Carter Kimberley Zonneveld

TITLE: Displacement of Leisure Items by Edible Items: A Systematic Replication

ETHICS CLEARANCE GRANTED

Type of Clearance: NEW Expiry Date: 6/1/2018

The Brock University Social Science Research Ethics Board has reviewed the above named research proposal and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement. Clearance granted from 6/26/2017 to 6/1/2018.

The Tri-Council Policy Statement requires that ongoing research be monitored by, at a minimum, an annual report. Should your project extend beyond the expiry date, you are required to submit a Renewal form before 6/1/2018. Continued clearance is contingent on timely submission of reports.

To comply with the Tri-Council Policy Statement, you must also submit a final report upon completion of your project. All report forms can be found on the Research Ethics web page at http://www.brocku.ca/research/policies-and-forms/research-forms

In addition, throughout your research, you must report promptly to the REB:

a) Changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) All adverse and/or unanticipated experiences or events that may have real or potential unfavourable implications for participants;
c) New information that may adversely affect the safety of the participants or the conduct of the study;
d) Any changes in your source of funding or new funding to a previously unfunded project.

We wish you success with your research.

Approved: ____________________________

Ann-Marie DiBiase, Chair
Social Science Research Ethics Board

Note: Brock University is accountable for the research carried out in its own jurisdiction or under its auspices and may refuse certain research even though the REB has found it ethically acceptable.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of research at that site.

Appendix B

Research Consent for Participants

Project Title: Displacement of Leisure Items by Edible Items: A Systematic Replication

Principal Investigators (PI):
Dr. Kimberley Zonneveld, BCBA-D, Assistant Professor, Centre for Applied Disability Studies; Ph: (905) 688-5550 x6708; Email: kzonneveld@brocku.ca

Principal Student Investigators:
Adam Carter, M.A. Student, Centre for Applied Disability Studies; Ph: (905) 688-5550 x3218; Email: ac15ly@brocku.ca

INVITATION

Your child is invited to participate in a research project to help us determine if the way we present food and toys to your child changes how much your child likes them. We also want to know if, and how, these items will affect your child's motivation to complete a simple task (e.g., cleaning up toys, stringing beads).

We will begin by asking you to complete a survey to help identify items that your child prefers. We will also ask for a list of any food allergies your child has, and any food or toy items you do not want your child to have during this study. After consulting the list, we will come up with a final list of 16 items to be included in this study – eight food items and eight toys, subject to your approval. To the best of our ability, we will use the top 8 food and toys, but there may be some instances where we cannot find the specific food or toy that your child likes.

To see what your child likes the most, we will conduct two assessments per day, for five days. Each assessment will take between 5 to 10 minutes to complete. One assessment will include the eight food items, and the other assessment will include the eight toys from your initial list. First, we will ask your child to try each item before each assessment begins. Once, the assessment begins, all eight items will be placed in front of your child and he/she will be asked to choose "his/her favourite." After your child eats or plays with the item chosen for about 30 seconds, we will present the remaining items, and repeat the above process until all items have been selected, or until your child does not make a choice or indicates that he/she doesn't want any of the items. This process allows us to identify high-preferred items (the first ones chosen) and low-preferred items (the last ones chosen). We want to conduct one of each assessment for five days because your child's preference may change over the course of a week and conducting these assessments over the course of a week will give us a clear picture of your child's preferences for food and toys.

Next, we will conduct five more assessments by conducting one assessment per day for five days. These assessments will be identical to the others described above, but this time we will combine food and toys into one assessment. That is, we will include the top four *food* items and top four *toys*, based on the results of the previous 10 assessments. These assessments will tell us what your child likes most when both food and toys are offered at the same time. Finally, we will use the top-ranked food item and the top-ranked toy from these last five assessments and see which one motivates your child the most to complete a task (e.g., cleaning up toys, stringing beads) more. Not all children will be included in this last phase. Only those that showed a clear preference for food or toy items will be considered. The names of all children that are eligible to participate in this last phase will be put into a hat and names will be drawn. Even if your child is picked, he/she may not be eligible, because we need to balance the number of males and females included.

First, we just want to see if your child can do the task (e.g., cleaning up task, putting blocks in a bucket, stringing beads), so we will not be giving your child his/her preferred food or toy for doing the task. Next, to help us figure out which item motivates your child more (food or toy), we will gradually ask your him/her to perform more of the task. If your child performs the task more when he/she gets one of the items, that item is said to be the best motivator for your child. For example, if your child strings more beads when he/she gets a toy than when she gets food for doing so, then that toy is said to be a better motivator for your child than food. These sessions will take a maximum of 30 minutes to complete, but if your child stops completing the task for one consecutive minute, we will stop the session. We will have a better understanding of how long this phase should take once we run the first few sessions with your child. However, the assessment phase should not exceed two to four weeks, depending on your child's availability. The total duration of the study is three to six weeks.

POTENTIAL BENEFITS AND RISKS

Your child may face potential psychological risks during this study, for two reasons. When we assess your child's preference for toy items, access to these toys is limited to 30 seconds. Afterwards, the child must give the item back, which can be upsetting if he/she does not want to. When we assess your child's performance on a task based on the presentation of their favourite food item or toy, her/she may feel frustrated or upset when we increase the number of responses required for your child to be given the item.

To mitigate the risks of this experiment, a positive environment will be maintained for the entirety of the experiment. Although your child may find the removal of a preferred item aversive, maintaining a positive mood and positive social interaction with your child will be done to mitigate the occurrence of problem behaviour. If we do observe problem behavior, we will terminate the session after the first instance of problem behaviour and ask you to join us in the session room to help calm/soothe your child. It should also be noted that the session will also be terminated if your child cries for 20 consecutive seconds.

Determining how a child's preference for items changes based on other available choices will have large effects on how caregivers and practitioners assesses preference for food items and toys. If the item found to be the most preferred (when both types of items are presented) motivates a child the most to complete a task, then practitioners and caregivers can continue to conduct assessments this way. Combining two types of items in one assessment, instead of conducting separate assessments for each type, can save precious teaching time that can be used to teach academic and social skills to a child. However, if the combined assessment is not a good predictor of the most motivating items for children, practitioners and caregivers would then need to conduct separate assessments (one with toys and one with food). Although this would take more time than one combined assessment, practitioners and caregivers would be confident that the results of the assessment accurately identify the most motivating items for a child that can be used to teach important skills.

CONFIDENTIALITY

Your child's data, video recordings of your child, and any information you provide us is considered confidential. Only members of the research team will have access to your child's data. We will refrain from using identifying information in e-mail correspondence, during presentations, or in publication of these results. Once your child's data is fully collected, his or her name will be changed into a pseudonym. A master list that links pseudonyms to real names will be stored on a network secured through Brock University's Information Technology Services. These pseudonyms will be the names that appear on any representation of your child's data.

Paper data collected during this study will be stored in a locked cabinet behind a locked door. Electronic data, including video recordings will be kept on a network secured through Brock University's Information Technology Services. All data will be kept for 10 years, after which time paper data will be securely shredded, and all electronic data (excluding video recordings) will be securely deleted from the secure network. If you provide consent for video recordings, all video recordings will be stripped of all personal identifiers and will be kept indefinitely for the purpose of teaching and/or dissemination at conferences.

Only the principal investigator and the students under her supervision will have access to the data.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. You may decline to answer any questions or have your child participate in any component of the study. Further, you may decide to withdraw from this study at any time up to and including the last study session and may do so without any reprisal from Brock University. If you choose to withdraw from the study, you will have the opportunity to decide what happens to your child's data. You may ask for it to be securely destroyed, for it to be used in the study, or for it to be returned to you. If you choose to have the data returned to you, Adam Carter will be available to meet with you should you have any questions.

We will also obtain verbal assent from your child to participate in this study. For children with limited communication abilities, we will ask for a list of ways they show that they do not want to do something. If a child revokes assent on three consecutive sessions, we will schedule a meeting with you (either via phone or in person) and indicate that she/he has indicated that she/he does not want to participate. We will then ask if you would like us to offer your child another opportunity to attend our research or if you would like to withdraw your child. If your child revokes assent on our next attempt, we will excuse her/him from the study.

PUBLICATION OF RESULTS

Your child's individual results may be published in professional journals and may be presented at conferences or workshops. Please note that only pseudonyms will appear on any representation of your child's data. Only the province, age, sex, and diagnosis (or lack thereof) of your child will be made available. The name, pseudonym, or specific location of residence of your child will not be made available in any published reports.

If you provide consent for video recordings, all names will be deleted from the video before the video is shown to anyone outside of our research team. Feedback about your child's results will be made available to you throughout the study. You can receive a graph of your child's results during the study. Further, you will be able to sit in on any (or all) sessions to observe your child while he or she participates in the study. Feedback regarding the final results of the study will either be mailed or emailed to you (depending on your preference). This feedback will be sent to you one month after the study ends. Throughout the study, you may contact Adam Carter, M.A. Student at 905-688-5550 ext. 3218, ac15ly@brocku.ca, or Dr. Kimberley Zonneveld, BCBA-D at 905-688-5550 ext. 6708, or through email at kzonneveld@brocku.ca.

*Please note that none of the members of this research team are psychologists and, as such, are not in a position to provide a clinical assessment of your child.

CONTACT INFORMATION AND ETHICS CLEARANCE

If you have any questions about this study or require further information, please contact Dr. Kimberley Zonneveld or Adam Carter using the contact information provided above. This study has been reviewed and received ethics clearance through the Research Ethics Board at Brock University #16-316. If you have any comments or concerns about your child's rights as a research participant, please contact the Research Ethics Office at (905) 688-5550 Ext. 3035, reb@brocku.ca.

PARTICIPANT CONSENT

I , ________________________________, agree to allow my child to participate in the study described above. I have made this decision based on the information I have read in this form. I have had the opportunity to receive any additional details I wanted about the study and understand that I may ask questions in the future. I understand that I may withdraw this consent at any time.

If necessary, I consent to my child participating in Study 2 (the reinforcer assessment):

☐ Yes

☐ No

Please note that members of the research team are under obligation to follow mandatory reporting laws. That is, if any instance of child abuse is disclosed to or observed by a member of the research team, that member is required to report it to child protective services.

Video Consent:

Please note that video consent is not required for your child to participate in this study.

If you provide any video consent, the name, pseudonym, or specific location of residence of your child will not be made available in the video. You will have the option to have your child's face to be blurred and your child's voice to be stripped from the video.

I agree for video recordings of my child to be used for data-collection purposes. I am aware that these videos will only be viewed by members of the research team.

☐ Yes

☐ No

I agree for video recordings of my child to be used for educational purposes in (please select all that apply):
☐ Classes
☐ Workshops
☐ Conferences

I would like my child's face to be blurred out in any video used for education purposes to protect the identity of my child:
☐ Yes
☐ No

I would like all audio removed in any video used for education purposes to protect the identity of my child:
☐ Yes
☐ No

Notification of Results
I would like to be notified of the final results of the study:
☐ Yes ☐ No
I would like to receive a graph of my child's progress in the study:
☐ Yes ☐ No

Child's Name: ___________________________________

Caregiver's Name: _____________________________ Ph./Email: _______________

Signature : _______________________________________ Date: __________________
(dd/mm/yy)

Appendix C

Multiple-Stimulus Without Replacement Preference Assessment Data Sheet

Type: Edible / Leisure / Combined

Participant Name ____

Codes: S = Selection SC = Selection and Consumption NS = No Selection E = Expulsion

Stimuli:

1.	2.	3.	4.	5.
6.	7.	8.		

Session 1	Date / Therapist/Reli:
Circle item position	**Item # Selected / Code**
Trial 1: A B C D E F G H	
Trial 2: A B C D E F G	
Trial 3: A B C D E F	
Trial 4: A B C D E	
Trial 5: A B C D	
Trial 6: A B C	
Trial 7: A B	
Trial 8: A	

Session 4	Date / Therapist/Reli:
Circle item position	**Item # Selected / Code**
Trial 1: A B C D E F G H	
Trial 2: A B C D E F G	
Trial 3: A B C D E F	
Trial 4: A B C D E	
Trial 5: A B C D	
Trial 6: A B C	
Trial 7: A B	
Trial 8: A	

Session 2	Date / Therapist/Reli:
Circle item position	**Item # Selected / Code**
Trial 1: A B C D E F G H	
Trial 2: A B C D E F G	
Trial 3: A B C D E F	
Trial 4: A B C D E	
Trial 5: A B C D	
Trial 6: A B C	
Trial 7: A B	
Trial 8: A	

Session 5	Date / Therapist/Reli:
Circle item position	**Item # Selected / Code**
Trial 1: A B C D E F G H	
Trial 2: A B C D E F G	
Trial 3: A B C D E F	
Trial 4: A B C D E	
Trial 5: A B C D	
Trial 6: A B C	
Trial 7: A B	
Trial 8: A	

Session 3	Date / Therapist/Reli:
Circle item position	**Item # Selected / Code**
Trial 1: A B C D E F G H	
Trial 2: A B C D E F G	
Trial 3: A B C D E F	
Trial 4: A B C D E	
Trial 5: A B C D	
Trial 6: A B C	
Trial 7: A B	
Trial 8: A	

Appendix D

Name: ___________________________ Date: ___________________________

Please rank 10 food items that your child enjoys eating, smelling, or playing with the most (in order of his or her preference):

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________
5. ____________________________
6. ____________________________
7. ____________________________
8. ____________________________
9. ____________________________
10. ____________________________

Please rank 10 leisure items (toys, videos) that your child enjoys playing with or looking at the most (in order of his or her preference):

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________
5. ____________________________
6. ____________________________
7. ____________________________
8. ____________________________
9. ____________________________
10. ____________________________

Please list your child's food allergies:

____

____

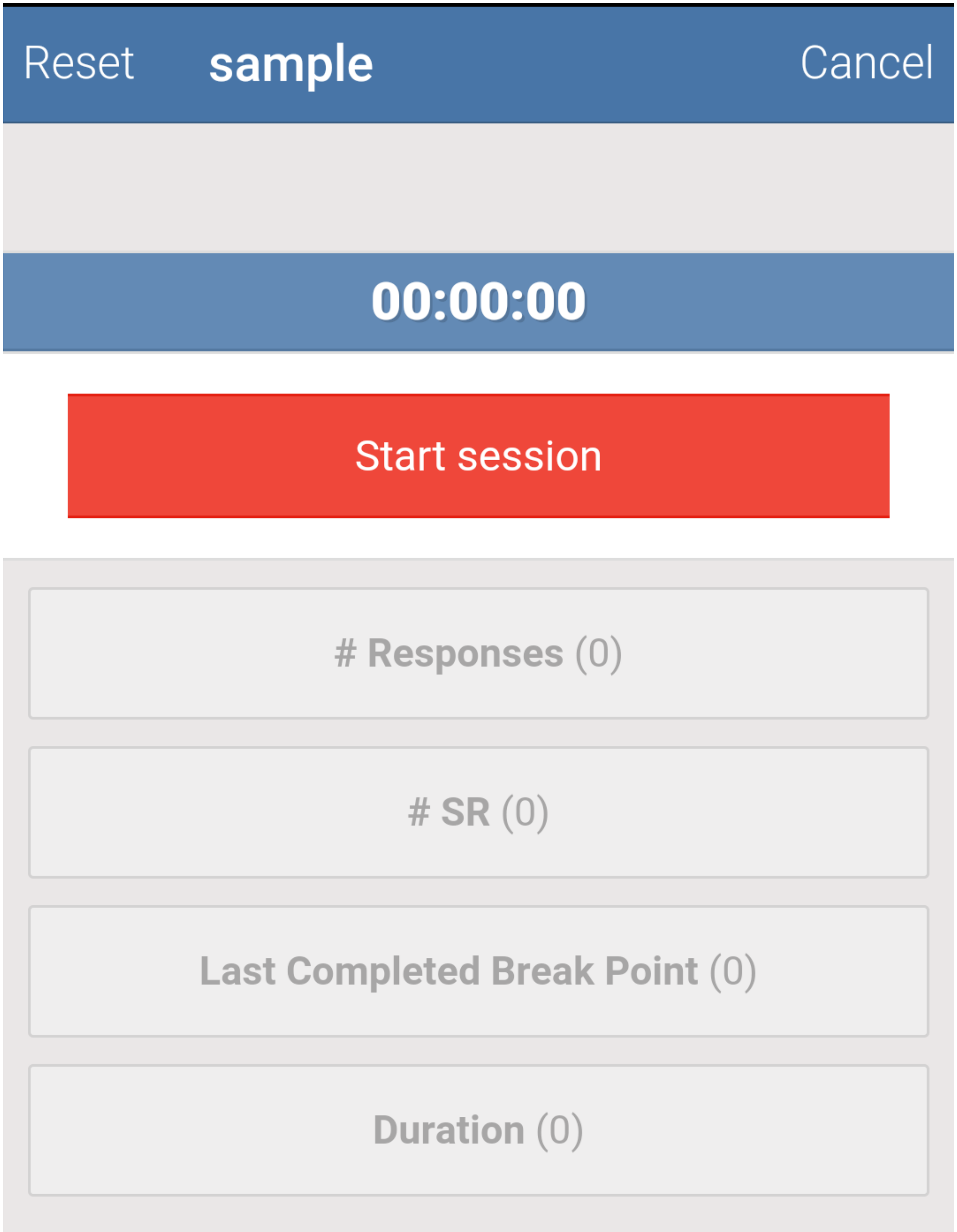
Additional comments (including food/toys you do not want your child to have during this study):

____

____

____

Appendix E


Reset
sample
Cancel
00:00:00
Start session
Responses (0)
SR (0)
Last Completed Break Point (0)
Duration (0)