Spring 4-22-2022

The Effectiveness of a Skills Assessment Sequence on Evaluating Independent Handwriting

Rebecca Mischuck
Rollins College, rmischuck@rollins.edu

The Effectiveness of a Skills Assessment Sequence on Evaluating Independent Handwriting

A Thesis
by
Rebecca A. Mischuck

Submitted to the Faculty of the Department of Health Professions
at Rollins College in Partial Fulfillment
of the Requirements for the Degree of

MASTER OF ARTS IN APPLIED BEHAVIOR ANALYSIS AND CLINICAL SCIENCE

April 2022
Winter Park, FL

Acknowledgements

A massive thank you to all my family and friends, but most especially to my parents. Cathy and Bob Mischuck surrounded me with encouragement and a never-ending supply of coffee. Thank you to my brother, Dr. Brian Mischuck, for pretending to be interested in ABA. I am so thankful for my Sunday study and prep sessions with Caroline Phan. A huge shout-out to the best cohort; I could not have survived these past few years without all of you. An extra special thanks to my niece, Lily Abbott, and nephews, Henry Abbott and Donovan Richardson, for their understanding and forgiveness when their aunt was unavailable for movie nights, Disney days, and weekend visits. I promise that you are all going to be sick of me once I graduate!

It was no easy feat conducting this research with three participants scattered across central Florida. I could not have completed this Thesis without a substantial amount of assistance. A huge thank you to Carol Milano, Morgan Smith, and Brianna Friese, for their help and generous access to their clients. We all know that RBTs are the backbone of this field, and I was helped tremendously by Ja'Vani Haisley and Samantha Kilgore.

I had the absolute dream team committee. Both Dr. Stephanie Kincaid and Chandler Pelfrey provided invaluable insights and wisdom during the proposal meeting and beyond. My advisor, Dr. Kara Wunderlich, kept me from panicking and always steered me in the right direction. She provided invaluable guidance, support, and knowledge. I would not have made it without her.

This Thesis is dedicated to Eleanor Mischuck.

Table of Contents

Abstract

Skills assessments are an important component of effective applied behavior analysis services. Rapid skills assessments can help clinicians determine whether an observed skill deficit requires intervention in the form of changing reinforcement contingencies or through teaching. Response prompt assessments determine which prompt type is most effective and efficient for individuals. Both assessments provide a more comprehensive approach to developing effective skill acquisition services. The purpose of this study was to combine the rapid skills and prompt type assessments into one assessment sequence. An adapted alternating treatments design examined the effectiveness of first assessing reinforcement alone; then a response prompt assessment consisting of verbal plus gestural prompts, modeling prompts, and full physical prompts was conducted to determine the most effective prompt. No participant met mastery criteria in the reinforcement alone condition, which indicated that the writing skill deficits were not performance deficits. No participant met mastery criteria in the response prompt assessment, indicating that for these three participants, response prompts were not an effective method for acquiring writing skills. Implications from this research and future research opportunities are discussed.

Keywords: rapid skills assessment, response prompt assessment, skill acquisition

The Effectiveness of a Skills Assessment Sequence on Evaluating Independent Handwriting

Determining skill acquisition goals is just one essential component of a behavior analyst's work. Despite the importance of developing the necessary and appropriate skill acquisition programs, only a limited amount of tools exist to help make this process more empirically based. Clinicians may rely on trial-and-error to determine appropriate goals and procedures, but using this method takes valuable time away from providing effective treatment. There are several ways to determine treatment goals, one of which is utilize skills assessments. Skills assessments allow clinicians to identify and target deficits in a logical order by interpreting data that has been collected systematically (Malkin et al., 2017; Schnell et al., 2019). Assessments are also used to determine teaching methods and to evaluate client progress (Schnell et al., 2019).

Perhaps the two most utilized skills assessments in applied behavior analysis (ABA) are the Assessment of Basic Language and Learning Skills-Revised (ABLLS-R) and the Verbal Behavior Milestones and Placement Program (VB-MAPP). The ABLLS-R is an extensive assessment that can potentially provide clinicians with a big picture understanding of overall client skill deficits. 544 skills across 25 categories comprise the ABLLS-R, which was designed as an assessment of current communication skills and the skills needed to learn from a variety of stimuli (Partington, 2010).

The VB-MAPP, which was designed for children with language delays and/or autism spectrum disorder (ASD), was developed from Skinner's descriptions of verbal behavior. Three different assessments are found within the VB-MAPP; this includes the Milestones Assessment, the Barriers Assessment, and the Transitions Assessment. The Milestones Assessment tests 170 skills in 16 categories across three developmental levels. The Barriers Assessment examines 24 barriers that have been previously observed to affect learning and

language development. The Transitions Assessment examines if a child is ready for a less restrictive environment. Two additional components, the Task Analysis and Skills Tracking, and the Placement and IEP goals, complete the VB-MAPP assessment (Sundberg, 2008).

Although the ABLLS-R and the VB-MAPP are both extensive skills assessments and provide clinicians with detailed information about potential skill deficits of new and current clients, the manual for either assessment does not indicate the amount of time required to adequately complete the assessment (Gould et al., 2011). Information about how much time is authorized by insurance companies to conduct these assessments is minimal. As an example, three hours is the average time used to complete either assessment across three different ABA clinics in central Florida. With minimal time allotted to conduct these assessments, it is questionable if all the skills are adequately assessed. If the skills have not been adequately assessed, the data from the assessments might not be a current representation of the client's current skills.

Further, the information provided by these assessments are often too general to target specific behaviors. Standardized assessments do not determine how to teach identified skill deficits (Lerman et al., 2004). Neither assessment provides a comprehensive evaluation of the client, establishes a curriculum, or determines appropriate teaching methods. Therefore, additional assessments are needed to provide precise information to determine treatment (Gould et al., 2011). If the VB-MAPP and the ABLLS-R are the only assessments used to determine skill acquisition programs, clinicians might not be designing effective treatment.

Effective treatment is a hallmark of quality ABA services. One way that practitioners can ensure that they are utilizing effective treatment is to rely on the use of evidence-based practice (EBP). Slocum et al. (2014) defined EBP as using the highest quality existing evidence that incorporates knowledge and experience of the clinician and the values of the client. That is, EBP is observed when decisions are made based on data (Slocum et al., 2014).

To rely on conceptually systematic methods, clinicians need to place value on using methods derived from research. This will help clinicians avoid poor treatment outcomes (Leaf et al., 2016).

According to *The Professional and Ethical Compliance Code for Behavior Analysis* (2014), behavior analysts are required to use assessments prior to the development of interventions, and these assessments should be relevant with regards to current research. The use of data and visual analysis is another ethical requirement required for all behavior analysts. The code also requires clinicians to use the least restrictive procedures (Behavior Analyst Certification Board, 2014). Thus, if behavior analysts are not utilizing assessments prior to developing programs, they are not providing ethical services. Further, if behavior analysts have not determined the level of prompting required before designing intervention strategies, they run the risk of not identifying least restrictive procedures.

Using assessments to determine best treatment for every client is important, as individuals with similar skill deficits respond differentially across differing teaching strategies (Gorgan & Kodak, 2019). A variety of other assessments are being researched to help clinicians connect the skills assessment results to designing effective treatment packages (Kodak et al., 2011; Kodak & Halbur, 2021). Assessment-based instruction involves examining several interventions on a participant's target behavior to select the intervention best suited for the participant (Kodak & Halbur, 2021). This approach takes the guess work out of the implementation of developing new skills. Further, if assessments can help clinicians develop treatment protocols that can be used for more than one skill, time can be saved, and a more efficient use of clinical practice can be developed. An additional benefit of using a skills assessment to determine treatment is that the skill is being acquired while the clinician is determining the best method for future treatment (Kodak & Halbur, 2021). Therefore, using skills assessments is an efficient way for clinicians to determine which skills

need assessment-based instruction and how to provide the best intervention for current and future skill acquisition programs.

Lerman et al. (2004) conducted one of the first rapid skills assessment by examining the effectiveness of reinforcement alone, prompts, or the combination of prompts and reinforcement. A variety of skills (e.g., matching colors, peg boards, puzzles, receptive numbers) were tested across all participants. The results were idiosyncratic across participants; this suggests that a rapid skills assessment should potentially be used for every client to inform skill acquisition programming. The results from the reinforcement alone condition show that three different skills across three participants reached mastery criterion after just receiving reinforcement. This indicates that the skills were already in the participant's repertoire as no prompting was required to reach mastery. The results of this study highlight the importance of examining if a perceived skill deficit needs intervention in the form of prompting or by changing reinforcement procedures. The prompts condition was designed idiosyncratically based on client history; this suggests that no one prompt type is effective for every client. However, this study did not assess if the chosen prompt type was most effective.

Lerman et al. (2004) ran the reinforcement condition first before implementing the prompt condition. In a similar study, Bourret et al. (2004) conducted a vocal mand assessment. At the start of every trial, the experimenters waited 10 s following the S^D. If the complete mand was stated, reinforcement was provided. This design suggests that assessing if the targeted behavior occurs for reinforcement only, the rest of the experimental design was not needed for that participant.

A limitation of the Lerman et al. (2004) was the combination of correct prompted and correct independent data collection. This combination does not demonstrate whether the skill was ever independently acquired. (Kodak et al., 2011; 2013). To address this limitation,

Kodak et al. (2011) replicated and extended Lerman et al. (2004) by conducting a functional assessment on instructional variables to teach conditional discriminations to children with autism. This study used baseline, reinforcement, extra stimulus prompts, and an additional identity matching condition. As with Lerman et al. (2004) different conditions led to mastery criteria for all participants. However, this study did differentiate between correct prompted and correct independent responding so the determination of independent responding could be detected. However, multiple experimental designs were used in this experiment (i.e., reversal, concurrent multiple baseline, and non-concurrent multiple baseline) which makes it difficult to compare results.

Kodak et al. (2013) replicated and extended Lerman et al. (2004) and Kodak et al. (2011) by using an alternating treatments design; this allowed for a more efficient assessment of the conditions: contingent praise, reinforcement, and a position prompt plus reinforcement. Further, only one skill, a conditional discrimination, across participants with an ASD diagnosis was examined. Two out of the three participants met mastery criteria more quickly in the position prompt condition. As with Lerman et al. (2004) and Kodak et al. (2011), the results indicate that the rapid skills assessment was an effective strategy to identify appropriate intervention for each participant. The results also indicate that a prompt assessment is a necessary component to identify efficient intervention.

Both Lerman et al. (2004), Bourret et al. (2004), and Kodak et al. (201l; 2013) showcased the effectiveness of using a skills assessment across a variety of skills. This information can help clinicians determine which skills to target during treatment. Although both studies used a prompts condition, neither research examined the effectiveness of differing prompt types. Prompting is a valuable tool to use when teaching skills because prompting can lead to fewer errors (Gorgan & Kodak, 2019; Halbur et al., 2019). Cooper et al. (2007) defined prompts as additional antecedent stimuli used to help evoke the correct

response in the presence of the relevant S^D. Verbal instructions, modeling, and physical guidance are the major forms of response prompts which targets the behavior and not the antecedent stimulus (Cooper et al., 2007).

Several studies have evaluated the efficacy of response prompts on skill acquisition. Seaver & Bourret (2014) evaluated the effectiveness of response prompts on behavior chaining to teach arbitrary Lego structures to children with ASD. Verbal and gestural prompts, modeling prompts, and physical prompts were all examined. For each participant, a differing response prompt was most effective and efficient at evoking correct independent responding. This research highlights the need to assess which response prompt is most effective for individuals. However, an arbitrary skill was taught. To save time, especially in a clinical setting, it might be more efficient for clinicians to assess prompt type using a functional skill.

Additional research examining the effectiveness of the most efficient prompt and prompt fading procedures has been conducted. Cengher et al. (2016) used a topography assessment that examined a no prompt, model, gestural, and physical prompts on one step directions. Although this study was a replication of Seaver & Bourret (2014), the researchers extended the previous research by targeting functional skills. Schnell et al. (2019) also replicated and extended Seaver & Bourret (2014) by examining the effectiveness of the model prompt, partial physical prompt, and full physical prompt on auditory-visual conditional discriminations. Like both Seaver & Bourret (2014) and Cengher et al. (2016), the most effective response prompt was idiosyncratic across participants.

Rapid skills assessments are effective at determining if a skill deficit requires teaching. Response prompt assessments are effective at determining which prompt method is most effective and efficient. This information can help clinician's streamline treatment. Both rapid skills assessments and prompt level assessments provide information to allow clinicians

to make evidence-based and ethical decisions when designing treatment. It has been suggested that both assessments could potentially save clinician's valuable time (Kodak et al., 2013; Seaver & Bourret, 2014).

However, if multiple assessments are needed to determine effective intervention, time might not be saved. Assessments that are too lengthy are less likely to be used by clinicians (Gould et al., 2011). If two assessments are combined into an assessment sequence, the same information could still be obtained in a shorter duration of time. Including a reinforcement alone condition before a prompt level assessment will allow clinicians to evaluate if a perceived deficit requires teaching before determining the appropriate prompt level. The purpose of this study was to determine whether specific instruction was needed for a hypothesized skill deficit while also assessing which response prompt was most effective and efficient.

Method

Participants and Setting

Three participants with a neurodevelopmental disorder were included in this study. All participants had the following prerequisite writing skills of tracing shapes and independent drawing of lines and circles. James was a seven-year-old male whose ABA therapy was beginning to target writing skills at the start of the study. He participated in research sessions once a week at his ABA clinic and once at his house. Lucy was a four-year-old-female whose treatment team stated that she was only able to write the letters of her name. She participated in research sessions twice weekly at her ABA clinic. Jake was a four-year-old-male whose treatment team confirmed that while he had the prerequisite skills, he was unable to write any letter or number independently. He participated in research sessions once-to-twice weekly at his home, where he was currently receiving ABA services. During

this research, Lucy and Jake were taught letters and numbers, and James was taught letters and shapes.

Response Measurement and Interobserver Agreement

An adapted alternating treatments design was used. Each session consisted of eight trials; a trial was defined as one presentation of the S^D (e.g., "write A"). During both the baseline and reinforcement alone conditions, each target was presented one time. Each letter and number were presented four times per session in the response prompt assessment. Paper and pencil were used to collect data. Each trial was scored as either correct independent, correct prompted, or incorrect/no response. A correct independent response was defined as the participant completing the instructed letter or number following the discriminative stimulus (S^D) and without any assistance from the researcher A correct prompted response was defined as the participant completing the instructed letter or number following the S^D and with the prompt level assigned for that condition. Incorrect/no response was defined as the participant failing to make a response or engaging in the wrong response.

Similar to Seaver & Bourret (2014), the most efficient prompt type was determined by the prompt that produced the targeted response at mastery criteria in the least amount of sessions. The same determination for most efficient prompt was used in this research, and prompt efficiency was calculated by dividing the number of independent responses by the total number of responses in each condition.

An independent observer collected trial-by-trial data, and the data was compared to the researchers' data. Exact agreement was calculated as agreements divided by agreements plus disagreements and multiplying by 100 for each participant. Interobserver agreement (IOA) data was collected in 36.6% of James' sessions and was 94.8%, 42.5% of Lucy's sessions and was 97.2%, and data was collected in 55% of Jake's sessions and was 100%.

Treatment integrity data was also collected by the independent observer in 35% of James' sessions, 43.7% of Lucy's sessions, and 63.2% in Jake's sessions. Data were collected on the implementation of all components. The appendix provides a data sheet that was used for collecting treatment integrity data. This included materials setup, delivery of the S^D, and correct consequence provided following the participants' response. During the progressive-time delay procedure data was also collected on if the correct time delay occurred before the prompt was provided. The independent observer used internal counting. Treatment integrity data is presented as percent correct and was calculated by the number of correct components divided by the total number of components multiplied by 100. Treatment integrity for James was 99.4%, Lucy was 99.9%, and Jake was 99.7%.

General Procedure

A white board and dry erase markers were used in all conditions. Each participant's treatment team selected the type of dry erase markers used by the participants. James used fine-tip dry erase markers, and Lucy and Jake used standard-sized dry erase markers. A differently colored card was placed on the table to serve as an S^D for each condition, and the same color dry erase marker was used by the participants. For example, a red card and red dry erase marker was always used when the model prompt procedure was in place. The same colors were assigned to the same conditions across all participants for the purpose of decreasing researcher error across participants. The materials were placed on a table before the start of the session. For the first trial of each session, the dry erase marker was placed in the middle of the whiteboard and the marker top was removed. This placement ensured that both right and left-handed participants had equal access to the materials and removing the top decreased difficulty. The researcher erased the participants' writing in between each trial.

Each response prompt assessment session consisted of writing one letter and one number for Lucy and Jake. The letter or number consisted of either two or three hand

movements for a total of five movements per pairing. Each pairing consisted of a letter or number that was all straight lines and one letter or number that had a curve. As an example, T and 5 (i.e., 2 hand movements for T and 3 hand movements for five) were used in the vocal and gesture condition for Jake. James was able to write numbers so shapes were used in place of numbers and each condition had a total of six hand movements. Table 1 provides a complete list of every pairing across all conditions for all participants. Letters and numbers with similar shapes (e.g., the number 9 and the letter P) were not selected to avoid confusion while the prompting conditions are assessed. The order of presentation of each letter and number were randomized per session. The pairings of all the letters remained consistent; additionally, each pairing was matched with one response type per participant (e.g., X and 5 were always be used with the model prompt for Lucy). The order of the response prompt sessions was presented randomly and was determined using randomizer.org.

Figure 1 displays a flowchart of the assessment sequence steps. As seen in Figure 1, a pre-assessment was conducted to determine whether the writing of letters and numbers was a skill deficit. Following the pre-assessment, baseline was conducted. After baseline, a reinforcement alone condition was then conducted. This component of the assessment determined whether the perceived skill deficit was a performance deficit or a deficit that required skill acquisition intervention. If reinforcement alone resulted in performance at the mastery criteria, the assessment ended. If this condition did not produce responding at mastery criteria, response prompts were then assessed.

The response prompting conditions followed the same general outline as Seaver & Bourret (2014). A progressive time delay was used in all prompting conditions. The prompt delays were 0-s,1-s, 2-s, and 4-s. The researcher counted internally rather than use a stopwatch. Internal counting was selected because the time delays were very short. Additionally, any sound made by the stopwatch or movements made by the researcher might

have served as an S^D for prompting. The time delays increased following a session with six out of eight trials (i.e., 75%) with prompted correct responses. If two consecutive sessions occur with one or more incorrect responses, the time delay was decreased. Reinforcement in the form of verbal praise (e.g., "awesome job!" "Fantastic writing") and access to a preferred item or edible was provided for all correct independent and correct prompted responses. If a completed number or letter attempt was on the whiteboard and the participant was no longer observed to be actively engaging in writing behavior before the time delay was completed (e.g., the participant incorrectly wrote the number 7 in 2-s during a 4-s time delay), the correct response was not prompted. The rationale for not prompting following an incorrect response was the determination that this was an antecedent assessment rather than a consequence assessment.

Mastery criteria for ending the assessment was set as correct independent responding in seven out of eight trials, or 87.5% accuracy, across three consecutive sessions for Lucy and across two consecutive sessions for James and Jake.

Preference Assessment

A multiple-stimulus-without-replacement (MSWO) preference assessment (DeLeon & Iwata, 1996) was conducted with James and Lucy. A free operant preference assessment (Roane et al., 1998) was used with Jake. The researcher conducted a reinforcer survey with the participant's BCBA or board-certified assistant behavior analyst (BCaBA), and the top 5 tangible and/or edible items was selected. The preference assessments were conducted 3 times to establish a reinforcer item hierarchy. For the purposes of this study, the highest item was used as a reinforcer. Fruit 'n' yogurt fruit snacks were used with James, sugar cookies bites were used with Lucy, and the iPhone was used with Jake. It must be noted that Jake's time with the iPhone was variable, as recommended by his treatment team. Instead of pausing

a song mid-phrase (e.g., “Old McDonald had a Farm, E, I”) at a predetermined time, his time ended at the end of a phrase (e.g., “Old McDonald had a farm, E, I, E, I O”).

Pre-Assessment

The participants were presented with a whiteboard and a black dry erase marker. The S^D “write___” was presented. Each letter, number, or shape was presented three times.

Baseline

Baseline was assessed for all targeted letters, numbers, and shapes. The researcher placed the whiteboard and a black dry erase marker in front of the participant. The researcher stated the S^D at the start of each trial. No prompting or consequences were provided.

Reinforcement Alone

This procedure was similar to the praise-only condition of Kodak et al. (2013). Baseline procedures were implemented with the addition of reinforcement (i.e., praise and a tangible or edible) contingent on correct independent responding. No prompts were provided. If participants met mastery criteria in this condition, the assessment ended before response prompts were assessed. If after three consecutive sessions, participants responded at or below chance level, this condition ended, and response prompts were assessed. However, no participant met mastery criteria during the reinforcement alone condition.

Response Prompt Assessment

Vocal and Gestural Prompts. This condition was similar to baseline except for the use a combination of vocal and gestural prompts. The combined prompt consisted of the researcher stating a predetermined phrase that described how to write each letter or number while also following the predetermined phrase with a finger in the air. Table 2 provides all the vocal prompts used for each participant. The vocal prompts were selected from Kiddos World TV (2021) and Harry Kindergarten (2014) on YouTube. For James, the researcher

developed the phrase for the shape used in this condition. Reinforcement was given following correct independent or correct prompted responses.

Model Prompt. This condition was similar to baseline but with the use of a model prompt and reinforcement following correct prompted and correct independent responses. The model prompt consisted of the researcher modeling how to write the targeted letter, number, or shape on a separate whiteboard with a separate dry erase marker. The researcher then immediately erased the targeted letter, number, or shape on their board.

Physical Prompt. The same procedures as baseline were in place with the inclusion of a physical prompt. The physical prompt consisted of the researcher using hand-over-hand to guide the participant's writing the targeted letter or number. Reinforcement was provided following correct prompted or correct independent responding.

Control Condition. This condition was the same as baseline except for the addition of a black color card placed in front of the whiteboard. No prompts or reinforcement were provided.

Results

Figures 2-4 displays the data as the percent of correct independent responses across sessions for all participants. As seen in Figures 2-4, two participants engaged in correct independent responding in multiple prompt conditions. This suggests that more than one response prompt was at least partially effective. However, none of the participants met mastery criteria with any response prompt.

Figure 2 shows the results for James. During the initial baseline sessions, James engaged in correct independent responding during two sessions. Shapes replaced numbers and several new letters were selected; baseline sessions then resumed. He engaged in correct independent responding for the letter X during all four sessions of the reinforcement alone condition. The letter X was assigned to the control condition and correct independent

responding persisted for this target. The increase in correct independent responding condition, as compared to the reinforcement alone condition, was due to the increased opportunities to write the target (i.e., one time in the reinforcement alone condition and four times in the response prompt assessment).

Figure 3 displays the correct independent results for Lucy. As seen in Figure 3, Lucy engaged in correct independent responding in only one trial in baseline. During the reinforcement alone condition, her correct independent responding was more variable, but she did not reach mastery criteria during the eight sessions in this condition. Of the two targets for which a correct response had occurred during the reinforcement alone condition, one was assigned to the control condition and the other target was assigned to the model prompt condition. Lucy engaged in correct independent responding above 80% correct several times in both the physical and model prompt conditions. However, she did not reach mastery criteria in either condition. Lucy also terminated four sessions; she walked away from the model prompt condition session 45, a model condition, the physical prompt condition sessions 75 and 88, and refused to participate in the control condition session 86. After multiple control condition sessions, Lucy was observed to not give assent when the control condition was presented. The control condition was then spaced out to occur less frequently.

Figure 5 shows Lucy's prompted correct responding across response prompt condition sessions. These data indicated that Lucy engaged in prompted correct responding across all three response prompt conditions. However, her level of prompted correct responding in sessions 14-46 was not high enough to move from the 0-s delay in both the model and vocal and gesture prompt conditions. Therefore, once she had participated in eight sessions across all conditions, the requirements for the progressive time delay changed from response-dependent to response-independent. Starting from session 47, the time delay

increased every session until the terminal delay was reached. If one or more incorrect responses or no responding occurred across two consecutive response prompt conditions when the terminal delay was used, the time delay decreased.

Figure 4 shows the correct independent results for Jake. As seen in Figure 4, Jake never engaged in correct independent responding. He was only able to engage in prompted correct responding in the physical condition. To allow Jake an increased opportunity to engage in correct independent responding, the progressive time delay was switched from response-dependent to response-independent in session 31. Despite the increase in time delay, Jake was unable to engage in correct independent responding with any response prompt conditions.

Slight procedural errors occurred for all participants. The time delay was incorrectly increased for the model prompt in session 19 for James. Additionally, a partial incorrect vocal prompt (e.g., the researcher stated “pull down, slant up, pull down” instead of the correct “pull down, slant up, slant down”) was stated for two vocal and gesture prompt sessions, 31 and 33. No color card was present for the first several trials in sessions 14 and 54 for James. In session 81, a physical condition, the incorrect time delay was used for Lucy. Instead of increasing to 4-s, the time delay remained at 2-s. Jake did not receive reinforcement in the physical prompt condition session 19 for three prompted correct trials. A dried-up marker was used for three trials in the control condition session 27. The control condition Session 37 was terminated after two trials when the researcher discovered that the wrong targets were being run.

Discussion

The purpose of this study was to examine the effectiveness of a skills assessment sequence on a perceived skill deficit while also determining the most effective method for intervention. This skills assessment was successful at determining whether the assessed

writing skill required intervention. However, this assessment was not as successful at determining the most effective method for acquiring independent writing of letters, numbers, and shapes. Although two out of the three participants were able to obtain the skill of writing at least one letter and one number through the response prompts, this assessment was not efficient. For example, Lucy participated in over 80 sessions and James participated in 60 sessions.

There are several possibilities as to why none of the participants reached mastery. First, the prerequisite skills required for participation in the study may not have been stringent enough. For example, Jake had no prior exposure to writing letters and numbers. He was unable to engage in correct independent responding. Participation in this study did not require the ability to trace letters and numbers, as those are stimulus prompts. Although neither James nor Lucy was able to meet mastery criteria, both were able to engage in correct independent responding. James and Lucy both had prior exposure to writing letters and numbers, according to their treatment teams. Future research is needed to evaluate if tracing letters and numbers should be a required prerequisite skill before assessing independent writing skills.

Second, idiosyncratic variables may have influenced responding. Lucy engaged in variable responding throughout each phase of this research; she was observed to draw pictures instead of writing. Further, her treatment team informed the researcher that her pre-school used whiteboards to draw. This suggests that there were competing motivational operations in place. Perhaps at times, it was more reinforcing to draw than engage in correct independent responding and receive the identified reinforcement (e.g., sugar cookie bite). Additionally, if mastery criteria goals were less stringent (i.e., two consecutive sessions instead of three consecutive sessions), Lucy would have met mastery criteria in session 70.

The stringent mastery criterion was set to meet a minimum requirement of mastery that her ABA clinic utilizes.

James' overall responding was less variable, as compared to Lucy. However, throughout the entire assessment, he was observed to engage in high variability of hand movements (e.g., using four hand movements to write X in the reinforcement alone condition and 2 hand movements for X in the response prompt assessment). This variability of hand movements often resulted in different, but not always incorrect, written letters or shapes. For example, when drawing a triangle, sometimes James drew a right triangle and other times his drawing resembled an isosceles triangle. Other trials, however, he wrote a letter or shape that might have some or even all the correct components, but not resemble the target enough to be correct. It is plausible that James was not able to discriminate between correct and incorrect responses. His variable responding also led to missed opportunities to prompt correct responding. As an example, James was observed to be engaging in the correct hand moments required for drawing a square, so the researcher did not provide a prompt. However, when he had finished responding, he had drawn a rectangle instead.

It is also possible that the researcher did not identify the reinforcing variables that were maintaining his responding. James never contacted reinforcement during the control condition, and yet his correct independent responding maintained for the letter X. This suggests that perhaps that there were other maintaining variables, likely automatic reinforcement.

Third, the use of the progressive time delay might have also contributed to the lack of mastery obtained by the participants. Progressive time delays are typically response-dependent, meaning that the delays increase or decrease dependent on a predetermined criterion of participant's responding (Casey, 2008). This research followed the general procedures as Seaver & Bourret (2014), with one modification. Seaver & Bourret (2014)

increased the time delay after two consecutive trials within a session; this research increased the delay after one session. Increasing and decreasing time delays within a progressive time delay is variable across the research (Walker, 2008). For example, in this study we increased the prompt delay after only one session with high levels of prompted correct responding, whereas other studies remained at a 0-s delay for at least two consecutive sessions (Grow et al., 2014; Vedora & Berry, 2016.) Increasing after only one session may, from the participants point of view, not provided clarity as to when prompts were to occur.

How this research implemented the progressive time delay might at least partially explain the variability of responding observed in two of the participants. James and Lucy both engaged in incorrect responding that was not corrected by the researcher during the response prompt assessment. Within the time delay before prompting was provided, it was often difficult to judge whether the responding was correct. For example, Lucy could engage in a complete incorrect response (e.g., write 7 with the horizontal line in the wrong direction) during a 4-s delay in the physical prompt condition before the prompt delay time had elapsed.

The use of a response-dependent progressive time delay also affected the participants' opportunities to engage in correct independent responding. James, Lucy, and Jake all demonstrated that keeping the delay at 0-s or moving back down all the way to 0-s masked the, albeit infrequent, occurrence of correct independent responding. For example, James was engaging in correct independent responding in the vocal and gesture prompts in sessions 55 and 56; however, he made at least one incorrect response in both sessions. Therefore, the delay was decreased back to 0 for session 59 which did not provide him with the opportunity to engage in correct independent responding. Both Jake and Lucy switched from response-dependent to response-independent time delays to allow for increased opportunities to engage in correct independent responding. Although Jake did not engage in correct independent

responding, he was given an opportunity across two sessions of each response prompt condition before the assessment ended.

Immediately after Lucy switched from response-dependent to response-independent time delays, her correct independent responding increased in both the model and the vocal and gesture prompt conditions. If the researcher had not implemented the change, it is possible that she would not have been able to demonstrate correct independent responding before the assessment was terminated. However, response-independent prompt delays are not thoroughly researched (Casey, 2008). The change from response-dependent to response-independent prompt delays was effective for Lucy, but further research is needed to demonstrate the effectiveness of response-independent prompt delays.

Beyond potential explanations for the lack of participants mastering the targeted skill, other observed factors warrant a closer examination, including the response prompts that were utilized. The combined vocal and gesture prompt condition was designed to replicate Seaver & Bourret (2014). They determined that a verbal prompt would be insufficient for their targeted task (i.e., completing a Lego structure). However, a gestural prompt for this experiment's targeted task was deemed insufficient to prompt the targeted behavior (i.e., pointing to a blank whiteboard does not prompt the correct response like pointing to the correct picture card does in a conditional discrimination task). Therefore, the two separate prompts were combined and presented together in this research to maximize effectiveness. Additionally, the combination of these two prompts is most likely commonly utilized in a variety of educational settings. For example, a math teacher might provide additional vocal prompts while also pointing to equation. However, no participant responded above 80% correct independent during this condition, suggesting that this combined prompt condition was not effective for any of the participants.

Both the physical prompt and model prompt left permanent products that were temporarily available for the participant to view. The researcher did not immediately erase the prompted correct writing sample on the participant's whiteboard during the physical prompt condition. Instead, the researcher reinforced the correct response by providing the participants with the reinforcing item before erasing, meaning that the correctly written target may have functioned as an additional consequence. Further, in the model prompt condition, the researcher erased the written letter, number, or shape, immediately after modeling correct responding. However, both James and Lucy were observed to attend to the researcher's whiteboard. It is plausible that these participants were attending to the written stimulus and not the hand movements made by the researcher. Although they were only visible temporarily, the permanent products in the model prompt condition may have thus functioned as a stimulus prompt, contributing to the higher efficacy of these conditions.

This research had several limitations. The researcher did not fully account for the permanent products that were in the physical and model prompt conditions. Additionally, the researcher did not pre-teach the vocal prompts used in the vocal and gesture prompt condition. It is unclear if the participants were able to follow directions such as "curve around," "slant down" or "straight across." The researcher also had to place a finger in the air at the start of the prompt; this might have functioned as an accidental additional hand movement that impacted the actual prompt.

A second limitation is outside exposure to letters, numbers, and shapes, and research materials. All participants received outside academic instruction. During the reinforcement alone condition, James' RBT mentioned that his treatment team was actively targeting writing the letter K, which was one of the targets of this assessment. The researcher confirmed with his BCBA, who offered to remove K from his current skill acquisition programming. The researcher confirmed that no other letters or shapes were currently in his

programming. Lucy was observed to be playing with magnet letters before research sessions began several times and ate alphabet cookies during her lunch breaks. These outside exposures might have influenced the participant's development of concept formation of the targeted letters, numbers, and shapes.

Another limitation of this research was the lack of permanent products used and collected. Because the participant's response was erased at the end of teach trial, the researcher's own behavior might have influenced the independent data collector's decisions instead of the actual response itself. Both IOA and treatment integrity data were collected in situ, meaning that the data collector observed what consequence the researcher provided, and this may have influenced how they scored the writing skill or the implementation of intervention steps. It is also possible that the researcher's decisions concerning the correct or incorrect responses might have been shaped by the participants' responses over the course of this research. Permanent products of the participant's responses would allow for an independent data collector to provide IOA data without observing the researcher. Permanent products would also allow for a comparison of participant responses over the course of the research.

There are several avenues for future research. The results of this current research suggests that response prompts are not an efficient intervention to utilize when targeting writing skills. Future research could examine the effectiveness of a treatment package for writing skills. Perhaps combining response prompts with an error correction procedure would lead to more efficient results. Future research could also examine if response prompts are more effective when combined with stimulus prompts. A treatment package that utilizes response prompts, stimulus prompts, and error correction might also be examined.

Future research could continue to examine the effectiveness of this assessment sequence (i.e., reinforcement alone followed by a response prompt assessment). Previous

studies have conducted skills assessments with tasks such as one step-directions and audio-visual conditional discriminations (Cengher et al., 2016; Schnell et al., 2019). Future research could use this assessment sequence on these skills. Other skills, like sorting laundry, could be assessed using this proposed model.

Additionally, this assessment sequence was designed to save clinician's time by combining key elements of two types of skills assessments. It could be conceptualized that practitioners utilize a skills assessment like the ABLLS-R or the VP-MAPP as the preassessment instead of designing their own. Future research could examine the efficacy of using one of the commonly used skills assessments as the first step.

If more than one response prompt was effective, the researcher had planned on conducting a concurrent-chains preference assessment. Concurrent-chains preference assessments have been utilized in skill acquisition programs to determine client preference by having clients select a representative stimulus (e.g., color card) of a particular teaching condition (Basile et al., 2021). Choice and preference are essential components ABA services and should always be taken into consideration and utilized when designing client programming Future research could examine the efficacy of a concurrent-chains preference assessment if more than one response prompt is deemed effective.

This research replicated and extended the research literature on both rapid skills assessments and response prompt assessments by combining the two into one skills assessment sequence. The researcher directly intervened on the skill deficit by teaching the skill while also assessing the best method of intervention for future targets. This highlights the efficiency of using this skills assessment sequence in clinical practice.

References

Behavior Analyst Certification Board (2014). *Professional and ethical compliance code for behavior analysts.* https://www.bacb.com/wp-content/uploads/2020/05/BACB-Compliance-Code-english_190318.pdf

Basile, C. D., Tiger, J. H., & Lillie, M. A. (2021). Comparing paired-stimulus and multiple-stimulus concurrent-chains preference assessments: Consistency, correspondence, and efficiency. *Journal of Applied Behavior Analysis*. https://doi.org/10.1002/jaba.856

Bourret, J., Vollmer, T. R., & Rapp, J. T. (2004). Evaluation of a vocal mand assessment and vocal mand training procedures. *Journal of Applied Behavior Analysis, 37*(2), 129–144. https://doi.org/10.1901/jaba.2004.37-129

Casey, S. D. (2008). A comparison of within- and across- session progressive time delay procedures for teaching sight words to individuals with cognitive delays. *The Behavior Analyst Today*, *9*(3-4), 162–171. https://doi.org/10.1037/h0100656

Cengher, M., Shamoun, K., Moss, P., Roll, D., Feliciano, G., & Fienup, D. M. (2015). A comparison of the effects of two prompt-fading strategies on skill acquisition in children with autism spectrum disorders. *Behavior Analysis in Practice*, *9*(2), 115–125. https://doi.org/10.1007/s40617-015-0096-6

Cooper, J.O., Heron, T.E., & Heward, W.L. (2007). *Applied Behavior Analysis* (2nd ed.). Pearson Education, Inc.

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29(4),* 519-532.https:// doi: 10.1901/jaba.1996.29-519

Gorgan, E. M., & Kodak, T. (2019). Comparison of interventions to treat prompt dependence for children with developmental disabilities. *Journal of Applied Behavior Analysis*. https://doi.org/10.1002/jaba.638

Gould, E., Dixon, D. R., Najdowski, A. C., Smith, M. N., & Tarbox, J. (2011). A review of assessments for determining the content of early intensive behavioral intervention programs for autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*(3), 990–1002. https://doi.org/10.1016/j.rasd.2011.01.012

Grow, L. L., Kodak, T., & Carr, J. E. (2014). A comparison of methods for teaching receptive labeling to children with autism spectrum disorders: A systematic replication. *Journal of Applied Behavior Analysis, 47*(3), 600–605. https://doi.org/10.1002/jaba.141

HarryKindergarten. (2014, December 10). *I can write my NUMBERS! (writing numbers 0-9 for kids)* [video]. YouTube. https://www.youtube.com/watch?v=2X-HAFPHBzg

Halbur, M. E., Kodak, T., Wood, R., & Corrigan, E. (2019). An evaluation of parent preference for prompting procedures. *Journal of Applied Behavior Analysis*. doi:10.1002/jaba.616

Kiddos World TV. (2020, January 07) *How to write the alphabet for kids - learn how to write letters a-z for kids - learn abc uppercase* [video]. YouTube. https://www.youtube.com/watch?v=_QPsKkRofEE&t=1027s

Kodak, T., Fisher, W. W., Clements, A., Paden, A. R., & Dickes, N. R. (2011). Functional assessment of instructional variables: Linking assessment and treatment. *Research in Autism Spectrum Disorders, 5*(3), 1059–1077. https://doi.org/10.1016/j.rasd.2010.11.012

Kodak, T., Clements, A., & LeBlanc, B. (2013). A rapid assessment of instructional strategies to teach auditory-visual conditional discriminations to children with autism. *Research in Autism Spectrum Disorders, 7*(6), 801-807. https://doi: 10.1016/j.rasd.2013.02.007

Kodak, T., & Halbur, M. (2021). A tutorial for the design and use of assessment-based instruction in practice. *Behavior Analysis in Practice*, *14*(1), 166–180. https://doi.org/10.1007/s40617-020-00497-w

Leaf, J. B., Leaf, R., McEachin, J., Taubman, M., Ala'i-Rosales, S., Ross, R. K., Smith, T., & Weiss, M. J. (2016). Applied behavior analysis is a science and, therefore, progressive. *Journal of Autism and Developmental Disorders*, *46*, 720-731. https:// doi: 2048/10.1007/s10803-015-2591-6

Lerman, D. C., Vorndran, C., Addison, L., & Kuhn, S. A. (2004). A rapid assessment of skills in young children with autism. *Journal of Applied Behavior Analysis, 37*(1), 11-26. https://doi:10.1901/jaba.2004.37-11

Malkin, A., Dixon, M. R., Speelman, R. C., & Luke, N. (2016). Evaluating the relationships between the PEAK Relational training system – Direct Training module, assessment of basic language and learning Skills – revised, and the VINELAND adaptive Behavior Scales – II. *Journal of Developmental and Physical Disabilities*, *29*(2), 341–351. https://doi.org/10.1007/s10882-016-9527-8

Partington, J. W. (2010). *The assessment of basic language and learning Skills-Revised: An Assessment, curriculum guide, and skills tracking system for children with autism or other developmental Disabilities. The ABLLS-R Protocol*. Behavior Analysts.

Research randomizer. Pair of dice. (n.d.). Retrieved September 11, 2021, from https://www.randomizer.org/.

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

Seaver, J. L., & Bourret, J. C. (2014). An evaluation of response prompts for teaching behavior chains. *Journal of Applied Behavior Analysis, 47*(4), 777-792. doi:10.1002/jaba.159

Schnell, L. K., Vladescu, J. C., Kisamore, A. N., DeBar, R. M., Kahng, S. W., & Marano, K. (2020). Assessment to identify learner-specific prompt and prompt-fading procedures for children with autism spectrum disorder. *Journal of Applied Behavior Analysis*. https://doi.org/10.1002/jaba.623

Slocum, T. A., Detrich, R., Wilczynski, S. M., Spencer, T. D., Lewis, T., & Wolfe, K. (2014). The evidence-based practice of applied behavior analysis. *The Behavior Analyst, 37*(1), 41–56. https://doi.org/10.1007/s40614-014-0005-2

Sundberg, M.L. (2008) *VB-MAPP: Verbal behavior milestones assessment and placement program*. Concord, CA: AVB Press.

Vedora, J., & Barry, T. (2016). The use of picture prompts and prompt delay to teach receptive labeling. *Journal of Applied Behavior Analysis, 49*(4), 960–964. https://doi.org/10.1002/jaba.336

Walker, G. (2008). Constant and progressive time delay procedures for teaching children with autism: A literature review. *Journal of Autism and Developmental Disorders, 38*(2), 261–275. https://doi.org/10.1007/s10803-007-0390-4

Table 1

Response Prompt Conditions for All Participants

Condition	James	Lucy	Jake
Vocal and Gesture	K, triangle	F, 2	T, 5
Model	Q, square	X,5	A, 2
Physical	A, heart	R, 7	D, 4
Control	X, diamond	D, 4	R, 7

Table 2

Vocal Prompts Provided in the Vocal and Gestural Prompt Condition

Participant	Letter, Number, Shape	Vocal prompt
James	K	"Pull down, slant up, slant down"
	Triangle	"Slant down, slant down, straight across
Lucy	F	"Pull down, across at the top, across at the middle"
	2	"Curve around and straight to the right"
Jake	T	"Across at the top, pull down"
	5	"Left, down, and cure around"

Figure 1

Flowchart of the Assessment Sequence Steps

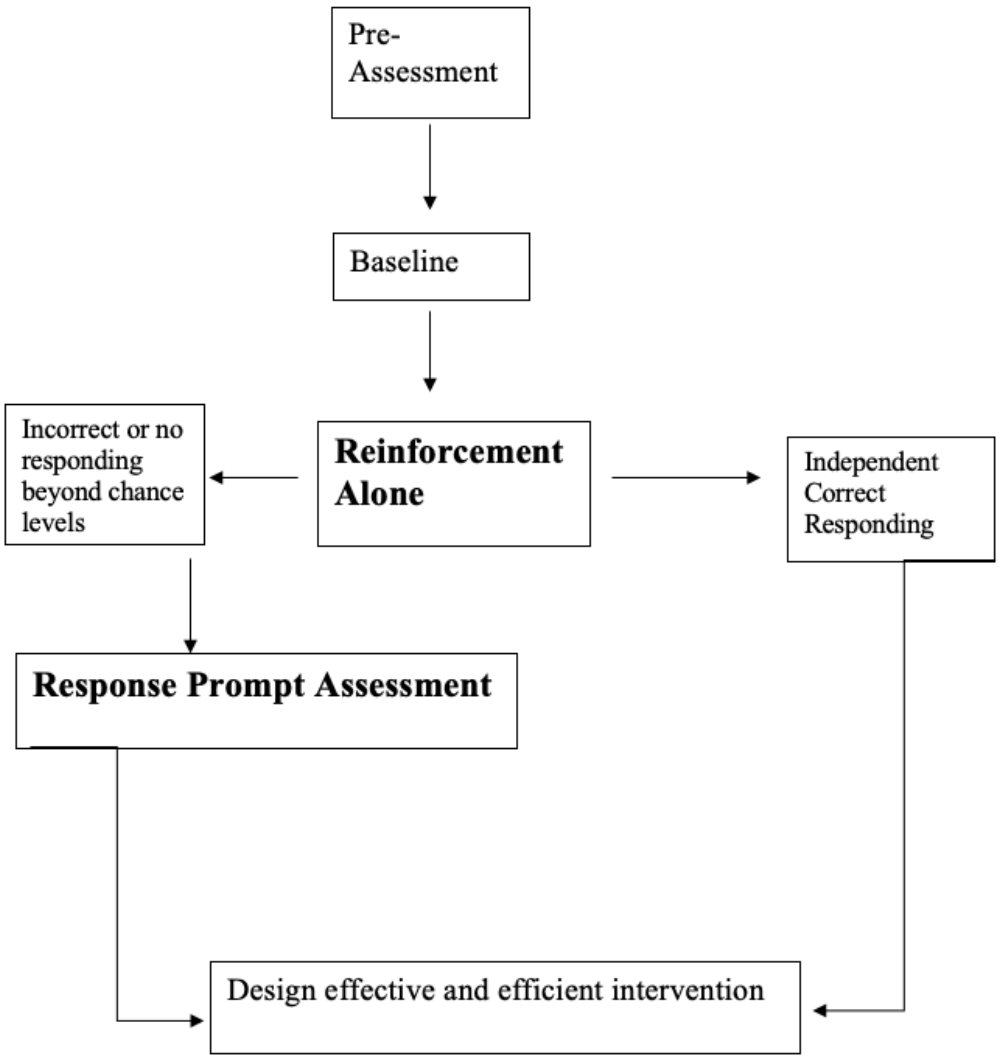
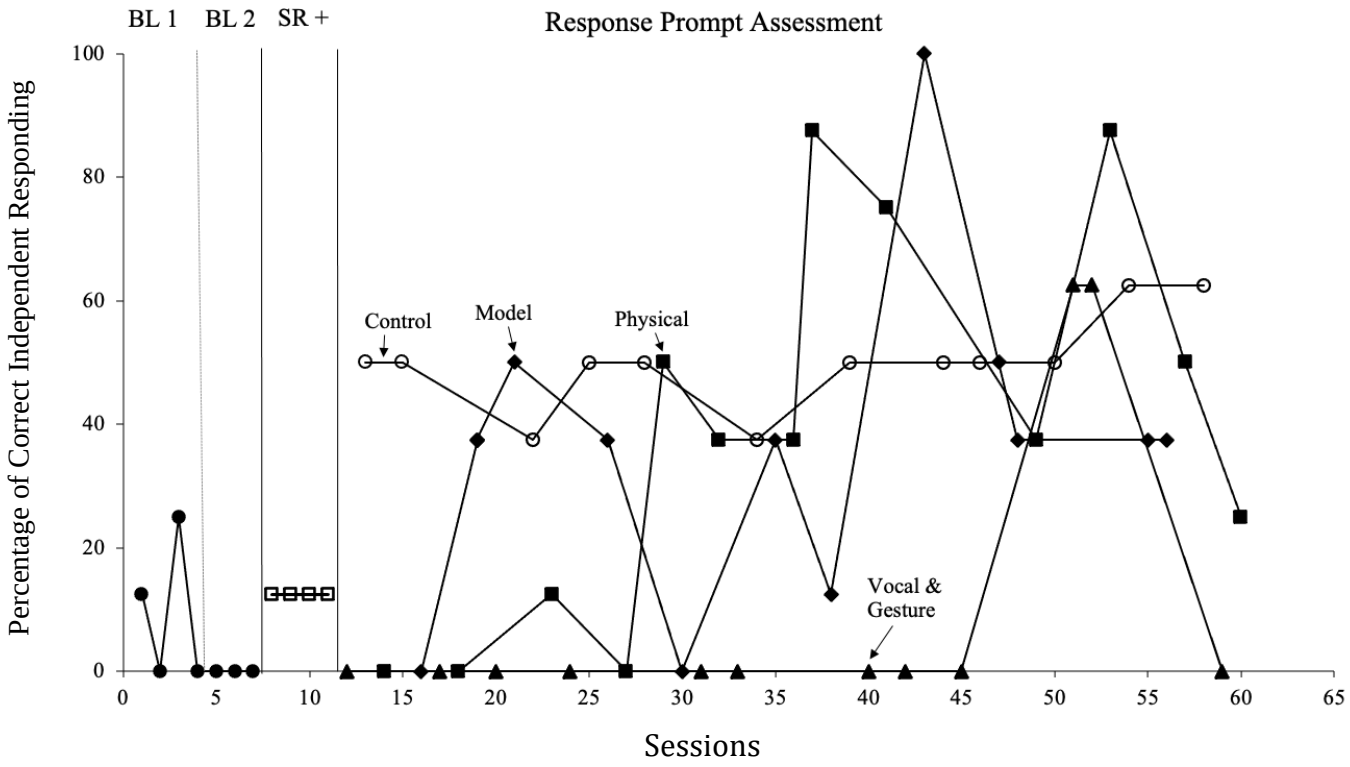


Figure 2

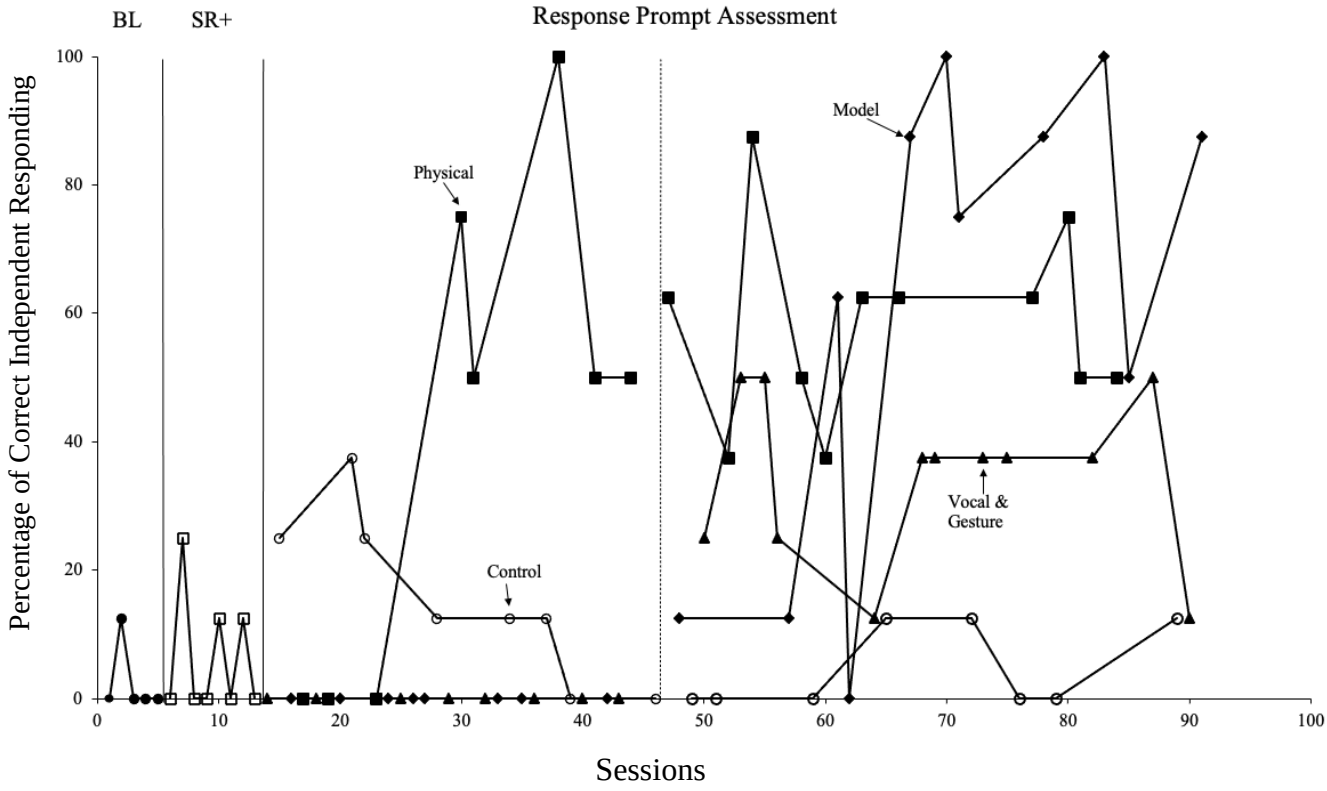
Percent of Correct Independent Responses Across All Sessions for James



Note. The dotted line between Baseline 1 and Baseline 2 indicates the usage of several new target letters and the usage of shapes to replace numbers.

Figure 3

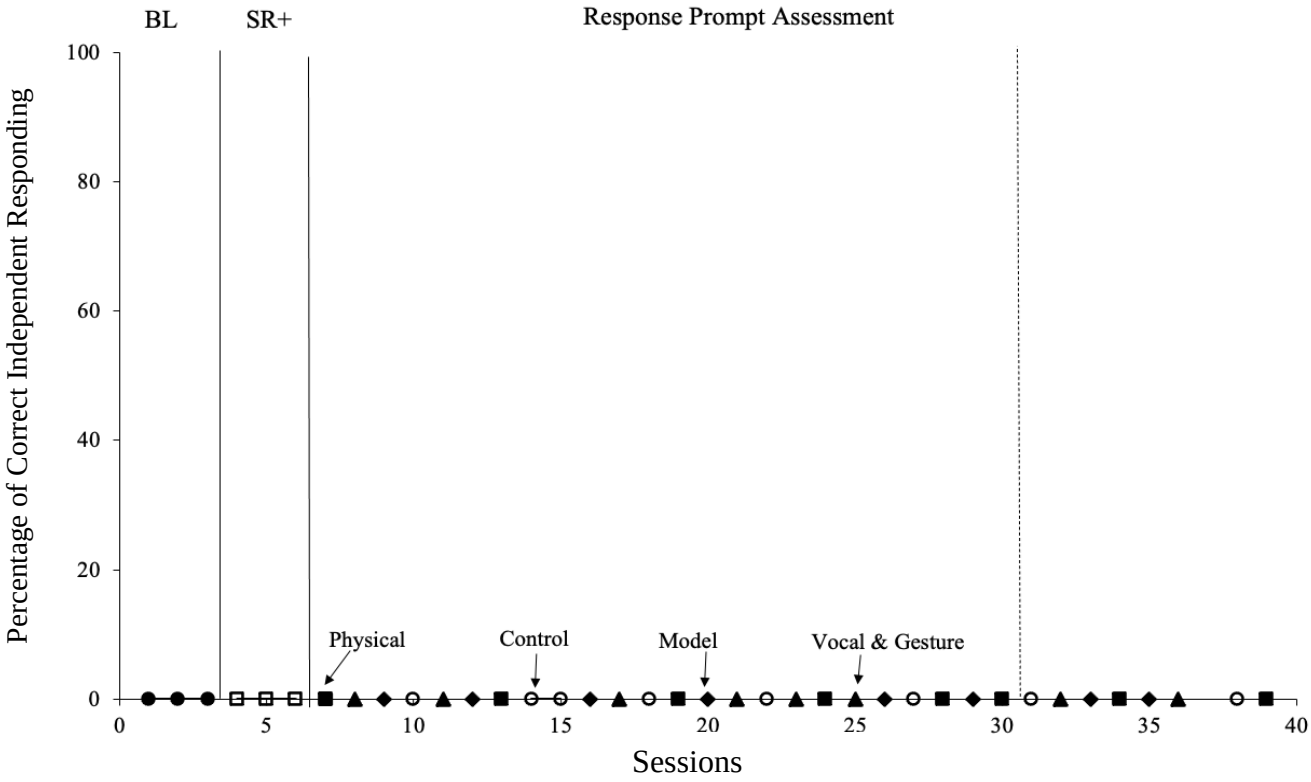
Percent of Correct Independent Responses Across All Sessions for Lucy



Note. The dotted line indicates a change from response-independent to response-dependent progressive time delay.

Figure 4

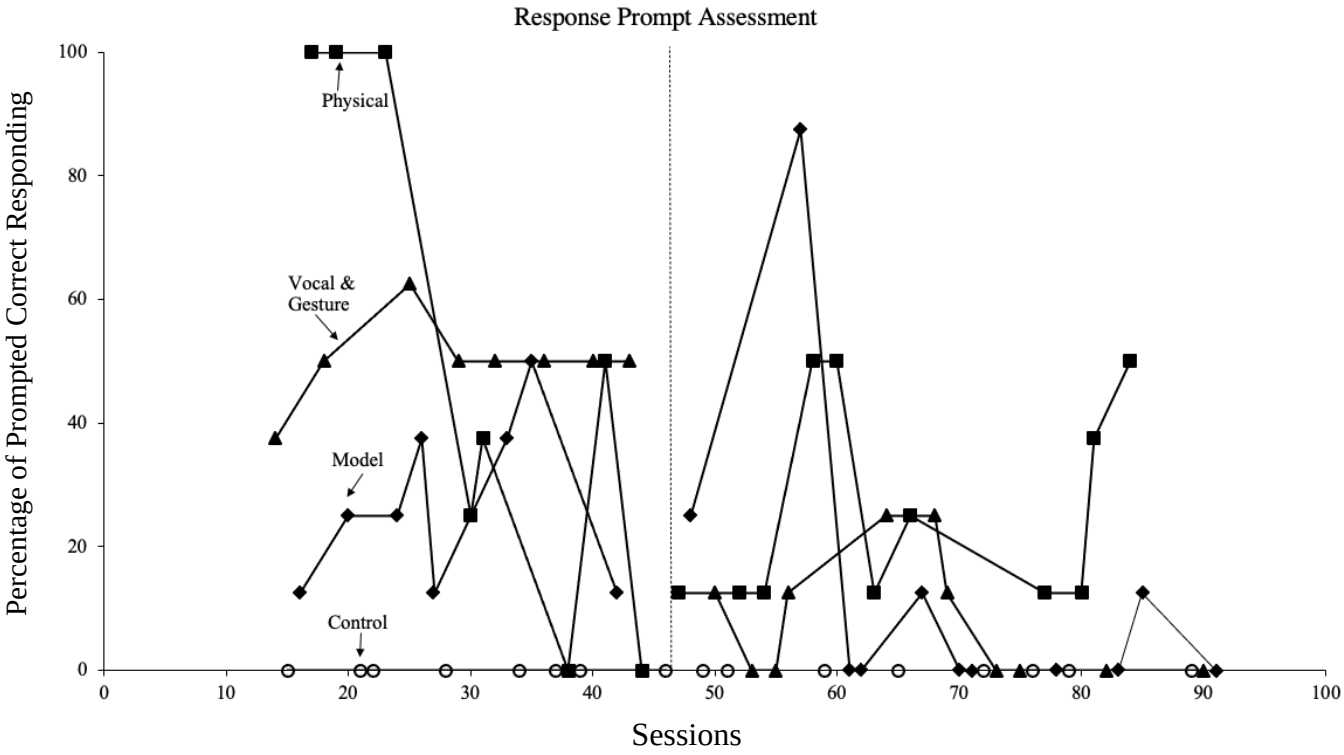
Percent of Correct Independent Responses Across All Sessions for Jake



Note. The dotted line indicates a change from response-independent to response-dependent progressive time delay.

Figure 5

Percent of Prompted Correct Responses Across All Sessions for Lucy



Note. The dotted line indicates a change from response-independent to response-dependent progressive time delay.

Appendix: Treatment Integrity and IOA Data Collection

IOA/TX Integrity data sheet

Participant: _____ Tx integrity assessor: _____ Experimenter: _____

Date: _____ Session #: _____ Prompt type: _____ Assigned Color: _____ Delay: _____

Circle **Y** for yes and **N** for No

Required steps	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8
Whiteboard is clean	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Correct color card on table, placed in front of whiteboard	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Correct color dry erase marker	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Dry erase marker cap off	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
~~Dry erase marker place on center of board~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~
S^D "write the letter or number___"	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Correct prompt type used	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Correct time delay used	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
Reinforcement provided or withheld as appropriate	Y N	Y N	Y N	Y N	Y N	Y N	Y N	Y N
~~Reinforcement provided for 30 s~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~	~~Y N~~

Total Y: _____ Total N: _____

Note. Two steps were crossed out for the data collectors. When the control condition was run, correct prompt type and correct time delay were also crossed out.

Participant: _____ Tx integrity assessor: _____ Experimenter: _____

Date: _____ Session #: _____ Prompt type: _____ Assigned Color:_____ Delay: _____

Circle participant response and add total for each response type at end of session

Code: **CI**= correct independent **PC**=prompted correct **I/NR**= incorrect/no response

	CI	PC	I/NR
	CI	PC	I/NR

	CI	PC	I/NR
	CI	PC	I/NR

	CI	PC	I/NR
	CI	PC	I/NR

	CI	PC	I/NR
	CI	PC	I/NR

CI: ____ PC: ____ I/NR: _____

Note. IOA and treatment integrity were collected in different sessions, except for one session for both James and Lucy. The data collectors reported that it was difficult to collect both, so the researcher changed it.