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A CLINICAL PROBLEM-SOLVING MODEL FOR IDENTIFYING AND ADDRESSING BARRIERS TO LEARNING IN SKILL-ACQUISITION PROGRAMS

by

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A Dissertation submitted to the Faculty of the Graduate School, Marquette University, in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

Milwaukee, Wisconsin

May 2024
ABSTRACT
A CLINICAL PROBLEM-SOLVING MODEL FOR IDENTIFYING AND ADDRESSING BARRIERS TO LEARNING IN SKILL-ACQUISITION PROGRAMS

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Marquette University, 2024

Applied Behavior Analysis (ABA) services for learners with autism spectrum disorder (ASD) and other intellectual and developmental disabilities frequently involve teaching a variety of skills, such as those related to communication, daily-living, and safety. There is an extensive literature available demonstrating effective instructional procedures (e.g., discrete-trial teaching, prompt-fading strategies) as well as procedural or environmental modifications that clinicians can apply when teaching these skills; however, minimal literature exists to guide clinicians in applying these procedures when learners encounter a barrier to learning. Thus, it is unclear what systematic methods, if any, clinicians are using to determine efficacious and efficient instructional modifications. The present study evaluated the application of a problem-solving model which considers barriers caused by skill- and performance-deficits to learners with ASD to identify and subsequently address barriers to learning on current acquisition goals.
A Clinical Problem-Solving Model for Identifying and Addressing Barriers to Learning in Skill-Acquisition Programs

BCBAs frequently design interventions to teach individuals with autism spectrum disorder (ASD) and other intellectual or developmental disabilities new skills, such as those related to communication, social interaction, activities of daily living, and safety. Researchers and clinicians have evaluated and applied a variety of instructional approaches to teach these skills, such as discrete-trial instruction (DTI), Direct Instruction, and natural environment training (NET; Dufek & Schreibman, 2014; Johnson & Street, 2008; Lerman et al., 2016). Instructional components that are commonly combined in these procedures include attending responses, controlling prompts, prompt-fading strategies, and schedules of reinforcement (Cooper et al., 2020). In the United States, the broad efficacy of these interventions has led to successful campaigns by consumers, providers, and policy makers in all 50 states to require insurance providers and Medicaid to fund applied behavior analysis (ABA) services for individuals with ASD (Autism Speaks, 2020).

Despite this broad efficacy, a learner’s response to any one combination of intervention components remains idiosyncratic. For example, research on different types of prompts (e.g., Seaver & Bourret, 2014), prompting strategies (e.g., Libby et al., 2008), error correction (e.g., McGhan & Lerman, 2013), and schedules of reinforcement (e.g., Hausman et al., 2013) all demonstrated mixed results as to which instructional components were most efficacious for each participant. Researchers have recommended the use of assessment-based instruction in initial and ongoing clinical practice to ensure that the most efficacious and efficient intervention components are applied with each client (Kodak & Halbur, 2021). Assessment-based instruction is the evaluation and comparison of a learner’s response to two or more interventions and using
assessment outcomes to inform instructional strategies for the learner’s intervention goals. Furthermore, using assessment results to inform the selection of appropriate behavior-change interventions is consistent with the ethics code for BCBAs (Behavior Analyst Certification Board [BACB], 2020).

Additional clinical assessments are also likely to be needed during service delivery, such as when a client encounters a barrier to learning for a given treatment goal. Barriers to learning may be related to several variables such as low or inconsistent procedural integrity, skill deficits, or performance deficits (e.g., Bergmann et al., 2021; Kodak & Halbur, 2021). Examples of barriers to learning caused by a skill deficit include issues of stimulus salience or disparity, insufficient teaching exemplars or motivating operations (MOs), insufficient practice or training, a missing or weak prerequisite skill, and difficulty fading prompts to promote the transfer of stimulus control. Examples of barriers to learning associated with a performance deficit include waiting for prompts before responding, the response effort of the skill being too high, and competing MOs or schedules of reinforcement.

Applied researchers have addressed these different barriers to learning using a variety of intervention procedures (e.g., error correction, teaching of prerequisite skills) and modifications (e.g., increasing the number of trials conducted per session, increasing density of reinforcement). However, the steps researchers take to address these barriers are not systematic across studies and may resemble a trial-and-error process of selecting intervention modifications when a barrier to learning is encountered (e.g., Bergmann et al., 2021; Grow et al., 2011; Kisamore et al., 2016, Petursdottir et al., 2011). A trial-and-error process involves evaluating one intervention modification at a time until the barrier to learning is resolved. For example, Kisamore et al. (2016) implemented a series of three intervention modifications to teach one participant, Jeb, to
engage in multiply controlled intraverbal responses. After a lack of acquisition of the intraverbal responses with the initial intervention procedures and modification (a prompt delay with error correction and a differential observing response with error correction), the researchers conducted an error analysis of Jeb’s responding. The results of the error analysis revealed that Jeb was engaging in a consistent response across targeted discriminative stimuli ($S^D$; e.g., saying “broccoli” after the questions “What is a fruit that is green,” and “What is a vegetable that is green?”). The researchers subsequently introduced a modified differential observing response in which Jeb was prompted to echo each component of the $S^D$ both during and after the presentation of the full $S^D$. When Jeb’s correct responding did not improve, the researchers next introduced a progressive prompt delay to attempt to transfer stimulus control to the original $S^D$. Finally, the researchers introduced a modified prompt delay with error correction, which resulted in Jeb acquiring the multiply controlled intraverbals.

Although a trial-and-error process may result in an effective modification that produces acquisition, the process may be lengthy and require a sequence of multiple modifications (e.g., Kisamore et al., 2016). That is, a series of intervention modifications conducted over weeks to months of the client’s services represents a prolonged period of services that did not produce an efficacious and efficient outcome. Overall, this could hinder a learner’s progress and could potentially lead to a funding source ending or decreasing an authorization for intervention services because the learner is not making satisfactory progress. Additionally, although it is possible that the clinician’s trial-and-error approach may eventually lead to an improvement in the learner’s responding (e.g., Kisamore et al., 2016), it may be unclear which modification(s) produced this outcome and why. That is, if the clinician simply made additive changes to the original intervention procedure, the clinician would not know whether it was the final change to
the intervention or the full package of modifications that resolved the barrier to learning. This could lead to the future application of an intervention package of unnecessary components that could increase the complexity of the procedures, making it more difficult to implement.

An alternative method to addressing barriers to learning is systematic clinical problem solving. Systematic clinical problem solving entails a sequence of analytical steps to identify the barrier(s) to learning as well as an appropriate intervention procedure or modification that can be applied to address the barrier(s). For example, if a client encountered a barrier to learning for an intraverbal program targeting responses to WH-questions, the clinician might conduct a series of observations and analyses to answer some of the following questions: Is the intervention program being conducted with high treatment integrity across all instructors? What is the current pattern of responding under these intervention procedures? Has the client successfully acquired new responses using these procedures before? Does the pattern of responding appear to suggest an underlying skill deficit or a performance deficit?

The benefits of systematic clinical problem solving are that the clinician (a) will identify the specific barrier to learning to inform current and future intervention modifications and (b) will minimize resources spent by clinicians on ineffective or inefficient interventions. There is also emerging evidence suggesting that problem solving skills, such as those applied both with clients and the workplace in general, are one of the most valued skills of behavior analysts and one of the skills most in need of improvement (Cowan & Kodak, 2022).

Some researchers have previously proposed decision-making models clinicians can use to guide their clinical practice. For example, Ferraioli et al. (2005) developed a series of questions that a clinician can consult when determining whether modifications are needed for DTI programs. The model developed by the authors guides the user to answer a series of yes/no
questions about variables such as the learner’s pattern of responding in the program of interest, their responding across all clinical programming, various aspects about the instructional materials and prompts being used, and the emergence of challenging behavior. This model provides the user with many variables to consider when evaluating the need for intervention modifications; however, the model was primarily designed to provide recommendations about common DTI procedures. Although DTI is a common intervention approach utilized during skill-acquisition services, not all types of skill-acquisition goals are commonly taught with this procedure (e.g., activities of daily living, social skills). Furthermore, the problem-solving model proposed by Ferraioli et al. did not include data on the application of the model to client barriers to learning. Given the limited frequency of citations of this article, which has only been cited seven times since its publication, it does not appear that this model of clinical decision making has been the focus of additional research to evaluate its use in practice.

A research-to-practice gap may exist for the use of systematic steps to engage in clinical problem solving when a barrier to learning is encountered in practice. This research-to-practice gap may be due to few published resources that are empirically validated for clinicians to reference as they attempt to problem solve their client’s barrier to learning. Thus, it is unclear what methods clinicians are using to address barriers to learning that occur while providing skill-acquisition services to learners. Researchers have called for the increased training of behavior analysts in complex decision making and problem solving (Daly et al., 2000; Wolfe et al., 2022). Therefore, the development and demonstration of a systematic problem-solving approach that can be applied across a large diversity of barriers to learning encountered by clients receiving skill-acquisition services represents a significant advancement on strategies behavior analysts can use to problem solve. Thus, the purpose of the present study was to evaluate the application
of a clinical problem-solving model to the identification and treatment of barriers to learning in skill-acquisition programs.

**General Method**

**Participants and Setting**

Four individuals diagnosed with ASD participated in this study. Table 1 lists each participant’s demographic information, setting, and the clinical program in which their barrier to learning was observed. All participants experienced the study procedures as part of their ongoing skill-acquisition intervention services at a university-based early intervention clinic that provides services for the treatment of language, academic, daily living, and social skills deficits. Individuals experiencing a barrier to treatment progress for intervention programs designed to decrease problem behavior did not participate in this study. Individuals were also excluded from participating in this study if their barrier to learning for a skill-acquisition goal had previously received more than one treatment modification that was not systematically evaluated during study participation using the clinical problem-solving model.

All sessions were conducted in each participant’s designated intervention space (e.g., private therapy room, individual table within larger space). The materials present for each session were limited to relevant instructional materials, participant-specific items for their schedule of reinforcement (e.g., toys, edibles, tokens), a table and chairs, video and audio recording equipment, and data collection materials.

**Study Enrollment**

Participants enrolled in this study following the identification of a barrier to learning for one of their intervention goals (e.g., tacting, intraverbal responding). The barrier to learning was identified at one of two stages of intervention (see Table 2): (a) before intervention on the skill
began (Stage 1), or (b) during intervention when acquisition of the skill remained low, variable, or there was an unexpected increase or emergence of challenging behavior for at least 5 sessions (Stage 2). Figure 1 depicts the procedures each participant experienced based on their enrollment at either Stage 1 or 2.

**Response Measurement and Data Collection**

The primary dependent variables were correct responses and prompted correct responses. Additional dependent variables related to the participant’s barrier to learning, such as attending and problem behavior, were also included. All operational definitions were individualized to each participant’s intervention goal and barrier to learning. For Alan, correct responses were defined as engaging in a grammatically accurate response related to the scenario presented (e.g., “The friend did not like the joke”) prior to the delivery of a prompt. Prompted correct responses were defined as engaging in a grammatically accurate response related to the scenario presented within 5 s of a prompt. For Harvey, correct responses were defined as engaging in a relevant response related to the scenario presented (e.g. “They have a paper cut”) prior to the delivery of a prompt. Prompted correct responses were defined as engaging in a relevant response related to the scenario presented within 5 s of a prompt. For James and Gilbert, correct responses were defined as engaging in an accurate response within 5 s of the instructor asking the target question. Prompted correct responses were defined as engaging in an accurate response within 5 s of a prompt. Independent differential observing responses (DORs) were defined as James or Gilbert engaging in the predetermined DOR (see below) within 5 s of the instructor’s cue. This correct DOR was required to include at least the WH- component and series component; however, repeating the full target question was also accepted. Prompted DORs were defined as James or Gilbert engaging in the predetermined DOR within 5 s of the instructor’s cue and vocal
model prompt. Correct responses and prompted correct responses are reported as a percentage by dividing correct or prompted correct responses by the total number of responses and then multiplying the quotient by 100.

**Interobserver Agreement**

Two independent observers collected data during each instructional trial for at least 28% of all sessions per study condition for each participant. For participants enrolled in the study based on the criteria of Stage 2, data for calculating interobserver agreement (IOA) were collected for all conditions once enrolled in the study (i.e., IOA data were not collected retrospectively for previous conditions which occurred before enrollment in the study). Interobserver agreement data on participant responding in each session and condition were calculated using exact trial-by-trial agreement per dependent variable. The number of trials with exact agreement between observers were divided by the total number of trials, and the quotient was multiplied by 100. Interobserver-agreement data were collected for Alan, Harvey, James, and Gilbert for 38-50%, 33-78%, 33-57%, and 28-44% of sessions per phase and condition, respectively. Agreement was 100% across all phases and conditions for Alan, 99.5% (range = 95-100%) for Harvey, 97% (range = 92-100%) for James, and 97% (range = 92-100%) for Gilbert.

**Procedural Integrity**

An experimenter collected data on the integrity of assessment and intervention implementation for at least 25% of all sessions per study condition for each participant. Procedural-integrity data for each intervention component were collected. Data collection was individualized to each participant’s intervention procedures but generally included the correct (a) set-up of instructional materials, (b) instruction delivery, (c) delivery of appropriate condition-
specific consequences following correct responses, (d) providing a prompt following an incorrect or no response in the appropriate time interval (if relevant to the condition), and (e) removal of instructional materials at the end of the trial. Procedural-integrity data were collected for Alan, Harvey, James, and Gilbert for 38-50%, 33-78%, 33-57%, and 28-44% of sessions, respectively. Integrity across all phases and conditions was 99% (range = 92-100%) for Alan, 99% (range =97-100%) for Harvey, 99% (range = 98-100%) for James, and 99% (range = 95-100%) for Gilbert.

Procedure
Each participant experienced an order of procedures based on enrollment at Stage 1 or 2. Refer to Figure 1 for the order of procedures.

Assessment of Reported Barrier to Learning (Stage 1)
Stage 1 participants (Harvey’s first half of participation, James, and Gilbert) were those who enrolled in the study before intervention on the target skill began. For example, Harvey enrolled in the study because his clinical team was uncertain about next steps in changing his schedule of reinforcement for skill-acquisition programs from a distributed schedule to an accumulated schedule. That is, Harvey’s clinical team wished to learn whether an accumulated schedule of reinforcement would be similarly efficacious to his current distributed schedule. To determine this, the experimenters first conducted an assessment comparing the efficacy of both distributed and accumulated schedules of reinforcement on Harvey’s acquisition of a novel skill (see below). Figure 1 depicts the order of procedures Harvey, James, and Gilbert experienced based on their enrollment at Stage 1.
**Observation of Current Intervention Procedures and Responding (Stage 2)**

For Stage 2 participants (Alan, and Harvey’s second half of participation), the experimenters first conducted a direct observation to measure the occurrence of the reported barrier to learning with the intervention procedures currently in place to teach that skill. Figure 1 depicts the order of procedures each participant experienced based on their enrollment at Stage 2. The experimenters collected IOA, procedural integrity, and descriptive data of the participant’s responding and therapist implementation for a minimum of three sessions. Examples of descriptive data the experimenters collected include the types of errors made, such as which stimulus was selected from the stimulus array or what vocal response was emitted in each trial.

**Data Analysis**

After conducting the direct observation of the reported barrier to learning, the experimenters conducted a data and error analysis of the participants’ responding and a review of the materials included in instruction. The experimenters reviewed these data to detect patterns of responding such as (a) position, stimulus, or response biases, (b) consistent error responses, (c) responding following prompts, (d) instances of no responding, (e) attending deficits, (f) partial performance of the response, (g) inconsistent or variable performance of the skill across trials or sessions, and (h) the occurrence of problem behavior. If additional data were needed to complete the error analysis, the experimenters and the participant’s clinical team modified data collection to include the additional dependent variables. For example, the experimenter might modify a participant’s data-collection system for an auditory-visual conditional discrimination task by including measures of the stimulus and position selected in each trial to detect a stimulus or position bias (e.g., Grow & LeBlanc, 2013). The experimenters inspected the instructional
materials for variables possibly leading to issues of faulty stimulus control, insufficient stimulus salience, or insufficient stimulus disparity.

After completing the data, error, and materials analysis, the experimenters conducted one of two subsequent assessments. The experimenters either conducted a barriers-to-learning assessment to confirm the participant’s specific barrier to learning or to evaluate the efficacy of two or more potential intervention modifications if more than one type of modification was matched as a solution to the identified barrier to learning.

**Barriers-to-Learning Assessment**

After completing the data, error, and materials analysis, the experimenters conducted an assessment to confirm the cause of the participant’s barrier to learning when there was a single matched intervention modification (Alan; e.g., a barrier to stimulus disparity when the relevant modification is to increase the disparity between stimuli) or if multiple treatment procedures needed to be compared to determine which was the most efficacious (Harvey, James, and Gilbert; e.g., comparison of different modifications to increase stimulus salience).

The barriers-to-learning assessment was conducted using procedures like those in the brief experimental analysis and assessment-based instruction literature (e.g., Eckert et al., 2000; Kodak & Halbur, 2021). That is, assessment conditions tested for the presence of hypothesized barriers to learning using an adapted-alternating treatments design in which conditions were rapidly alternated to evaluate participant responding. The experimenters developed and assigned novel instructional targets, comparable to those in the original treatment goal, to each assessment condition. The barriers-to-learning assessment continued until (a) the participant’s responding met the mastery criterion for one or more assessment conditions or (b) the participant’s responding did not demonstrate an increasing trend after five cycles of the assessment in at least
one condition. If the participant’s responding met the latter criterion (Harvey), the experimenters modified the assessment to better match the participant’s pattern of responding (e.g., conducted discrimination training on assessment conditions and added an additional control condition to increase discriminability).

**Application of Assessment Results to Intervention Procedures.** After identifying the source of the participant’s barrier to learning, the experimenters modified the participant’s original intervention procedures with a relevant modification to address it (see Table 3 and Figure 2 for examples). If new targets were included during intervention (Alan), a new baseline with modified targets was conducted. If the intervention modification required modified targets (James and Gilbert), then the intervention modification was added as the next phase of the skill-acquisition program.

**Participant 1: Alan**

**Study Enrollment**

Alan participated in this study due to low levels of correct responses during intervention (Stage 2) for a program designed to teach him to identify social problems and relevant solutions in small scenes depicted with figurines.

**Observation of Current Intervention Procedures and Responding**

To begin, the experimenters observed the current intervention in place, a 5-s prompt delay (PD) with vocal prompts. The two scenarios targeted in this intervention were recommended by his special education teacher for inclusion in treatment and related to a group of students in Alan’s classroom talking about a topic that was either familiar (e.g., Star Wars) or unfamiliar (e.g., tectonic plates) to him. In addition to IOA and procedural-integrity data, the
experimenters collected descriptive data on the vocal responses Alan emitted in each trial and visually examined the materials included during instruction.

Data Analysis

The experimenters reviewed Alan’s vocal responses in each trial. The experimenters also reviewed data for two other sets of targets for this program Alan acquired previously. The same intervention procedures as the current set of targets were used to teach two previous sets. Based on data collected in the direct observation, the experimenters identified that Alan was providing the same problem and solution responses for both scenarios across sessions. Upon reviewing the instructional materials used in this program, the experimenters identified that the same figurines were used in both target scenarios. Further, the figurines were positioned the same way (standing in a circle) and acted out a problem during a discussion in both scenarios.

Barriers-to-Learning Assessment

The experimenters hypothesized that Alan’s barrier to learning was due to low stimulus disparity between the target scenarios and program materials. To confirm this hypothesis, the experimenters created two sets of scenarios; one set included two, high-disparity scenarios, and one set included two, low-disparity scenarios. The scenarios in the high-disparity condition used different materials and figurines in each scenario and depicted two different activities (a figurine sleeping past his alarm and missing the bus and a figurine using an inappropriate tone of voice with a peer). The scenarios in the low-disparity condition used the same materials and figurines and depicted similar activities (a figurine telling a Star Wars joke that no one laughed at and the same figurine using a sarcastic tone after another figurine talked about Star Wars).

Application of Assessment Results to Intervention Procedures. After completing the disparity assessment, the experimenters modified the original intervention procedures to match
the high-disparity condition. That is, the target set was modified to increase the stimulus disparity between target scenarios. The original target scenario depicting a social conversation about a familiar topic (e.g., Star Wars) was changed to reflect a scene of a child figurine exiting a vehicle and walking away without an adult accompanying them. The experimenters then conducted two baseline probes of the modified target scenario; one probe before the disparity assessment and one immediately after. Finally, the experimenters implemented a 5-s PD procedure to teach the modified target set.

**Participant 2: Harvey**

**Study Enrollment**

Harvey enrolled in this study at Stage 1. At the time of this study, all of Harvey’s skill-acquisition programming incorporated a distributed schedule of reinforcement. That is, Harvey received a 20-30-s break following each correct response during a teaching session. During most reinforcement intervals, Harvey selected to engage in pretend-play activities (e.g., pretend play with dolls). Harvey’s clinical team identified that the total session duration of skill-acquisition programs was becoming significantly longer due to the additional time in-between learning trials that it took to transition to and from Harvey’s pretend-play activities. Therefore, Harvey’s clinical team wished to learn whether Harvey’s schedule of reinforcement could be transitioned to an accumulated schedule of reinforcement (i.e., each correct response adds additional time to one reinforcement interval delivered at the end of a teaching session) to decrease the total number of transitions for reinforcement intervals that occurred during sessions.

**Assessment of Reported Barrier to Learning (Stage 1)**

To begin, the experimenters conducted an assessment to compare Harvey’s acquisition with distributed and accumulated schedules of reinforcement. The experimenters selected three
schedules of reinforcement to include in the assessment: (a) distributed reinforcement, (b) accumulated reinforcement with tokens, and (c) accumulated reinforcement without tokens. The purpose of comparing accumulated reinforcement with and without tokens was to determine whether the delivery of physical tokens to signal the accumulation of time impacted learning outcomes. The experimenters wished to evaluate this because the accumulated reinforcement without tokens arrangement was most comparable to the reinforcement parameters Harvey experienced in his school environment.

The experimenters conducted this assessment with one of Harvey’s current treatment goals designed to teach him to identify common types of childhood illnesses and injuries (e.g., bloody nose, scrapped knees) as well as an appropriate remedy (e.g., telling an adult and getting a tissue or a bandage). The experimenters selected 15 common illnesses and injuries to teach Harvey. The targets were divided into three equated sets of five and were randomly assigned to one of the three schedules of reinforcement conditions using procedures described by Kodak and Halbur (2021). A colored piece of paper was paired with each schedule of reinforcement condition and was present during each session to enhance discriminability of assessment conditions using procedures described by Heal et al. (2009).

All targets were taught using a 5-s PD procedure to teach Harvey to identify both the illness or injury and an appropriate remedy. Each target was presented twice per session, for a total of 10 teaching trials per session. Each correct response resulted in a brief statement of praise and a 20-s reinforcement interval wherein Harvey was given access to a preferred tangible item (e.g., dolls, tablet).

**Distributed Reinforcement.** Following each correct response, the experimenter provided brief praise and gave Harvey a token. The experimenter then immediately signaled Harvey to
exchange the token by holding out their hand with their palm open. Following the exchange, the experimenter gave Harvey access to a preferred item for 20 s. After the 20 s had elapsed, the experimenter reclaimed the preferred item and immediately began the next teaching trial.

**Accumulated Reinforcement with Tokens.** Following each correct response, the experimenter provided Harvey brief praise and a token. At the conclusion of the 10 teaching trials, the experimenter signaled Harvey to exchange the tokens. After Harvey exchanged all 10 tokens, the experimenter gave Harvey access to a preferred item for a duration of 20 s for each of 10 tokens (3 min 20 s) and told him how long he was able to play (e.g., “You can play for 3 minutes and 20 seconds!”). After the 3 min 20 s had elapsed, the experimenter reclaimed the preferred item and ended the session.

**Accumulated Reinforcement without Tokens.** Following each correct response, the experimenter provided Harvey brief praise. At the conclusion of the 10 teaching trials, the experimenter gave Harvey access to a preferred item for the duration of 20 s for each correct response and told him how long he was able to play. After the 3 min 20 s had elapsed, the experimenter reclaimed the preferred item and ended the session.

**Application of Assessment Results to Intervention Procedures**

**First Application Assessment.** Based on the results of the initial assessment suggesting that all three schedules of reinforcement were relatively equally efficacious, the experimenters next assessed Harvey’s preference between these schedules to determine whether one schedule of reinforcement was more preferred relative to the others. This schedule of reinforcement preference assessment was conducted using procedures like those described in Hanley et al. (1997). At the beginning of each session, the experimenter laid out all three colored pieces of paper that were paired with the three schedules of reinforcement on the table in front of Harvey.
The experimenter then conducted a brief, two-trial teaching session with each of the schedules of reinforcement to expose Harvey to all three conditions. The experimenter first instructed Harvey to touch one of the three colors of paper. After Harvey touched the instructed color, the experimenter conducted two trials of the given schedule of reinforcement as described above. After completing the first schedule of reinforcement, the experimenter repeated this process with each of the two remaining schedules of reinforcement.

After completing the initial exposure to each of the schedules of reinforcement, the experimenter re-presented the three colored pieces of paper in front of Harvey and instructed him to select one. Following Harvey’s selection, the experimenter conducted a 10-trial teaching session of the condition associated with the selected color. For example, if Harvey selected the color associated with accumulated reinforcement with tokens, the experimenter conducted a teaching session with that schedule of reinforcement as described above.

**Discrimination Training.** After 15 sessions of the preference assessment were conducted, Harvey’s preference did not meet the termination criteria of four consecutive sessions selecting the same schedule of reinforcement. During these sessions, the experimenters observed behaviors from Harvey suggesting that he was not discriminating between the conditions. Specifically, he selected the condition placed on the right-hand side of the array in a majority of trials (i.e., a side bias). Therefore, the experimenters conducted supplemental training with Harvey to enhance his discrimination between conditions. The development and implementation of these procedures corresponded to the protocol for participants who entered the study at Stage 2. First, the experimenters added a fourth assessment condition, a control condition, in which Harvey did not receive any access to a preferred item. Instead, he was required to engage in work tasks for 3 min and 20 s. The purpose of this control condition was to ensure that Harvey
discriminated between the presence and absence of reinforcement in the assessment. Next, the experimenters conducted three sessions in which Harvey was instructed to repeat a vocal description of each condition’s color and associated schedule (“Black means tokens with short breaks,” “Brown, means tokens with long breaks,” “White means no tokens with long breaks,” and “Orange means keep working”). After Harvey correctly repeated each condition’s contingency, the experimenter conducted a two-trial teaching session and implemented the associated schedule of reinforcement. For the control condition, the experimenter presented previously mastered tasks to Harvey for 1 min.

After the three sessions of repeating the condition contingencies, the experimenters next conducted two sessions in which Harvey was asked to point to the correct color of paper that corresponded to each rule. That is, the experimenter laid all four colored pieces of paper in front of Harvey and delivered the instruction, “Which color means ____?” Following a correct response, the experimenter delivered brief praise, reshuffled the placement of each of the colored pieces of paper on the table, and presented the next trial. Each session consisted of four presentations of each rule for a total of 16 trials.

**Post-Discrimination Training Application Assessment.** Following discrimination training, the procedures of the first preference assessment were repeated. The only change from the original procedures was that the control condition was added as a selection.

**Participant 3: James**

**Study Enrollment**

James participated in this study due to a history of slow or minimal acquisition of correct responses during intervention for a series of programs designed to teach verbal conditional discriminations between various WH- questions (e.g., “What do you eat?” versus “Where do you
James’ clinical team wished to enroll him in this evaluation to determine an appropriate intervention modification that could be made to increase the efficacy and efficiency of subsequent verbal conditional discrimination programs.

**Review of Current Intervention Procedures and Responding**

To begin, the experimenters reviewed data on James’ responding in previous verbal conditional discrimination programs. The general protocol for each of these sets was the instructor presenting a WH-question related to a central topic (e.g., WH-questions about school, community helpers, daily routines) followed by the delivery of a vocal-model prompt either immediately (0-s PD) or on a 5-s PD. Each of the WH-questions based on the same central topic were written to be as identical as possible except for the WH-word that began the sentence. For example, the only difference between the WH-questions based on the topic of eating was whether the question began with “What” or “Where.”

**Data Analysis**

The experimenters reviewed data on James’ responding across previous verbal conditional discrimination programs. The instructors who implemented these programs recorded the response James provided in each instructional trial. Therefore, the experimenters were able to review these data for any patterns of errors. The experimenters identified that James frequently provided the same response for all WH-questions of the same topic. That is, James provided the relevant response to the “Who” question for most WH-questions on the same topic.

**Barriers-to-Learning Assessment**

The experimenters hypothesized that James’ barrier to learning was caused by low stimulus salience of the WH-questions being asked. Specifically, the experimenters hypothesized that his attending to the WH-component of each of these questions (i.e., “What”
versus “Where” or “Who”) was not sufficient. To resolve this barrier to learning in future verbal conditional discrimination programs, the experimenters wished to compare two different intervention modifications that could be made to increase the salience of the WH-component in each question. The two intervention modifications the experimenters evaluated were the use of a differential observing response (DOR) and an emphasis prompt for the WH-component (see below). The experimenters also included a control condition in the assessment in which no intervention procedures were implemented (i.e., baseline procedures).

The experimenters developed eight series of WH-questions to use in the assessment. Each series of questions on a central topic had a “What,” “Who,” and “Where” question. Each WH-question was made up of three words (e.g., “Who can cook?” “Where can cook?” and “What can cook”). Although this resulted in some target questions not being a complete sentence, the purpose of formatting questions this way was to keep the questions in each series identical except for the WH-component. Two series of questions were paired together to form a set of 6 questions (3 questions for 2 series) and were then randomly assigned to an assessment condition. Each WH-question was presented two times per session for a total of 12 trials per session. To control for consistency of the presentation of each WH-question across trials and sessions, each question was recorded as an audio file that could be played on a tablet. The experimenters evaluated the efficacy of both intervention modifications using a concurrent multiple probe design.

**Baseline and Control.** In each trial, the instructor presented the audio file of the target question and waited 5 s for James to respond. The instructor did not provide feedback to James regardless of his response. The instructor interspersed asking a previously mastered question approximately every two trials and provided praise and a token contingent upon correct response
which James could exchange later for access to a preferred item (e.g., game on a tablet). James could exchange his accumulated tokens for 1 min of access to a preferred item on a variable ratio (VR) 6 schedule of trials.

**Differential Observing Response (DOR).** In DOR sessions, James was required to echo the WH- component and the series component (e.g., “Who cook” “Where cook” or “What cook”) before responding to the question. Immediately following baseline sessions, James experienced two teaching sessions in which the instructor prompted him to engage in the DOR immediately after the audio file for each question was played (e.g., “Say Who cook”; 0-s PD). After James correctly echoed this phrase, the instructor replayed the audio file of the target question and then immediately prompted James to say the correct response. The instructor delivered praise and a token to James following correct responses and allowed him to exchange his accumulated tokens for 1 min of access to a preferred items on a VR 6 schedule of trials.

Following these two sessions of a 0-s PD for both the DOR and the correct response to the question, the instructor then implemented a 5-s PD for both the DOR and the correct response for all subsequent sessions. That is, the instructor provided 5 s for James to independently emit the DOR and the correct response in each portion of the trial. If James did not engage in the DOR within 5 s, the instructor then prompted James to emit it. If James did not engage in an independent correct response within 5 s, the instructor re-started the full trial by replaying the audio file, requiring James to emit the DOR, replaying the audio file a second time, and then immediately prompting the correct response.

**Emphasis.** In emphasis sessions, the audio file of each target question was modified such that the WH- component of each question was spoken at an elevated volume relative to the rest of the question (e.g., “WHO can cook?”). Immediately following baseline, James experienced
two teaching sessions in which the instructor immediately prompted James to echo the correct response (0-s PD). Following correct responses, the instructor delivered praise and a token to James following correct responses and allowed him to exchange his accumulated tokens for 1 min of access to a preferred items on a VR 6 schedule of trials.

Following the two 0-s PD sessions, the instructor then implemented a 5-s PD for all subsequent sessions. If James did not independently engage in a correct response within 5 s of the presentation of the audio file, the instructor replayed the audio file and then immediately prompted the correct response. After James’ responding met the mastery criteria in this condition (i.e., two consecutive sessions with 90% or greater independent correct responding), the experimenters removed the emphasis on the WH- component from the audio file (i.e., returned to the original audio file used in baseline). The procedures for these sessions were identical to the 5-s PD used previously except for the absence of the emphasis. The purpose of these sessions was to evaluate whether James could now engage in discriminated responding without the assistance of the emphasis modification.

**Application of Assessment Results to Intervention Procedures.** Following the conclusion of the comparison of the DOR and emphasis conditions, the experimenters applied the DOR procedure to the sets from the control condition. In the comparison, the DOR and emphasis procedures were equally efficacious in teaching James to engage in verbal conditional discriminations (see Figure 6). In determining which intervention modification to apply to James’ future programming, the experimenters concluded that the DOR procedure was relatively less complicated to use compared to the emphasis prompt which requires the clinical team to record audio files of each target question that have the emphasis on the WH- component. The DOR procedure was first applied to the control set from the first comparison of the assessment
using the same procedures as described above. This procedure was then subsequently applied to the control set from the second comparison of the assessment following the mastery of the first.

**Participant 4: Gilbert**

**Study Enrollment**

Like James, Gilbert participated in this study due to a history of slow or minimal acquisition of correct responses during intervention for a series of programs designed to teach verbal conditional discriminations between various WH-questions (Stage 1). Both Gilbert’s family and clinical team reported that Gilbert would frequently answer any question he was asked as if it was a “What” question (e.g., answering the question, “Where do you eat” by saying “food” as if he was asked, “What do you eat?”). Previously, Gilbert had also received instruction on a series of programs teaching him intraverbal-tacts of various pictures that involved WH-questions (e.g., answering “Dad,” “Ball,” and “Park” when asked, “Who,” “What,” and “Where,” respectively, about a picture of dad throwing a ball at a park). However, Gilbert’s correct responding to questions similar to those asked in this program decreased when the visual stimulus was removed from instruction. Therefore, Gilbert’s clinical team wished to enroll him in this evaluation to determine an appropriate intervention modification that could be made to increase the efficacy of subsequent verbal conditional discrimination programs that did not involve visual components.

**Review of Current Intervention Procedures and Responding**

To begin, the experimenters reviewed data on Gilbert’s responding in previous verbal conditional discrimination programs. The general protocol for each of these sets was similar to James with the instructor presenting a WH-question related to a central topic (e.g., WH-questions about school, community helpers, daily routines) followed by the delivery of a vocal-
model prompt either immediately (0-s PD) on a 5-s PD. Each of the WH- questions based on the same central topic were written to be as identical as possible except for the WH- word that began the sentence. For example, the only difference between the WH- questions based on the topic of brushing teeth was whether the question began with “Who,” “What,” or “Where.”

**Data Analysis**

The experimenters reviewed data on Gilbert’s responding across previous verbal conditional discrimination programs. The instructors who implemented these programs recorded the response Gilbert provided in each instructional trial. Therefore, the experimenters were able to review these data for any patterns of errors. A review of these data in addition to the reports of Gilbert’s clinical team and family confirmed that Gilbert often responded to any form of WH-question with a response most relevant to a “What” question.

**Barriers-to-Learning Assessment**

Similar to James, the experimenters hypothesized that Gilbert’s barrier to learning was caused by low stimulus salience of the WH- questions being asked. Specifically, the experimenters hypothesized that his attending to the WH- component of each of these questions (i.e., “What” versus “Where” or “Who”) was not sufficient. Therefore, the experimenters decided to conduct an assessment to compare two different intervention modifications that could be made to increase the salience of the WH- component in each question. The intervention modifications included in this assessment were identical to those in James’ assessment. The experimenters created twelve series of WH- questions that were formatted identically to those in James’ assessment. The only difference between James’ and Gilbert’s assessments was that the specific topics of the questions was based on their individual treatment goals. These series were then randomly assigned to sets in either the DOR, emphasis, or control conditions. The
experimenters evaluated the efficacy of both intervention modifications across two comparisons using a concurrent multiple probe design.

**Baseline and Control.** Sessions procedures during baseline and in the control condition were identical to those described for James. The only difference for Gilbert was that he was provided the opportunity to exchange accumulated tokens for either 1 min of access to a preferred item or three pieces of a preferred edible on a VR 4 schedule of trials.

**DOR.** Procedures of the DOR condition were identical to those described for James except for two components. First, Gilbert was provided the opportunity to exchange accumulated tokens for either a preferred item or edible on a VR 4 schedule of trials. Second, the experimenters wished to evaluate whether correct responding at mastery levels would maintain if the requirement to engage in the DOR was removed. The experimenters evaluated this with the second DOR set following Gilbert’s responding meeting mastery in the second comparison. The instructor collected data on whether Gilbert independently emitted the DOR in each trial but did not require him to emit it at any time.

**Emphasis.** Sessions in the emphasis condition were identical to those described for James except for the differences already noted in Gilbert’s schedule of reinforcement.

**Application of Assessment Results to Intervention Procedures.** Following the conclusion of the second comparison of the DOR and emphasis conditions, the experimenters applied the DOR procedure to the sets from the control condition. This application was identical to the procedures described for James.
Results

Alan

The data of Alan’s responding for his original targets, the barriers-to-learning assessment, and the application of assessment results to intervention procedures are depicted in Figure 3. Alan’s responding for his original targets (top-left panel) during the 5-s PD phase was low ($M = 16.7\%$; range, 0-25%) despite an initial five-session teaching phase with a 0-s PD. During the barriers-to-learning assessment (bottom panel), Alan’s correct responding for the high-disparity target set reached the mastery criterion of two sessions with 100% correct responding in 13 sessions, whereas correct responding remained low throughout 13 sessions of the low-disparity target set ($M = 19.2\%$; range, 0-75%). The experimenters subsequently modified Alan’s original target set to reflect the characteristics of the high-disparity condition from the barriers-to-learning assessment (top-right panel). Alan’s correct responding for the modified target set reached the mastery criterion within 12 sessions. The total duration of Alan’s participation in this study was 1 hr and 15 min.

Harvey

The data of Harvey’s correct responding during teaching sessions with the distributed reinforcement (top), accumulated reinforcement with tokens (middle), and accumulated reinforcement without tokens (bottom) conditions are depicted in Figure 4. Across all three conditions, Harvey’s correct responding met the mastery criteria of two sessions with 100% accuracy of both correct tacts of illness and the remedy in four (distributed) or five sessions (accumulated with and without tokens). In the second teaching session of the accumulated reinforcement with tokens condition, the experimenters modified the acceptable correct responses for the remedy for a cough by making it a shorter response due to Harvey’s difficulty
in correctly echoing the full statement. These data suggested that all three reinforcement arrangements were relatively comparable in efficacy.

The data of Harvey’s selections during the schedule of reinforcement preference assessment are depicted in Figure 5. During the first 15 sessions of the preference assessment (top left panel), Harvey selected the distributed reinforcement condition in four sessions, the accumulated reinforcement with tokens in five sessions, and the accumulated reinforcement without tokens in six sessions. Harvey’s selection behavior did not meet the termination criteria of five consecutive sessions of selecting the same schedule of reinforcement. During the discrimination training the experimenters conducted to increase Harvey’s discrimination of the reinforcement contingencies of each condition (bottom panel), Harvey engaged in 100% correct echoic behavior during the three sessions of echoic and exposure training. He also engaged in 100% correct responding during the two sessions of listener training.

Harvey’s did not select the distributed reinforcement or newly added control conditions in any of the following 15 sessions. Harvey selected the accumulated reinforcement with tokens condition during six sessions. He selected the accumulated reinforcement without tokens condition during nine sessions. Although Harvey’s selection behavior still did not meet the mastery criterion of five consecutive sessions, he did exclusively allocate all his selections to the accumulated reinforcement conditions. The experimenters therefore concluded that Harvey preferred accumulated reinforcement arrangements relative to distributed reinforcement conditions with a slight preference for an accumulated reinforcement arrangement without tokens. The total duration of Harvey’s participation in this study was 7 hr 8 min.
**James**

The data of James’ barriers-to-learning assessment in which two potential intervention modifications, a DOR and emphasis prompt, were compared are depicted in Figure 6. Following the introduction of the 5-s PD, James’ correct responding met the mastery criterion of two consecutive sessions with 90% or greater accuracy in four sessions for both the DOR and emphasis conditions. Additionally, correct responding remained at mastery levels in the emphasis condition when the emphasis prompt was removed from the audio files. Upon introduction of the DOR protocol to targets in the control conditions, James’ correct responding met the mastery criterion in seven sessions for the first set and five sessions in the second set. The total duration of James’ participation in this study was 5 hr and 38 min. The total duration of the data and error analysis and the development of the assessment methods by the experimenters was 2 hr and 40 min.

**Gilbert**

The data for Gilbert’s barriers-to-learning assessment in which two potential intervention modifications, a DOR and emphasis prompt, were compared are depicted in Figure 7. Following the introduction of the 5-s PD in the first comparison, Gilbert’s correct responding met the mastery criterion of two consecutive sessions with 90% or greater accuracy in 17 sessions for the DOR condition and 14 sessions for the emphasis condition. Following the removal of the emphasis prompt from the condition, correct responding decreased slightly but returned to mastery levels in 11 sessions. During the second comparison, Gilbert’s correct responding met the mastery criterion in seven sessions for the DOR condition and five sessions for the emphasis condition. Following the removal of the requirement for Gilbert to emit the DOR from the condition, correct responding decreased slightly but returned to mastery levels in eight sessions.
Following the removal of the emphasis prompt from the condition, correct responding remained at mastery levels. Upon introduction of the DOR protocol to targets in the control conditions, Gilbert’s correct responding met the mastery criterion in three sessions for the first set and in two sessions for the second set. The total duration of Gilbert’s participation in this study was 11 hr and 41 min. The total duration of the data and error analysis and the development of the assessment methods by the experimenters was 1 hr and 20 min.

**Discussion**

We evaluated the application of a clinical problem-solving model to the identification and treatment of barriers to learning in skill-acquisition programs for four different learners with ASD. For one learner, Alan, we applied this problem solving model to address a barrier to learning encountered for one set of targets in a program he had previously acquired other sets of targets. We identified that the barrier to learning was caused by a low degree of stimulus disparity between the target scenarios included in the instructional set. We subsequently designed an assessment to evaluate the impact that differing levels of stimulus disparity had on Alan’s skill acquisition. The assessment confirmed that the level of stimulus disparity was indeed a relevant factor in Alan’s acquisition of new skills. We used these assessment results to subsequently modify Alan’s original teaching program to increase the stimulus disparity between the target scenarios included in the instructional set. We then observed an increasing trend in correct responding across session, which resembled Alan’s previous rates of acquisition of novel skills.

For a second learner, Harvey, we applied this problem solving model to obtain guidance on changes that could be made to Harvey’s schedule of reinforcement used in his skill-acquisition programming. We first compared the efficacy of three different reinforcement
arrangements (distributed reinforcement, accumulated reinforcement with tokens, and accumulated without tokens). Harvey’s data suggested that all three arrangements were equally efficacious. We then sought to evaluate Harvey’s preference for each of these reinforcement arrangements through a preference assessment. Initially, Harvey displayed a lack of differentiation in his preferences which suggested that Harvey may not have acquired discriminations between each of the colored papers paired with the reinforcement conditions. We addressed this in a relatively quick manner by conducting a brief discrimination training to ensure Harvey could discriminate between the stimuli associated with each condition and different reinforcement arrangements. After completing discrimination training, Harvey began to demonstrate a clear preference for accumulated schedules of reinforcement. Interestingly, Harvey selected the accumulated reinforcement without tokens condition more frequently than the accumulated reinforcement with tokens condition.

Although we observed Harvey make positive remarks about the tokens used in this evaluation (characters from his favorite television show), we hypothesize that Harvey’s responding may have become sensitive to the additional delay to reinforcement he experienced in the token condition when he was required to hand each of his tokens to the experimenter. That is, Harvey’s responding may have become sensitive to fact he could access reinforcement more immediately in the accumulated condition that did not require a token exchange. Harvey’s clinical team used the results of this assessment to inform the transition to utilizing an accumulated schedule of reinforcement without tokens arrangement broadly for all of Harvey’s programming. Additionally, the clinical team agreed to periodically offer Harvey the opportunity to acquire physical tokens as well to attempt to incorporate Harvey’s preferences for different reinforcement arrangements in his services.
For two other participants, James and Gilbert, we conducted a comparison of two different intervention modifications that were matched to the barrier to learning that was observed to be present for both of them in their programming to teach verbal conditional discriminations (lack of stimulus salience for WH-questions). The results of both of their assessments demonstrated that both intervention modifications, a DOR and an emphasis prompt, were both efficacious to teach James and Gilbert novel verbal conditional discriminations. For James, both intervention modifications were similarly efficacious and efficient. James’ clinical team ultimately selected to apply a DOR procedure to future verbal conditional discrimination programs due to its ease of implementation relative to an emphasis-prompt procedure that required additional materials preparations (i.e., recording each of the emphasis audio files). For Gilbert, his responding met the mastery criterion in slightly fewer sessions in both comparisons with the emphasis prompt compared to the DOR condition; however, Gilbert’s clinical team concluded that the possible difference in efficiency was not significant enough to warrant an emphasis prompt’s use over the relatively simpler procedure to implement (the DOR). In addition, Gilbert’s school requested information about how to teach responding to varied WH-questions, and the clinical team anticipated the DOR would have higher social validity than suggesting teachers use emphasis prompts in their classroom setting.

Each of these applications of the problem-solving model to a learner’s clinical programming is an example of a systematic, rather than trial-and-error, process to resolving barriers to learning that emerge in the context of skill-acquisition services for individuals with ASD. A trial-and-error process to resolving barriers to learning may involve the sequential introduction of multiple intervention modifications that may or may not be efficacious in resolving the core barrier. This process could eventually lead to an appropriate intervention being
put in place that adequately resolves the barrier to learning; however, there is no guarantee that the first, second, or third modification that is tried will be efficacious or the most efficient option to resolve the barrier to learning. Additionally, even if a modification does result in a resolution of the barrier to learning, the clinician may still not have enough information to understand why that modification was effective.

Compared to a trial-and-error approach, a systematic problem-solving model helps to guide the clinician through a functional analysis of all potentially relevant variables at the onset of problem solving (Kodak et al., 2011). This process can help narrow down any further information or data that the clinician needs to make an informed decision about an intervention modification that is best matched to the observed barrier to learning. In many ways, this process is comparable to a medical model of intervention (Farre & Rapley, 2017). That is, the clinician first asks a series of questions about the learner’s responding and the learning task itself. The clinician then uses that information to determine the need for further assessments (i.e., a barriers-to-learning assessment). Once the clinician completes the necessary assessment(s), the clinician can then prescribe an appropriate intervention modification that is matched to the observed barrier to learning and then monitor to see whether the modification resolves the initial barrier to learning or whether further assessments or modifications are necessary.

Calls for increased training of behavior analysts in strategies for clinical problem solving and complex decision making have been made over the last 24 years (Daly et al., 2000; Ferraioli et al., 2005; Wolfe et al., 2022). The results of this study contribute to the identification and validation of problem solving models with which behavior-analysts can utilize when the clients they serve encounter a barrier to learning during their skill-acquisition services. This proposed clinical problem-solving model aims to be applicable to many of the different types of barriers to
learning that can arise during skill-acquisition services (issues of treatment fidelity, skill deficits, performance/motivational deficits). By offering a general method which can be applied across barriers to learning that emerge across a diverse array of skill-acquisition programs, as demonstrated in this study, we suggest that this problem-solving model (and other proposed models; e.g., Ferraioli et al., 2005) may serve as the basis for clinical training for individuals preparing to become behavior analysts. When comparing this problem-solving model with earlier models, such as Ferraioli et al. (2005), the current model may extend previous models by applying a systematic decision-making process to a broader range of skills and intervention approaches other than DTI procedures that clinicians may target in practice.

Additional research, however, is needed to inform the clinical problem-solving model that can be used by current and future behavior analysts to address client barriers to learning. First, the current study contains a relatively small sample of applications of the proposed problem-solving model ($n = 4$). Second, the current investigation demonstrated the problem-solving model’s sensitivity (i.e., the ability for a model to detect the presence of a given variable) but did not demonstrate the model’s specificity (i.e., the ability for a model to detect the absence of a given variable) for the included barriers to learning (Kodak et al., 2011). The demonstration of a model’s sensitivity and specificity is essential when evaluating both its validity and utility. Therefore, collecting additional data sets will be necessary to evaluate the model’s generality, sensitivity, and specificity across participants and barriers to learning.

It is also important to note that this problem-solving model represents a series of relatively complicated clinical behaviors that also require training. For example, the user of the problem-solving model must be familiar with components of assessment-based instruction that are commonly incorporated into the barriers-to-learning assessments. Individuals must also be
familiar with each of the types of barriers to learning displayed in the problem-solving model to ensure they can discriminate one barrier (and its matched treatment modifications) from another. We are currently working to develop a series of materials that consist of tutorials and checklists that can guide the user through each of these complex steps.

Further research is also needed to understand the time and other resources needed to complete a clinical problem-solving process for a barrier to learning. That is, future research is needed to evaluate the costs of this problem-solving model to ensure that the time spent engaging in problem-solving activities does not significantly interfere with a clinician’s responsibilities and case management for that learner. Regardless of whether the clinician utilizes a trial-and-error or systematic problem-solving approach to address a barrier to learning, a certain amount of time and other resources will be needed to resolve it. Thus, it is important to ensure that the resources spent engaging in systematic problem solving do not significantly impact a clinician’s productivity. In the current study, participants completed their enrollment in 1 hr 15 min (Alan), 7 hr 8 min (Harvey), 5 hr 38 min (James), and 11 hr 41 min (Gilbert). When evaluating these durations, it is important to refrain from comparing durations across participants. That is, these durations are not easily comparable due to individual differences in the session protocols each participant experienced, differences in the number of conditions included in each assessment, and the number of targets taught in each condition. For example, the average duration of each session in Alan’s barriers-to-learning assessment was approximately 2 min compared to an average duration of 6 min per session for Gilbert. Additionally, Alan’s assessment included one comparison of two assessment conditions followed by an application of the assessment results back to the original teaching targets, whereas Gilbert’s assessment included two comparisons of two assessment conditions followed by an application of the assessment results to the control
conditions in each comparison. Therefore, certain differences in assessment duration between participants are inherent based on the specific barrier to learning being assessed. One limitation of the reported duration data in this study is that these durations do not include the duration of the initial data and error analysis the experimenters conducted to identify the barrier to learning or the duration of development of the assessment methods for two participants (Alan and Harvey). For James and Gilbert, the experimenters spent 2 hr and 40 min and 1 hr and 20 min, respectively, conducting the data and error analysis and the development of assessment methods. Future studies should include measurements of specific data and error analyses conducted to provide a more representative report on the total duration of participants’ enrollment.

Additional research is also needed to continue conducting demonstrations of this problem-solving model with additional types of barriers to learning. The participants in the current study exemplified three different types of barriers to learning that may be encountered during skill-acquisition services; however, there are certainly many more than that. In the current version of the clinical problem-solving model proposed in this study, an additional seven types of barriers to learning are included. It is important to continue applying this model to additional barriers to learning to demonstrate the generality of the proposed methodology across many types of clinical barriers.

The demonstration of a systematic problem-solving approach that can be applied across a large diversity of barriers to learning encountered by clients receiving skill-acquisition services represents an advancement on previous research in which a trial-and-error process has been used. Future research in this area will lead to the refinement of methods to engage in effective problem solving and help behavior analysts systematically address a wide variety of barriers to learning that arise in the span of their careers.
References

 https://www.autismspeaks.org/state-regulated-health-benefit-plans


<table>
<thead>
<tr>
<th>Participant and age (years)</th>
<th>Sex</th>
<th>Race/ethnicity</th>
<th>Skill experiencing barrier to learning</th>
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<tbody>
<tr>
<td>Alan, 13</td>
<td>Male</td>
<td>White</td>
<td>Identification of social problem and relevant solution in small vignettes</td>
</tr>
<tr>
<td>Harvey, 8</td>
<td>Male</td>
<td>White</td>
<td>Uncertain next step in transitioning to a leaner schedule of reinforcement for skill-acquisition programming</td>
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<tr>
<td>James, 11</td>
<td>Male</td>
<td>Black</td>
<td>Verbal conditional discriminations</td>
</tr>
<tr>
<td>Gilbert, 10</td>
<td>Male</td>
<td>Middle Eastern</td>
<td>Verbal conditional discriminations</td>
</tr>
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</table>
### Table 2

*Stages for Study Enrollment*

<table>
<thead>
<tr>
<th>Stage of Intervention</th>
<th>Barrier to Learning is Identified</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1</strong></td>
<td>Before intervention on the skill begins; based on caregiver or service-provider report</td>
<td>A clinician identifies an unclear next step in the client’s services, such as uncertainty about whether the client’s schedule of reinforcement can be changed from a distributed schedule to accumulated</td>
</tr>
<tr>
<td><strong>Stage 2</strong></td>
<td>During intervention when acquisition of the skill remains low, variable, or there is an unexpected increase or emergence of challenging behavior</td>
<td>A clinician implements an intervention procedure to teach a client intraverbal responses, but no acquisition has occurred after 5 sessions</td>
</tr>
<tr>
<td>Barrier to Learning</td>
<td>Relevant Intervention Modification</td>
<td>Select Citations</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Staff Deficit</td>
<td>Conduct training with staff members to improve integrity</td>
<td>Colón &amp; Ahearn (2019)</td>
</tr>
<tr>
<td>Low or variable treatment integrity</td>
<td>Teach a differential observing response (DOR) or modify instructional materials to increase salience</td>
<td>Reid et al. (2021)</td>
</tr>
<tr>
<td>Attending or salience issue</td>
<td>Implement multiple exemplar training (MET) or increase the number of MOs included in training</td>
<td>Dube &amp; McIlvase (1999)</td>
</tr>
<tr>
<td>Insufficient exemplars or motivating operations (MOs)</td>
<td>Increase the frequency or duration of practice opportunities or add in error correction</td>
<td>Schnell et al. (2018)</td>
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<tr>
<td>Insufficient practice or training</td>
<td>Modify instructional materials to increase stimulus disparity</td>
<td>Haq et al. (2015)</td>
</tr>
<tr>
<td>Skill Deficit</td>
<td>Conduct training for the missing pre-requisite skill(s)</td>
<td>DeSouza et al. (2019)</td>
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<tr>
<td>Stimulus disparity issue</td>
<td>Modify instructional materials to increase stimulus disparity</td>
<td>Fisher et al. (2019)</td>
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<tr>
<td>Missing or weak pre-requisite skill</td>
<td>Evaluate different prompt-fading strategies or prompts</td>
<td>Halbur et al. (2021b)</td>
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<tr>
<td>Trouble fading prompts</td>
<td>Evaluate different prompt-fading strategies or prompts</td>
<td>DeLeon et al. (2014)</td>
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<td>Waits for prompts before responding</td>
<td>Include differential reinforcement or an extended response interval</td>
<td>Cividini-Motta &amp; Ahearn (2013)</td>
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<tr>
<td>Performance Deficit</td>
<td>Manipulate task parameters to decrease response effort</td>
<td>Friman &amp; Poling (1995)</td>
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<td>Task too effortful</td>
<td>Manipulate MOs or reinforcement parameters</td>
<td>Ghaemmaghami et al. (2018)</td>
</tr>
<tr>
<td>Competing motivating operations (MOs)</td>
<td></td>
<td>Davis et al. (2012)</td>
</tr>
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Figure 1

Sequence of Study Participation

Stage 1:
Barrier to learning reported by caregiver or clinical team prior to instruction

Assessment of reported barrier to learning and data analysis

Stage 2:
Identification of barrier to learning during instruction

Observation of current responding and data analysis

Use of the problem-solving model

Assessment developed based on the hypothesized barrier to learning from the problem-solving model

Application of the assessment outcomes to current and/or future instruction
**Figure 2**

*Clinical Problem Solving Model*

- **Client not making progress on acquisition goal**
  - **Skill Deficit**
    - Attending or Salience Issue
    - Stimulus Disparity Issue
    - Insufficient Practice or Training
    - Insufficient Exemplars or Motivating Operations (MOs)
    - Missing or Weak Pre-Requisite Skill
    - Trouble Fading Prompts
    - Wait for Prompts Before Responding
    - Task too Effortful
    - Competing Motivating Operations (MOs)
  - **Performance Deficit**
    - Differential Observing Response (DOR) or Material Modifications
    - Multiple Exemplar Training (MET) or increase number of MOs
    - Increase Frequency/Duration of Practice Opportunities or Add Error Correction
    - Material Modifications
    - Conduct Training for the Pre-Requisite Skill
    - Evaluate Different Prompt-Fading Strategies or Prompts
    - Differential Reinforcement or Extended Response Interval
    - Manipulate Task Parameters

- **Is the program being conducted with high procedural fidelity?**
  - **Yes**
  - **No**
    - Conduct training with staff member(s) to improve fidelity and reassess.
Figure 3

Clinical Problem Solving Data for Alan

Note. Alan’s percentage of correct responses during teaching of the target scenarios (top panel) and the disparity assessment (bottom panel). Alan’s enrollment in the study began during session 14 of teaching the target scenarios. BL = baseline condition, PD = prompt delay, HD = high disparity.
Figure 4

*Harvey’s Acquisition of Targets in Each Reinforcement Arrangement*

Note. Harvey’s percentage of correct tacts of the illness (circles) and an appropriate remedy (squares) across the distributed reinforcement (top), accumulated reinforcement with tokens (middle), and accumulated reinforcement without tokens (bottom) conditions. Harvey’s correct responding in each session of the initial preference assessment is depicted on the right-hand side of each panel. BL = baseline condition, PD = prompt delay.
Figure 5

Harvey’s Schedule of Reinforcement Preference Assessment and Discrimination Training

Note. Harvey’s cumulative selection responses (top left and top right panels) between the distributed reinforcement (circles), accumulated reinforcement with tokens (squares), accumulated reinforcement without tokens (triangles), and the control (diamonds) conditions. Correct responding during the phases of discrimination training (echoic and exposure training and the listener training) are depicted in the bottom panel.
Figure 6

Clinical Problem-Solving Data for James

Note. James’ percentage of correct responding during the intervention comparison (top) of the DOR (triangles), emphasis (closed squares), and control (circles) conditions. The replication of the DOR procedures to the second control set is depicted in the bottom panel. Sessions in the emphasis condition in which the emphasis prompt was removed are depicted as open squares. BL = baseline condition, DOR = differential observing response.
**Figure 7**

*Clinical Problem-Solving Data for Gilbert*

*Note.* Gilbert’s percentage of correct responding during the first (top) and second (bottom) comparisons of the DOR (triangles), emphasis (closed squares), and control (circles) conditions. Sessions in the DOR condition in which the requirement to engage in the DOR was removed are depicted as open triangles. Sessions in the emphasis condition in which the emphasis prompt was removed are depicted as open squares. BL = baseline condition, DOR = differential observing response.