Behavior Analysis in Practice (2021) 14:1144–1156
https://doi.org/10.1007/s40617-020-00539-3

DISCUSSION AND REVIEW PAPER

Stimulus Preference Assessment Decision-Making System (SPADS): A Decision-Making Model for Practitioners

Jordan D. Lill[1] · Mark D. Shriver[1] · Keith D. Allen[1]

Accepted: 9 December 2020 / Published online: 30 April 2021

Abstract
A stimulus preference assessment (SPA) is a fundamental tool used by practitioners to predict stimuli that function as reinforcers. The Behavior Analyst Certification Board (BACB) requires that all certified behavior analysts and behavioral technicians be trained in SPA methodology (BACB, 2017). SPA procedures are used by nearly 9 out of 10 behavior analysts in the field (Graff & Karsten, 2012). Over the last 4 decades, there has been a litany of research on SPA procedures. Despite the universality of training, application, and research, discussions on the selection of SPA procedures have been sparse. Two peer-reviewed articles have focused on clinical decision making in the selection of SPA procedures. Karsten et al. (2011) introduced an in situ decision-making model, whereas Virues-Ortega et al. (2014) developed an a priori algorithm based on client and stimuli characteristics. The SPADS addresses the limitations of prior models by considering the effects of stimuli dimensions, client characteristics, relative administration times, and the outcomes agreement between two potentially efficacious, context-specfic SPA procedures.

Keywords Preference assessment · Decision making · Clinical practice

A stimulus preference assessment (SPA) is a well-established practice in the field of applied behavior analysis. The purpose of an SPA is to identify stimuli that likely function as reinforcers. Stimuli identified as preferred by an SPA are good predictors of reinforcers (Cooper et al., 2007; Hagopian et al., 2001; Piazza et al., 1996). The use of preferred stimuli as contingent reinforcers increases the efficacy of the treatment of problematic behavior compared to the use of arbitrary stimuli (Hagopian et al., 2001; Ringdahl et al., 1997; Vollmer et al., 1994). Over 4 decades of SPA research has identified six distinct empirically derived methods to identify stimulus preference. Each method is markedly different but allows the practitioner to identify at least one preferred stimulus to leverage as a potential reinforcer.

The first SPA procedure published in the literature was the single-stimulus (SS) preference assessment. SS procedures involve the practitioner providing access to one stimulus at a time while observing whether the client engages with or consumes the stimulus (Pace et al., 1985). A paired-choice (PC) preference assessment involves providing the client with a choice between two stimuli, observing the client's choice making and engagement with the selected stimulus, and alternating choice options among paired stimuli (Fisher et al., 1992). A multiple-stimulus with-replacement (MS) preference assessment involves providing the client with an array of stimuli (typically more than three) and allowing access to the item following selection (postselection access). Following engagement with the selected stimulus, that stimulus is replaced among the unselected stimuli. A multiple-stimulus without-replacement (MSWO) preference assessment is very similar to the MS preference assessment, except that the selected stimulus is not returned to the array of unselected stimuli (DeLeon et al., 1999). A free-operant (FO) preference assessment involves procedures in which the client is provided access to all available stimuli and is allowed to freely engage with any stimuli presented. The practitioner then monitors and collects data on the duration of engagement or consumption

Author Note
This review was conducted by Jordan Lill in partial fulfillment of the requirements for a doctorate of philosophy in applied behavior analysis from the University of Nebraska-Medical Center's Munroe-Meyer Institute. We thank Joseph Evans, Brian Greer, and William Higgins for their valuable contributions to this article.

✉ Jordan D. Lill
jordan.lill@unmc.edu

[1] Department of Psychology, Munroe-Meyer Institute for Genetics and Rehabilitation, University of Nebraska Medical Center, Omaha, NE 68198-5450, USA

for a specified period of time (Ringdahl et al., 1997). Finally, response restriction (RR) includes free access to available stimuli and the removal of the most highly preferred stimuli following a predetermined period of time (i.e., 5 min) until all stimuli are subsequently removed (Hanley et al., 2003a, b).

SPA procedures are so ubiquitous and potentially effective that the Behavior Analyst Certification Board (BACB) requires training in SPA methodology for all Board Certified Behavior Analysts (BCBAs), Board Certified Assistant Behavior Analysts (BCaBAs), and Registered Behavior Technicians (BACB, 2017). Approximately 89% of BCBAs and BCaBAs report conducting empirically supported SPA procedures in their settings (Graff & Karsten, 2012). Despite the universality of SPA training and its application, the development of empirically supported decision-making models to aid practitioners in the selection of SPA procedures are sparse.

A review of the literature to find such decision-making models was completed by inputting a combination of words and terms—"stimulus preference assessment" and "clinical decision making"—into the search engines Google Scholar, ERIC, PsycInfo, and MEDLINE. Two peer-reviewed articles that discussed clinical decision making in the selection of SPA procedures were identified: Karsten et al. (2011) and Virues-Ortega et al. (2014). Both articles provide practitioners with empirically supported guidance based on considerations such as time constraints, the need for a preference hierarchy, and avoidance of problem behavior.

Karsten et al. (2011) described and evaluated an in situ decision-making model in which the practitioner first implements MSWO procedures with the client. The authors suggested starting with MSWO procedures because these procedures have demonstrated less positional biases in participants' selection compared to PC procedures. Additionally, MSWO procedures are time efficient and identify relative preference through a preference hierarchy (DeLeon & Iwata, 1996; Kang et al., 2013; Windsor et al., 1994). However, if outcomes are undifferentiated, or if positional bias is observed, the authors instructed clinicians to either modify the MSWO procedures, conduct a PC preference assessment, or implement FO procedures. For example, if a client consistently selects stimuli presented in the same position within the array (e.g., positional bias), then the practitioner should consider an unorganized arrangement. An additional suggestion is that if problematic behavior is observed during an MSWO preference assessment, the practitioner would then implement FO procedures.

Buchmeier et al. (2018) used this in situ model to determine procedural modifications following undifferentiated outcomes of older adults with developmental disabilities. The authors conducted an MSWO preference assessment with three stimuli to determine moderately preferred colors to inform reinforcer assessment procedures. Two participants were observed to have positional bias during the MSWO preference assessment. A PC preference assessment with a vertical arrangement rather than a horizontal arrangement was used to reduce the occurrence of positional bias for one participant. For the other participant, it was hypothesized that visual impairments may have occasioned positional bias. For this participant, the color cards were replaced as stimuli with shapes to aid in the discrimination of stimuli. The Karsten et al. (2011) decision-making model aided in identifying procedures and modifications that predicted reinforcers (Buchmeier et al., 2018).

The limitation to an in situ model is that it does not allow the practitioner to consider important characteristics of the client that may influence the selection of SPA procedures. For example, if the practitioners in the Buchmeier et al. (2018) study had considered the individual's visual impairments before the administration of MSWO preference assessment, the practitioner may have avoided additional and unnecessary SPA procedures. Instead, the practitioner may have chosen to select an SS procedure for a client with significant visual impairments (Cannella et al., 2005; Green & Reid, 1996; Logan & Gast, 2001). Additionally, the in situ model does not consider the function of problem behavior when selecting SPA procedures. For example, if a client engages in problem behavior maintained by access to preferred stimuli, the removal of selected stimuli during the MSWO preference assessment may evoke problem behavior (Kang et al., 2010, 2011).

In contrast to the in situ model, Virues-Ortega et al. (2014) introduced an a priori clinical decision-making algorithm for the selection of SPA procedures from among several empirically supported SPA procedures, not just the MSWO and FO preference assessments. The a priori algorithm allows the practitioner to make decisions prior to the implementation of SPA procedures, which may reduce error. The authors first provided a systematic review of SPA literature between 1985 and 2013, which was used to inform the algorithm. The goal of the algorithm was to aid the clinician in the selection of 1 of 12 possible SPA procedures or variations, including pictorial SPA procedures, reinforcer assessments, and "indirect/idiosyncratic response preference" (p. 165). The algorithm included 12 yes/no questions that guided the clinician to one final, empirically supported SPA method.

The questions are related to client characteristics (e.g., the function of problem behavior, prerequisite behavior/skills), time constraints within the practitioner's setting, the identification of long-duration preference stimuli, and the identification of a stimulus preference hierarchy. The clinician answers each question and follows the algorithm until a specific SPA procedure is identified. For example, Virues-Ortega et al. (2014) suggested that an MSWO preference assessment is the most efficacious SPA method if tangible stimuli are needed, if the participant can either make a selection response or engage with a stimulus, if tangible-maintained problem behavior must be avoided, if the individual can engage with a stimulus but not make a selection response, if a relatively short administration time is needed, and if the participant can choose between more than two stimuli.

Although the a priori algorithm presented by Virues-Ortega et al. (2014) appears to be more comprehensive than the in situ model, it has limitations that it shares with the in situ model. First, neither decision-making model addresses, nor discusses, outcome agreement between SPA procedures. For example, MSWO and PC procedures have demonstrated high agreement across outcomes in identifying highly preferred stimuli, as well as good agreement identifying preference hierarchies (DeLeon & Iwata, 1996; Verriden & Roscoe, 2016). In contrast, other SPA procedures have low agreement and are not likely to be appropriate substitutes for each other. For example, FO procedures do not often identify similar moderate-, or low-preferred items as identified by either MSWO or PC procedures (Kang et al., 2013; Steinhilber & Johnson, 2007). Congruent outcomes across different procedures can lead to greater reliability of the results and thus allow the practitioner an array of efficacious procedures to use in practice. Knowledge and reference toward the degree to which SPA procedures agree may allow practitioners a choice of efficacious procedures to use under certain conditions. Future models should include at least two empirically supported, efficacious procedures from which the practitioner can choose.

Second, neither model provides guidance on how the effects of stimulus dimensions might impact SPA outcomes. This is an important omission because dimensions like the type, or class, of stimuli; the inclusion of multiple stimulus classes; postselection access; and the physical properties of the stimuli presented have been found to influence SPA outcomes (Bojak & Carr, 1999; Clay et al., 2018; Hoffmann et al., 2017; Jones et al., 2014). Therefore, special considerations of such stimulus dimensions should be done prior to the selection and administration of SPA procedures. Considerations of the stimuli used within SPA procedures should be included in decision making regarding efficacious procedures.

Third, neither model discusses or provides guidance on how motivating operations (e.g., satiation) may differentially affect SPA outcomes. For example, Klatt et al. (2000) found that access to stimuli before an SPA may decrease the likelihood of the stimulus being selected, or the order of its selection, during an SPA. Similarly, withholding access to the stimulus prior to SPA administration may also increase the likelihood of the stimulus being selected, or affect the order in which it is selected (Chappell et al., 2009). Specific and empirically based guidance prior to the preparation and implementation of SPA procedures may increase the efficacy of results and decrease the time needed to complete the SPA.

The current article introduces an alternative a priori decision-making model for choosing empirically supported, context-specific SPA procedures. The stimulus preference assessment decision-making system (SPADS) is intended to guide the practitioner to select the most efficacious SPA procedure. Similar to the previous decision-making models, the SPADS considers specific client, stimulus, and setting characteristics. However, the SPADS aims to improve on previous decision-making models by addressing their limitations in three ways. First, the SPADS considers the agreement across SPA procedures to provide practitioners with an empirically based and context-specific choice of SPA procedures. Second, the SPADS provides preadministration guidance to the practitioner that considers stimulus dimensions such as stimulus class, novelty, and postselection access. Finally, the SPADS provides the practitioner with guidance on the effects of motivating operations on SPA outcomes. The information is synthesized into an a priori decision-making model that is intended to guide the practitioner to select at least two situationally appropriate SPA procedures.

The SPADS

The SPADS was developed based on a review and synthesis of the literature on SPA procedures. Articles were identified through an ancestral search within the reference sections of the review papers of Karsten et al. (2011), Virues-Ortega et al. (2014), and literature reviews of SPA procedures (e.g., Cannella et al., 2005; Hagopian et al., 2004; Kang et al., 2013; King & Kostewicz, 2014; Piazza et al., 2011; Rush et al., 2010; Tullis et al., 2011). The first author also conducted literature searches within the *Journal of Applied Behavior Analysis*, *Behavior Analysis in Practice*, *The Behavior Analyst Today*, *Behavior Analysis: Research and Practice*, *Behavior Modification*, the *Journal of Developmental and Physical Disabilities, Research in Autism Spectrum Disorders*, and *Research in Developmental Disabilities* between 2013 and 2018.

The literature search targeted articles published between 2013 and 2018 as this was the time period between Virues-Ortega et al. (2014) and the time of the literature search. The journals were selected given their propensity for publishing articles about SPA procedures and with a behavior-analytic focus. Search terms included a combination of "preference assessment," "stimulus preference," and "motivating operations." Studies were included for review if they evaluated the effects of the client, stimuli, and setting on SPA outcomes. A total of 65 peer-reviewed research articles were used to inform the SPADS.

In the following section, we introduce and describe the SPADS. This section will describe the decision making, and examples will be provided throughout the article. Figure 1 presents the SPADS as an easy-to-follow flowchart. An overview of the flowchart is provided first, and then each decision along the SPADS will be described in more detail.

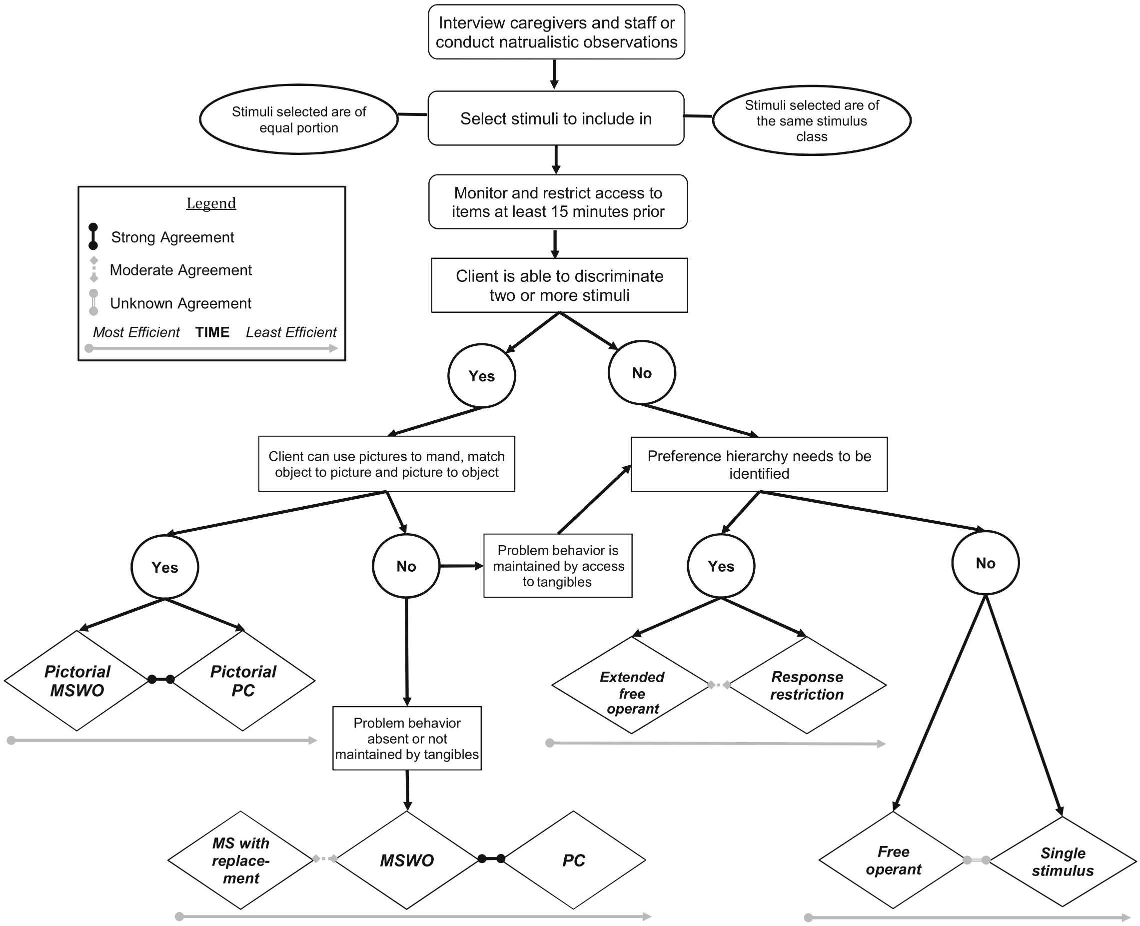

Fig. 1. The stimulus preference assessment decision-making system. *Note.* MSWO = multiple stimulus without replacement; PC = paired choice

Using the SPADS

Agreement across SPA procedures is identified by differentiated lines between procedures, as shown in the legend in Figure 1. SPA procedures with closed dark circles connected with a black line are considered to have strong agreement. In other words, identical preferences and similar preference hierarchies will likely be identified using either procedure. SPA procedures with closed gray circles connected by a gray dotted line are considered to have moderate agreement. Moderate agreement would suggest that these SPA procedures will likely result in either identifying similar highly preferred items or similar preference hierarchies. Finally, agreement between SPA procedures that are connected by a gray double line has not yet been compared in the literature. Summaries of agreement were derived from the original studies that either evaluated or calculated agreement between at least two SPA procedures (see Verriden & Roscoe, 2016; Virues-Ortega et al., 2014). We then categorized agreement classifications based on the percentage of agreement reported in either the original study or the findings described in Verriden and Roscoe (2016) and Virues-Ortega et al. (2014). Strong agreement suggests that two SPA procedures identified the same highly preferred stimulus in at least 85% of trials as reported in the literature. Moderate agreement suggests two SPA procedures identified the same highly preferred stimulus between 84% and 70% of the time as reported in the literature, and unknown agreement indicates that agreement between two SPA procedures has not yet been evaluated in the literature. For example, studies were not found in our review of the literature that evaluated the outcome agreement between FO and SS procedures.

An estimated time-efficiency scale is provided at the bottom of the legend. Time efficiency was determined by the time administration reported in each relevant study and as summarized by Verriden and Roscoe (2016) and Virues-Ortega et al. (2014). The most time-efficient SPA procedures are presented on the left side, whereas the less time-efficient procedures are located on the right. Users should note that the time-efficiency scales are relative to the SPA procedures located above the solid gray line. The time-efficiency scale was included to provide the practitioner with an option to consider relative time efficiency between two or three possible SPA procedures.

When working through the decision-making flowchart, one should consider the guidance in the rounded rectangles and ovals, which may not necessarily affect decision making but is recommended as best practice when preparing to conduct an SPA, as the subsequent sections will explain. The rectangles signal to the practitioner that they are to answer yes or no. The diamonds represent the end of the SPADS, which provide the reader with a choice of empirically supported, context-specific procedures based on the answers provided.

Selecting Stimuli to Include in SPA Procedures

Stimuli evaluated within SPA procedures have varied from edibles (DeLeon & Iwata, 1996; Tiger et al., 2006) and toy/leisure items (Daly et al., 2009; Fisher et al., 1992; Hanley, Iwata, Lindberg, and Conners, 2003; Hanley, Iwata, Roscoe, et al., 2003) to different topographies of social attention (Clay et al., 2013, 2018; Nuernberger et al., 2012; Smaby et al., 2007). The selection of specific stimuli to be included in an SPA has been arbitrary (Geckeler et al., 2000; Pace et al., 1985; Steege et al., 1989), based on naturalistic observations (Northup et al., 1996), based on caregiver input (Fisher et al., 1996), or a combination of these methods (Call et al., 2012; Noonan & McCormick, 2006). Because an SPA may include such a wide variety of stimuli, the practitioner must take care in considering the impact of stimulus classes, stimulus dimensions, motivating operations, and postselection access when identifying specific stimuli to include in SPA procedures.

Interview and Observe

The first step must be input from caregivers or staff as to which stimuli to include in the SPA procedure. Caregiver or staff interviews of the client's stimulus preferences can lead to improved SPA outcomes and perhaps identify previously unknown preferences (Fisher et al., 1996). In addition, the information yielded from interviews with caregivers can identify information regarding stimulus preference that may not otherwise be observed in the clinical or school setting. When conducting SPA interviews, practitioners should include categorical and descriptive cues for consideration by caregivers or staff (Fisher et al., 1996; Green et al., 1991). These categorical cues could include describing stimuli as "food" or "video." Categorical cues should give the caregiver a brief and general description of the stimuli. Descriptive cues may be more specific, such as when asking questions about food or asking if the client likes "crunchy food" or "chewy food." Examples of descriptive cues for other stimuli may be "toys that make sounds," "videos with fast motion," or "toys from movies."

Practitioners may consider structured caregiver or staff interviews such as the Reinforcer Assessment for Individuals With Severe Disabilities (Fisher et al., 1996) or the Barrier Assessment found in the Verbal Behavior Milestones Assessment and Placement Program (Sundberg, 2008). Using structured interviews may allow the practitioner to conduct a thorough interview that may include stimulus classes not previously considered by the caregiver or practitioner prior to the interview. Structured interviews may also provide the practitioner with a script of questions or cues when asking questions. However, structured interviews may take longer to administer and may include questions that are not necessarily relevant to the client or setting. Unstructured interviews may decrease administration time but may not be as thorough. Less experienced practitioners, or those practitioners administering SPA procedures for the first time, may consider first using structured interviews. As the practitioner acquires more experience, they may begin to use more unstructured, but targeted interviews adapted for the particular client with whom they are working.

Naturalistic observations of clients engaging with various stimuli have also been used to identify stimuli to include in SPA procedures (e.g., Kelly et al., 2014; Northup et al., 1996). Observing and noting how the client may interact with each stimulus may aid the practitioner in identifying the method by which the client may make a selection during SPA procedures. Naturalistic observation may include observations of a client engaging with or consuming particular stimuli. For example, a naturalistic observation could include taking notes on which item the client engages with during play. During the observation, the practitioner may choose to note which stimuli the client engages with and the duration of engagement. The practitioner may also note how the client interacted with the stimulus.

Using the information obtained during interviews and observations, the practitioner would then select stimuli to include within the SPA procedure. Stimuli that the client frequently engages with, and those identified within an interview, should be included in the SPA procedure. However, there are additional considerations regarding the selection of stimuli to include in SPA procedures. These considerations include the stimulus class, the novelty of the stimuli, the portion/size of the stimuli presented to the client, the duration of postselection access, and access to selected stimuli before SPA administration.

Select Stimuli From the Same Stimulus Class

Although the first SPA procedures published included stimuli from multiple stimulus classes (DeLeon & Iwata, 1996; Fisher et al., 1992; Pace et al., 1985), researchers later demonstrated that the inclusion of multiple stimulus classes (i.e., edible and tangible) differentially affected SPA outcomes (Bojak & Carr, 1999; Clay et al., 2018; DeLeon et al., 1997; Fahmie et al., 2015). For example, DeLeon et al. (1997) found that the inclusion of edible stimuli decreased the selection of preferred tangible stimuli when multiple stimulus classes were included in a single MSWO procedure. The inclusion of edible stimuli may also be insensitive to manipulations of motivating operations (Bojak & Carr, 1999). In other words, relative to other stimulus classes, preferred edible items are more likely to be selected by the client despite the client being potentially satiated. Practitioners should evaluate edible and tangible stimuli within separate SPA procedures. Including edible stimuli may overidentify edible stimuli as preferred compared to tangible stimuli. For example, whereas jelly beans within an edible-exclusive MSWO procedure may have been ranked fourth among cookies, crackers, raisins, yogurt, and cereal, jelly beans may have been identified as the most highly preferred among stimuli such as bubbles, blocks, a marble run, and a dry erase board with a marker. Although there have not been studies that have evaluated whether the inclusion of different topographies of attention with other stimulus classes affects SPA outcomes, it could be hypothesized that inclusion may differentially affect SPA outcomes for some clients based on the research presented. Preference for different topographies of attention and other stimulus classes should also be evaluated using separate assessments.

There is also research to suggest that the quality of the stimulus (i.e., high tech vs. low tech) could also differentially affect stimulus preference (Hoffmann et al., 2017). For example, Hoffmann et al. (2017) included high-tech stimuli (i.e., iPad, videos) with low-tech stimuli (i.e., toy cars, books) and found that participants selected access to high-tech stimuli more frequently than low-tech stimuli. Additionally, when the duration of postselection access to high-tech stimuli was shorter than postselection access to low-tech stimuli, participants continued to select high-tech stimuli as more preferred than low-tech stimuli. Furthermore, high-tech stimuli functioned as reinforcers, whereas low-tech stimuli did not demonstrate the same effects on responding. The practitioner may consider evaluating low- and high-tech stimuli within separate procedures. Conducting separate SPA procedures for low- and high-tech stimuli may aid the practitioner in identifying a highly preferred high-tech stimulus and low-tech stimulus that may not have been identified if both high- and low-tech stimuli were included in the same procedure. However, doing so increases administration time. The practitioner should weigh whether time efficiency is more important than evaluating high- and low-tech stimuli separately. For example, if high-tech stimuli are often shared or restricted to certain times of the day, evaluation of the client's preference for low-tech stimuli may be worth further consideration despite an increase in administration time.

Novel Stimuli

There is also emerging research to suggest that novel stimuli may be identified as preferred for children with autism and that these stimuli may also function as reinforcers (Kenzer et al., 2013; Livingston & Graff, 2018; Spear et al., 2018). Kenzer et al. (2013) demonstrated that novel stimuli not only were preferred but also functioned as more robust reinforcers compared to preferred familiar stimuli. For example, for a client who was identified to prefer a familiar stimulus like gum (i.e., a categorically chewy item), a novel chewy item such as gummy bears was also identified as a preferred item. The inclusion of a novel stimulus with similar properties—in this case, "chewy texture"—may allow the practitioner to identify additional stimuli to include in the preference assessment. The inclusion of novel stimuli or novel stimuli that are similar to other stimuli may introduce clients to potentially new preferences, thus expanding their leisure repertoire. The practitioner may want to include at least one novel stimulus in SPA procedures to evaluate changes in preference and to expose the client to additional stimuli.

Stimuli Selected Are of Equal Portion

Within clinical practice, the portion or size of the stimulus presented within SPA procedures is either arbitrarily selected or selected out of practicality. However, there is recent evidence to suggest that the physical properties of stimuli presented may influence selection beyond that of their value alone. Moore et al. (2017) found differences in stimulus selection when they compared SPA outcomes between portion-controlled stimuli and non-portioned-controlled stimuli. When portions are controlled (e.g., similar across stimuli), previously less preferred stimuli may more likely be identified as more preferred. The portion, or size, of the stimulus may influence selection during SPA procedures. In other words, if Stimulus A is larger or there is a greater amount of it than Stimulus B, the selection may be biased toward Stimulus A. Practitioners may use same-size containers to sort and manage stimuli to help ensure uniformity. For example, if a practitioner is evaluating a client's preference using Legos, toy cars, toy animals, and so forth, the practitioner should try to use containers of equal size to hold the stimuli and present them to the client. When evaluating audio/visual stimuli, or different topographies of attention, the practitioner should hold postselection access constant (e.g., access is 30 s). Maintaining uniformity of portion, size, and duration of postselection access is likely to reduce selection bias (DeLeon & Iwata, 1996; Moore et al., 2017).

Postselection Access to Stimuli

Postselection access should also be equal across all stimuli within SPA procedures. Duration of postselection access refers to the period of time in which the client is allowed to engage with a selected stimulus after making a choice. The reduction or removal of postselection access can be an advantage because it decreases SPA administration time (Davis et al., 2010; Jones et al., 2014; Rapp et al., 2010; Steinhilber & Johnson, 2007). Highly preferred stimuli and preference hierarchies can still be identified without postselection access (Davis et al., 2010; Higbee et al., 2000; Jones et al., 2014;

Rapp et al., 2010). However, there are conditions in which the practitioner should consider allowing postselection access. For example, if stimuli used during the SPA are typically used for longer periods of time (i.e., movies, iPad), then postselection access can increase the efficacy of the SPA procedure in identifying a reinforcer by closely replicating the duration of access the client may experience in their environment (Jones et al., 2014; Steinhilber & Johnson, 2007). In some cases, extending postselection access may more closely match how the stimuli would typically be consumed in the natural environment, thus increasing the validity of the assessment. Usage of postselection access times that match closely with schedules found in the client's environment may also predict the utility of that stimulus functioning as a reinforcer (Jones et al., 2014; Steinhilber & Johnson, 2007).

Dynamic qualities of a particular tangible stimulus may also influence selection. A stimulus that is highly dynamic may include interactive audio/visual displays, whereas a less dynamic stimulus, such as a pinwheel, may only have one function. Hoffmann et al. (2017) found that highly dynamic stimuli (i.e., iPad, phone apps, toys with sound and lights) are typically preferred when the duration of postselection access is longer. Additionally, dynamic stimuli functioned as more robust reinforcers compared to less dynamic stimuli. In other words, as response requirements increased, contingent access to dynamic stimuli continued to function as a reinforcer for work completion. Conversely, less dynamic items (i.e., book, a toy car) are more preferred when postselection access is shorter in duration.

Several factors may influence the practitioner's decision on how long to provide access to stimuli following selection. The practitioner may consider the time allocated to conducting the SPA. Obviously, the greater the postselection access provided, the more time needed to complete the SPA. However, if access is not provided following selection, the stimulus may be less valuable, thus possibly affecting outcomes of the SPA. When evaluating preference for highly dynamic stimuli, the practitioner may consider greater durations of postselection access. If the practitioner conducts frequent SPAs with a client when evaluating highly dynamic stimuli, the practitioner may begin with a longer duration of postselection access when initially conducting an SPA, then gradually decrease postselection access during future administrations. For example, when evaluating a client's preference for different videos, the practitioner could consider providing 3–5 min of postselection access if access to the video in the natural environment were to be 15–20 min. Over time, and across multiple SPA administrations, the practitioner may gradually reduce postselection access in order to increase time efficiency.

Monitor and Restrict Access to SPA Stimuli

Restricting access to stimuli to be used during SPA procedures may reduce the likelihood of satiation effects that may affect outcomes (Chappell et al., 2009). Extended periods of deprivation may increase the consumption of edible stimuli or the selection of tangible stimuli during an SPA (Chappell et al., 2009; Gottschalk et al., 2000; Klatt et al., 2000). Deprivation of access to stimuli may lead to the identification of a greater number of potential reinforcers. Satiation of stimuli may decrease the selection of stimuli within SPA procedures (Chappell et al., 2009; Gottschalk et al., 2000). The timing of the administration of SPA procedures should also be considered. For example, SPA procedures that are evaluating edible stimuli should be conducted before meals, not following meals. Prior to conducting any SPA procedure, the practitioner should consider restricting access to stimuli that may be used during the SPA for at least 15 min. Restricting access to stimuli that are selected to be evaluated within SPA procedures could reduce the effects of motivating operations on the selection of stimuli.

Although motivating operations have affected the outcomes of SPA procedures, these effects on highly preferred stimuli are relatively muted over several replications, and thus the preference rank of such stimuli remains relatively stable compared to moderately and low-preferred stimuli (Call et al., 2012; Green et al., 1991; Hanley et al., 2006). For example, Hanley et al. (2006) examined the effects of motivating operations on stimulus preference across multiple administrations. The results indicated that deprivation might not necessarily affect the preference rank of highly preferred stimuli. However, deprivation may affect the selection rank of moderately and low-preferred items.

In order to minimize the effects of motivating operations on SPA outcomes, the SPADS recommends that practitioners monitor and restrict access to stimuli to be used within the SPA procedure for at least 15 min. To restrict access, the practitioner may provide alternative stimuli that will not be evaluated in the SPA, give work tasks, or provide access to attention. Restricting access stimuli to be used during the SPA may include removing stimuli from the room, placing them out of view, or placing them behind locked doors or in cabinets. If stimuli to be evaluated are visual or auditory (e.g., music), then access to these specific shows, artists, and so forth may be restricted by not allowing access to the device. Although there is not yet empirical support, the practitioner may also consider restricting access to stimuli of the same class as the stimuli to be evaluated. Thus, the practitioner would restrict access not only to Duplo blocks but also to all blocks, as they would be in the same stimulus class. Restricting stimuli within the same stimulus class may prevent satiation and may, in turn, create an establishing operation for stimuli within the restricted class.

Client's Selection Response

Common stimulus selection responses identified in the literature include reaching, grabbing, and interacting with a particular stimulus. However, the physical capabilities of the client may impact how the individual selects and engages with stimuli during SPA procedures (Cannella et al., 2005; Fleming et al., 2010; Ivancic & Bailey, 1996; Logan & Gast, 2001; Paclawskyj & Vollmer, 1995; Spevack et al., 2008). Physical capabilities may include the client's vision, hearing, and motor movements. Paclawskyj and Vollmer (1995) used physical guidance to assist with presentation and selection for children with developmental disabilities and significant vision impairments. Allowing the child to physically manipulate the stimulus before selection within PC and SS procedures led to the identification of effective reinforcers within their SPA procedures. For clients who may have difficulty with reaching toward, pointing at, or grabbing stimuli due to physical disabilities (i.e., cerebral palsy, dystonia), the practitioner should identify a reliable response that indicates selection. For example, the client's eye gaze or increased emotional responding may be an appropriate modification to identify stimulus preference (Fleming et al., 2010; Spevack et al., 2008). Practitioners may identify these responses through an interview with the client's caregivers or through observation of the client with various stimuli. For example, the client may smile and vocalize when access to bubbles is provided but may frown or turn away when a toy phone is presented. Identification of alternative selection responses if a client has physical impairments may lead to efficacious SPA outcomes. Eye gaze and changes in emotional responding are two examples of alternatives to common selection responses during an SPA.

The client's ability to discriminate between multiple stimuli and their ability to perform simple imitation have been identified as prerequisite skills that increase the efficacy of MSWO, PC, and SS outcomes (Conyers et al., 2002; Martin & Yu, 2000; Thomson et al., 2007). Practitioners may assess these prerequisite skills through file review, observation, or direct assessment of such abilities, such as the Assessment of Basic Learning Abilities (Kerr et al., 1977) or the Verbal Behavior Milestones Assessment and Placement Program (Sundberg, 2008). The identification, or assessment, of these prerequisite skills may not only aid the practitioner in selecting a specific SPA procedure but also identify particular modifications necessary to complete the SPA (Clevenger & Graff, 2005; Conyers et al., 2002; Graff & Gibson, 2003; Heinicke et al., 2016; Martin & Yu, 2000; Thomson et al., 2007).

Using pictorial representations of stimuli may be an effective modification to an SPA. Pictorial-based representation of stimuli involves the practitioner showing a picture of a potentially preferred activity or stimulus during the SPA, rather than presenting the actual activity or stimulus (Daly et al., 2009; Richman et al., 2016). Using pictures has the advantage of allowing the practitioner to assess preference for intangible activities, such as social attention (e.g., Clay et al., 2013, 2018; Kelly et al., 2014; Nuernberger et al., 2012), or activities that are difficult to deliver immediately (e.g., Daly et al., 2009; Northup et al., 1996; Richman et al., 2016). Additionally, the use of pictures can increase the time efficiency of the assessment (Groskreutz & Graff, 2009; Richman et al., 2016; Virues-Ortega et al., 2014) because there is less time spent manipulating materials.

For a pictorial-based SPA to be effective for the identification of stimulus preference, multiple-stimulus discrimination may be an especially important prerequisite skill (Heinicke et al., 2016). For example, reliable discrimination of two stimuli and simple imitation may be necessary prerequisite skills that predict efficacious SPA outcomes (Conyers et al., 2002; Karsten et al., 2011; Martin & Yu, 2000; Thomson et al., 2007). Additionally, object-to-picture and picture-to-object matching have been identified as necessary prerequisite skills that affect the efficacy of pictorial SPA procedures (Clevenger & Graff, 2005; Graff & Gibson, 2003; Heinicke et al., 2016; Thomson et al., 2007).

Occurrence and Function of Problem Behavior

An SPA is often used to identify reinforcers to use in behavior interventions to reduce problem behavior. Many SPA procedures include the removal or denial of access to stimuli, which may evoke problem behavior (Ringdahl et al., 1997; Roane et al., 1998). For example, within the MSWO preference assessment, the selected stimulus is removed in subsequent trials (DeLeon & Iwata, 1996). PC procedures also include the removal of the selected stimulus, but the previously removed stimulus may appear later in future trials (Fisher et al., 1992). In RR and SS procedures, following the client's selection of a stimulus and engagement with it, that stimulus is removed and no longer available (Hanley, Iwata, Lindberg, and Conners, 2003; Hanley, Iwata, Roscoe, et al., 2003; Pace et al., 1985). Stimuli are also briefly removed and restricted during MS procedures; however, previously selected stimuli are returned to the array in subsequent trials (DeLeon & Iwata, 1996; Mason et al., 1989). Problem behavior maintained by access to tangible stimuli may be evoked by the removal or restriction of a preferred stimulus during MSWO and PC procedures (Kang et al., 2010, 2011; Tung et al., 2017; Verriden & Roscoe, 2016).

Increased exposure to the contingencies within MSWO and PC procedures may reduce the occurrence of problem behavior through extinction, given that removal of the stimulus is brief and access to the stimulus can be obtained through selection (Verriden & Roscoe, 2016). FO procedures are the only SPA procedure in which the selected stimulus is not removed or restricted (Ringdahl et al., 1997). If problem behavior occurs in the client's environment, the practitioner should consider the function of the client's problem behavior.

If problem behavior is absent or if problem behavior is not maintained by access to tangibles, then the practitioner may select between MS, MSWO, and PC procedures. MS procedures have moderate agreement with MSWO procedures. MS and MSWO outcomes may identify similar highly preferred stimuli and do not necessarily produce similar hierarchical results. However, MSWO and PC procedures have demonstrated high agreement across outcomes in identifying highly preferred stimuli, as well as good agreement identifying preference hierarchies (DeLeon & Iwata, 1996; Verriden & Roscoe, 2016). Table 1 provides a summary of how stimuli used in SPA procedures are presented, restricted, and removed and whether the stimuli are replaced for convenient review.

To hypothesize or assess the function of a client's problem behavior, practitioners should review the client's file first to determine whether a functional behavior assessment was recently completed, or whether other hypotheses related to the function of problem behavior are available. If the function of the client's problem behavior is unknown, the practitioner may consider conducting a functional behavior assessment. A functional behavior assessment may include either indirect (i.e., descriptive analysis, questionnaire) or direct assessment of problem behavior (i.e., a functional analysis). Practitioners who are unfamiliar with conducting a functional behavior assessment should seek other practitioners who have experience conducting such an assessment and refer to Lewis et al. (2017) for guidance.

Although functional behavior assessments can be time consuming, an SPA should be completed regardless of whether the function of problem behavior is known or unknown. The outcomes of an SPA provide information that could impact treatment recommendations by providing precise details on which stimuli are preferred and therefore more likely to function as reinforcers (Piazza et al., 2011). Outcomes of functional behavior assessments may provide practitioners with information on which stimulus class functions as a reinforcer, but an SPA will inform practitioners about which stimuli within that stimulus class will function as reinforcers.

Necessity of a Preference Hierarchy

A preference hierarchy may be needed if practitioners need to identify alternative stimuli if highly preferred stimuli are not available or are restricted, or if moderately preferred stimuli are used as part of intervention procedures (Piazza et al., 1996, 2011). Identifying a preference hierarchy may also be useful for the treatment of problem behavior maintained by access to tangibles in order to identify potential alternatives if highly preferred items are unavailable or restricted. A preference hierarchy results from the rank order of selected stimuli from SPA procedures. Less preferred stimuli may reduce the likelihood of problem behavior if highly preferred items are not available.

Preference hierarchies are most often identified by using PC or MSWO procedures (DeLeon & Iwata, 1996; Fisher et al., 1992; Piazza et al., 1996, 2011). However, if a client has difficulty discriminating between two or more stimuli and has problem behavior maintained by tangibles, PC and MSWO procedures may not be appropriate. FO, MS, and SS procedures may all require multiple administrations, or extended administration times, to identify a preference hierarchy (DeLeon & Iwata, 1996; Hagopian et al., 2001; Piazza et al., 2011; Rapp et al., 2010; Worsdell et al., 2002). Therefore, if a preference hierarchy is needed for a client who has difficulty discriminating between two or more stimuli and has problem behavior maintained by tangibles, the practitioner may select between FO and RR procedures (Hanley, Iwata, Lindberg, and Conners, 2003; Hanley, Iwata, Roscoe, et al., 2003). Outcome agreement across FO and RR procedures is considered moderate, as the procedures are likely to identify similar highly preferred stimuli but may identify different moderately and low-preferred stimuli (Verriden & Roscoe, 2016). It is here that the practitioner would determine whether an extended FO or RR procedure would be used because problem behavior is least likely to be evoked by the

Table 1. Summary of stimulus preference assessment procedures

Stimulus preference assessment	Stimuli presented	Stimuli restricted	Stimuli removed	Stimuli replaced
Multiple stimulus without replacement (DeLeon & Iwata, 1996)	Multiple stimuli in an array	All but the selected stimulus	Selected stimulus removed after the postselection access	Selected stimulus not replaced
Paired choice (Fisher et al., 1992)	Stimuli pairs	Unselected stimulus	Selected stimulus removed after postselection access	Selected stimulus may be replaced in a new pair
Response restriction (Hanley, Hanley, Iwata, Lindberg, and Conners, 2003; Hanley, Iwata, Roscoe, et al., 2003)	All stimuli available	Unselected stimuli	Selected stimulus removed after postselection access	Selected stimulus not replaced
Single stimulus (Pace et al., 1985)	One stimulus	None	Stimulus removed after postselection access	Stimulus not replaced
Multiple stimulus with replacement (DeLeon & Iwata, 1996)	Multiple stimuli in an array	All but selected stimulus	Selected stimulus removed following postselection access	Selected stimulus replaced within the array
Free operant (Roane et al., 1998)	All stimuli available	None	Stimuli not removed during the assessment	Not applicable

removal or restriction of preferred stimuli while providing the practitioner with a preference hierarchy.

Administration time may be a consideration when the practitioner chooses to conduct an extended FO or RR procedure. For example, extended FO procedures require that the time needed to conduct the procedure exceeds the commonly used 5- or 10-min administration times found in the literature (Rapp et al., 2010). Although an extended FO procedure may require more time than FO procedures commonly referenced in the literature, extended FO procedures are typically more time efficient than RR procedures, which may require 90 to 120 min to complete (Hanley, Iwata, Lindberg, and Conners, 2003; Hanley et al., 2003a, b; Virues-Ortega et al., 2014; Verriden & Roscoe, 2016).

Additionally, practitioners should consider how the stimuli used during the FO or RR procedure are typically used in the client's environment. For example, stimuli that are typically interacted with for long durations (e.g., access to a movie or YouTube clip) may need extended postselection access to accurately determine preference (Jones et al., 2014; Steinhilber & Johnson, 2007). For example, if the practitioner provides 20-s postselection access during an eight-item SS procedure, the administration time of this particular SS procedure would be far less than a 10-min FO procedure. Conversely, if postselection access during a four-item SS procedure is 2 min, a 5-min FO procedure would be more time efficient. The practitioner should also consider that outcome agreement between FO and SS procedures has not yet been evaluated in the literature.

Conclusions

The identification of stimulus preference provides the practitioner with important information that predicts not only stimuli that may likely function as reinforcers but also stimuli that may not have been otherwise identified as preferred. The SPADS aims to provide practitioners with practical decision-making guidance as to which SPA procedures would be the most efficacious given their particular situation. The SPADS considers the client and the stimuli within the context of the client's environment, as well as the time allotted to conduct the SPA. Although other decision-making models also provide evidence-based solutions, the SPADS provides the practitioner with choices that are equally efficacious given the current literature. Additionally, the SPADS provides a decision prior to the administration of procedures that will likely decrease the time required for identifying stimulus preference.

However, like the other models, the SPADS should not be a substitute for direct supervision and training. The SPADS assumes that the practitioner has prerequisite knowledge of various preference assessment procedures and behavior-analytic principles. For example, despite the SPADS providing at least two equally efficacious evidence-based solutions for the practitioner to consider given specific contexts, there may be instances that the practitioner may not have experience or knowledge of the SPA procedures identified. The SPADS should be used along with appropriate and sufficient training and supervision, consistent with best practice.

Although the SPADS extends the current literature by proposing an a priori decision-making model, there are limitations. Although 65 articles are cited within the current article, the methodology may have limited the results. We included a combination of the terms "preference assessment," "stimulus preference," and "motivating operations," which may have resulted in a limited number of articles identified. We also included a hand search of articles referenced by SPA methodology reviews (e.g., Cannella et al., 2005; Piazza et al., 2011; Tullis et al., 2011) and the two previous clinical decision-making models (Karsten et al., 2011; Virues-Ortega et al., 2014) to increase the breadth of the search. Despite the multimethod search, we may have unintentionally excluded relevant articles.

Although the SPADS is derived from an amalgamation of empirical findings, the social validity and efficacy of the SPADS have not been evaluated. Future research should evaluate the social validity of the SPADS. Assessment of the social validity of the SPADS would enhance the decision-making model and may increase its potential for usage in the field. Researchers could evaluate the SPADS's social validity by a survey of experienced and novice practitioners. The survey may include questions about the SPADS's conceptualization, potential ease of use, and accuracy of decision making based on each respondent's training or experience.

Comparing the outcomes between the in situ model (Karsten et al., 2011), the a priori algorithm (Virues-Ortega et al., 2014), and the current SPADS decision-making model should also be evaluated to determine clinical validity. A comparison of the models may identify which model more greatly reduces the errors in selection, such as repetition of procedures and false positives. A comparison of outcomes derived by each model could also evaluate client errors in selection (i.e., selection bias) and the occurrence of problem behavior that should be reduced or avoided using any of the decision-making models. Finally, comparing outcomes of each decision-making model would also help determine the efficacy of each model in the identification of preferences and reinforcers.

The literature review in the current article also identified that outcome agreements between FO and SS procedures have not yet been evaluated. Researchers may consider evaluating outcome agreements between FO and SS procedures. A comparison across multiple clients' preferences when given both FO and SS procedures should determine whether the procedures identify congruent outcomes. For example, if there is agreement, the FO and SS procedures should identify the same stimuli as highly preferred. The SPADS a priori decision-making model indicates that there may be specific contexts when practitioners may decide between these two potentially efficacious SPA procedures. The SPADS suggests that if a client does not reliably discriminate between two or more stimuli, and problem behavior is either not a concern or it is not maintained by access to tangible stimuli, either the FO or SS procedure would be efficacious for identifying stimulus preference. Evaluation of outcome agreement between these procedures could aid in providing practitioners with two equivalent procedures and also provide practitioners with increased variety when conducting an SPA within these contexts.

There has been no study to date that has evaluated the potential displacement of preferences when topographies of attention are evaluated within an SPA that includes multiple stimulus classes. DeLeon and Iwata (1996), and most recently Fahmie et al. (2015), demonstrated that an SPA that included multiple stimulus classes often displaces preferences of tangible items in favor of edible stimuli. Replication of the procedures outlined in DeLeon and Iwata (1996) and Fahmie et al. (2015) could help practitioners conducting SPAs in the clinical setting. Understanding whether preferences for attention, edible, and tangible stimuli are displaced when including multiple stimulus classes may impact SPA outcomes and ultimately treatment outcomes.

Despite the vast amount of research conducted on SPA procedural variations and outcomes, very little research or peer-reviewed guidance has been published on clinical decision making when selecting SPA procedures. The SPADS is an a priori decision-making tool that can aid practitioners in making empirically derived decisions. The SPADS could also assist supervisors during discussions with supervisees and students about best practice decision making and the research that supports the model. The aim of the SPADS is to identify SPA procedures that may reduce problem behavior during assessment, decrease administration time, and improve treatment efficacy by identifying procedures based on the characteristics of the individual client and the stimuli being evaluated within the SPA procedure.

Declarations

Ethical Approval This article does not contain any studies with human or nonhuman animal participants by any of the authors.

Informed Consent This article does not contain studies in which the authors had to obtain informed consent.

Conflict of Interest All authors declare that they have no conflict of interest.

References

Behavior Analyst Certification Board. (2017). *BCBA/BCaBA task list* (5th ed.). Littleton, CO: Author.

Bojak, S. L., & Carr, J. E. (1999). On the displacement of leisure items by food during multiple-stimulus preference assessments. *Journal of Applied Behavior Analysis, 32*(4), 515–518. https://doi.org/10.1901/jaba.1999.32-515.

Buchmeier, A. L., Baker, J. C., Reuter-Yuill, L. M., & MacNeil, B. R. (2018). Considerations for preference and reinforcer assessments with older adults with developmental disabilities. *Behavior Analysis: Research & Practice, 18(1)*, 103–116. https://doi.org/10.1037/bar0000085.

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

Cannella, H. I., O'Reilly, M. F., & Lancioni, G. E. (2005). Choice and preference assessment research with people with severe to profound developmental disabilities: A review of the literature. *Research in Developmental Disabilities, 26(1)*, 1–15. https://doi.org/10.1016/j.ridd.2004.01.006.

Chappell, N., Graff, R. B., Libby, M. E., & Ahearn, W. H. (2009). Further evaluation of the effects of motivating operations on preference assessment outcomes. *Research in Autism Spectrum Disorders, 3(3)*, 660–669. https://doi.org/10.1016/j.rasd.2009.01.002.

Clay, C. J., Samaha, A. L., Bloom, S. E., Bogoev, B. N., & Boyle, M. A. (2013). Assessing preference for social interaction. *Research in Developmental Disabilities, 34(1)*, 362–371. https://doi.org/10.1016/j.ridd.2012.07.028.

Clay, C. J., Samaha, A. L., & Bogoev, B. K. (2018). Assessing preference for and reinforcing efficacy of components of social interaction in individuals with autism spectrum disorder. *Learning and Motivation, 62*, 4 14. https://doi.org/10.1016/j.lmot.2017.03.008.

Clevenger, T. M., & Graff, R. B. (2005). Assessing object-to-picture matching as prerequisite skills for pictorial preference assessments. *Journal of Applied Behavior Analysis, 38(4),* 543–547. https://doi.org/10.1901/jaba.2005.161-04.

Conyers, C., Doole, A., Vause, T., Harapiak, S., Yu, D. T. C., & Martin, G. L. (2002). Predicting the relative efficacy of three presentation methods for assessing preference of persons with developmental disabilities. *Journal of Applied Behavior Analysis, 35(1)*, 49–58. https://doi.org/10.1901/jaba.2002.35-49.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed.). Pearson.

Daly, E. J., Wells, N. J., Swanger-Gagne, M. S., Carr, E, J., Kunz, G. M., & Taylor, A. M. (2009). Evaluation of the multiple-stimulus without replacement preference assessment method using activities as stimuli. *Journal of Applied Behavior Analysis, 42(3)*, 563–574. https://doi.org/10.1901/jaba.2010.43-137.

Davis, C. J., Brock, M. D., McNulty, K., Rosswurm, M. L., Bruneau, B., & Zane, T. (2010). Efficiency of forced choice preference assessment: Comparing multiple presentation techniques. *Behavior Analyst Today, 10*, 445–455. https://doi.org/10.1037/h0100682.

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

DeLeon, I. G., Iwata, B. A., Conners, J., & Wallace, M. D. (1999). Examination of ambiguous stimulus preference with duration-based measures. *Journal of Applied Behavior Analysis, 32(1)*, 111–114. https://doi.org/10.1901/jaba.1999.32-111.

DeLeon, I. G., Iwata, B. A., & Roscoe, E. M. (1997). Displacement of leisure reinforcers by food during preference assessment. *Journal of Applied Behavior Analysis, 30(3)*, 475–484. https://doi.org/10.1901/jaba.1997.30-475.

Fahmie, T. A., Iwata, B. A., & Jann, K. E. (2015). Comparison of edible and leisure reinforcers. *Journal of Applied Behavior Analysis, 48(2)*, 331–343. https://doi.org/10.1002/jaba.200.

Fisher, W. W., Piazza, C. C., Bowman, L. G., & Amari, A. (1996). Integrating caregiver report with a systematic choice assessment to enhance reinforcer identification. *American Journal on Mental Retardation, 101(1)*, 15–25.

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25(2)*, 491–498. https://doi.org/10.1901/jaba.25-491.

Fleming, C. V., Wheeler, G. M., Cannella-Malone, H. I., Basbagill, A. R., Chung, Y. C., & Day, K. G. (2010). An evaluation of the use of eye gaze to measure preference of individuals with severe physical and developmental disabilities. *Developmental Neurorehabilitation, 13(4)*, 266–275. https://doi.org/10.3109/17518421003705706.

Geckeler, A. S., Libby, M. A., Graff, R. B., & Ahearn, W. H. (2000). Effects of reinforcer choice measured in single-operant and concurrent-schedule procedures. *Journal of Applied Behavior Analysis, 33(3)*, 347–351. https://doi.org/10.1901/jaba.2000.33-347.

Gottschalk, J. M., Libby, M. E., & Graff, R. B. (2000). The effects of establishing operations on preference assessment outcomes. *Journal of Applied Behavior Analysis, 33(1)*, 85–88. https://doi.org/10.1901/jaba.2000.33-85.

Graff, R. B., & Gibson, L. (2003). Using pictures to assess reinforcers in individuals with developmental disabilities. *Behavior Modification, 27(4)*, 470–483. https://doi.org/10.1177/0145445503255602.

Graff, R. B., & Karsten, A. M. (2012). Assessing preference of individuals with developmental disabilities: A survey of current practices. *Behavior Analysis in Practice, 5(2)*, 37–48. https://doi.org/10.1007/BF03391822.

Green, C. W., & Reid, D. H. (1996). Defining, validating, and increasing indices of happiness among people with profound multiple disabilities. *Journal of Applied Behavior Analysis, 29(1)*, 67–78. https://doi.org/10.1901/jaba.29-67.

Green, C. W., Reid, D. H., Canipe, V. S., & Gardner, S. M. (1991). A comprehensive evaluation of reinforcer identification processes for persons with profound mental handicaps. *Journal of Applied Behavior Analysis, 24(3)*, 537–552. https://doi.org/10.1901/jaba.1991.24-537.

Groskreutz, M., & Graff, R. B. (2009). Evaluating pictorial preference assessment: The effect of differential outcomes on preference assessment results. *Research in Autism Spectrum Disorders, 3(1)*, 113–128. https://doi.org/10.1016/j.rasd.2008.04.007.

Hagopian, L. P., Lewin, A. B., & Rush, K. S. (2004). Preference assessment procedures for individuals with developmental disabilities. *Behavior Modification, 28(5)*, 668–677. https://doi.org/10.1177/0145445503259836.

Hagopian, L. P., Rush, K. S., Lewin, A. B., & Long, E. S. (2001). Evaluating the predictive validity of a single stimulus engagement preference assessment. *Journal of Applied Behavior Analysis, 34(4)*, 475–485. https://doi.org/10.1901/jaba.2001.34-475.

Hanley, G. P., Iwata, B. A., & Roscoe, E. M. (2006). Some determinates of changes in preference over time. *Journal of Applied Analysis, 39(2)*, 189–202. https://doi.org/10.1901/jaba.2006.163-04.

Hanley, G. P., Iwata, B. A., Lindberg, J. S., & Conners, J. (2003a). Response-restriction analysis: I. Assessment of activity preference. *Journal of Applied Behavior Analysis, 36(1)*, 47–58. https://doi.org/10.1901/jaba.2003.36-47.

Hanley, G. P., Iwata, B. A., Roscoe, E. M., Thompson, R. H., & Conners, J. (2003b). Response-restriction analysis: II. Alteration of activity preferences. *Journal of Applied Behavior Analysis, 36(1)*, 59–76. https://doi.org/10.1901/jaba.2003.36-59.

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

Higbee, T. S., Carr, J. E., & Harrison, C. D. (2000). Further evaluation of the multiple-stimulus preference assessment. *Research in Developmental Disabilities, 21(1)*, 61–73. https://doi.org/10.1016/S0891-4222(99)00030-X.

Hoffmann, A. N., Samaha, A. L., Bloom, S. E., & Boyle, M. A. (2017). Preference and reinforcer efficacy of high- and low-tech items: A comparison of item type and duration of access. *Journal of Applied Behavior Analysis, 50(2)*, 222–237. https://doi.org/10.1002/jaba.383

Ivancic, M. T., & Bailey, J. S. (1996). Current limits to reinforcer identification for some persons with profound multiple disabilities. *Research in Developmental Disabilities, 17*, 77–92. https://doi.org/10.1016/0891-4222(95)00038-0.

Jones, B. A., Dozier, C. L., & Niedart, P. L. (2014). An evaluation of the effects of access duration on preference assessment outcomes. *Journal of Applied Behavior Analysis, 47(1)*, 209–213. https://doi.org/10.1002/jaba.100.

Kang, S., Lang, R., O'Reilly, M. F., Davis, T. N., Machalicek, W., Rispoli, M. J., & Chan, J. M. (2010). Problem behavior during preference assessments: An empirical analysis and practical recommendations. *Journal of Applied Behavior Analysis, 43(1)*, 137–141. https://doi.org/10.1901/jaba.2010.43-137.

Kang, S., O'Reilly, M. F., Fragale, C., Rispoli, A. J., & Lang, R. (2011). Evaluation of the rate of problem behavior maintained by different reinforcers across preference assessments. *Journal of Applied Behavior Analysis, 44(4)*, 835–846. https://doi.org/10.1901/jaba.2011.44-835.

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

Karsten, A. M., Carr, J. E., & Lepper, T. L. (2011). Description of a practitioner model for identifying preferred stimuli with individuals with autism spectrum disorders. *Behavior Modification, 35(4)*, 347–369. https://doi.org/10.1177/0145445511405184.

Kelly, M. A., Roscoe, E. M., Hanley, G. P., & Schlichenmeyer, K. (2014). Evaluation of assessment methods for identifying social reinforcers. *Journal of Applied Behavior Analysis, 47(1)*, 113–135. https://doi.org/10.1002/jaba.107.

Kenzer, A. L., Bishop, M. R., Wilke, A. E., & Tarbox, J. R. (2013). Including unfamiliar stimuli in preference assessments for young children with autism. *Journal of Applied Behavior Analysis, 46(3)*, 689–694. https://doi.org/10.1002/jaba.56.

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

King, S. A., & Kostewicz, D. E. (2014). Choice-based stimulus preference assessment for children with or at-risk for emotional disturbances in educational settings. *Education and Training of Children, 37(3)*, 531–558. https://doi.org/10.1353/etc.2014.0026.

Klatt, K. P., Sherman, J. A., & Sheldon, J. B. (2000). Effects of deprivation on engagement in preferred activities by persons with developmental disabilities. *Journal of Applied Behavior Analysis, 33(4)*, 495–506. https://doi.org/10.1901/jaba.2000.33-495.

Lewis, T. J., Hatton, H. L., Jorgenson, C., & Maynard, D. (2017). What beginning special education teachers need to know about conducting functional behavior assessments. *Teaching Exceptional Children, 49(4)*, 231–238. https://doi.org/10.1177/0040059917690885.

Livingston, C. E., & Graff, R. B. (2018). Further evaluation of the use of preference categories to identify novel reinforcers: A systematic replication. *Behavioral Interventions, 33(2)*, 173–184. https://doi.org/10.1002/bin.1519.

Logan, K. R., & Gast, D. L. (2001). Conducting preference assessments and reinforcer testing for individuals with profound multiple disabilities: Issues and procedures. *Exceptionality, 9(3)*, 123–134. https://doi.org/10.1207/S15327035EX0903_3.

Martin, G., & Yu, D. (2000). Overview of research on the Assessment of Basic Learning Abilities test. *Journal on Developmental Disabilities, 7(2)*, 10–36.

Mason, S. A., McGee, G. G., Farmer-Dougan, V., & Risley, T. R. (1989). A practical strategy for ongoing reinforcer assessment. *Journal of Applied Behavior Analysis, 22(2)*, 171–179. https://doi.org/10.1901/jaba.1989.22-171.

Moore, J. W., Radley, K. C., Dart, E. H., Whipple, H. M., Ness, E. J., Murphy, A. N., Furlow, C., Wimberly, J. K., & Smith, A. (2017). The impact of stimulus presentation and size on preference. *Behavior Analysis in Practice, 10(2)*, 172–177. https://doi.org/10.1007/s40617-016-0148-6.

Noonan, M. J., & McCormick, L. (2006). *Young children with disabilities in natural environments: Methods and procedures.* Brookes.

Northup, J., George, T., Jones, K., Broussard, C., & Vollmer, T. R. (1996). A comparison of reinforcer assessment methods: The utility of verbal and pictorial choice procedures. *Journal of Applied Behavior Analysis, 29(2)*, 201–212. https://doi.org/10.1901/jaba.1996.29-201.

Nuernberger, J. E., Smith, C. A., Czarpar, K. N., & Klatt, K. P. (2012). Assessing preference for social interaction in children diagnosed with autism. *Behavioral Intervention, 27(1)*, 33–44. https://doi.org/10.1002/bin.1336.

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

Paclawskyj, T. A., & Vollmer, T. R. (1995). Reinforcer assessment for children with developmental disabilities and visual impairments. *Journal of Applied Behavior Analysis, 28(2)*, 219–224. https://doi.org/10.1901/jaba.1995.28-219.

Piazza, C. C., Fisher, W. W., Hagopian, L. P., Bowman, L. G., & Toole, L. (1996). Using a choice assessment to predict reinforcer effectiveness. *Journal of Applied Behavior Analysis, 29(1)*, 1–9. https://doi.org/10.1901/jaba.1996.29-1.

Piazza, C. C., Roane, H. S., & Karsten, A. K. (2011). Identifying and enhancing the effectiveness of positive reinforcement. In W. W. Fisher, C. C. Piazza, & H. S. Roane (Eds.), *Handbook of applied behavior analysis (pp. 151–164)*. New York: The Guilford Press.

Rapp, J. T., Rojas, N. C., Colby-Dirksen, M., Swanson, G. J., & Marvin, K. L. (2010). Predicting preference for items during periods of extended access based on early response allocation. *Journal of Applied Behavior Analysis, 43(3)*, 473–486. https://doi.org/10.1901/jaba.2010.43-473.

Richman, D. M., Branard-Brak, L. B., Abby, L., & Grubb, L. (2016). Multiple-stimulus without replacement preference assessment: Reducing the number of sessions to identify preferred stimuli. *Journal of Developmental and Physical Disabilities, 28(3)*, 469–477. https://doi.org/10.1007/s10882-016-9485-1.

Ringdahl, J. E., Vollmer, T. R., Marcus, B. A., & Roane, H. S. (1997). An analogue evaluation of environmental enrichment: The role of stimulus preference. *Journal of Applied Behavior Analysis, 30(2)*, 203–216. https://doi.org/10.1901/jaba.1997.30-203.

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

Smaby, K., MacDonald, R. P. F., Ahearn, W. H., & Dube, W. V. (2007). Assessment protocol for identifying preferred social consequences. *Behavioral Interventions, 22(4)*, 311–318. https://doi.org/10.1002/bin.242.

Spear, M. A., Karsten, A., & White, E. A. (2018). Restricted interests and autism: Further assessment for a variety of leisure items. *Behavior Modification, 42(1)*, 108–125. https://doi.org/10.1177/0145445516686301.

Spevack, S., Wright, L., Yu, C. T., Walters, K. L., & Holborn, S. (2008). Passive and active approach responses for children with profound multiple disabilities and minimal movement. *Journal of Developmental Disabilities, 14(2)*, 61–68.

Steege, M. W., Wacker, D. P., Berg, W. K., Cigrand, K. K., & Cooper, L. J. (1989). The use of behavioral assessment to prescribe and evaluate treatments for severely handicapped children. *Journal of Applied Behavior Analysis, 22(1)*, 23–33. https://doi.org/10.1901/jaba.1989.22-23.

Steinhilber, J., & Johnson, C. (2007). The effects of brief and extended stimulus availability on preference. *Journal of Applied Behavior Analysis, 40(4)*, 767–772. https://doi.org/10.1901/jaba.2007.767-772.

Sundberg, M. L. (2008). *VB-MAPP Verbal Behavior Milestones Assessment and Placement Program: A language and social skills assessment program for children with autism or other developmental disabilities: Guide*. Concord: AVB Press.

Thomson, K. M., Czarnecki, D., Martin, T. L., Yu, C. T., & Martin, G. L. (2007). Predicting optimal preference assessment methods for individuals with developmental disabilities. *Education and Training in Developmental Disabilities, 42(1)*, 107–114.

Tiger, J. H., Hanley, G. P., & Hernandez, E. (2006). An evaluation of the value of choice with preschool children. *Journal of Applied Behavior Analysis, 39(1)*, 1–16. https://doi.org/10.1901/jaba.2006.158-94.

Tullis, C. A., Cannella-Maione, H. I., Basbigill, A. R., Yeager, A., Fleming, C. V., Payne, D., & Pai-Fang, W. (2011). Review of the choice and preference assessment literature for individuals with severe to profound disabilities. *Education and Training in Autism and Developmental Disabilities, 46(4)*, 576–595. http://www.jstor.org/stable/24232368.

Tung, S. B., Donaldson, J. M., & Kahng, S. (2017). Effects of preference assessment type on problem behavior. *Journal of Applied Behavior Analysis, 50(4)*, 861–866. https://doi.org/10.1002/jaba.414.

Verriden, A. L., & Roscoe, E. M. (2016). A comparison of preference-assessment methods. *Journal of Applied Behavior Analysis, 49(2)*, 265–285. https://doi.org/10.1002/jaba.302.

Virues-Ortega, J., Pritchard, K., Grant, R. L., North, S., Hurtado-Parrado, C., Lee, M. S. H., Temple, B., Flavia, J., & Yu, C. T. (2014). Clinical decision making and preference assessment for individuals with intellectual and developmental disabilities. *American Journal on Intellectual and Developmental Disabilities, 119(2)*, 151–170. https://doi.org/10.1352/1944-7558-119.2.151.

Vollmer, T. R., Marcus, B. A., & LeBlanc, L. (1994). Treatment of self-injury and hand mouthing following inconclusive functional analyses. *Journal of Applied Behavior Analysis, 27(2)*, 331–344. https://doi.org/10.1901/jaba.1994.27-331.

Windsor, J., Piche, L. M., & Locke, P. A. (1994). Preference testing: A comparison of two presentation methods. *Research in Developmental Disabilities, 15(6)*, 439–455. https://doi.org/10.1016/0891-4222(94)90028-0.

Worsdell, A. S., Iwata, B. A., & Wallace, M. D. (2002). Duration-based measures of preference for vocational tasks. *Journal of Applied Behavior Analysis, 35(3)*, 287–290. https://doi.org/10.1901/jaba.2002.35-287.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.