7-2021

Using Programmed Instruction Modules to Improve Training Outcomes

Zoe Cosato

Using Programmed Instruction Modules to Improve Training Outcomes

by

Zoe Cosato

A Thesis

Submitted to the Graduate Faculty of

St. Cloud State University

in Partial Fulfillment of the Requirements

for the Degree

Master of Science in

Applied Behavior Analysis

August, 2021

Thesis Paper Committee:
Benjamin Witts, Chairperson
Odessa Luna
Michele Traub

Abstract

There are many different methods of training staff, but all have limitations. Programmed Instruction is one such method to train staff that can be a more convenient way to teach basic knowledge. New staff at an autism clinic were delivered three courses of programmed instruction modules for skillsets related to correctly implementing programs to identify if this method was an effective way to improve treatment integrity outcomes. A multiple baseline design across skills that was replicated across staff evaluated treatment integrity performance for behavior technicians. Out of the six behavior technicians that received the brief programmed instruction modules, no meaningful changes in performance were observed for any behavior technician. The brief programmed instruction modules did not create more stable responding in the intervention phase and most participants exhibited similar patterns of responding (e.g., highly variable) between baseline and intervention. The lack of an identifiable meaningful improvement in behavior technician performance may be due to multiple factors, including the sporadic and infrequent data collection that occurred in this applied setting. There are still many avenues of exploration for programmed instruction in the future, including the need for more current analog research on programmed instruction to support using programmed instruction in the natural environment in the age of computers.

Table of Contents

Page

Chapter Page

List of Figures

Figure Page

Chapter 1: Introduction

Competent services require competent training, one of the reasons that the Behavior Analyst Certification Board (2012) requires all supervisors to receive training on behavioral skills training (BST). BST has been used to teach staff, parents, and children skills to the desired levels of competency in a variety of settings (Gianoumis et al., 2012; Himle et al., 2004; Miltenberger et al., 2004; Sarokoff & Sturmey, 2004). However, BST comes with some downfalls. Regardless of a practitioner's competency on a procedure, they can only consistently demonstrate effective staff training using BST if the practitioner has been trained in BST (Parsons et al., 2013). Becoming sufficiently skilled in BST and conducting skill training for BST can be a time-consuming endeavor that is not always achievable in many settings (Parsons et al., 2013). This issue of time-consuming implementation and training has led some to explore ways to improve efficiency on dissemination of BST via BST, such as pyramidal staff training (Parsons et al., 2013). However, pyramidal staff training may not be the solution for efficient dissemination of high quality staff training, as the non-expert trainers suggested to conduct the bulk of training may be subject to competing contingencies (i.e., competing job expectations, insufficient time for typical job duties and training dissemination) that prevent them from carrying out their roles as trainers at the desired levels of integrity (Parsons et al., 2013). Others have turned to exploring more automated ways of delivering components of training, like basic Applied Behavior Analysis (ABA) knowledge or the information-based components of BST, using tools such as: eLearning, in service training, vaguely described "multicomponent training," computer-based BST instruction, and computer-based programmed instruction (Granpeesheh et al., 2010; Ingvarsson & Hanley, 2006; Luiselli et al., 2010; Nosik et al., 2013; Tudor & Bostow, 1991; van Oorsouw et al., 2009).

Automated Trainings

These non-BST methods are important to explore because trainings delivered over the computer, like eLearning and computer-based programmed instruction (referred to as programmed instruction from here), have the potential to be more accessible when expert level trainers, like those required for BST, are not readily available (Granpeesheh et al., 2010). Alternative methods of instruction are not new and many even predate BST. However, the "hardware problem" noted with program instruction's zenith of the 1950s and 60s rendered much of programmed instruction and related literature inefficient, impractical, poorly controlled, and wildly useless for real world training in many settings (Lockee et al., 2004; Tudor & Bostow, 1991). However, the advent of the computer and proliferation of computer skills and access justifies renewed interest in these automated learning methods and continued exploration of this body of literature.

Granpeesheh et al. (2010) found that learners performed better on tests of basic ABA knowledge in a traditional lecture format compared to eLearning; however, learners still demonstrated the desired levels of knowledge acquisition in the eLearning condition. It is also worth noting that eLearning is a rather vague term, so it is possible that skillfully designed programmed instruction would have resulted in more similar or better performance to the traditional lecture style component. Granpeesheh et al. (2010) identified that improved performance in the lecture condition may have been due to participants' ability to ask clarifying questions and receive immediate feedback that would not have been available in the eLearning condition. However, if the eLearning condition had been set up like true programmed instruction, learners should have had the ability to contact the immediate feedback necessary to better improve scores and remedial or repeated frames to remedy poor performance.

Automated trainings that do not require the immediate presence of a trainer also offer the added benefit of cost and time savings (Granpeesheh et al., 2010; Ingvarsson & Hanley, 2006; Nosik et al., 2013). A single expert level trainer could create programmed instruction modules that are accessed by a limitless number of trainees per day, compared to BST where a single expert trainer could train only a handful of participants per day or lecture where a large group of people were present with little to no participation and individualization. The components of BST (instruction, modeling, and feedback) delivered via computer-based instruction alone were not sufficient to develop and support the desired levels of therapist performance in the training environment with a research assistant or in the natural environment with a client according to findings by Nosik et al. (2013). However, the traditional BST condition took three times as long to complete than did computer-based instruction, with the more efficient computer-based instruction still producing stark improvements in therapist ability compared to baseline (Nosik et al., 2013). Incorporating programmed instruction into staff training has the potential to meaningfully increase the number of staff that are competently trained when it is paired with the components of BST that cannot be automated, like roleplay, or ongoing feedback.

Programmed instruction can also provide learners with more flexible learning schedules, immediate feedback, easy score assessment and reporting, consistency of expert-level instruction between learners, and mimic the effects of high quality, individualized instruction in settings where individualized instruction with an expert would not be feasible (Fernald & Jordan, 1991; Ingvarsson & Hanley, 2006; Nosik et al., 2013).

Not all of the automated, more consistent methods of delivering staff training have been labeled as and meet the criteria of programmed instruction, such as the study by Granpeesheh et al. (2010). Programmed instruction can come in many variations, but all programmed instruction

should contain seven key elements: clear learning objectives, small steps, a logical sequence, active responding, immediate feedback, drill and practice, and stimulus fading (see Fernald & Jordan [1991] for full details). Despite the variations that programmed instruction can contain, researchers have consistently demonstrated programmed instruction as a meaningful way to improve learner performance (Fernald & Jordan, 1991; Ingvarsson & Hanley, 2006; Kritch & Bostow, 1998; Kulik et al., 1980; Tudor, 1995; Tudor & Bostow, 1991). For example, Tudor and Bostow (1991) demonstrated the essential nature of the active responding component to improve learner performance on tests of the selected topic when compared to simply reading the material or answering questions covertly when using programmed instruction. The meaningful increase in performance created by frequent, active participant responding is likely key for the improvements in performance and is not necessarily available, frequent, or evenly dispersed across other teaching formats that allow for simultaneous training of many people like they are in programmed instruction (e.g., lecture, in-service; Kritch & Bostow, 1991; Tudor, 1995).

Programmed Instruction

Programmed instruction was one of the first occurrences of when methods of instructional design and development were empirically created and tested (Lockee et al., 2004). The state of the literature leaves some to disagree on what programmed instruction is conceptually and its key components, so the descriptions of programmed instruction included here may be at odds with other existing literature but will be used to guide the course of this study (Lockee et al., 2004). Programmed instruction, as originally envisioned by Skinner (1968), would rely on positive reinforcement to avoid using aversive control, provide immediate feedback, be a skillfully designed program that uses successive approximations to reach the terminal behavior, and provided the high number of contingencies necessary to master the

behavior (Lockee et al., 2004; Skinner, 1968/2003). Skinner's original ideas necessitated some degree of automaticity, which took the form of his early teaching machines, so that humans could be used to focus on the components of instruction that could not be automated while allowing learners to use teaching machines to contact highly individualized instruction and the number of contingencies necessary for mastery (Lockee et al., 2004; Skinner, 1968/2003). Programmed instruction can be conceptualized as a product and a process, but the conceptualizations of programmed instruction as a product are most relevant to this course of study (Bullock & Langdon, 1978; Lockee et al., 2004). As a product, programmed instruction should be a mediated, self-paced or self-administered learning program composed of a "structured sequence of instructional units" (Bullock & Langdon, 1978, p. 3; see also Lockee et al., 2004). For the purpose of this study, programmed instruction will be delivered using electronic technology, though it has historically been delivered with mechanical machines or on paper.

Each instructional unit would be called a "frame;" the contents of each frame can vary from entirely text, question only, text and a question, feedback on question, etc. Regardless of what comprises a frame, the frame can be best conceptualized as the smallest instructional unit within programmed instruction. For the purpose of this study, a frame was what the learner had access to at one time. The frames in this study contained text (sometimes pictures or videos if necessary) on the target behavior, a related question, or choice-specific feedback based on the answer selected. A series of frames can then be assembled into a module (Molenda, 2008). Modules can be further assembled into a series or course of programmed instruction (Molenda, 2008). The most familiar conceptualization of programmed instruction would likely be to describe it in terms of a textbook. A textbook, or a course of programmed instruction, is

subdivided into chapters. Each chapter is similar to a module, where it represents a relevant subtopic within the textbook. Like a book chapter is comprised of pages organized together into a logical, sequential manner that is intended to build on itself, each frame is a single unit of instruction that is sequentially ordered to build on itself and can be combined into a module when joined as part of a series of frames.

Issues like the size of each frame or linear vs branching program sequences do not determine if something is or is not programmed instruction (Molenda, 2008). However, these issues are what must be altered for a programmed instruction course to be most appropriate for the environment, teaching medium (e.g., book vs computer), and learner. However, the components described above by Fernald and Jordan (1991) describe the essential components. For example, a series of meaningfully sequenced frames cannot be developed if Fernald and Jordan's first criteria, clear learning objectives, are not met, making the first criteria of clear learning objectives conceptually essential to programmed instruction. Second, small steps were identified as a necessary component by Fernald and Jordan, but should be best conceptualized as the smallest appropriate step—some learners can be successful with what would be too large a step for another.

The third point required of programmed instruction is a logical sequence, which is necessary for a mediated system of teaching to produce the desired outcomes—concepts must be introduced in such a way that basic concepts necessary for more complex skills must precede the complex skill teaching (Fernald & Jordan, 1991). This order is necessary because programmed instruction was created to result in learning in the absence of an expert-level teacher available to alleviate questions caused by poor sequencing (Lockee et al., 2004; Skinner, 1968/2003).

Fourth, active responding is required for something to be considered programmed instruction (Fernald & Jordan, 1991). Tudor (1995) had demonstrated that constructed responses were the most successful type of active response, but constructed responses are not essential to conceptually meet the criteria of programmed instruction. Active responses, such as selecting and submitting the answer on multiple choice questions, are sufficient to meet the active response criteria but may result in poorer performance compared to constructed responses (Tudor, 1995). However, active responding of some sort is required so that a learner can be immediately delivered the correct feedback and given the next most appropriate frame or module; the programmed instruction cannot determine what feedback or frames would be appropriate to give without an active response.

Fifth, immediate feedback is considered essential to programmed instruction, as this was one of the original conceptual issues Skinner used to separate it from more traditional forms of instruction (Lockee et al., 2004; Skinner, 1968/2003.). Traditional forms of instruction, like lectures, failed to provide immediate individualized feedback to all students, which Skinner viewed as inhibiting learning (Lockee et al., 2004; Skinner, 1968/2003).

Sixth, drill and practice was identified as a key component of programmed instruction (Fernald & Jordan, 1991). Drill and practice is the sixth essential conceptual component of programmed instruction, because Skinner identified it as a key feature that must be present when conceptualizing a method to improve instruction compared to the traditional methods used (Lockee et al., 2004; Skinner, 1968/2003). Skinner (1968/2003) identified traditional means of instruction as providing insufficient opportunities and contingencies necessary to achieve mastery of a skill, with programmed instruction being the way to remedy this problem by

providing substantially more of these opportunities through mediated/automated drill and practice (Lockee et al., 2004).

The final conceptual component of programmed instruction is stimulus fading (Fernald & Jordan, 1991). Programmed instruction should be designed so that a learner's responses are almost always correct (there is debate on what "almost always correct" should be when converted to a percentage correct), but prompts and priming must be used for a learner to contact this condition. However, prompts that are used must be faded as part of the logical sequencing and small steps so that learners can exhibit independent responding on the program (Fernald & Jordan, 1991).

Automated Programmed Instruction and Staff Training

The company where the study took place already engages in staff training components like teaching basic ABA knowledge and ongoing feedback for all staff. However, companies can differ in their expectations of therapeutic elements like prompting, error correction, behavior management, etc. As the current company continues to grow and Board Certified Behavior Analysts have to trade off some of their job duties (e.g., new staff training) to people who have taken on these roles as a full-time position but are not BCBAs, the company runs the risk of having non-experts adulterate the desired topics of staff training with misinformation or misrepresentation. Additionally, using instruction materials that were created by other companies has the added risk of wasting time covering topics that are not relevant to the population served, facility guidelines, and state policies and never covering topics that a new hire will need for work at this facility. Adding brief programmed instruction to the facility's new hire training has the potential to improve new hire performance, since new hires will be contacting and receiving accurate feedback on information that is created by an expert, conceptually systematic, consistent

with company policies and expectations, and receiving information at a pace that is most likely to evoke a new hire's best performance (i.e., training will not move too fast or slow). Brief, company-specific programmed instruction modules can also be disseminated to all relevant sites at the company as it grows, can easily be used for booster sessions with poor performers, and provide training that is guaranteed to be consistent across all new hires (where human led trainings run the risk of becoming wildly inconsistent).

Brief modules (designed with a fifteen minute or less goal in mind, although actual time spent will vary across learner based on their skill set) are proposed so that they will be easy to incorporate in a typical behavior therapist's daily routine from hiring until mastery, will not become tedious, and address the topics most essential for improved therapist performance. It is important for the modules to avoid tedium, since programmed instruction relies on learners contacting very little error correction so feedback will primarily mimic praise and, therefore, function as a reinforcer (Fernald & Jordan, 1991). It has been identified that a knowledge of the results is not universally reinforcing across learners, so this strategy of brief instruction as incorporated with the company's typical in situ training and ongoing feedback should be more appropriate across the body of learners included (Molenda, 2008). Modules that are too long may lose their reinforcing properties simply because a behavior therapist has habituated to the little reinforcement naturally embedded into programmed instruction. Brevity is also a primary interest of these programmed instruction modules so behavior therapists will still have time to participate in other trainings routinely implemented, like in situ training and feedback, that have been demonstrated as essential for ultimately getting behavior therapists to reach mastery criterion in the natural environment. However, using programmed instruction to address knowledge questions, practice discrimination, and attempt generalization should promote more

efficient skill acquisition among behavior therapists relevant to the time spent on instruction. For example, a senior staff member does not have to spend time explaining the error correction procedure or what a type of prompt is, they can simply observe the behavior tech attempt the targeted behavior, provide the relevant feedback, and quickly move on to observing the next target skill. Therefore, this study will address how brief programmed instruction modules can be used to supplement the typical new hire training to promote improved treatment integrity across four skill groups currently targeted in the company's treatment integrity monitoring.

Chapter 2: Method

Participants

For a behavior technician (BT) to be included, they must have started on site at the facility within the last one to six weeks of the study start date. All participants were required to be newly hired BTs at the facility and not returning hires. Eight BTs met inclusion criteria. Two BTs were excluded from participation due to being unavailable during the study (e.g., on vacation, out sick).

Setting

This study was conducted at a center that provided applied behavior-analytic treatment to clients and led individual and group parent trainings based on ABA. The facility does not specialize in any specific type of maladaptive behaviors (e.g., not a feeding clinic) but does specialize in autism and related diagnoses. All aspects of the study were conducted at the facility; no parts of the study involved BTs running programming at the client's home or other settings outside of the clinic. The typical diagnosis of clients at the clinic included: autism spectrum disorder (ASD), intellectual disabilities, and/or developmental disabilities. The facility is situated in a metropolitan area exceeding 100,000 people. The company had four active locations, three of which were in the aforementioned metropolitan area. The metropolitan area encompassed two counties which were 90.8% and 87.5% white, 5.2% and 7.8% black or African American, 0.6% and 0.4% American Indian or Alaska Native, 1.1% and 2.4% Asian, and less than 0.1% and 0.1% Native Hawaiian and other pacific islander (United State Census Bureau, 2020). The company was in the process of opening four additional locations outside the metropolitan area. This study was conducted at one facility within the company that contained four teams of six to ten clients. The clients at this facility ranged in age from four to eighteen. Clients were placed on

a team with other children of similar skill sets and ages and staff were assigned to work on a specific team where they spent most of their time.

New staff were restricted from working with clients with difficult programming or challenging behavior. Due to the scope of this study, it was determined in conjunction with the facility representative that treatment integrity data should not be collected on new staff if they were placed with a client who has overly complex programming. This was not a formal policy at the company, but one that the facility's representative, a Board-Certified Behavior Analyst, deemed most appropriate for the facility where the study was being conducted. It was determined a priori which clients and/or programs should be included and excluded from treatment integrity data collection. Treatment integrity data were collected for clients and programs that were identified as being something a new staff should be able to competently execute. It was possible that new staff were placed with more challenging clients for some brief sessions if there were no more experienced staff available to work with the more challenging client.

Materials

The behavior support plan programs were shared on the platform Central Reach. Programs on Central Reach can, but do not always, include information on: S^Ds, materials, response definition, reinforcement, prompting, error correction, and the procedure. These programs on Central Reach comprise the behavior support plans that are always available to BTs. An iPad is provided to all BTs at the facility, which was used to complete the digital programmed instruction modules (PIM) via Adobe Captivate Prime and access client programs on Central Reach.

PIMs were presented as a module that could be completed independently by the BT in what was hoped to be no more than 15 minutes by the BT. However, no time limitations were

implemented on the module and the BT could leave the module whenever it was appropriate to do so (i.e., when they were scheduled to work with a client). Adobe Captivate (module authoring tool) and Adobe Captivate Prime (learning management system) were used to create and deliver the PIMs because it allowed for forced repetition of incorrect questions, automatically reported scores to the supervising BCBA and researchers, and allowed us to provide the BT with the module they would need to complete next.

Brief Programmed Instruction Modules

PIMs were accessible to the BT via Adobe Captivate Prime. The skills tracked by the company for treatment integrity were divided into four courses, with each course focused on a different therapist skillset. These courses covered the skillsets of setting and resetting the environment, running trials, prompting, and trial response. Each course consisted of multiple PIMs addressing components of that course's skill. The PIM for each component skill was comprised of several frame types[1]. These frame types included conceptualization frames, discrimination frames, and generalization frames. Conceptualization frames consisted of text on the topic followed by a question on conceptualizing the topic with access to the conceptualization text. A discrimination frame consisted of having a BT discriminate an example of the skill from non-examples or having a BT discriminate a non-example from an example with access to the conceptualization text, i.e., discriminating the example from three nonexamples or one nonexample from three examples. A generalization frame consisted of identifying the option that contained a key feature or identifying the option that was missing a key feature without access to the conceptualization text. Each component had up to 26 possible

[1] In programmed instruction, a frame is anything that the learner can view at one time, based on the origin of programmed instruction where each frame is the content visible in the teaching machine window. A frame can contain text, questions, and/or feedback on questions.

frames programmed (two conceptualization frames with four answer-specific frames for feedback, two discrimination frames with four answer-specific feedback frames per discrimination frame, and two generalization frames with four answer-specific feedback frames per generalization frame), but an employee might not access all frames if no errors occurred on the first 11 frames. If an employee made no errors, they would only receive: (1) Conceptualization text frame, (2) Conceptualization question frame, (3) Conceptualization question feedback, (4) Discrimination question frame, (5) Discrimination feedback frame, (6) Discrimination question frame, (7) Discrimination feedback frame, (8) Generalization question frame, (9) Generalization feedback frame, (10) Generalization question frame, and (11) Generalization feedback frame.

Regardless of the question frame type, all question frames had the same system of response options. The options included a correct answer, close-in incorrect, far-out incorrect, and distractor (see also Tiemann and Markle, 1990). A correct answer contained all the elements needed to be correct. A close-in incorrect answer was correct in all elements except one or was deceptively similar to the correct answer. A far-out incorrect was correct in some or most elements but was less deceptively similar to the correct answer. A distractor was not intended to deceive the BT as potentially being a correct answer. Take for example the conceptualization frame from the fixed ratio schedules PIM. The question was: “In fixed ratio schedules, you provide clients with reinforcement based on:” The correct answer was: “A repeating pattern of the number of behaviors completed.” This was the correct answer because it has the elements of repeating (i.e., fixed), being based on the number of behaviors (i.e., ratio), and describes reinforcement as contingent on the behavior. The close-in incorrect was: “A variable pattern of the number of behaviors completed.” This was the close-in incorrect because it had the elements

of being variable instead of fixed but was based on the number of behaviors and described reinforcement as contingent on the behavior. The far-out incorrect was: “The time that has elapsed since starting the program.” This was the far-out incorrect because it did not describe a repeating pattern (i.e., fixed) and did not describe a behavior-based pattern (i.e., ratio) that did not clearly identify the behavior as being contingent on a specific number of behaviors. The distractor option was: “Schedules of reinforcement describe when reinforcement is delivered.” This is a distractor option because it relates to the topic discussed but does not clearly relate to the question asked as a potentially reasonable answer.

Each PIM consisted of introducing a topic (e.g., defining it, relating the skill to programming, providing a conceptual statement), having the participant identify what an example of the skill is, having the participant identify what a nonexample of the skill is, having the participant identify which example has a feature, and which example does not have a feature of the skill. For example, in the fixed ratio component skill for the therapist skillset of trial response, BTs were introduced to how fixed ratio schedules are unchanging, repeating patterns where reinforcement was contingent on the number of correct behaviors the client completed. Next, the BT received a question on conceptualization of the skill, in this case, the question was about how fixed ratio schedules are a repeating (fixed) count based (ratio) system of reinforcement delivery contingent on correct responding. The BT was then directed to feedback specifically for the option they selected. If the option they selected was correct, they would then be sent to the next question which was on discrimination. If the option they selected was one of the three incorrect options, they would first receive feedback specific to their option and then be required to repeat the conceptualization question until correct. Next, they received a question that required them to discriminate a fixed ratio schedule from schedules that were not fixed ratio.

Like the previous question, correct answers resulted in being sent to the next question while incorrect answers required the BT to repeat the question. The third question was on discriminating a non-example of a fixed ratio schedule from example of a fixed ratio schedule. The fourth question required the BT to identify the option that contained a feature of a fixed ratio schedule without any access to the conceptualization text. The fifth question was the final question and required the BT to select the option that was missing a feature of a fixed ratio schedule. After the BT got all five questions correct, they were done with the module and received a message that prompted them to exit the current module and start another module if it was available and they had the time or to return to their scheduled activities. See the Appendix for an example module.

The forced repetition of incorrect questions was not stopped by the software at any time, but the BT could leave the modules whenever they were scheduled to complete other activities. The PIMs were designed with brevity in mind (i.e., should be able to be completed in 15 minutes or less), but some PIMs could have taken longer if the BT continued to get incorrect answers. Some PIMs featured short videos (e.g., 30-seconds) or photos that modeled the topic being assessed, provided an exemplar of correct or incorrect responding, etc. that the BT needed to view and answer questions about.

The required repetition of incorrect questions was not compatible with the more stringent mastery criteria of getting 100% on each question on the first attempt with Adobe Captivate and Adobe Captivate Prime. Mastery criteria of the PIMs was set at simply earning a score of 100% on the PIMs because this study was focused more on making the most effective use of the little reinforcement available in this mode of learning while also being the most consistent with programmed instruction. If a more stringent mastery criteria of 100% correct on each question

the first time it was encountered was used, the BT would have to repeat the entire module multiple times and it would not be possible to require them to repeat questions that were incorrect until they were correct. After a BT had mastered a PIM, they would cease to receive the mastered PIM while previously mastered PIMs would continue to be available to them. They would then receive the next PIM for the skillset until all had been completed. Mastery of a PIM was getting all questions of the PIM correct.

To create the PIMs, target behaviors were pulled from the company's original treatment integrity data collection system. The target behaviors were grouped according to skillset they best fit with. The skillsets were defined and sent to the BCBA that oversaw the company's team of BCBAs to ensure that the skill groupings and definitions comported with company standards. Following approval of the supervising BCBA, these skill domains and definitions were shared with the company's team of behavior analysts (comprised of BCBAs and those pursuing certification while working in a behavior analyst role under the supervision of a BCBA) for feedback to ensure all definitions were comprehensive and applicable across clients served. The definitions were adjusted based on the clinical team's feedback. Next, the hierarchy diagrams (see Tiemann and Markle, 1990) were completed based on the approved skills and definitions to isolate the relationship between skills for the purpose of creating multiple choice question answers that complied with the a priori criteria set. Those a priori criteria included a correct option, a close-in incorrect option, a far-out incorrect option, and a distractor option. Following completion of the hierarchy for multiple choice questions, the module conceptualization text, questions, multiple choice answer options, and feedback for each answer option were created. The modules were then sent to the company's BCBAs for final review. Recommended changes were made based on BCBA feedback and then assembled into modules using Adobe Captivate.

The modules were uploaded to the platform Adobe Captivate Prime for learner access and assigned to the learner when they were supposed to work on it.

Target Behavior Selection, Definitions, and Measurement

The target behavior under investigation was the percent of correctly implemented behaviors for the four skillsets of Setting and Resetting the Environment, Running Trials, Prompting, and Trial Response. The course Setting the Environment consisted of three modules on Setting up, Identifying reinforcers, and Resetting the environment. The course Running Trials consisted of three modules on Removing the reinforcer, Securing client attention and providing the correct S^D, and Intertrial behavior. The course Prompting consisted of three modules on Prompts, Response prompts, and Stimulus prompts. The course Trial Response consisted of five modules on Reinforcement, Fixed ratio schedules, Variable ratio schedules, Interval schedules, and Error correction.

Performance was presented as the percentage of steps where the BT correctly implemented the targeted skill domain for the program as described in the client's behavior support plan. Each skillset was broken down into a checklist of steps that were either marked as being completed correctly, incorrectly, or should have occurred but did not per 30-second interval. Senior behavior technicians (SBT) supervised the BT to collect the treatment integrity data following training. An SBT already regularly overlaps BTs per facility policies, so the treatment integrity checks for programs were incorporated into these existing supervision opportunities to map onto current facility practices at the risk of slower or sporadic data collection. The SBT needed to collect five uninterrupted minutes of treatment integrity per skillset for the data collected to count as a session for data analysis. SBTs regularly overlap BTs to answer questions on programming, model programming, provide feedback on programming,

and to support safely responding to challenging behavior. Therefore, at the end of each five-minute data collection period per skill group, the SBT marked the interval as either “keep” or “discard.” Allowing the SBT to immediately mark interrupted sessions as keep or discard allowed for more accurate data to be collected without the ethical complications of trying to determine post hoc what data (if any) should be discarded. Only five-minute data collection periods where an interruption as described above occurred was eligible to be discarded. Data collectors were not permitted to discarded data based on data being too bad or too few intervals having data. Data collection periods where the target behavior occurred for only a couple of intervals had the potential to make the data skew more harshly to one extreme or another, but no criteria was outlined a priori for the number of intervals where data collection must occur to mark as “keep” or “discard”, so it was all kept for analysis. No data marked “keep” by an SBT was discarded post hoc.

Variables and Blinding

The independent variable in the current study was the delivery of skill-specific PIMs. The dependent variable is a staff’s performance with each skillset. BTs were told that the PIM training is part of the onboarding process to the clinic.

Treatment integrity data were collected by senior behavior technicians who typically spend some part of their day “overlapping” a BT to provide support and feedback. During these sessions, BTs did not normally collect data on paper or use an interval recording system that was audible to others. Therefore, it was anticipated that BTs would find the overlapping staff’s behavior odd and may question it. If any behavior technicians asked what the data collector was doing, the data collector told the BT that they were practicing taking data to improve their skills as an overlapper. Only four SBTs (one per team) were selected by the company to pilot an

interval-based treatment integrity data collection system, which may have impacted blinding among the data collectors as they were trained and tasked with collecting extra data that others in their roles were not. Due to these data collectors' role within the company, some also knew that the treatment integrity data were being used for a master's thesis but was not aware of all components of the thesis. All data collectors were told that following the pilot of collecting treatment integrity data with one SBT from each team, every senior on every team would be expected to learn to collect these data using an interval recording system. The data collectors were given a list of staff to overlap and told that the facility is first collecting data on new staff performance to better identify how to support new staff to better support blinding.

Design

This study was a multiple baseline design across skill domains, replicated and counterbalanced across BTs. Each participant had four tiers, with each tier consisting of a different skill domain. The first tier was an AB design, the second tier was an AB design with the A phase of tier two being longer than the A phase of tier one, the third tier was an AB design with the A phase of tier three longer than the A phase of tier two, and the fourth phase was a control tier. Baseline and control phases consisted of the BT having written instruction, in the form of the client's behavior support plan, available to them at all times, after starting on site. A control tier was included to better rule out any practice effects that may occurred.

Tiers one, two, and three all required a phase change. Phase change for tier one occurred when a BT has had at least one session observed following the completion of rapport building. Rapport building is typically the first one to two weeks a BT is on site, but the exact length of the rapport building phase depends on the BT's skills and how many hours per week they work. BTs do not typically independently run programming before their first 40 hours of employment and

up to first 80 hours of employment. Phase change for tier two occurred at least three days after intervention started for tier one. Phase change for tier three occurred at least three days after intervention started for tier two. Tier four stayed in baseline for the duration of the study. These time-based criteria were implemented to better accommodate the needs of the facility though a specific number of sessions observed could not be guaranteed.

Inter-Observer Agreement

Given the parameters at the clinic, it was not typically possible to have two observers present to collect IOA nor is it frequently possible to record sessions for later direct observation by a second recorder. Therefore, IOA was collected by overlapping each data collector for a minimum of one skill group per week with additional IOA data collected as scheduling allowed. During IOA data collection, the observers shared one iPad with a video that contained auditory and visual prompts for interval data collection on one side of the screen and the client's program pulled up on the other side.

Data collectors were trained by the first author, using methods approved by the facility representative. Data collectors were required to take data with the first author using the methods described above until the data collector achieved three sessions where IOA was 80% or greater. Following each training session, the first author and data collector reviewed the data collected and discussed it for discrepancies related to behaviors observed and how it fit with the given definitions. Two data collectors were enrolled in a master's programs in applied behavior analysis and two data collectors were pursuing or had attained a four year degree or other advanced education in a field related to behavior analysis at the time of the study.

Procedure

Informed Consent

Informed consent was sought from the facility whose new staff training was being altered. When obtaining informed consent from the facility, an approved representative reviewed the proposal and sent the study proposal to the organization's legal department after the approved representative had no further changes to recommend.

New Hire Training

The clinic's new hire training consisted of new BTs starting on site for their first day. Over the course of their first few weeks of employment, they were expected to complete the Behavior University 40-hour RBT training, observe clients on their team, and rapport build with clients on their team. During baseline, a BT had access to the client's programs in the form of written instructions on Central Reach available to them but was not required to read the programs or be tested on programs at any point. However, most supervisors did recommend reading through programs that another BT was running when observing the client.

Baseline

In baseline, the BT worked with the client to run the behavior support plan programs per the written instructions they normally received after being given the instruction to begin running programming with clients by their direct supervisor or team's behavior analyst. The BT was not required to read through or be tested on the written instruction at any point.

Intervention

In intervention, the BT continued to have access to any forms of written instruction available in baseline (e.g., behavior support plan programs via Central Reach, scheduling info kept in client materials). Every day that the BT had fifteen minutes of free time from clients or lunch, the BT was expected to work through as many modules of programmed instruction as they

could for the current skillset course. BTs were allowed to work through as many modules as they have time to work on if they have additional free time and modules available.

Chapter 3: Results

Participant 1

See Figure 1 for participant 1's data. Participant 1 received the skills in the order of (1) Prompting, (2) Trial Response, (3) Setting and Resetting the Environment, and (4) Running Trials. This participant did not have any data collected in intervention for any skill, no data for the skill of Running Trials, and only had one baseline data point collected in the skills of Prompting, Trials Response, and Setting and Resetting the Environment. Therefore, there is no data available for percent of non-overlapping data points, nor averages scores to compare between baseline and intervention.

Participant 2

See Figure 2 for participant 2's data. Participant 2 received the skills in the order of (1) Trial Response, (2) Setting and Resetting the Environment, (3) Running Trials, and (4) Prompting. Two data points of baseline and eleven data points of intervention were collected for Trial Response. Nine data points of baseline and seven data points of intervention were collected for Setting and Resetting the Environment. Nine data points of baseline and seven data points of intervention were collected for Running Trials. Prompting served as the control skill where thirteen data points were collected.

For the skill of Trial Response, there were zero non-overlapping data points. Participant 2 scored an average of 55% across baseline and 66% across intervention, demonstrating an 11% improvement. However, the scores remained variable and were trending downwards.

For the skill of Setting and Resetting the Environment, there were zero non-overlapping data points. Participant 2 scored an average of 97% across baseline and 86% across intervention,

demonstrating a 12% worsening in skills. However, the scores remained consistent in baseline and intervention, excluding one outlier data point in intervention.

For the skill of Running Trials, there were zero non-overlapping data points. Participant 2 scored an average of 61% across baseline and 92% across intervention, demonstrating a 30% improvement in skills. The scores in intervention appear somewhat stable, excluding one data point that breaks from the trend. Similar scores were seen in intervention and baseline, following the first two data points in baseline.

For the skill of Prompting, participant 2 scored an average of 72%. Participant 2's scores remained highly variable with the skill of prompting throughout, which may be due to how data was collected for the skill of prompting.

Participant 3

See Figure 3 for participant 3's data. Participant 3 received the skills in the order of (1) Setting and Resetting the Environment, (2) Prompting, (3) Trial Response, and (4) Running Trials. Four data points of baseline and one of intervention are available for the skill of Setting and Resetting the Environment. Five data points of baseline and one of intervention were collected for the skill of Prompting. Seven data points of baseline were collected for the skill for Trial Response. Participant 3 was able to complete two of the three modules for Trial Response at the time of this study's completion. Running trials served as the control skill where five data points were collected.

For the skill of Setting and Resetting the Environment, there were zero non-overlapping data points. Participant 3 scored an average of 88% across baseline and 100% across intervention, demonstrating a 12% improvement in skills. However, the scores remained fairly consistent between baseline and intervention.

For the skill of Prompting, there were zero non-overlapping data points. Participant 3 scored an average of 90% across baseline and 90% across intervention, demonstrating a 0% average change. Participant 3's scores remained fairly consistent with the skill of prompting throughout, which may be due to how data was collected for the skill of prompting.

For the skill of Trial Response, participant 3 scored an average of 45%. However, the scores remained variable and were trending with this skill.

For the skill of Running Trials, participant 3 scored an average of 84%.

Participant 4

See Figure 4 for participant 4's data. Participant 4 received the skills in the order of (1) Running Trials, (2) Prompting, (3) Trial Response, and (4) Setting and Resetting the Environment. Two data points of baseline and one data point of intervention were collected for Running Trials. Three data points of baseline and one data points of intervention were collected for Prompting. No data points were able to be collected for Trial Response. Setting and Resetting the environment served as the control skill where four data points were collected.

For the skill of Running Trials, there were zero non-overlapping data points. Participant 4 scored an average of 55% across baseline and 60% across intervention, demonstrating a 5% improvement.

For the skill of Prompting, there were zero non-overlapping data points. Participant 4 scored an average of 53% across baseline and 33% across intervention, demonstrating a 20% worsening in skills. However, the scores remained consistent in baseline and intervention.

For the skill of Trial Response, no data was able to be collected.

For the skill of Setting and Resetting the Environment, participant 4 scored an average of 98%. Participant 2's scores remained consistent across the three data points.

Participant 5

See Figure 5 for participant 5's data. Participant 5 received the skills in the order of (1) Setting and Resetting the Environment, (2) Running Trials, (3) Prompting, and (4) Trial Response. One data point of baseline and three data points of intervention were collected for Setting and Resetting the Environment. Two data points of baseline and one data points of intervention were collected for Running Trials. Four data points were collected for Prompting. Trial Response served as the control skill where three data points were collected.

For the skill of Setting and Resetting the Environment, there were zero non-overlapping data points. Participant 5 scored an average of 100% across baseline and 84% across intervention, demonstrating an 16% worsening.

For the skill of Running Trials, there were zero non-overlapping data points. Participant 5 scored an average of 94% across baseline and 100% across intervention, demonstrating a 6% improvement in skills.

For the skill of Prompting, participant 5 scored an average of 90%. Participant 5 appeared to be making mild, consistent improvement over the course of baseline which may indicate a practice effect.

For the skill of Trial Response, participant 5 scored an average of 76%. Participant 5's scores remained consistent with the skill of Trial Response throughout.

Participant 6

See Figure 6 for participant 6's data. Participant 6 received the skills in the order of (1) Prompting, (2) Trial Response, (3) Running Trials, and (4) Setting and Resetting the Environment. One data point of baseline and one data points of intervention were collected for Prompting. Zero data points of baseline and one data point of intervention were collected for

Trial Response. Two data points of baseline and one data point of intervention were collected for Running Trials. Setting and Resetting the Environment served as the control skill where two data points were collected.

For the skill of Prompting, there were zero non-overlapping data points. Participant 6 scored an average of 100% across baseline and 80% across intervention, demonstrating a 20% worsening.

For the skill of Trial Response, there were zero non-overlapping data points. No data was available for baseline. Participant 6 scored an average of 78% across intervention.

For the skill of Running Trials, there were zero non-overlapping data points. Participant 6 scored an average of 70% across baseline and 100% across intervention, demonstrating a 30% improvement in skills.

For the skill of Setting and Resetting the Environment, participant 6 scored an average of 100%.

IOA per data collector

See Figure 7 to review data collector A's scores. See Figure 8 to review data collector B's scores. See Figure 9 to review data collector C's scores. See Figure 10 to review data collector D's scores. Based on Figures 7, 8, 9, and 10, no one data collector seemed to be significantly inaccurate with their data collection relative to the IOA data. Some major differences do appear in the scores between the data collectors and IOA, but these larger differences appear more frequently at the beginning of the data collection process than towards the end of the data collection process. Disagreements in scores between the data collectors and IOA are less extreme as more data was collected. Data collector A had four instances of perfect agreement with IOA across all four skillsets. Data collector B had four instances of perfect

agreement with IOA across all four skillsets. Data collector C had four instances of perfect agreement with IOA across all four skillsets. Data collector D had two instances of perfect agreement with IOA across all four skillsets.

Chapter 4: Discussion

Programmed instruction, as executed in this study, was not effective at improving staff performance when implementing ABA programming with clients. The average scores between baseline and intervention were not meaningfully different, nor was there an improvement in the variability between baseline and intervention for most skills and participants. However, it is worth noting that the results observed for participants in the study might not have reflected the level of improvement that could have been observed with a different system of programmed instruction than the one used in this study. As noted in the introduction, programmed instruction does have the ability to make meaningful, although limited, improvements in skills that require generalization beyond simply answering questions. Pursuing programmed instruction further as a means to teach basic conceptual understanding is likely going to be the most appropriate use of programmed instruction in this type of setting. Improvements related to actually implementing programs with fidelity might not truly be possible without the learner contacting some type of feedback on their performance implementing the skill (e.g., BST, in-situ training components, etc.). Programmed instruction, as delivered in this study, was structured in a way that was not specifically designed for learners with a specific learning history (e.g., someone with a high school diploma, someone who has not worked with children before, etc.). Due to how programmed instruction was targeted broadly at new staff in this study, it may not be possible for these programmed instruction courses to be effective at improving staff performance with implementing programs. In essence, programmed instruction likely improved knowing *about*, but showed no evidence of improving knowing *how*. Given the complex nature of ASD intervention, knowing about arguably helps to scaffold knowing how, but without that latter piece we perhaps should not be surprised limited change was seen.

One reason these modules may not improve performance with implementing programs is that staff may need more specific support related to their skills so they can identify when they are making errors. Learners who cannot identify they are making errors may be less likely to change their behavior because they do not have the skill to recognize stimuli signaling their behavior should be changed. For learners without many relevant skills, they may do better with programmed instruction geared at reviewing many trials of programming and identifying what steps were done correctly or incorrectly and why, than to have questions that focus too much on conceptualizing these skillsets. The focus on brief programmed instruction may have denied the learners the opportunity to contact the number of trials they needed for true skill mastery in favor of focusing on preventing habituation to the reinforcement available in this system of learning and promoting active responding in a format that would work best in the clinical setting where answers selected need to be automatically scored so the learner can be immediately routed to the next appropriate frame.

It is worth noting that the system of programmed instruction used here is only one way to implement programmed instruction in this setting. These courses of programmed instruction were not branching in nature, as learners did not receive remedial instruction for poor performance but were instead cycled repeatedly through the same frames until desired performance was achieved. A system of branching programmed instruction may be more appropriate when working with a series of learners with different learning histories. BTs in this study ranged in formal education from high school diplomas to enrollment in master's programs. However, it would be appropriate to conclude that this exact iteration of programmed instruction may be insufficient to evoke the desired level of performance and alterations should be made in future research.

It is also worth noting that those who fulfill a different role at this facility may benefit more from programmed instruction learning opportunities than the learners selected for this study (i.e., new staff). The senior behavior technicians at this facility may have been a better group to target with programmed instruction as a means to improve their ability to recognize if BTs were implementing skills correctly, what types of errors were made, and what types of behaviors warranted praise. Programmed instruction may better map onto skills that rely on proficient discriminating and tacting features of correct and incorrect responding.

Behavior technicians need skills beyond discrimination and tacting; they need to develop skills related to motor behavior, timing, and engaging in specific vocal behaviors that may be nearly impossible to target directly using programmed instruction with currently available technology. However, there is the exciting possibility that with the development of virtual reality technologies, more complex systems of programmed instruction that better maps onto providing a high number of consistently high-quality, self-paced learning opportunities that target both gross and fine motor behavior, timing of therapy skills used, and vocal responses may be possible with these new technologies in the future.

Also, some of these modules may have been more appropriate for staff who have been with the company a while. Some of the behaviors tracked included items such as reading procedures or identifying reinforcers prior to starting programming, for example. Employees that have been with the company for longer and are more familiar with the preferences and programs of all the children they work with, may be less likely to do all these steps for each session over time even though they should. Using the brief PIMs from this study as a refresher training for existing staff may be a more appropriate use of brief PIMs, while more intensive and branching

programmed instruction may be more appropriate for new staff and better cater to the vast and unpredictable range of skills and learning histories of new staff.

Regarding the skill of Setting and Resetting the environment specifically, it contains behaviors that BTs may already be more likely to do because they are new to the facility. Some of those behaviors that new staff may already be likely to do include reading procedures, gathering all program materials prior to starting the program, identifying reinforcers prior to starting the program, and checking the schedule when starting their session. This may also account for why every BT scored nearly 100% in baseline for this skill. Also, the highly consistent correct implementation of this skillset during baseline that began to trend down for some BTs as they proceeded into intervention may be explained by the following possibility. Staff may be more likely to read procedures and prep materials for programming prior to starting novel programs than familiar ones. Staff may also be more likely to identify reinforcers and check the schedules for novel clients than familiar ones. As staff become more familiar with clients and their programming, they may be less likely to do these things. It may be better to identify this skillset as one that is easily acquired by most BTs and that poor implementation of this skill is not related to ability, but to the fact that continuing to do this behavior does not contact sufficient reinforcement in the environment to sustain it.

Regarding the skill of prompting, data was collected specifically on one's ability to use the appropriate prompt delay (e.g., five second delay vs immediate prompt) and to correctly execute the prescribed prompt. On trials of programming that were independent, a correct response from the BT would be to present the client with the S^D, followed by waiting for up to five seconds. On prompted trials, a BT was expected to use the prompt immediately following presentation of the S^D and correctly implement the prescribed prompt which is arguably a more

difficult skill for many new staff compared to simply doing nothing for five seconds. Knowing this about the skill of prompting explains why so many BTs continue to have variable success with this skill, the BTs were not being required to run exclusively independent or prompted trials. Breaking out the data according to prompted and independent trials may correlate more directly to the variability in responding, which would be recommended for future researchers to do. The data on if programs were on independent or prompted trials is not available.

Four data collectors were taking data on client performance, but data collector D became unavailable during the course of the study due to moving to a different position within the company. In each BT's graph, the data does not reflect who collected that data. This leaves the possibility that disagreements between data collectors or observer drift may account for all the variability seen in BT performance. Therefore, graphs of how each data collector's scores compared to IOA are available to allow for more transparent data interpretation. Client performance is not necessarily correlated with BT performance, which is why that variable has not been reported.

Limitations

Data collection in this study often occurred in clusters and with long breaks in data collection. This occurred because data collection was incorporated into existing observations that occurred within the clinic, which were subject to changes or cancellations based on staff availability. This method of data collection was most practical for the applied setting where this study took place but did little to support the use of brief programmed instruction in other settings or with new staff in the future. Due to these gaps in data collection, it becomes increasingly difficult to evaluate what truly had a significant impact on evoking high-quality performance when it did occur. The control tier does provide some support for ruling out practice effects, but

completely ruling out practice effects is not possible due to the variability in responding across the skills and between the skills when paired with the many days where data collection does not occur for some participants. Due to the facility's scheduling system and BT's availability, some participants have little to no data available. All participants who completed modules were included in this report regardless of how little data was collected to support more transparent reporting and evaluation.

The IOA data collected contains multiple areas of large disagreement; however, this is largely influenced by the fact that scores are based on the behaviors that occurred during the 30-second intervals of the five-minute data collection period. If the target behavior only occurred during two intervals and there was a disagreement between scorers on one interval, the IOA score would automatically skew to an extreme.

An additional limitation of the study is that there were no restrictions on how long a BT had access to the PIMs. This may be deemed a limitation of the current study, as implementing some sort of time limitation may require a BT to respond more fluently to the learning material. However, time limitations may also evoke counter control from the BT because one of the only reinforcers that could be offered in programmed instruction was escape from the programmed instruction (i.e., negative reinforcement). However, if learners had to continue to repeat the PIMs until they were able to complete them in a given time, they may be more likely to not even attempt to engage with the materials at all as a means to escape the module using the lowest effort behavior possible. Considering these factors, an exploration into the use of time limitations as part of mastery criteria within program instruction would likely be necessary as a first step following module development. It is also possible that large, semi-random question banks may help guard against counter control associated with time limitations that support skill fluency.

Also, determining how long a learner needs to complete the module would be difficult to determine and standardize across learners who may have different learning histories, disabilities, and levels of education even if determined with a first study. These factors contributed to the decision to not restrict access to the PIMs, even though it may have forced a BT to become more fluent in the material which may have resulted in better or more stable treatment integrity performance.

Another limitation of the study is that all BTs received a self-paced online RBT training through Behavior University, which they had access to starting with their first day of employment. Since PIMs only provide factual knowledge and not the opportunity to practice skills beyond basic discrimination, it is possible that any improvement that could have occurred with a self-paced training was already accomplished by the self-paced Behavior University RBT training. The PIMs in this study were more specific to the facility; however, there may have been overlaps between content covered in the Behavior University training and the PIMs used in this study so that any gains made with the PIMs were too subtle to notice given the insensitive data collection system and large overlap between the two trainings. It is possible that given all these factors, the BT may have needed to spend more time with the PIMs and receive more questions on these topics to have a sufficient number of learning opportunities to reach the desired level of treatment integrity performance.

It is also worth considering that the data collection system used may not have been sensitive enough to accurately ascertain true BT performance, as it appears there may be a ceiling effect on some skills. With this data collection system, each skill set was observed for only five minutes. Those five minutes were divided into seven 30-second intervals with 15-second periods to document what occurred after each interval. Because of this, there is a strong

likelihood that not enough of each target behavior was observed to make accurate conclusions regarding the BT's skills.

Finally, the system for constructing the PIMs was decided a priori. This system did not change throughout the course of the study at any point. After reviewing the data, it appears possible that the criteria for what each module must contain may not have been skillfully or accurately executed or the criteria outlined may have been too inflexible to functionally adapt to each of the different skillsets being taught using programmed instruction. A more flexible approach to module creation and contents may result in better instruction for the BT, especially because it may become much less predictable and require more active responding from the BT. Question answers were randomized, which provides some level of protection against formatting being too predictable. However, continued exposure to these very formulaic modules may eventually become very predictable to the BT.

Future Directions

Regardless of the degree of support this study provides for using programmed instruction as a component of staff training with new behavior technicians, further investigation into how to create more effective programmed instruction modules as a learning tool is warranted due to the fact that many different learning institutions are using some form of self-paced, computer-mediated instruction to teach learners whether those learners be employees, students, hobbyists, or other learners. Identifying the most systematic way to create self-paced learning and what components are most likely to translate into improvement of real-world skills will be fundamentally important to anyone tasked with teaching.

In the future, it would be beneficial to explore using this training at different levels within the company to see who might benefit the most from these brief programmed instruction

modules, as it may not be new staff like was originally anticipated. Additionally, isolating the influence of brief programmed instruction compared to longer periods of learner engagement in programmed instruction may help determine how long programmed instruction modules should be and how they should be sequenced for maximum success.

Considering some of the limitations observed in this study, it is recommended that future researchers explore what type of programmed instruction modules are most likely to evoke the best performance first in an analog setting. An analog setting is likely to provide a much better environment in which to explore the best way to implement this particular system of self-paced learning with far fewer complications and extraneous variables that have rendered any conclusions drawn in this study moderately trustworthy at best. After all the potential ways to implement programmed instruction have been explored with modern technology in an analog setting, it would then be more appropriate to take it into the applied setting where this study was conducted, given much of the analog literature on programmed instruction is extremely outdated.

References

Behavior Analyst Certification Board. (2012). Supervisor training curriculum outline. *Behavior Analyst Certification Board*.

Bullock, D. H., & Langdon, D. G. (Ed.). (1978). *The instructional design library: Vol. 14 programmed instruction.* Educational Technology Publications.

Fernald, P. S., & Jordan, E. A. (1991). Programmed Instruction versus Standard Text in Introductory Psychology. *Teaching of Psychology, 18*(4), 205-211. https://doi.org/10.1207/s15328023top1804

Gianoumis, S., Seiverling, L., & Sturmey, P. (2012). The effects of behavior skills training on correct teacher implementation of natural language paradigm teaching skills and child behavior. *Behavioral Interventions, 27*(2), 57–74. https://doi.org/10.1002/bin.1334

Granpeesheh, D., Tarbox, J., Dixon, D. R., Peters, C. A., Thompson, K., & Kenzer, A. (2010). Evaluation of an eLearning tool for training behavioral therapists in academic knowledge of applied behavior analysis. *Research in Autism Spectrum Disorders, 4*, 11-17. https://doi.org/10.1016/j.rasd.2009.07.004

Himle, M. B., Miltenberger, R. G., Flessner, C., & Gatheridge, B. (2004). Teaching safety skills to children to prevent gun play. *Journal of Applied Behavior Analysis, 37,* 1–9. https://doi.org/10.1901/jaba.2004.37-1

Ingvarsson, E. T., & Hanley, G. P. (2006). An evaluation of computer-based programmed instruction for promoting teachers' greetings of parents by name. *Journal of Applied Behavior Analysis, 39,* 203-214. https://doi.org/10.1901/jaba.2006.18-05

Kritch, K. M., & Bostow, D. E. (1998). Degree of constructed-response interaction in computer-based programmed instruction. *Journal of Applied Behavior Analysis, 31*, 387-398. https://doi.org/10.1901/jaba.1998.31-387

Kulik, C. C., Kulik, J. A., & Cohen, P. A. (1980). Instructional Technology and College Teaching. *Teaching of Psychology, 7*(4), 199-205. https://doi.org/10.1207/s15328023top0704_1

Lockee, B. B., Moore, D. M., & Burton, J. K. (2004). Foundations of programmed instruction. D. H. Jonassen (Ed.), Handbook of research on educational communications and technology (2nd ed., pp. 545-570). New York: Lawrence Erlbaum.

Luiselli, J. K., Bass, J. D., & Whitcomb, S. A. (2010). Teaching applied behavior analysis knowledge competencies to direct-care service providers: Outcome assessment and social validation of a training program. *Behavior Modification, 34*, 403-414. https://doi.org/10.1177/0145445510383526

Miltenberger, R. G., Flessner, C., Gatheridge, B., Johnson, B., Satterlund, M., Egemo, K. (2004). Evaluation of behavior skills training to prevent gun play in children. *Journal of Applied Behavior Analysis, 37*, 513-516. https://doi.org/10.1901/jaba.2004.37-513

Molenda, M. (2008). The Programmed Instruction Era: When Effectiveness Mattered. *TechTrends, 52*(2), 52-58. https://doi.org/10.1007/s11528-008-0136-y

Nosik, M. R., Williams, W. L., Garrido, N., & Lee, S. (2013). Comparison of computer based instruction to behavior skills training for teaching staff implementation of discrete-trial instruction with an adult with autism. *Research in Developmental Disabilities, 34*, 461-468. https://doi.org/10.1016/j.ridd.2012.08.011

Parsons, M. B., Rollyson, J. H., & Reid, D. H. (2013). Teaching practitioners to conduct behavioral skills training: A pyramidal approach for training multiple human service staff. *Behavior Analysis in Practice, 6*, 4-16. https://doi.org/10.1007/bf03391798

Sarokoff, R. A., & Sturmey, P. (2004). The effects of behavioral skills training on staff implementation of discrete-trial teaching. *Journal of Applied Behavior Analysis, 37*, 535-358. https://doi.org/10.1901/jaba.2004.37-535

Skinner, B. F. (2003). *The Technology of Teaching* (J. S. Vargas, Ed.). B. F. Skinner Foundation. (Original work published 1968)

Tiemann, P. W., & Markle, S. M. (1990). *Analyzing instructional content: A guide to instruction and evaluation*. Seattle, Washington: Morningside Press.

Tudor, R. M. (1995). Isolating the effects of active responding in computer-based instruction. *Journal of Applied Behavior Analysis, 28*, 343-344. https://doi.org/10.1901/jaba.1995.28-343

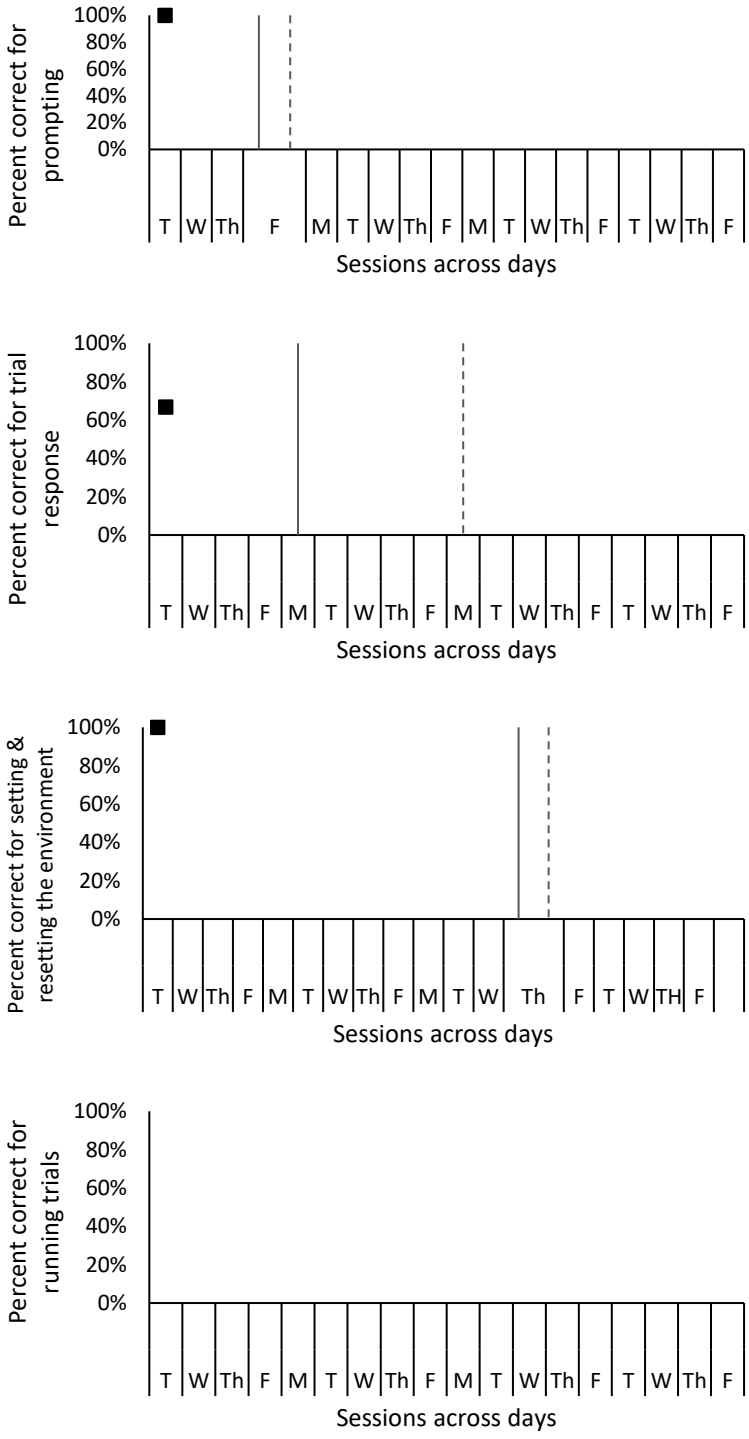
Tudor, R. M., & Bostow, D. E. (1991). Computer-programmed instruction: The relation of required interaction to practical application. *Journal of Applied Behavior Analysis, 24*, 361-368. https://doi.org/10.1901/jaba.1991.24-361

United States Census Bureau. (2020). QuickFacts. https://census.gov/quickfacts

van Oorsouw, W. M., Embregts, P. J., Bosman, A. M., & Jahoda, A. (2009). Training staff serving clients with intellectual disabilities: A meta-analysis of aspects determining effectiveness. *Research in Developmental Disabilities, 30*, 503-511. https://doi.org/10.1016/j.ridd.2008.07.011

Figure 1

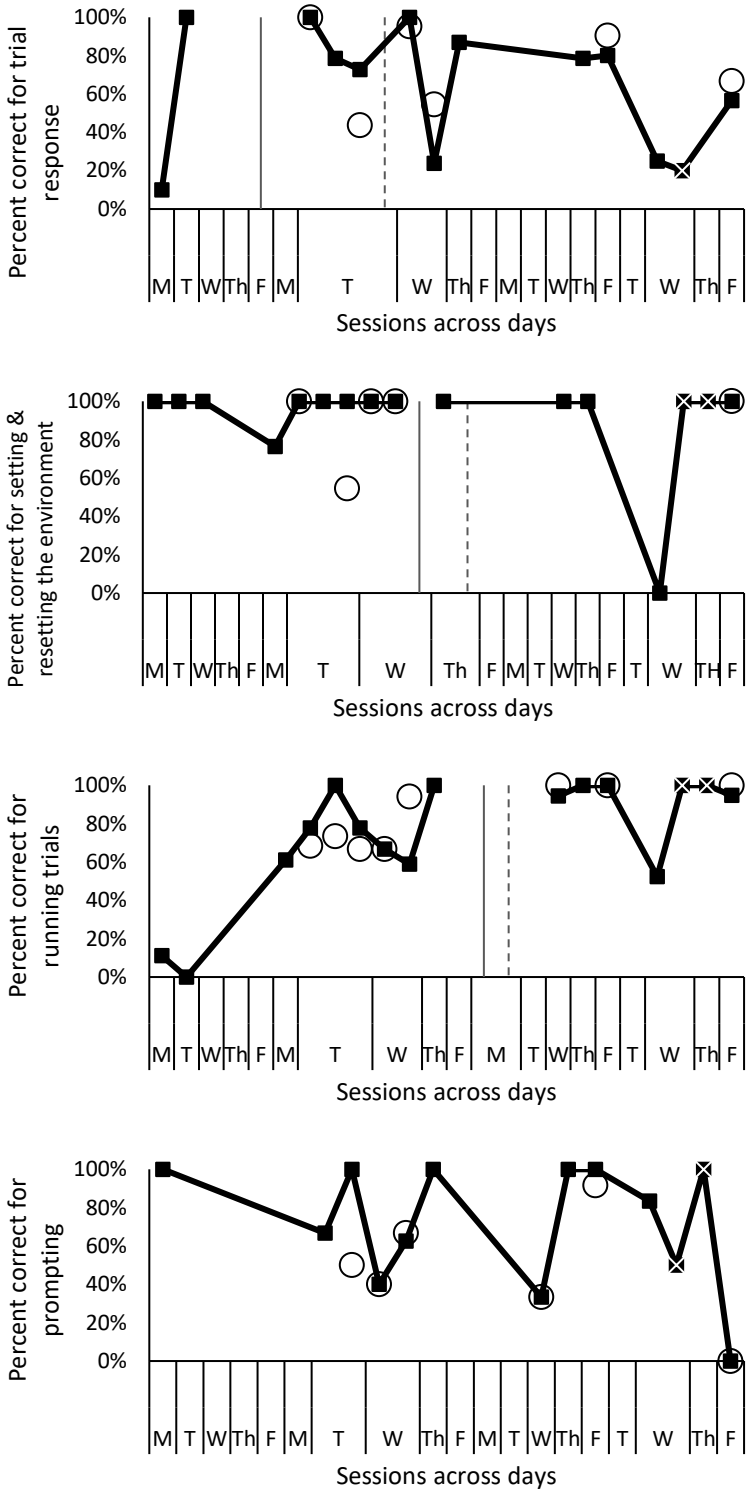
Participant 1 Performance



Note. This is the data for participant 1. Participant 1's tiers occurred in the order of Prompting, Trial Response, Setting and Resetting the Environment, and Running Trials. Closed squares indicate treatment integrity data collected by the data recorders. Open circles indicate IOA treatment integrity data. Solid lines indicate when the PIM for that skillset became available and the dashed line indicates when it was completed.

Figure 2

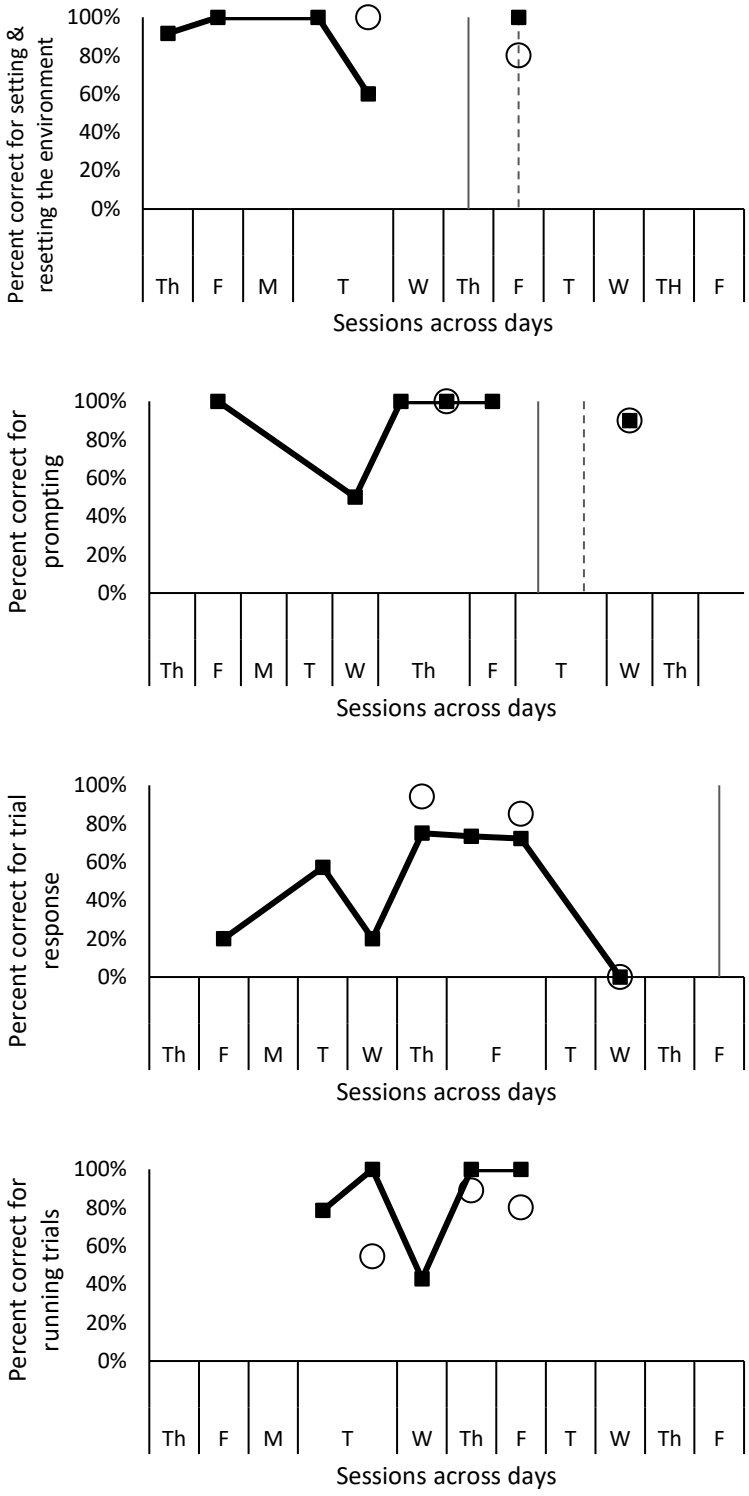
Participant 2 Performance



Note. This is the data for participant 2. Participant 2's tiers occurred in the order of Trial Response, Setting and Resetting the Environment, Running Trials and Prompting. Closed squares indicate treatment integrity data collected by the data recorders. Open circles indicate IOA treatment integrity data. Solid lines indicate when the PIM for that skillset became available and the dashed line indicates when it was completed. One data collector became unavailable for the last week of data collection prior to taking IOA. This data collector's data were included but denoted with a white "X" over the data points.

Figure 3

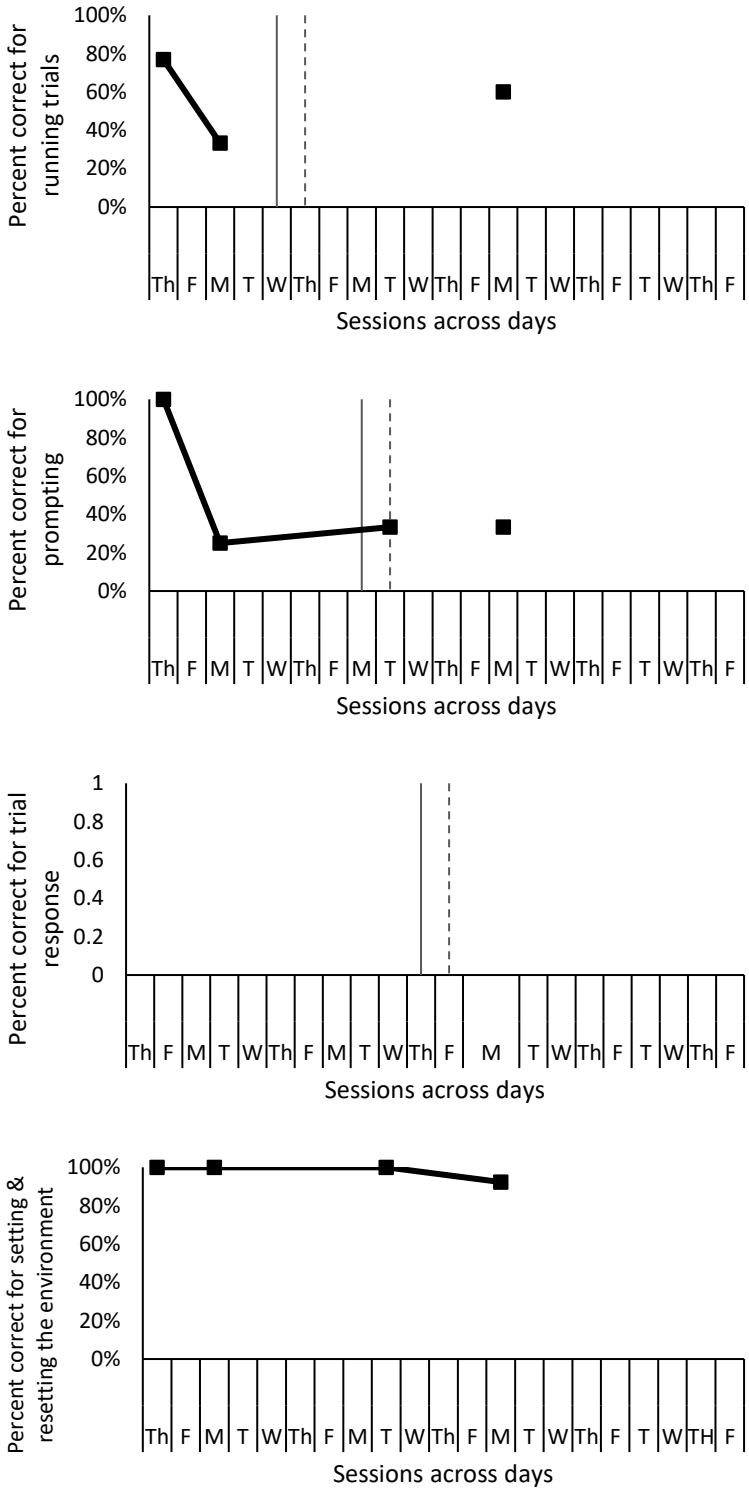
Participant 3 Performance



Note. This is the data for participant 3. Participant 3's tiers occurred in the order of Setting and Resetting the Environment, Prompting, Trial Response, and Running Trials. Closed squares indicate treatment integrity data collected by the data recorders. Open circles indicate IOA treatment integrity data. Solid lines indicate when the PIM for that skillset became available and the dashed line indicates when it was completed.

Figure 4

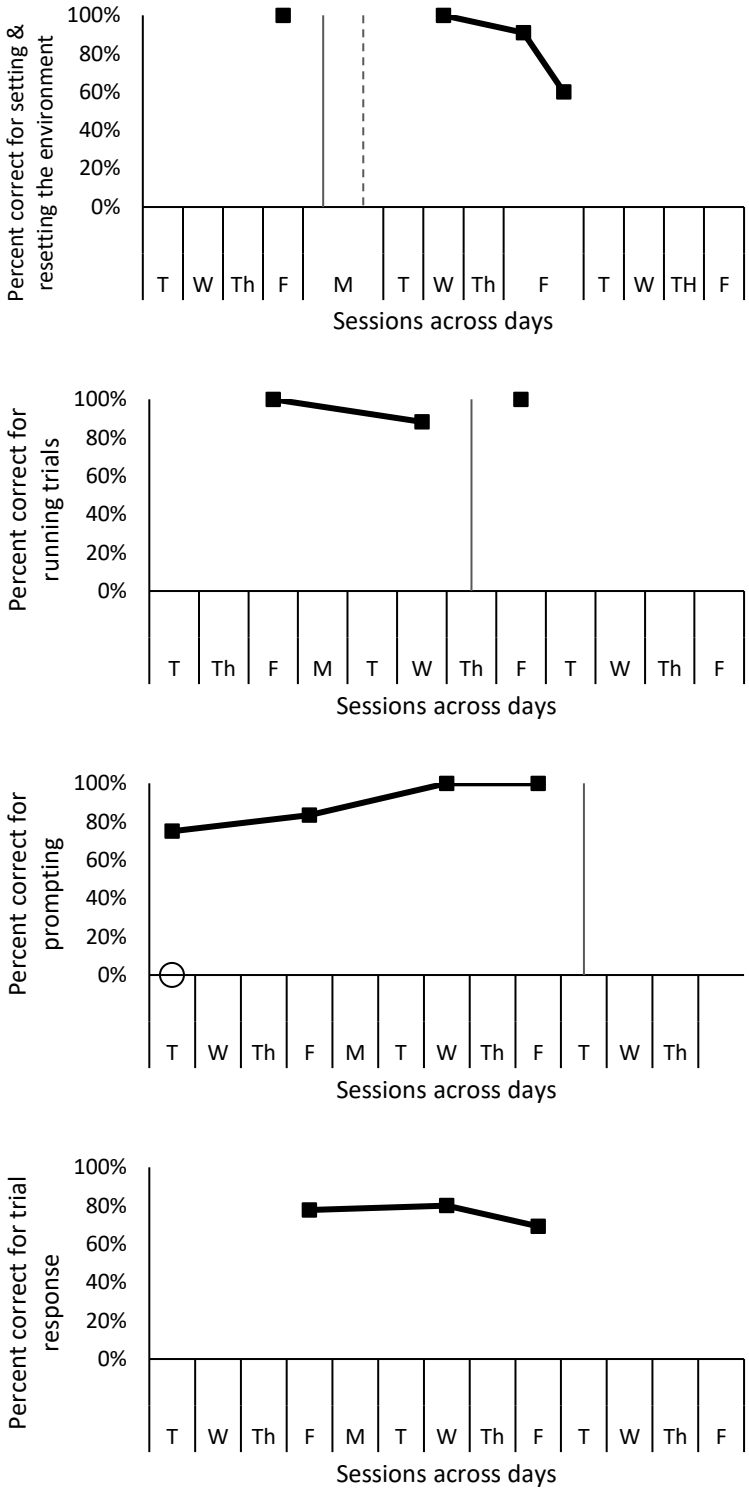
Participant 4 Performance



Note. This is the data for participant 4. Participant 4's tiers occurred in the order of Running Trials, Prompting, Trial Response, and Setting and Resetting the Environment. Closed squares indicate treatment integrity data collected by the data recorders. Open circles indicate IOA treatment integrity data. Solid lines indicate when the PIM for that skillset became available and the dashed line indicates when it was completed.

Figure 5

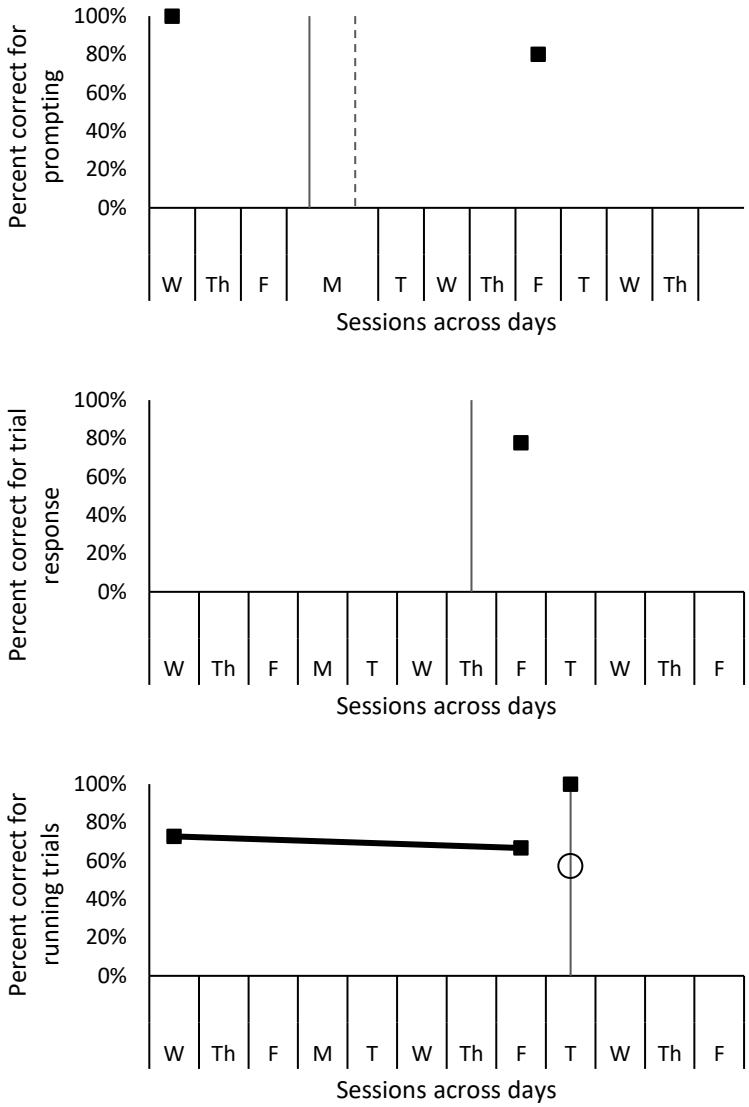
Participant 5 Performance

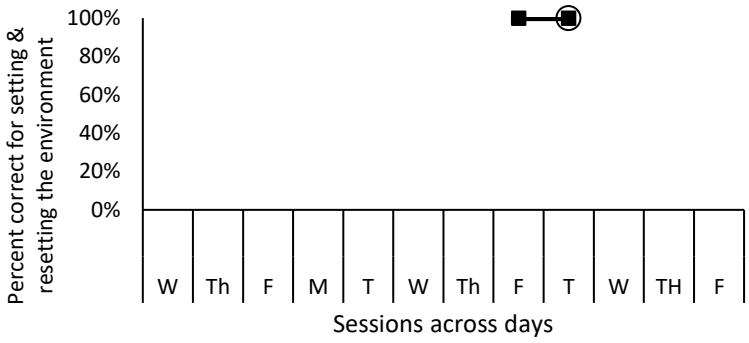


Note. This is the data for participant 5. Participant 5's tiers occurred in the order of Setting and Resetting the Environment, Running Trials, Prompting, Trial Response, and. Closed squares indicate treatment integrity data collected by the data recorders. Open circles indicate IOA treatment integrity data. Solid lines indicate when the PIM for that skillset became available and the dashed line indicates when it was completed.

Figure 6

Participant 6 Performance

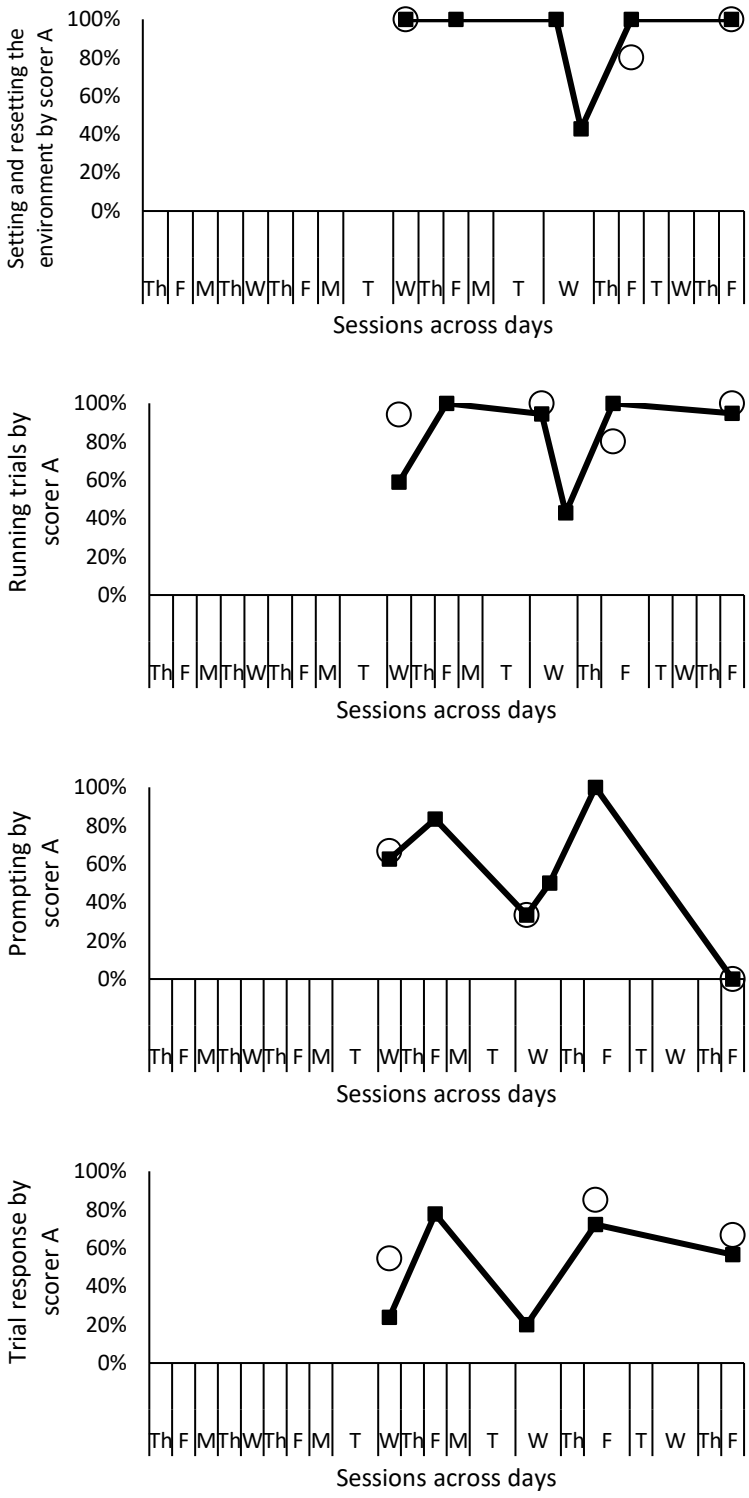




Note. This is the data for participant 6. Participant 6's tiers occurred in the order of Prompting, Trial Response, Running Trials, and Setting and Resetting the Environment. Closed squares indicate treatment integrity data collected by the data recorders. Open circles indicate IOA treatment integrity data. Solid lines indicate when the PIM for that skillset became available and the dashed line indicates when it was completed.

Figure 7

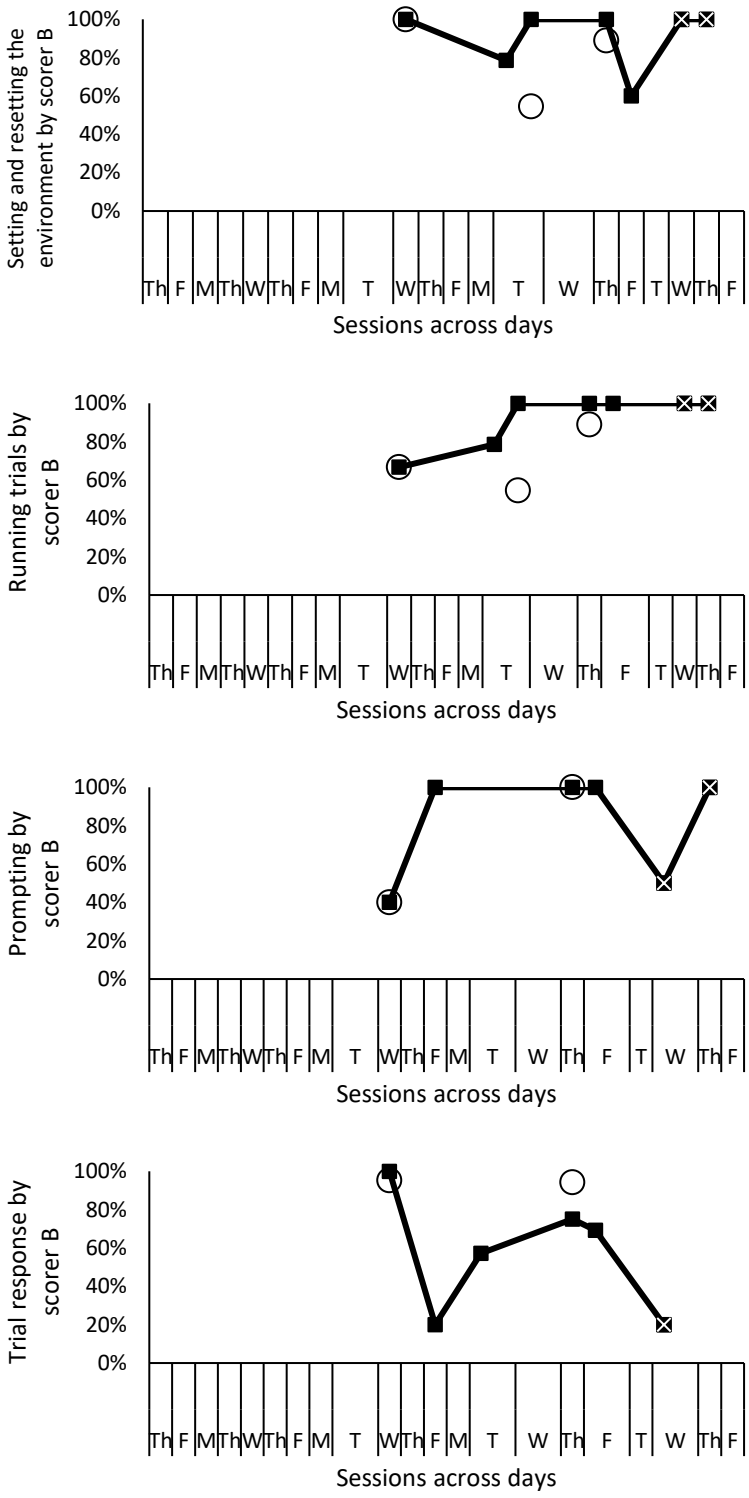
Treatment Integrity Data Collected by Data Collector A



Note. This is the treatment integrity data collected by data collector A. Closed squares indicate treatment integrity data collected by the data collector. Open circles indicate IOA treatment integrity data.

Figure 8

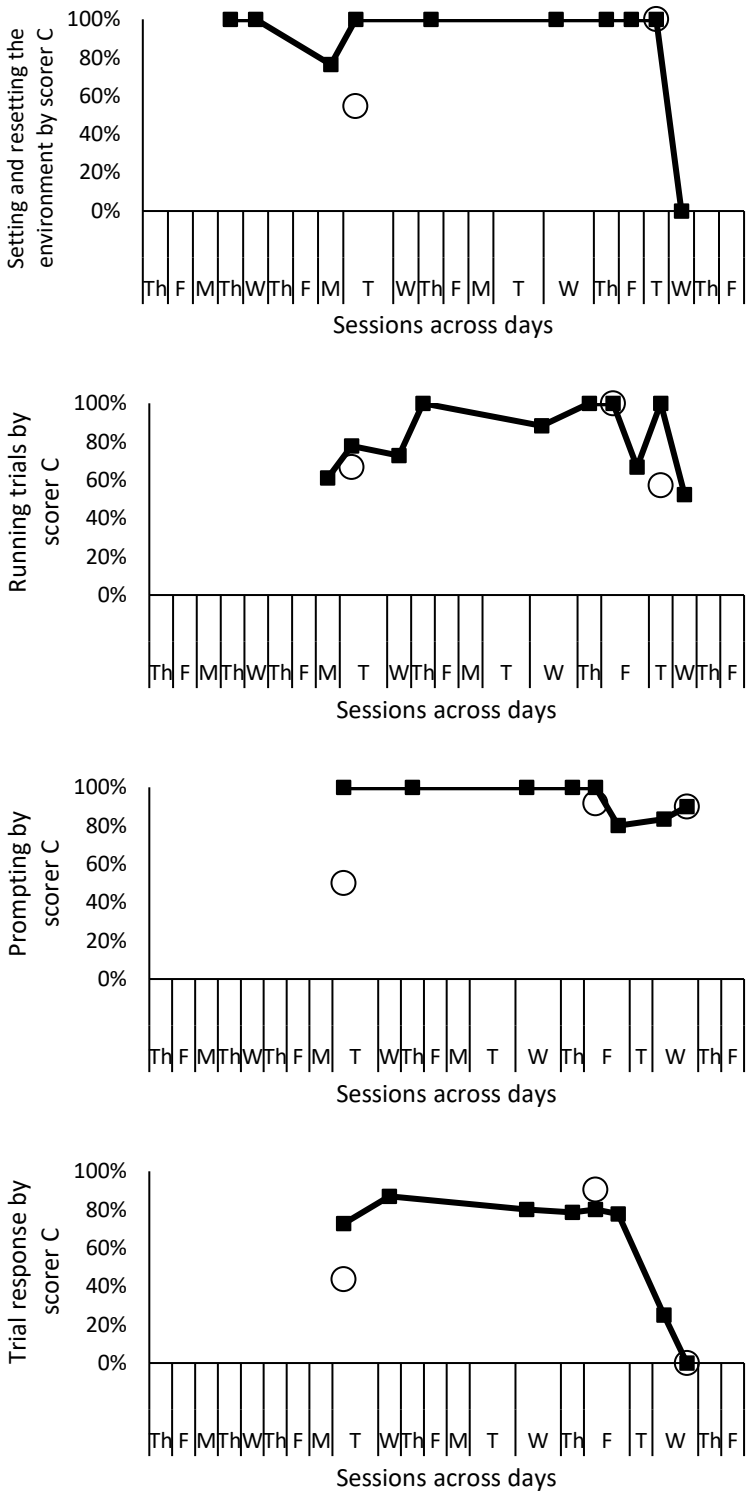
Treatment Integrity Data Collected by Data Collector B



Note. This is the treatment integrity data collected by data collector B. Closed squares indicate treatment integrity data collected by the data collector. Open circles indicate IOA treatment integrity data. This data collector become unavailable for data collection the last week of the study, so no IOA was able to be collected. The data collector's data is included, with data points from the week without IOA denoted by a white "X" over the data point.

Figure 9

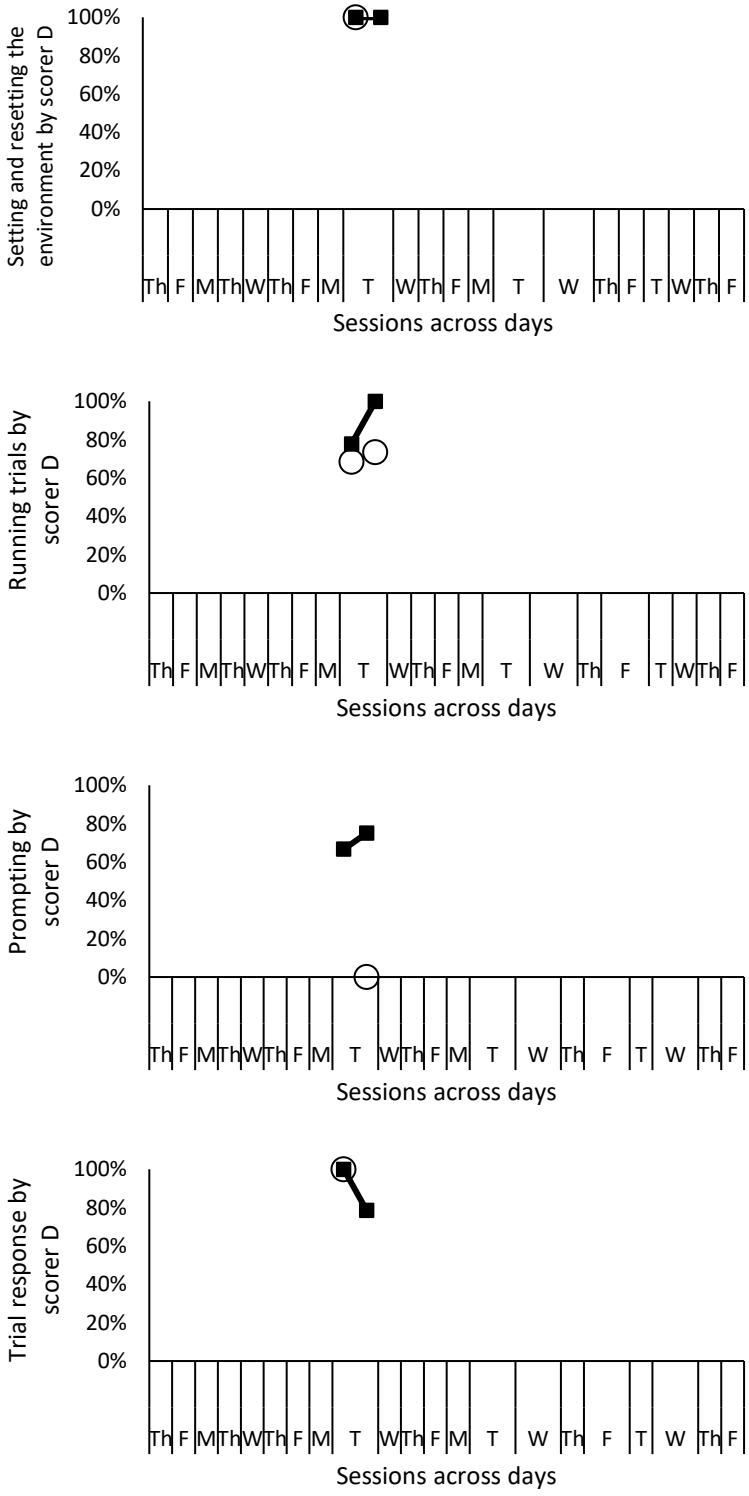
Treatment Integrity Data Collected by Data Collector C



Note. This is the treatment integrity data collected by data collector C. Closed squares indicate treatment integrity data collected by the data collector. Open circles indicate IOA treatment integrity data.

Figure 10

Treatment Integrity Data Collected by Data Collector D



Note. This is the treatment integrity data collected by data collector D. Closed squares indicate treatment integrity data collected by the data collector. Open circles indicate IOA treatment integrity data.

Appendix


COMPANY LOGO
In Central reach, you'll see things like FR1 and VR3. What do these things mean?
The F stands for fixed, which is a repeating pattern. The V stands for variable, which is a flexible or "variable" pattern.
The R stands for ratio, which describes what the pattern is based on - the number of behaviors! Together, these describe when reinforcement is delivered.
Let's start by talking about the FR schedules and learning about that in more detail.
If I have an FR1 or FR3, I know something must be different between these - but what?
The difference is the 1 and the 3, which refer to how often we give reinforcement. In FR1, we give reinforcement after every 1 behavior occurs. In FR3, we give reinforcement after every 3 behaviors occur.
Click to return to the beginning


COMPANY LOGO
Review it!
In Central reach, you'll see things like FR1 and VR3. What do these things mean?
The F stands for fixed, which is a repeating pattern. The V stands for variable, which is a flexible or "variable" pattern.
The R stands for ratio, which describes what the pattern is based on - the number of behaviors! Together, these describe when reinforcement is delivered.
Let's start by talking about the FR schedules and learning about that in more detail.
If I have an FR1 or FR3, I know something must be different between these - but what?
The difference is the 1 and the 3, which refer to how often we give reinforcement. In FR1, we give reinforcement after every 1 behavior occurs. In FR3, we give reinforcement after every 3 behaviors occur.

COMPANY LOGO

Click for review

In fixed ratio schedules, you provide clients with reinforcement based on:

- A repeating pattern of the number of behaviors completed
- A variable pattern of the number of behaviors completed
- The time that has elapsed since starting the program
- Schedules of reinforcement describe when reinforcement is delivered.

Click to return to the beginning

Question 1 of 5

COMPANY LOGO

Fixed schedules are those with repeating, unchanging patterns. Ratio schedules deliver reinforcement after the predetermined number of behaviors have occurred correctly. You are correct!

Click to return to the beginning

COMPANY LOGO

Variable schedules are those that do not stay the same, fixed schedules use repeating or unchanging patterns. Ratio schedules depend on the number of behaviors that occur. Reread the passage and try the question again.

Click to return to the beginning

COMPANY LOGO

Schedules that deal with time, like this one, are not a type of ratio schedule. Ratio schedules are those that depend solely on the number of behaviors that occur to determine when you should give the client a reinforcer. Reread the passage and try the question again.

Click to return to the beginning

COMPANY LOGO

It is true that reinforcers are given following a correct response. However, this question is about correctly identifying the schedule of reinforcement that is shown in the table. Reread the question and try again.

Click to return to the beginning

COMPANY LOGO

Click for review

Bobby is running a "Match to sample" program with a client. The client is presented with an example of something (sample), and then is provided three items from which to match: one item that matches the example (match) and two distractor items (do not match). The numbers below indicate the trial, the client's behavior, and the consequence of that behavior. Based on the information below, identify what type of schedule is being used.

Trial	Behavior	Consequence
1	Correct	***Reinforcement!***
2	Correct	***Reinforcement!***
3	Correct	***Reinforcement!***
4	Correct	***Reinforcement!***
5	Correct	***Reinforcement!***
6	Correct	***Reinforcement!***
7	Correct	***Reinforcement!***
8	Correct	***Reinforcement!***
9	Correct	***Reinforcement!***
10	Correct	***Reinforcement!***
11	Correct	***Reinforcement!***
12	Correct	***Reinforcement!***

- (•) Fixed ratio 1 (FR1)
- ( ) Fixed ratio 2 (FR2)
- ( ) Variable ratio 2 (VR2)
- ( ) The reinforcer is given after a behavior is done correctly.

Click to return to the beginning

Question 2 of 5

COMPANY LOGO

In this example, a reinforcer is given every time the behavior is done correctly. This means that the client only needs to do 1 correct behavior to earn the reinforcer. Also, the number of behaviors that the client must do to earn the reinforcer is the same for every trial. Therefore, this program is a fixed ratio 1 (FR1) schedule of reinforcement because earning the reinforcer depends on the number of behaviors, the number of behaviors does not change across the program, and 1 behavior is required. You are correct!

Click to return to the beginning

COMPANY LOGO

In this example, a reinforcer is given every time the behavior is done correctly. This means that the client only needs to do 1 correct behavior to earn the reinforcer. Also, the number of behaviors that the client must do to earn the reinforcer is the same for every trial. Therefore, this program is not a fixed ratio 2 (FR2) schedule of reinforcement. Reread the question and try again.

Click to return to the beginning

COMPANY LOGO

In this example, a reinforcer is given every time the behavior is done correctly. This means that the client only needs to do 1 correct behavior to earn the reinforcer. Also, the number of behaviors that the client must do to earn the reinforcer is the same for every trial. Therefore, this program is not a variable ratio 2 (VR2) schedule of reinforcement. Reread the question and try again.

Click to return to the beginning

Company Logo

It is true that reinforcers are given following a correct response. However, this question is about correctly identifying the schedule of reinforcement that is shown in the table. Reread the question and try again.

Click to return to the beginning

COMPANY LOGO

Click for review

Trial	Behavior	Consequence	Trial	Behavior	Consequence
1	Incorrect	No reinforcer	1	Correct	***Reinforcement!***
2	Correct	***Reinforcement!***	2	Correct	No reinforcer
3	Correct	***Reinforcement!***	3	Correct	No reinforcer
4	Incorrect	No reinforcer	4	Correct	***Reinforcement!***
5	Correct	***Reinforcement!***	5	Correct	No reinforcer
6	Correct	***Reinforcement!***	6	Correct	***Reinforcement!***
Trial	Behavior	Consequence	Trial	Behavior	Consequence
1	Correct	No reinforcer	1	Correct	***Reinforcement!***
2	Correct	***Reinforcement!***	2	Correct	***Reinforcement!***
3	Correct	No reinforcer	3	Correct	***Reinforcement!***
4	Correct	***Reinforcement!***	4	Correct	***Reinforcement!***
5	Correct	No reinforcer	5	Correct	***Reinforcement!***
6	Correct	***Reinforcement!***	6	Correct	***Reinforcement!***

Identify which example is ***not*** a fixed ratio schedule of reinforcement.

- Blue
- Orange
- Green
- Yellow

Click to return to the beginning

Question 3 of 5

COMPANY LOGO

In the option you selected, 1 correct response gets reinforcement, then 3 correct responses get reinforcement, then 2 correct responses get reinforcement.

Click to return to the beginning

COMPANY LOGO

The option you selected is a fixed ratio 2 schedule, which ***is*** a fixed ratio of reinforcement. Every 2 correct response result in access to the reinforcer. This question is asking about which schedule of reinforcement is ***not*** a fixed ratio schedule of reinforcement. Reread the question and try again.

Click to return to the beginning

Company Logo

The option you selected is a fixed ratio 1 schedule, which is a fixed ratio of reinforcement. Every correct response results in access to the reinforcer. This question is asking about which schedule of reinforcement is ***not*** a fixed ratio schedule of reinforcement. Reread the question and try again.

Click to return to the beginning

Company Logo

The option you selected is a fixed ratio 1 schedule, which is a fixed ratio of reinforcement. Every correct response results in access to the reinforcer. This question is asking about which schedule of reinforcement is ***not*** a fixed ratio schedule of reinforcement. Reread the question and try again.

Click to return to the beginning

Company Logo

Identify the instruction below that would indicate reinforcement should be given on a fixed ratio schedule:

- If JK correctly imitates you, provide him with praise and 15-20 s of tangible access. If JK errs or does not respond, restate the S^D and use the next most intrusive prompt to prompt a correct response.
- If JK correctly imitates you, provide him with praise and 15-20 s of tangible access after an average of three consecutive correct responses. If JK errs or does not respond, restate the S^D and use the next most intrusive prompt to prompt a correct response.
- If JK correctly requests the item back after allowing you to play with it for 30 s, provide him with praise and 1 min of access to the requested item. If JK asks before 30 s is up, errs, or does not respond, restate the S^D and use the next most intrusive prompt to prompt a correct response.
- The procedures for a program are located on the righthand side of the session page in Central Reach, and I should check there for information on the program's schedule of reinforcement.

Click to return to the beginning

Question 4 of 5

Company Logo

Fixed ratio schedules require the same number of correct responses (i.e., behaviors) to earn a reinforcer every time and does not change across the program. You selected the option with the fixed ratio schedule. You are correct!

Click to return to the beginning

Company Logo

Fixed ratio schedules require the same number of correct responses (i.e., behaviors) to earn a reinforcer every time and does not change across the program. Variable ratio schedules require a varying number of correct responses (i.e., behaviors) to earn a reinforcer across the entire program. You selected the option with a variable ratio schedule. Reread the question and try again.

Click to return to the beginning

Company Logo

Fixed ratio schedules require the same number of correct responses (i.e., behaviors) to earn a reinforcer every time and does not change across the program. Fixed interval schedules require the same time to pass between instances of the behavior that are given reinforcement. You selected the instructions for a fixed interval schedule. Reread the question and try again.

Click to return to the beginning

Company Logo

It is true that the procedures for a program are located on the righthand side of the session page in Central Reach and that you should check the program procedures for information on the program's schedule of reinforcement. However, this question is about identifying which program description is for a fixed ratio schedule of reinforcement.

Click to return to the beginning

Company Logo

Below is Jennifer's manding program. Select the sentence that is missing that would make this program a program with a fixed ratio schedule. Program: Gain JB's attention. Provide JB with the S^D of removing the iPad or other preferred tangible by telling JB it is your turn to play with it. If JB correctly requests the item back _____. If JB errs or does not respond, restate the S^D and use the next most intrusive prompt to prompt a correct response.

- ...provide her with praise and 15-20 s of tangible access.
- ...provide her with praise and 15-20 s of tangible access after an average of three consecutive correct responses.
- ...after allowing you to play with it for 30 s, provide her with praise and 1 min of access to the requested item.
- ...after allowing you to play with it for an average of 30s across all trials (no longer than 45 s and shorter than 15 s), provide her with praise and 1 min of access to the requested item.

Click to return to the beginning

Question 5 of 5

COMPANY LOGO

You selected a sentence for a program with a fixed ratio schedule. It is a schedule that requires the same number of correct responses (i.e., behaviors) to earn a reinforcer every time and does not change across the program. You are correct!

Click to return to the beginning

Company Logo

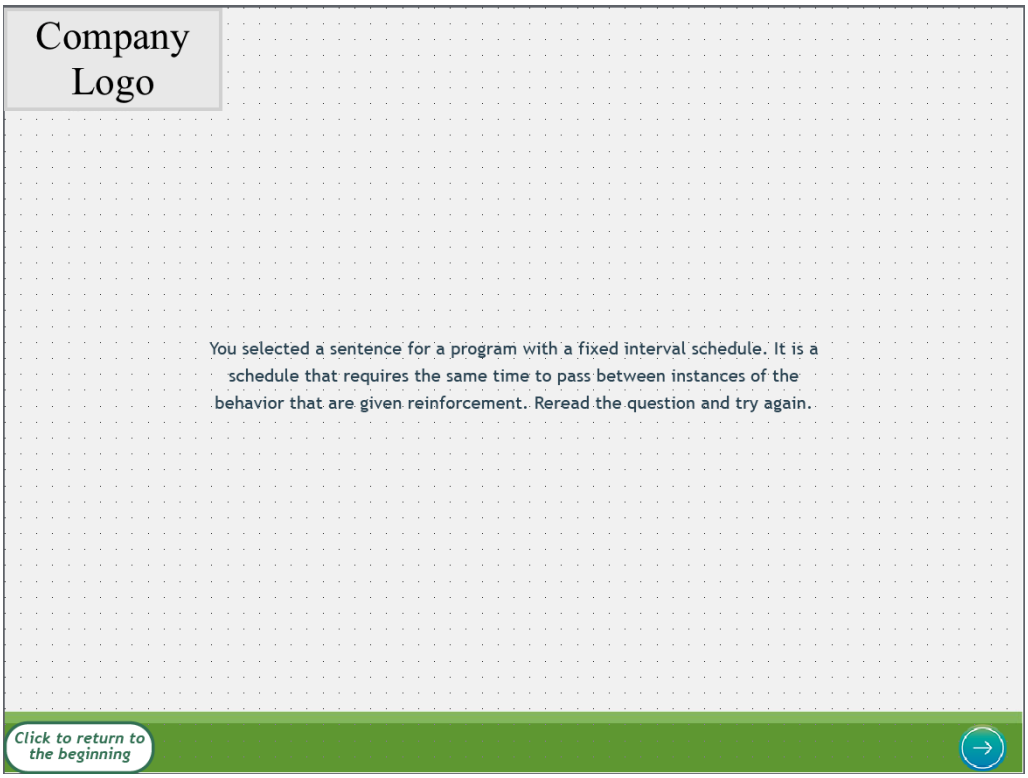
You selected a sentence for a program with a variable ratio schedule. It is a schedule that requires a varying number of correct responses (i.e., behaviors) to earn a reinforcer across the entire program. Reread the question and try again.

Click to return to the beginning

Company Logo

You selected a sentence for a program with a variable interval schedule. It is a schedule that requires a varying time to pass between instances of the of the behavior that are given reinforcement. Reread the question and try again.

Click to return to the beginning


Company Logo
You selected a sentence for a program with a fixed interval schedule. It is a schedule that requires the same time to pass between instances of the behavior that are given reinforcement. Reread the question and try again.
Click to return to the beginning