Evaluation of a Functional Analysis Decision-Making Model

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Abstract

Functional analyses are the most precise method for determining behavioral function (Iwata et al., 2000); however, there are many behavioral and environmental constraints that may prevent clinicians from conducting a standard functional analysis (Oliver et al., 2015). There are functional analysis variations that address constraints such as time (e.g., pairwise, Tarbox et al., 2004; brief, Northup et al., 1991), high-risk behavior (e.g., precursor, Fritz et al., 2013; Smith & Churchill, 2002), and setting (e.g., trial-based; Bloom et al., 2013). The purposes of the current study were to create and validate a functional analysis decision-making model for selecting an initial functional analysis variation (Study 1) and to evaluate the decision-making model with and without training for selecting an initial functional analysis variation given a scenario (Study 2). Results of Study 1 suggest the validity of the decision-making model due to the partial and exact agreement with experts. Results of Study 2 suggest the decision-making model in the absence of training was effective for three participants, whereas additional training components (i.e., computer-based training, rehearsal and feedback) were needed for five of eight participants. Half of the participants met mastery criteria.

Keywords: functional analysis, decision-making model, computer-based training

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Table of Contents

Abstract iii

Acknowledgments iv

List of Figures vii

List of Tables viii

Evaluation of a Functional Analysis Decision-Making Model 1

Study 1: Development of the Decision-Making Model 6

Method 6

Participants, Setting, and Materials 6

Response Measurement 7

Development and Validation of the Decision-Making Model 7

Results and Discussion 8

Study 2: Evaluation of the Decision-Making Model 9

Participants, Setting, and Materials 10

Response Measurement, and Interobserver Agreement (IOA) 11

Procedures 12

General Procedures 12

Baseline 12

Decision-Making Model 13

Computer-Based Training (CBT) 13

Rehearsal and Feedback 13

Design 13

Results 14

Discussion 16

References 25

Appendix A: Example Scenarios 36

Appendix B: Finalized Decision-Making Model 37

Appendix C: Demographic Survey 38

Appendix D: Example Qualtrics Survey 40

Appendix E: CBT Quiz Questions 43

List of Figures

Figure 1 31

Figure 2 32

Figure 3 33

List of Tables

Table 1 34

Evaluation of a Functional Analysis Decision-Making Model

A functional analysis (FA) involves the manipulation of antecedents and consequences in the environment to determine a functional relationship, or cause, for behavior (Iwata et al., 1982/1994). FA is the most precise method for identifying behavioral function (Iwata et al., 2000) in which trained therapists manipulate conditions in the environment to evoke behavior. Experimental analysis of behavior is essential to verify suspected or obvious environment-behavior relationships or to detect potentially subtle relationships (Iwata et al., 1990).

FA has been researched extensively for the assessment of problem behavior (e.g., Iwata et al., 1982/1994; Iwata et al., 1990; Kurtz et al., 2015; Northup et al., 1991). Typically, the sources of reinforcement evaluated in an FA include social positive reinforcement in the forms of attention and tangible, social negative reinforcement in the form of escape from academic demands, and automatic reinforcement (Iwata & Dozier, 2008). FA methodology was described by Iwata et al. (1982/1994) in which participants were exposed to four experimental conditions (i.e., social disapproval [attention], academic demand [escape], unstructured play [play or control], and alone) in a multielement design for 15-min sessions. During each test and control condition, specific antecedents (i.e., discriminative stimuli and motivating operations) and consequences are programmed. For example, during the social disapproval condition, academic demands are placed and contingent on problem behavior, escape is delivered. Behavior that occurs more often during one or more test conditions as compared to a control condition will be determined the reinforcing variable(s). Identification of behavioral function allows for the development of effective and efficient function-based treatment (Horner, 1994). That is, FAs are conducted to inform treatments that will (a) neutralize and eliminate variables that

may evoke problem behavior and (b) arrange the environment to establish consequences that increase appropriate behavior and decrease problem behavior (Ingram et al., 2005).

Researchers (e.g., Ingram et al., 2005; Iwata et al., 1990; Perrin et al., 2008) and reviewers (e.g., Beavers et al., 2013; Hanley et al., 2003) have demonstrated and evaluated the effectiveness of FAs. Beavers et al. (2013) reviewed 158 studies that reported FA results and found 91.7% of studies reported differentiated responding. These results suggest FAs are an effective method for identifying behavioral function, and results of FAs can be used to develop function-based treatments. Although their effectiveness has been established, Oliver et al. (2015) discovered a research-to-practice gap in which clinicians reported rarely implementing FAs. They surveyed 682 board-certified behavior analysts at the undergraduate, master's, and doctoral levels about their functional behavior assessment (FBA; i.e., informant or indirect assessment, direct assessment, and functional analysis) practices and barriers to FA implementation. They found 75% of practitioners almost always or always use informant assessments, 94% of practitioners use descriptive assessments, and 36% of practitioners use FAs, while 62.7% of respondents reported never or almost never using FAs. A total of 92.4% of practitioners reported that FBAs are required for developing effective intervention strategies (e.g., function-based interventions); however, it is unclear what percentage believe FA is necessary for developing effective intervention strategies. Practitioners reported lack of time and lack of space or materials as the primary barriers to implementing FAs. Other barriers reported include administrative policies prohibiting the use of FAs, lack of trained staff, lack of approval from administration or families, belief that FAs are not necessary or useful, and lack of funding. In addition to the barriers noted by Oliver et al., other barriers have been identified in the research literature such

as potentially dangerous behavior or limited control over environmental conditions (Iwata & Dozier, 2008).

Given the reported barriers to the use of FA, researchers have developed several FA variations to the standard FA methodology originally described by Iwata et al. (1982/1994) to address certain behavioral or environmental constraints. When a behavior is too dangerous (e.g., intense self-injury and aggression) to allow repeated exposure to contingencies, clinicians could use a precursor (Fritz et al., 2013; Smith & Churchill, 2002) or latency FA (Thomason-Sassi et al., 2011). To conduct a precursor FA (Fritz et al., 2013; Smith & Churchill, 2002), the clinician would need to identify a reliable precursor (i.e., a behavior that reliably occurs immediately before the problem behavior and not during other situations). During FA sessions, contingencies are on the precursor rather than severe behavior. Precursor FA allows for identification of behavioral function while minimizing the need to evoke dangerous behavior. If the dangerous behavior does not have a reliable precursor or if the behavior is session resetting (e.g., elopement, disrobement), clinicians can conduct a latency FA (Neidert et al., 2013; Thomason-Sassi et al., 2011) in which consequences are delivered and sessions are terminated following the first instance of problem behavior. Latency FAs allow for identification of behavioral function while minimizing repeated exposure of the dangerous behavior to session contingencies and decreasing the likelihood of confounding results by resetting the session.

When a time constraint is identified (e.g., limited assessment time), clinicians could conduct a brief FA in which single exposures to each condition are conducted (e.g., Northup et al., 1991) or conditions are conducted for a shorter amount of time (e.g., 5 min; Wallace & Iwata, 1999). Clinicians could also consider conducting a pairwise (Tarbox et al., 2004) or extended alone FA (Querim et al., 2013). Brief, pairwise, and extended alone FAs allow for more

efficient identification of behavioral function. To determine whether a clinician should conduct a brief, pairwise, or extended alone FA, initial assessments should be conducted to identify whether there is a hypothesized function. For example, clinicians often conduct indirect assessments (e.g., Kelley et al., 2011) or direct observations (Thompson & Borrero, 2011) prior to conducting an FA (Thompson & Iwata, 2007). If these initial assessments do not suggest a function, clinicians should conduct a brief FA in which behavior is exposed to each test and control condition. However, if the initial assessments suggest a social function, clinicians could conduct a pairwise FA in which one or more test conditions hypothesized to maintain behavior are alternated with a control condition. If the assessments reveal a potential automatic or sensory function, clinicians could conduct a series of extended alone or no interaction conditions (Querim et al., 2013). If a setting constraint is identified in which the clinician does not have a structured or controlled environment to conduct the assessment (e.g., classroom), the clinician could conduct a trial-based FA (Bloom et al., 2013) in which brief trials of each test and control condition are embedded into ongoing activities. Trial-based FAs allow for identification of behavioral function when controlled settings are not available.

These FA variations address several of the reported barriers from practitioners; however, they may not address all barriers to FA implementation. Another large barrier to FA implementation is training. FAs are complex and require many skill sets (Iwata et al., 2000). To perform an FA from start to finish, there are several skills a clinician will need. First, clinicians must evaluate their clinical case to identify the most appropriate FA variation (e.g., latency FA, precursor FA) given the behavioral and environmental constraints (e.g., dangerous behavior, limited time). Second, clinicians must develop the procedures for their test and control conditions that will allow for adequate evaluation of environmental variables hypothesized to be

controlling behavior. Third, clinicians must be trained in conducting each condition such that they can conduct the conditions and train others to do so as well (Iwata et al., 2000; Moore et al., 2002; Pence et al., 2014). Fourth, clinicians must be able to graph and visually analyze the data throughout and following implementation to determine when to conclude their FA and identify the function(s) of the behavior (Hagopian et al., 1997; Retzlaff et al., 2020; Saini et al., 2018). Finally, clinicians will need to match a function-based treatment to the outcome of the FA (Ingram et al., 2005; Kurtz et al., 2015).

Several of the skill sets required to conduct an FA have been evaluated. For example, Moore et al. (2002) trained teachers to implement FA methodology using behavioral skills training (BST). BST was effective for increasing accurate implementation of FA methodology. Hagopian et al. (1997) developed a structured criteria for identifying the function of FA results. Pre-doctoral interns were trained in the structured criteria via didactic instruction, modeling, and practice with feedback to interpret FA results. Results suggested the use of the structured criteria increased agreement on the function of problem behavior from an average of .46 to an average of .90 between participants. Finally, Chok et al. (2012) used a training package to teach practitioners how to conduct the FA conditions, interpret the multielement FA graphs, determine next steps when data are undifferentiated, and select function-based interventions. When teaching practitioners to select interventions, practitioners experienced a 30-min training and were required to write essay responses that included a (a) function-based treatment which increased a functional alternative behavior and decreased problem behavior and (b) description of the principle of behavior or its common name from the behavior-analytic literature related to the procedure. Feedback was provided in the form of praise for correct

responses and corrective feedback for incorrect responses. All participants met mastery criteria within 10.5 to 12.5 hours of training.

Although research has been conducted on training FA procedures and visual analysis, little research has been conducted on the most effective methods for training clinicians to select an appropriate FA variation given the behavioral and environmental constraints. Each FA variation contains its own methodology with its own set of advantages and disadvantages based on variables such as assessment time (e.g., Bloom et al., 2013; Kahng & Iwata, 1999) and severity of problem behavior (e.g., Heath Jr. & Smith, 2019; Thomason-Sassi et al., 2011). The variety of FAs and lack of research in training clinicians how to determine which variation they should use may contribute to the research-to-practice gap, decreasing the likelihood of FA implementation and identification of function-based treatments. Therefore, the purposes of the current study were to (a) create a decision-making model to determine which FA variation to use for an initial FA, (b) validate the decision-making model, and (c) evaluate the use of the decision-making model with and without training with certificate and master's students.

Study 1: Development of the Decision-Making Model

The purpose of Study 1 was to create and validate the decision-making model.

Method

Participants, Setting, and Materials

Participants were two experts in the field of applied behavior analysis. Experts were doctoral-level behavior analysts with 33 combined years in assessment and treatment of problem behavior, served in various clinical positions across a variety of populations, taught FBA courses at their respective institutions, and advised students and clinicians in the assessment and

treatment of problem behavior. The researcher met with the two experts during a single, 1-hour meeting (Hagopian et al., 1997).

Prior to the meeting, the researcher provided the experts with 47 scenarios (see Appendix A for example scenarios) and the decision-making model via email. Each scenario contained subject demographics, the behavior of interest, potential underlying medical causes of the behavior, and behavioral and environmental constraints (i.e., high risk/dangerous behavior, session resetting behavior, time constraint, setting constraint, precursor behavior, hypothesized function).

Response Measurement

Researchers collected data via paper and pencil on the FA variation identified by the experts and the one identified by the researcher using the decision-making model. An *exact agreement* was defined as scenarios in which the experts and researcher identified the same FA variation(s). A *partial agreement* was defined as scenarios in which the experts agreed upon one FA variation but disagreed upon another. For example, the experts identified two FA variations (e.g., precursor FA, pairwise FA), whereas the researcher identified one (e.g., precursor FA). Exact and partial agreement were calculated. Exact agreement was calculated by dividing the number of scenarios with exact agreement by the total number of scenarios. Partial agreement was calculated by dividing the number of scenarios with partial agreement by the total number of scenarios.

Development and Validation of the Decision-Making Model

The preliminary decision-making model was developed by students in an online graduate class for FBA. Students reviewed the literature for common barriers to FA implementation and

recommended variations to address these barriers. Based on their review of the literature, a preliminary decision-making model was created.

Prior to the meeting with the experts, the researcher reviewed each scenario using the decision-making model to identify an FA variation. During the meeting, the experts met with the researcher to review the scenarios and preliminary decision-making model. First, the researcher reviewed each scenario with the experts in the absence of the decision-making model. Based on the information contained in the scenario, each expert identified the FA variation they would use. If there was a disagreement, the experts would discuss until a consensus was agreed upon. Second, the researcher reviewed the consensus agreed upon by the experts with the FA variation identified via the decision-making model. If there was a disagreement, the experts and researcher discussed until a consensus was agreed upon. Third, the experts provided feedback regarding edits that could be made to the decision-making model to make the decision-making model easier to follow and understand (see Appendix B for finalized decision-making model). Edits from the experts included adding the "no barriers" box, renaming "full FA" to the "standard FA," and adding more description to the brief FA box including one exposure to each condition and shorter session durations.

Results and Discussion

Exact agreement between the experts and researcher using the decision-making model for identifying an appropriate FA variation given scenarios was 87.2%, and partial agreement was 100%. Partial agreements occurred when the experts identified two appropriate FA variations for the scenario and the researcher identified one. This occurred during six scenarios in which the researcher and experts decided both identified variations were potentially correct given the

information in the scenario. The high agreement between the researcher and experts suggests the validity and utility of the decision-making model.

Although the model attempts to provide some objectivity to selecting initial FA variations and demonstrates high correspondence with experts, there may still be some subjectivity and clinical judgement that should be used when selecting a variation. For example, in the current study, there were six scenarios in which more than one FA variation was deemed appropriate. For all six scenarios, one variation was a pairwise FA; three were paired with a standard FA, two were paired with a latency FA, and one was paired with a trial-based FA. The prevalence of the pairwise FA suggests clinicians should clearly identify hypothesized functions such that they can save time by conducting only relevant conditions. Additionally, this may suggest that several FA variations may be appropriate given the environmental or behavioral constraints. Thus, clinical judgement should still play a role in identifying the most appropriate FA variation.

Further, some clinical cases may have several constraints to implementation such as dangerous behavior and time constraint, which is not addressed in the current model. To address multiple constraints, clinicians could determine which constraint is most important (e.g., client or staff safety, location, time) and use the decision-making model to determine which initial variations to choose. Clinicians could also combine the FA variations given the constraints they address. That is, if a latency and pairwise FA are both identified, the clinician could conduct a latency FA with only the relevant conditions in a pairwise fashion. Although this may be a feasible option and potential solution to addressing multiple constraints, not all possible combinations of FA variations have been evaluated and validated against the standard FA.

Study 2: Evaluation of the Decision-Making Model

The purpose of Study 2 was to evaluate the decision-making model with certificate and master's students with and without training.

Participants, Setting, and Materials

Participants were one master's and seven certificate students enrolled in applied behavior analysis coursework at two Midwestern universities. Participants had access to a computer or electronic device with screen recording capabilities and internet access. Participants were excluded if they did not have a computer with screen recording capabilities and internet access or were not attending classes in the field of applied behavior analysis. All participants completed a demographic survey (see Appendix C) to assess their familiarity with behavior analysis and FA. The demographic survey consisted of 11 questions that asked about (a) education and behavior-analytic coursework, (b) clinical experience, and (c) FBA experience and familiarity.

Results of the demographics survey are depicted in Table 1. At the time of the study, three participants (Participant 3, 5, 8) were Registered Behavior Technicians. Six participants (Participants 1, 2, 3, 4, 5, 9) were enrolled in an online certificate program for applied behavior analysis, one participant (Participant 10) was concurrently enrolled in an online certificate and doctoral program in a related field, and one participant (Participant 8) was enrolled in an online master's program. All participants had taken at least four courses (range, 4-8) in behavior analysis. Six participants (Participants 1, 2, 3, 4, 9, 10) were enrolled and currently taking, one participant (Participant 8) had already completed, and one participant (Participant 5) had not taken an FBA course. Five participants (Participants 1, 2, 3, 4, 8) reported experience with indirect assessments, descriptive assessments, or both; two participants (Participants 5, 8) reported experience with FA; and two participants (Participants 9, 10) reported no experience with FBA. All participants reported familiarity with at least one FA variation (range, 1-8).

Sessions took place asynchronously at the participant's convenience via the researcher emailing the participant links and materials needed to complete the session. Depending on progression through the study, materials may have included (a) a Qualtrics link to five brief scenarios with multiple choice and an other response option with which participants determined the corresponding FA variation based on behavioral and environmental constraints (Appendix D), (b) the decision-making model (Appendix B), and (c) a computer-based training (CBT) with an embedded quiz (Appendix E). Scenarios were the same as those in Study 1 and were quasi-randomly distributed across Qualtrics surveys using a random number generator. Further, each variation only occurred in a survey once, and scenarios were counterbalanced across surveys such that all scenarios were used; however, not all variations appeared in each survey. Survey order was also counterbalanced across participants. Further, each participant experienced each variation at least once within each condition (i.e., baseline, decision-making model, CBT). CBT consisted of the participants watching a video with voiceover in which the researcher walked through how to use the decision-making model and demonstrated using the decision-making model on two example scenarios. Following the video, participants took a quiz containing five questions about the decision-making model and were required to get all questions correct.

Response Measurement, and Interobserver Agreement (IOA)

Researchers collected data via paper and pencil on a scenario-by-scenario basis. Responses were scored as correct or incorrect for each scenario. *Correct responses* were defined as the participant selecting the correct FA variation, whereas *incorrect responses* were defined as the participant selecting an incorrect FA variation. At the end of each session, the researcher calculated the percentage correct by dividing the number of correct responses by the total number of correct and incorrect responses and multiplying by 100.

A second, trained observer scored an average of 46% (range, 33%-71%) of sessions across each participant. For both correct and incorrect responses, we calculated interobserver agreement by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100. An agreement was defined as both data collectors scoring a correct or incorrect response on the same scenario. A disagreement was defined as the researchers scoring different responses on the same scenario. Across all participants, IOA was 100%.

Procedures

General Procedures

At the start of each session, the researcher emailed the participant a link to five scenarios that were embedded within a Qualtrics survey. Upon opening the Qualtrics link, the participant was shown brief instructions that (a) described what the participant would do while completing the survey, (b) stated they could use any materials provided by the researcher, (c) requested the participant to begin their screen recording, and (d) provided a reminder to upload the screen recording following completion of the session. Mastery criteria was 100% correct responses across three sessions.

Baseline

The participant was instructed to review the scenario and determine the FA variation they would conduct in the absence of materials. There were no programmed consequences for correct or incorrect responses.

Decision-Making Model

Sessions were similar to baseline; however, participants were also provided with the decision-making model and instructed to use the decision-making model when reviewing scenarios to determine the FA variation they would conduct.

Computer-Based Training (CBT)

Prior to the first CBT session, participants were provided with a video with voiceover of how to use the decision-making model to select an FA variation and two example scenarios in which the researcher demonstrated using the decision-making model to identify initial FA variation. Following the training and completion of a brief quiz to 100%, sessions were conducted similar to decision-making model.

Rehearsal and Feedback

If participants did not meet mastery criteria in CBT, the researcher conducted rehearsal and feedback during a single meeting. During the meeting, the researcher and the participant reviewed up to 10 scenarios that were previously scored incorrect by the participant. The participant described to the researcher how they determined the chosen variation, then the researcher provided feedback using the decision-making model. All FA variations were included in the feedback scenarios; however, rehearsal and feedback may have ended before the participant contacted all FA variations. That is, rehearsal and feedback ended once a participant identified the correct FA scenario in the absence of feedback on two consecutive scenarios. Following rehearsal and feedback, three sessions were conducted similar to decision-making model.

Design

A nonconcurrent multiple baseline design (Watson & Workman, 1981) across participants was used to evaluate the effectiveness of the decision-making model with and without additional training components for selecting appropriate FA variations and to demonstrate experimental control. That is, the implementation of the independent variables (i.e., decision-making model, CBT, rehearsal and feedback) were staggered across participants. The decision-making model was implemented with participants in the top panel of graphs following at least three baseline sessions in which stable or decreasing response patterns were observed. All training components were implemented sequentially in a similar manner (i.e., at least three sessions in which stable or decreasing response patterns were observed). The independent variables were implemented with the participants in the second panel when and only when there was a change in responding in the top panel. Similarly, the independent variables were implemented with participants in the third panel when and only when there was a change in responding in the second panel.

Results

Figures 1 through 3 depict the results of the study. Across all figures, sessions are scaled to the x-axis, and percentage correct is scaled to the y-axis. Figure 1 depicts the data for Participants 9, 8, and 3. During baseline, Participant 9 engaged in a moderate level of percentage correct. When the decision-making model was implemented, the level of percentage correct immediately increased, and mastery criteria were met after six sessions. During baseline, Participant 8 engaged in a moderate to high level of percentage correct. When the decision-making model was implemented, level of percentage correct increased, and mastery criteria were met after four decision-making model sessions. During baseline, Participant 3 initially engaged in a moderate level of percentage correct followed by an increasing trend. At the end of baseline,

a decrease in percentage correct was observed to a moderate level. When the decision-making model was implemented, percentage correct immediately increased to a higher level with more consistent responding, and mastery criteria were met after nine sessions.

Figure 2 depicts the data for Participants 1, 2, and 5. During baseline, Participant 1 engaged in low to moderate levels of percentage correct. When the decision-making model was implemented, percentage correct immediately increased to a high level followed by a decreasing trend to a moderate level. When CBT was implemented, percentage correct immediately increased and maintained at a high level, and mastery criteria were met after six sessions. During baseline, Participant 2 engaged in low to moderate levels of percentage correct. When the decision-making model was implemented, percentage correct increased to a moderate level but became more variable. When CBT was implemented, percentage correct initially increased to moderate to high levels; however, towards the end of CBT, percentage decreased to a lower level. When rehearsal and feedback was implemented, correct percentage maintained at a similar level as CBT. Participant 2 did not reach mastery criteria. During baseline, Participant 5 engaged in low to moderate levels of percentage correct. When the decision-making model was implemented, percentage correct immediately increased to a higher level which maintained around 80%. When CBT was implemented, correct responding slightly increased in level. A similar pattern of responding occurred during rehearsal and feedback. Participant 5 did not reach mastery criteria.

Figure 3 depicts the data for Participants 4 and 10. During baseline, Participant 4 engaged in a moderate level of percentage correct with some variability. When the decision-making model was implemented, level and variability of percentage correct did not change. When CBT was implemented, percentage correct immediately increased to a higher level; however,

percentage correct decreased to a moderate level following the sixth session. When rehearsal and feedback were implemented, level of percentage correct decreased to similar levels as baseline and decision-making model. Participant 4 did not reach mastery criteria. During baseline, Participant 10 engaged in a moderate level of percentage correct with some variability. When the decision-making model was implemented, percentage correct became stable at a similar level to baseline. When CBT was implemented, a similar pattern of percentage correct was obtained. When rehearsal and feedback were implemented, percentage correct immediately increased to a high level but decreased during the last two sessions to a similar level as baseline, decision-making model, and CBT. Participant 10 did not reach mastery criteria.

Discussion

We created, validated, and evaluated the effectiveness of an FA decision-making model on choosing an appropriate initial FA variation given hypothetical scenarios with and without training. When compared with experts in the assessment and treatment of problem behavior, the decision-making model had high reliability. Partial agreements occurred when the experts identified two possible FA variations and the decision-making model identified one. This would suggest that this model may be valid in selecting an initial FA variation; however, our results suggest that most individuals will require additional training in identifying an appropriate FA variation given behavioral and environmental constraints. That is, the decision-making model alone was effective for three participants, and additional training (i.e., CBT or CBT and feedback) was necessary for five participants. Four of the five participants did not reach mastery criteria with the trainings assessed in the current study.

Although most participants reported experience with FBA, familiarity with FA variations, and FBA coursework, baseline contingencies were ineffective. All participants correctly

identified the initial FA variation for some scenarios; however, correct responding was typically below 80%. These data may suggest that the current structure of FBA courses and clinical experience at the Registered Behavior Technician level are not sufficient for identifying initial FA variations. It is possible that embedding more practice experience into coursework would increase the likelihood of correct identification of initial variation; however, this would need to be evaluated. Additionally, clinical experience at the Registered Behavior Technician level is likely not sufficient either as their role is to implement procedures developed by master's-level clinicians. Potentially more guided clinical experience and oversight would increase accuracy of responding under baseline conditions.

Interestingly, the decision-making model was effective in the absence of training for three participants (Participants 3, 8, 9). It is possible the decision-making model functioned as enhanced written instructions (e.g., Berkman et al., 2019; Graff & Karsten, 2012; Lo & Starling, 2009). Enhanced written instructions are an antecedent intervention that have been demonstrated to be effective at increasing accuracy of skills such as preference assessment implementation (Graff & Karsten, 2012) and graphing (e.g., Berkman et al., 29109; Lo & Starling, 2009). Given the presentation of the decision-making model as a flowchart and limited use of technical jargon, it is possible the decision-making model functioned as enhanced written instructions, increasing the accuracy of selecting an initial FA variation by providing clinicians with specific discriminative stimuli. Our decision-making model does differ from typical enhanced written instructions (e.g., Graff & Karsten, 2012) in that the model is a flowchart and did not include step-by-step written instructions or pictures. These differences may account for the limited number of participants for which the decision-making model alone was effective. Further, the decision-making model does not define or describe FA

variations, so it is unclear whether clinicians are required to have background knowledge on FA variations prior to using the model.

Although seven of eight participants had taken or were currently enrolled in an FBA course and all participants reported familiarity with FA variations, it is possible Participant 8's familiarity with FA resulted in acquisition and mastery in the absence of training. That is, Participant 8 reported completing all master's-level coursework and conducting a brief FA at the time of this study. Participant 8 also reported involvement with data collection, data entry, visual inspection, and conducting sessions of the brief FA. It is possible that Participant 8's history of coursework and experience with FA resulted in mastery due to more exposure to FA research and clinical experience, allowing more effective identification of behavioral and environmental constraints. Thus, the decision-making model may be helpful in isolation for those with coursework and clinical experience with FA; however, this finding would need to be replicated across additional participants as Participant 9 reported no experience with FA and was enrolled in an FBA course at the time of study, and Participant 3 was a Registered Behavior Technician but reported being currently enrolled in an FBA course and no FA experience.

For five participants (Participants 1, 2, 4, 5, and 10), the decision-making model alone was ineffective in the absence of additional training, and CBT was required to train the use of the decision-making model; however, CBT was only effective for one participant (Participant 1). CBT consisted of voiceover instruction in which the researcher described the use of the decision-making model, highlighted and described all behavioral and environmental constraints, and provided two models of selecting FA variations given scenarios. Example scenarios included a precursor and an extended alone FA. Following CBT, participants completed a short quiz to 100%. Video modeling with voiceover instruction has been shown to be an effective antecedent

intervention in teaching a variety of skills (e.g., Berkman et al., 2019; Bovi et al., 2016; Vladescu et al., 2012) potentially due to its increased saliency of parts of the video (Bovi et al., 2016) by including further descriptions of important parts of the video or additional accurate modeling for behaviors that may be more complex. Our CBT included specific step-by-step instructions with minimal technical language and a screen recorded video of the tasks being modeled accurately (Berkman et al., 2019; Tyner & Fienup, 2015), which may have also contributed to the efficacy of CBT. Although CBT was effective for one participant, it is not clear which portions of CBT were necessary and sufficient as instructions, video modeling, and an embedded quiz were programmed. Additionally, it may be possible to increase the efficacy of CBT for more participants by increasing the number of scenarios modeled such that each behavioral and environmental constraint was modeled. Limited number of video models may have contributed to the variable responding during CBT, as participants did not experience video modeling for each variation.

Finally, rehearsal and feedback were necessary for four of eight participants (Participants 2, 4, 5, and 10); however, rehearsal and feedback resulted in variable response patterns across participants and did not increase participant responding to mastery criteria. It is unclear why rehearsal and feedback were ineffective in increasing responding to mastery criteria; however, there are several possible variables that may have affected responding. First, it is possible our rehearsal and feedback procedures were ineffective. That is, one rehearsal and feedback session was conducted at the start of the phase rather than following each session or each scenario. Additionally, during rehearsal and feedback up to 10 scenarios were reviewed. If a participant correctly identified the FA variation on two consecutive scenarios, rehearsal and feedback ended (i.e., two consecutive correct scenarios or 10 scenarios, whichever occurred first, ended rehearsal

and feedback). The researcher reviewed seven scenarios with Participant 2, and they did not contact a standard or latency FA scenario. The researcher reviewed eight scenarios with Participant 5, and they did not experience a standard, trial-based, or precursor FA scenario. The researcher reviewed seven scenarios with Participant 4, and they experienced all variations. The researcher reviewed five scenarios with Participant 10, and they did not experience a standard, brief, or trial-based FA scenario. Therefore, it is possible that the behavioral and environmental constraints a participant struggled with the most were not reviewed; however, scenarios were chosen based on previous incorrect responding throughout the study. Researchers should consider modifying when and how feedback is conducted. If similar procedures are used, researchers should ensure all variations are reviewed such that correct FA variations are identified across all environmental and behavioral constraints. Second, it is possible that participants had generated rules that competed with the decision-making model (Henley et al., 2017). Potentially, participants had received prior coursework or clinical instruction that differed from the decision-making model, which could influence responding. For example, participants could have been instructed a brief FA could be used for high-risk behavior due to its potential for fewer opportunities to engage in high-risk behavior that may cause injury. Third, it appears that several participants needed more direct training on identifying hypothesized functions, specifically automatic reinforcement, within scenarios which resulted in identification of a brief FA rather than extended alone. These participants had limited clinical experience, so it may be important to do more directed training related to identifying hypothesized functions within scenarios.

Overall, participants that required additional training on the decision-making model had less academic and clinical experience. Participants 1, 2, 3, 4, and 10 had taken or were enrolled

in an FBA course but had no experience conducting an FA. Participant 5 had not taken a course in FBA, and had experience developing the protocol for a brief FA. These data may suggest that coursework alone is insufficient for acquiring this skill and additional clinical experience related to FA is necessary. Thus, it may be important to evaluate more intensive training on FA variations or specific instructions on how to use this decision-making model when individuals have little to no clinical experience with FAs. It may also be important to train clinicians to identify behavioral and environmental variables that would affect which variation should be chosen. Anecdotally, one participant noted that they were unsure of how many hours constituted a time constraint. For example, one scenario stated there were 10 hours for assessment time, which this participant interpreted as a time constraint, though 10 hours is likely enough time to conduct an FA. Training packages could include CBT, behavioral skills training (Moore et al., 2002; Ward-Horner & Sturmey, 2012), or other instructional programs including readings, watching a video, passing a quiz, and receiving feedback during sessions (Iwata et al., 2000). A component analysis may also be warranted to determine whether education, clinical experience, or both affect the effectiveness of the decision-making model.

There are several limitations that may have affected responding in the current study. The online, asynchronous nature of the sessions may have allowed participants to access other people or materials. Variable and decreasing patterns of responding during baseline and decision-making model suggest participants likely did not access other materials during sessions. Further, responding typically immediately increased for participants who experienced CBT and rehearsal and feedback, which suggests the decision-making model and CBT likely increased responding rather than outside people or materials. Researchers might consider conducting this study in an in-person format to control for potential use of other people and materials during the study.

However, this may not be ecologically valid as clinicians typically have access to colleagues and materials (e.g., research literature) when conducting assessments and interventions. Should participants have accessed other people or materials, this would more accurately reflect a clinical environment; however, it would not isolate the specific training components necessary for acquisition. An additional limitation that may have affected responding across participants was academic and clinical experience. Participant 8 had significantly more academic experience (i.e., eight classes compared to four) and was the only participant who reported practicing clinically in behavior analysis at the time of this study. Therefore, this participant had more academic and clinical experience compared to other participants, which may have contributed to differences in responding. Thus, it may be important for researchers to control for training history and provide training to participants who do not have extensive clinical or academic experience. Similarly, it would be interesting to replicate these results with clinicians in the field or those with more academic experience to see whether similar patterns of responding would be obtained.

Another possible limitation is the high mastery criteria in which there was no room for error. Given the limited number of scenarios in each session, if a participant got one FA variation incorrect, they immediately scored 80%. Thus, requiring participants to score 100% across three consecutive sessions may not allow room for clinical judgement or variability in some scenarios. The most common error observed was participants selecting a brief FA when an extended alone FA should have been selected and vice versa. Potentially, the behavioral and environmental constraints described in brief and extended alone scenarios were similar and thus more difficult for the participants to discriminate whether there was no hypothesized function or a hypothesized automatic function. Clinically, this could be problematic if clinicians are unable

to discriminate between a hypothesized automatic function and no hypothesized function of maladaptive behavior because conducting an extended alone FA when there are no hypothesized functions could result in missing a social function during the FA.

Future research should evaluate the effectiveness of the decision-making model with both written and enhanced instructions (Graff & Karsten, 2012). Results of Graff and Karsten (2012) suggest that written instructions alone were ineffective at increasing accuracy of implementation of preference assessments but enhanced written instructions did increase correct responding. Because the decision-making model itself may function as enhanced written instructions, simple written instructions combined with the decision-making model may be effective in teaching the use of the decision-making model; however, enhanced written instructions on the use of the decision-making model may be necessary for clinicians to understand and use the model accurately. Researchers could also consider providing actual clinical cases for clinicians to determine the most appropriate FA variation as opposed to hypothetical scenarios. The hypothetical scenarios may more clearly provide the details of behavioral and environmental constraints than what occurs in the clinical environment. Clinical cases may also have more than one barrier that should be considered when choosing an initial FA variation for which the hypothetical scenarios did not control.

Finally, researchers should also consider providing training on FA methodology following implementation of the study. Because the present study did not train participants how to conduct conditions for each FA variation, the training received would not qualify these individuals as competent in conducting an FA. Although this decision-making model may be beneficial in guiding practitioners to select an initial FA variation, it does not mean a clinician has acquired all the skills to conduct an FA. Extensive training is required for a clinician to (a)

develop procedures for their test and control conditions to effectively evaluate the function of behavior, (b) conduct each condition accurately (e.g., Iwata et al., 2000), (c) graph and visually analyze the data (Hagopian et al., 1997; Retzlaff et al., 2020; Saini et al., 2018), and (d) match a function-based treatment to the outcome of the FA (Kurtz et al., 2015). Additionally, there are many times in which an FA results in undifferentiated responding. Thus, it is important that guidance on next steps when results are undifferentiated is developed in conjunction with this model as this may help clinicians make decisions related to their FA methodology from start to finish.

Overall, the results of the current study suggest an FA decision-making model may be effective in assisting individuals experienced with FA to select an initial FA variation, and additional training will likely be necessary for the model to be effective with those with less extensive clinical experience. The decision-making model may be used to select initial FA variations, but clinicians should seek other training to ensure they are competent in conducting all variations of FA before implementing an FA clinically. The importance of conducting FAs is well known (e.g., Iwata & Dozier, 2008), and while the use of this model does not train clinicians how to conduct an FA, it may increase clinician confidence in choosing the most appropriate initial FA variation based on behavioral and environmental constraints.

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Figure 1

Percent Correct for Participant 9 (top panel), Participant 8 (middle panel), and Participant 3 (bottom panel)

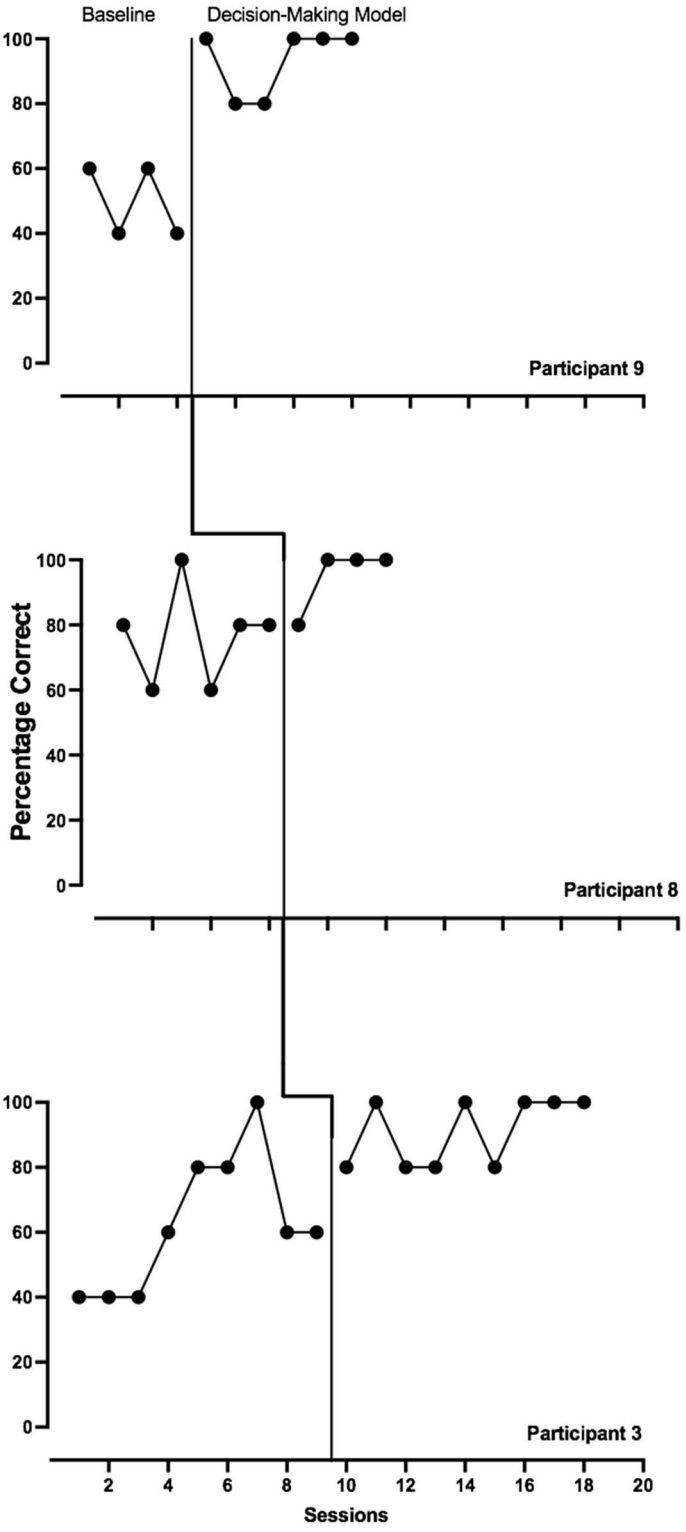


Figure 2

Percent Correct for Participant 1 (top panel), Participant 2 (middle panel), and Participant 5 (bottom panel)

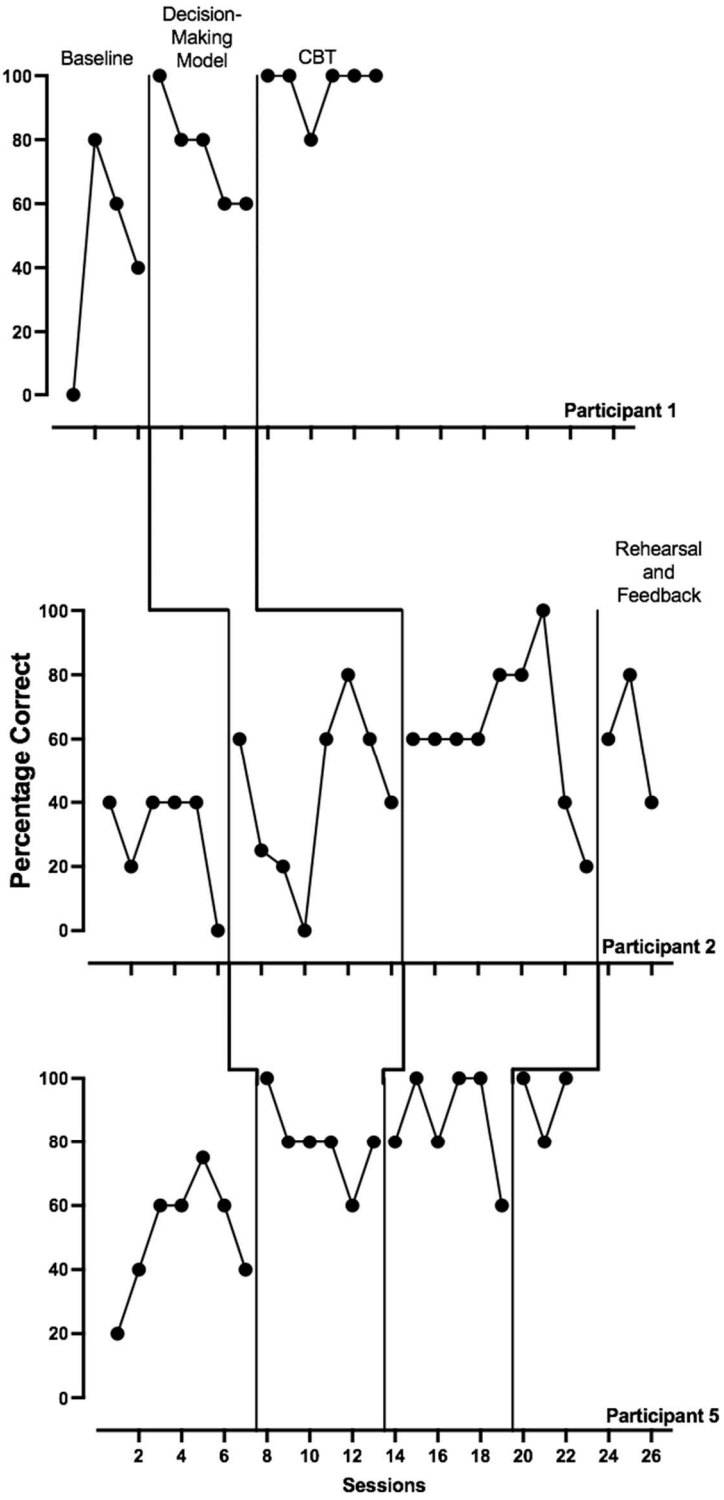


Figure 3

Percent Correct for Participant 4 (top panel) and Participant 10 (bottom panel)

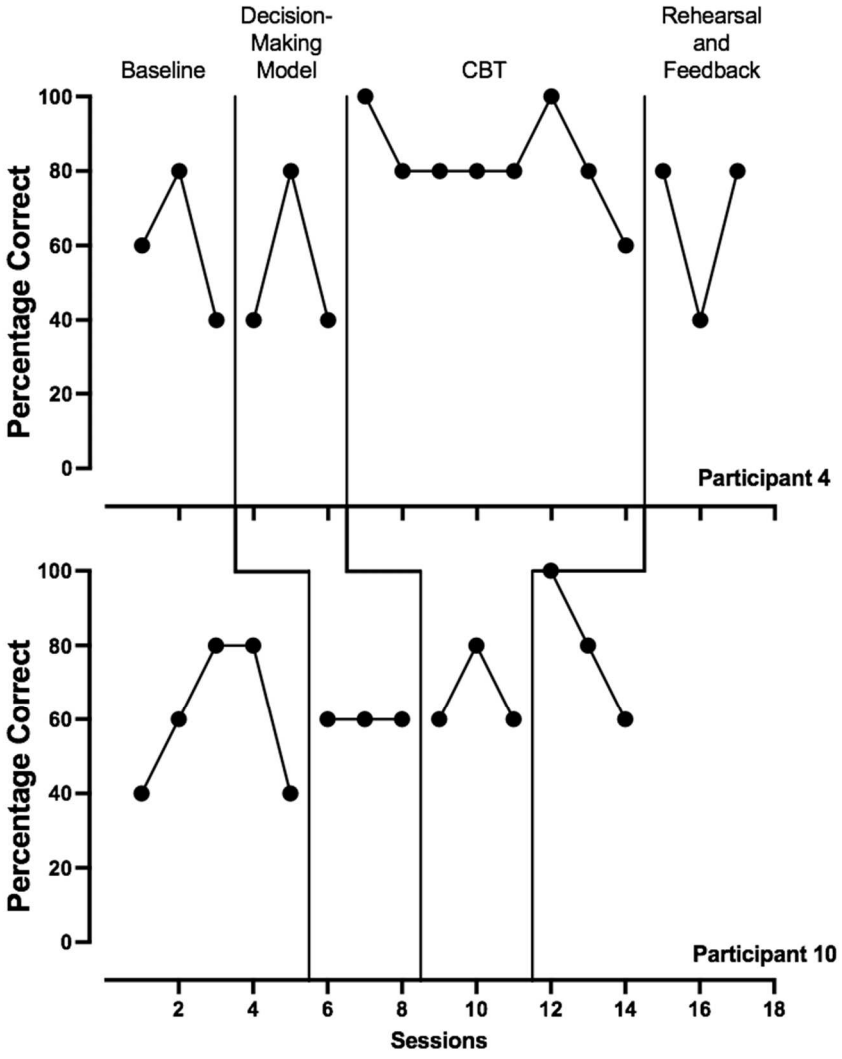


Table 1

Demographics Survey Results

Participant	BACB Certification	ABA Program	ABA Classes	FBA Course	FBA Experience	FA Variations
1	N/A	Certificate	4	Enrolled	IA, DA	Standard, Brief, Pairwise, Trial-based
2	N/A	Certificate	4	Enrolled	IA, DA	Standard, Brief, Brief w/ within session analysis, Trial-based
3	Registered Behavior Technician	Certificate	4	Enrolled	DA	Standard, Brief, Brief w/ within session analysis, Precursor, Trial-based
4	N/A	Certificate	4	Enrolled	IA, DA	Standard, Brief, Brief w/ within session analysis, extended alone, latency, pairwise, precursor, trial-based
5	Registered Behavior Technician	Certificate	5	No	FA	Brief
8	Registered Behavior Technician	Masters	8	Taken	IA, DA, FA	Standard, Brief, extended alone, latency, pairwise, precursor, trial-based, IISCA

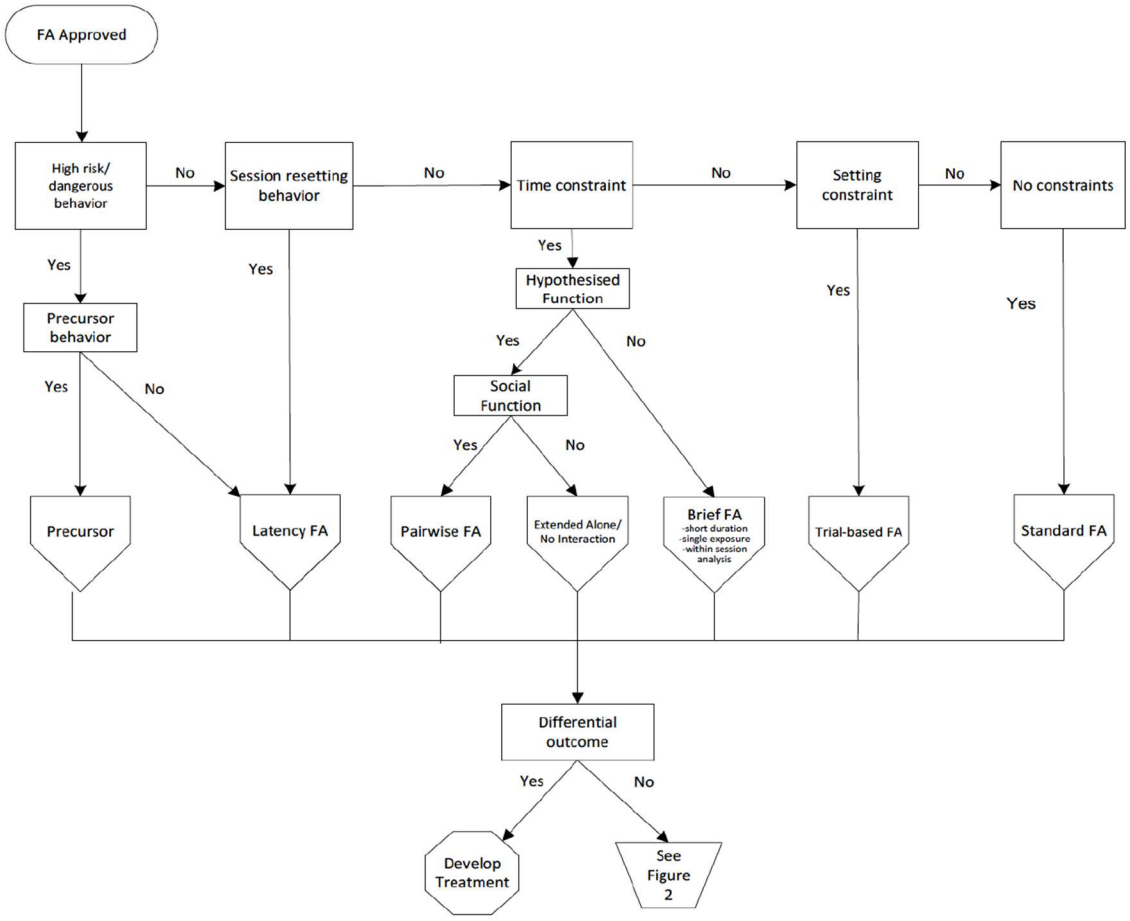
Participant	BACB Certification	ABA Program	ABA Classes	FBA Course	FBA Experience	FA Variations
9	N/A	Certificate	4	Enrolled	No	Standard, brief, brief w/ within session analysis, extended alone, latency, pairwise, precursor, trial-based
10	N/A	Certificate & PhD	6	Enrolled	No	Standard, brief, latency

Appendix A: Example Scenarios

Ben is a 7-year-old male diagnosed with autism spectrum disorder. He is a new client at a university-based early intensive behavioral intervention (EIBI) clinic and frequently exhibits problem behaviors such as aggression and self-injurious behavior when items are restricted and he is asked to complete self-care tasks. Because Ben engages in frequent but low intensity problem behavior, his BCBA has decided to conduct a functional analysis to determine the function of his problem behavior to inform an effective treatment. It is important to the BCBA and team working with Ben to fully understand the function of his problem behavior as they are unaware of the behavior's reinforcement history. Medical causes for the self-injurious behavior have been ruled out by Ben's doctor. The team has access to a controlled, structured environment to conduct the sessions and ample time to run the assessment.

Hannah is a large, 10-year-old student diagnosed with Pervasive Developmental Disorder. She attends a behavior analytic clinic for children. She engages in severe aggression in the form of biting and kicking towards her treatment team such that these staff need to leave the environment to assess and treat bruises and lacerations caused by the aggressive behaviors. They would like to conduct a functional analysis on Hannah's aggression; however, are trying to keep the assessment brief to avoid injury to the staff members. Her treatment team has also not been able to identify a reliable situation in which these behaviors typically occur.

Appendix B: Finalized Decision-Making Model



Appendix C: Demographic Survey

FA Decision-Making Model Demographics

Please enter your initials.

Are you currently a student in behavior analysis?
- o Yes
- o No

In which program are you enrolled?
- o Online master's program
- o Online certificate program
- o On-campus master's program
- o On-campus doctoral program

Are you a practicing clinician in behavior analysis?
- o Yes
- o No

Which BACB certification(s) do you hold?
- o BCBA
- o BCBA-D

What university are you attending/did you attend for your graduate training in behavior analysis?

How many courses have you taken related to behavior analysis?

What courses have you taken in behavior analysis? Select all that apply.
- ▢ Principles of Behavior Analysis
- ▢ Ethics
- ▢ Experimental Analysis of Behavior
- ▢ Conceptual Foundations
- ▢ Research Methods
- ▢ Functional Behavior Assessment
- ▢ Organizational Behavior Management
- ▢ Behavior Analysis in Intellectual and Developmental Disabilities

- ▢ Introduction to Applied Behavior Analysis
- ▢ Other _____

Have you conducted any part of a functional behavior assessment? Select all that apply.

- ▢ Indirect Assessment
- ▢ Direct Assessment
- ▢ Functional Analysis

What was your role(s) in the functional analyses you have conducted?

- ▢ Developing functional analysis protocol
- ▢ Data collection
- ▢ Data entry
- ▢ Visual inspection of data
- ▢ Conducting sessions
- ▢ Supervising functional analysis
- ▢ Other _____

Which variations of functional analysis (FA) have you conducted? Check all that apply.

- ▢ Standard FA
- ▢ Brief FA
- ▢ Brief FA with within session analysis
- ▢ Extended Alone/No Interaction FA
- ▢ Latency FA
- ▢ Pairwise FA
- ▢ Precursor FA
- ▢ Trial-Based FA
- ▢ Other _____

Which functional analysis (FA) variations are you familiar with (i.e., learned about or read about)? Select all that apply.

- ▢ Standard FA
- ▢ Brief FA
- ▢ Brief FA with within session analysis
- ▢ Extended Alone/No Interaction FA
- ▢ Latency FA
- ▢ Pairwise FA
- ▢ Precursor FA
- ▢ Trial-Based FA
- ▢ Other _____

Appendix D: Example Qualtrics Survey

FA Model 2

You will be presented with five scenarios in which you will determine which variation of functional analysis is the most appropriate given the scenario. You may use any materials that have been provided to you from the researcher. Please start your screen recording using Zoom while on this instructions screen. Once you have completed the survey, upload your Zoom recording to the OneDrive folder provided to you by the researcher.

Please enter your initials.

Ron is a small, 7-year-old client diagnosed with down syndrome. He engages in aggression in the form of hitting and kicking towards his staff and towards peers. Both the hitting and the kicking is mild, and rarely causes injuries to staff or peers. Observations of Ron in his clinic have suggested that the aggression frequently occurs when he has been denied access to an item, or when the staff or peers have their attention directed elsewhere. Ron's BCBA has a large caseload, so there is not much time to conduct the assessment; however, they would still like to conduct a functional analysis.

- ▢ Standard FA
- ▢ Brief FA
- ▢ Extended Alone/No Interaction FA
- ▢ Latency FA
- ▢ Pairwise FA
- ▢ Precursor FA
- ▢ Trial-Based FA
- ▢ Other (Please Explain) _____

Tom is a small, 7-year-old child diagnosed with autism spectrum disorder in a special education classroom who frequently engages in property destruction with toys when playing cooperatively with his peers; however, the toys are typically smaller objects, and he does not usually throw toys in the direction of peers, so injury to peers is not a concern. His teacher has called the school's behavior analyst for help with the situation, who has ample time to conduct the analysis. The behavior analyst has suggested conducting a functional analysis of the property destruction; however, the school is reluctant as they do not have any structured locations to conduct the analysis.

- ▢ Standard FA
- ▢ Brief FA
- ▢ Extended Alone/No Interaction FA
- ▢ Latency FA
- ▢ Pairwise FA
- ▢ Precursor FA
- ▢ Trial-Based FA
- ▢ Other (Please Explain) _____

Ben is a 7-year-old male diagnosed with autism spectrum disorder. He is a new client at a university-based early intensive behavioral intervention (EIBI) clinic and frequently exhibits problem behaviors such as aggression and self-injurious behavior when items are restricted and he is asked to complete self-care tasks. Because Ben engages in frequent but low intensity problem behavior, his BCBA has decided to conduct a functional analysis to determine the function of his problem behavior to inform an effective treatment. It is important to the BCBA and team working with Ben to fully understand the function of his problem behavior as they are unaware of the behavior's reinforcement history. Medical causes for the self-injurious behavior have been ruled out by Ben's doctor. The team has access to a controlled, structured environment to conduct the sessions, and ample time to run the assessment.

- ▢ Standard FA
- ▢ Brief FA
- ▢ Extended Alone/No Interaction FA
- ▢ Latency FA
- ▢ Pairwise FA
- ▢ Precursor FA
- ▢ Trial-Based FA
- ▢ Other (Please Explain) _____

Jenny is a 14-year-old student diagnosed with Pervasive Developmental Disorder who attends a special education classroom for adolescents. During the day, she engages in moderate aggression in the form of hitting her peers and teacher in the head and upper body at the table that often distracts and injures her peers and the teacher. Jenny quietly taps her fingers on the table before she engages in aggression. The consulting behavior analyst would like to conduct a functional analysis of aggression which seems to primarily occur throughout all activities regardless of antecedents and consequences; however, the teacher has asked that the behavior analyst not disrupt the classroom as much as possible and to quickly conduct the assessment such that Jenny and other students can more quickly return to a healthy learning environment. Previously, the behavior analyst has used the school psychologist's office for student assessments, which is currently available. The behavior analyst will use only teachers in the functional analysis, so as to ensure no peers are injured during the assessment.

- ▢ Standard FA
- ▢ Brief FA
- ▢ Extended Alone/No Interaction FA
- ▢ Latency FA
- ▢ Pairwise FA
- ▢ Precursor FA
- ▢ Trial-Based FA
- ▢ Other (Please Explain) _____

Q6 Scott is an 8-year-old client diagnosed with autism spectrum disorder. His treatment team has conducted observations of his self-injurious behavior at different points during the day such as mealtime, free time, and work periods. Typically, the self-injurious behavior involves Scott slapping his legs. The slapping has been observed to occur during almost all the daily activities (e.g., work time, independent play, peer play) for long durations. Scott's doctor has ruled out any potential medical causes for the self-injurious behavior. The treatment team can use Scott's personal work room to complete the assessment, but will need to conduct the functional analysis quickly, such that they can implement treatment to decrease the behavior.

- ▢ Standard FA
- ▢ Brief FA
- ▢ Extended Alone/No Interaction FA
- ▢ Latency FA
- ▢ Pairwise FA
- ▢ Precursor FA
- ▢ Trial-Based FA
- ▢ Other (Please Explain) _____

Appendix E: CBT Quiz Questions

Now that you have completed the lecture portion of the training, please answer the following 5 questions. You must answer the questions correctly before moving on. Once you have completed the training, you may proceed to the provided survey links.

Please enter your initials

If your situation has a time constraint, but your behavior of interest has no hypothesized function, what variation of FA should you conduct?
- Latency FA
- Pairwise FA
- Brief FA
- Extended Alone FA

Your behavior of interest is a high risk and dangerous self-injurious behavior with no precursor behavior. What variation of FA should you conduct?
- Trial-based FA
- Precursor FA
- Brief FA
- Latency FA

What step in the decision-making model follows determining a "yes" for hypothesized function when there is a time constraint?
- Precursor behavior
- Pairwise FA
- Brief FA
- Social function(s)

If your situation does not have a high risk behavior, a session resetting behavior, or a time constraint, what behavioral or environmental constraint should you assess next?
- Setting constraint
- Precursor behavior
- Hypothesized function
- Staffing constraint

If you determine you have a time constraint and your behavior of interest has a hypothesized function that is not a social function, what variation of FA should you conduct?
- Standard FA
- Brief FA
- Extended Alone FA
- Pairwise FA