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Teaching Rule-Governed Behavior to Children with Autism

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by

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Abstract

Title: Teaching Rule-Governed Behavior to Children with Autism

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This study aimed to teach rule-governed behavior to children with autism. Few studies have examined rule-governed behavior in children with autism. Of the few studies that exist, results have shown that using behavior-consequence rules produce quicker acquisition of learning than using antecedent-behavior rules. In the current study, participants were given two behavior-consequence rules, one resulting in the presentation of a preferred or nonpreferred consequence and the other resulting in avoidance of that consequence. The percentage of rules followed independently and correctly was measured. A constant prompt delay was implemented due to the lack of progress. However, some participants began exhibiting prompt dependency. Inconsistent with previous results, none of the participants acquired the skill by reaching mastery. Limitations that may have contributed include the sophistication of the participants' repertoires, nonpreferred items not functioning as intended, and a lack of formal reinforcer assessments.

Keywords: autism spectrum disorder, mand, multiple exemplar training, rule-governed behavior

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Teaching Rule-Governed Behavior to Children with Autism

Rules and rule-governed behavior are some of the most prominent yet understudied concepts in the science of human behavior. Behavior analysts spend much of their focus on reinforcement contingencies and evaluating the learning histories of clients to implement programs that will better their clients' lives. While direct contingencies are a very important part of learning more about human behavior, rules are often overlooked despite the control they exert over behavior. Rule-governed behavior is omnipresent, from paying taxes to correspondence training to baseball (Torgler, 2003; Deacon & Konarski, 1987; Poling et al, 2011). Skinner wrote extensively about the importance of rules and rule-governed behavior. Skinner (1974) stated that rule-governed behavior is essential to human civilization, and that without rules, humans would have to start civilization over each generation. Rules allow people to conserve effort by responding only when reinforcement is signaled to be available, rather than by responding when reinforcement is unavailable (Skinner, 1969).

Rules provide a way for people to behave without directly contacting the contingencies for their behaviors (Skinner, 1969). For example, a rule that many people hear as children is "do not touch the stove while it is hot, or you will get burned." The statement of the rule as a verbal "warning" allows the child to avoid something painful without having to experience the pain. The rule allows them to learn the contingency without having to experience its consequences. Following rules allows people to learn from others' experiences and benefit from them instead of having to experience direct contingencies themselves. Rule-governed behavior can apply to any behavior, even that of applying behavior analytic principles. Rule-governed behavior explains why people can go to school to learn more about a subject, and then apply what they have learned in the real world immediately after, instead of having to discover the principles in the natural world all over again (Tarbox et al., 2011). Once people learn to follow rules and engage in rule-governed behavior, generalization can allow them to follow novel rules describing novel contingencies that are then reinforced as well. This is especially useful for contingencies that describe aversive consequences, allowing the learner to avoid—rather than escape—the contingency altogether. Rules can also aid in skill acquisition by increasing the rate at which acquisition occurs compared to acquisition rates when experiencing a novel contingency (Arntzen et al., 2009; Fox & Kyonka, 2017).

With contingency-shaped behavior, the learner is required to contact the consequence at least once, but it may often require more than one trial to acquire the response under the correct stimulus conditions (Joyce & Chase, 1990). With rule-governed behavior, the learner is signaled immediately to which pattern of responding will result in reinforcement (Joyce & Chase, 1990). This is also one reason why rule-governed behavior has been shown to be more resistant to changes in the environment or relevant contingencies (Joyce & Chase, 1990; Weiner, 1970). For example, if a person deprived of money is told that they will receive a small bonus at work every month that they come in 15 min early, they are more likely to start coming in 15 min early right away. If they are receiving that bonus, there is little chance they will exhibit variability in how early they come to work. The rule decreased the likelihood of the person contacting the bonus by chance with variable responding. Because the rule was delivered and consistently reinforced, responding is more likely to be insensitive to changes in the environment. Even if the bonus is no longer provided, the individual will likely continue to arrive to work 15 min early due to the history of reinforcement for adhering to the rule.

Joyce and Chase (1990) conducted an experiment elucidating these effects. The study tasked college students with pressing a button for points to determine the association between variety in responding and resistance to change with reinforcement schedules. College students were given complete or incomplete instructions regarding the reinforcement schedule for button pressing. The students given incomplete instructions showed more variable responding and sensitivity to changes in the reinforcement contingencies. In contrast, students given complete instructions showed less variable responding insensitivity to changes in the reinforcement contingencies.

Rules are effective for the same reason any other antecedent stimuli are effective: their association with the consequences delivered after the response (Cooper et al., 2020). From a young age, most children are taught to follow rules and receive reinforcement or avoid punishment for doing so. Fox and Pietras (2013) demonstrated that when it came to monetary penalties, deviations from rule-following still occurred when reinforcement for breaking the rule was greater than the reinforcement for following the rule, even when still under threat of punishment. For example, a parent may instruct their child to finish their homework before playing games, but if left on their own, the child may just play games without finishing their homework anyway. Just because a rule is delivered does not guarantee that the individual will respond in accordance with those rules.

With the wide variety of rules that people are taught to follow, behaviors that adhere to the rules become reinforced as well, which then can generalize to include novel rules. Even as adults, people follow rules because they have a long history of reinforcement for rule-following behavior. A common misconception, however, is that rules directly affect behavior. In actuality, rules affect other stimuli which in turn directly affect behavior.

Skinner (1969) referred to rules as contingency-specifying stimuli and classified them as discriminative stimuli (SDs). When a response is reinforced, the stimuli present acquire some degree of control over the response, such that the response is more likely to occur when those stimuli are present (Skinner, 1969). For example, a child asks their mother for candy before dinner, and she denies the request. The child then asks their father for candy before dinner, and he allows one piece. Therefore, the child will ask their father for candy before dinner in the future, not their mother. Due to the reinforcement of receiving candy after asking, the father has become an SD for candy before dinner. However, Blakely and Schlinger (1987) proposed that rules instead be classified as function-altering contingency-specifying stimuli (CSSs). Function-altering events refer to stimuli that alter the function of other stimuli (e.g., increase the evocative effects, decrease the punishing effects; Schlinger & Blakely, 1994). An example of an SD would be the sight of bread on the counter when a child is hungry, which then evokes the behavior of making a sandwich. The SD did not alter the function of any other stimuli, but rather evoked the behavior of interest—making the sandwich. Another example of a rule is a mother telling her child that he can have a sandwich if the dishes in the dishwasher are clean. Normally, the sight of a clean dishwasher may not affect a child's behavior. However, with the statement of the rule, the sight of a clean dishwasher evokes the behavior of making a sandwich. In this way, the rule did not evoke behavior, but rather altered the function of another stimulus, which in turn evoked behavior.

The first reason for separating rules from SDs is that SDs have immediate effects on behavior, whereas rules tend to show their effects after a period of delay (Blakely & Schlinger, 1987). SDs can evoke behavior sooner due to a longstanding history of reinforcement being available when they are presented (Blakely & Schlinger, 1987). Also, a rule does not evoke behavior, but rather it alters the evocative properties of some other stimulus (Blakely & Schlinger, 1987). For example, if someone is told "get the mail when the mailman drops it off," they are not going to get the mail immediately. They wait until they see the mailman arrive, at which point their behavior of getting the mail is evoked. While the behavior might be immediate—say if the mailman were arriving as the rule was presented—it is not always, and that delay is a significant factor separating rules from SDs.

Another issue with classifying rules as SDs is that it overshadows the significant and unique function-altering effects of rules (Blakely & Schlinger, 1987). As in the previous example, the rule alters the function of the antecedent stimulus, or the sight of the mailman arriving. Whereas previously that stimulus may have been neutral or had no apparent effect on behavior, now the sight of the mailman evokes going out to get the mail. This shows rules' ability to alter the function of other stimuli similar to the way operant and respondent contingencies alter stimuli's functions (Blakely & Schlinger, 1987; Schlinger, 1990).

The third issue is that, by grouping rules with SDs, it becomes harder to appropriately compare rules with contingencies, despite their function-altering effects (Blakely & Schlinger, 1987). Defining rules as SDs, which evoke or "occasion" behavior rather than alter the function of other stimuli, takes away the importance of the rule's effects and the comparability to that of respondent or operant contingencies (Blakely & Schlinger, 1987).

Rules that only specify a behavior (e.g., “Do this”) are more similar to SDs because they acquired their evocative effects through a history of differential reinforcement, rather than showing a function-altering effect (Blakely & Schlinger, 1987). These may be better classified specifically as “commands” and distinguished from “rules” (Blakely & Schlinger, 1987). While SDs and commands only require one component of the three-term contingency, rules require at least two components to describe a relationship (e.g., antecedent and behavior, behavior and consequence; Tarbox et al., 2011). Also, rule-governed behavior does not mean that behavior is evoked by the rule, but rather that the events within the rules evoke the behavior (Blakely & Schlinger, 1987). It is important to distinguish rules from SDs based on their observed effects, not on outdated classifications.

Rule-following is an important adaptive skill that is associated with a variety of important behaviors, such as safety (Cooper et al., 2020). Rather than engaging in unsafe behavior, children can learn rules that prevent them from experiencing painful or dangerous situations. Any good parent wants their child to be safe, which is why “stranger danger” and peer pressure are such large concerns for the parents and teachers of children and adolescents. However, those with autism tend to have more trouble with social interaction and communication, making these matters more of a concern (American Psychiatric Association, 2013). To date, few studies have focused on rule-governed behavior for children with autism.

One study by Tarbox et al. (2011) evaluated whether or not multiple exemplar training (MET) would be an effective method of teaching children with autism to follow simple antecedent-behavior rules, and then evaluate how well those skills generalized to new rules. The researchers recruited three young boys with autism spectrum disorder (ASD) who were able to tact items, mand appropriately, and follow one-step instructions. However, none of the participants followed simple, novel rules. The investigators implemented the study in the children’s regular home-based programs. Before the study started, the researchers probed stimuli they sought to include in the study to ensure that participants could tact and receptively identify those stimuli. They also probed simple instructions (e.g., "clap your hands") to make sure the participants were able to respond correctly to them. Using a concurrent multiple probe across participants study, they taught each rule to mastery before implementing the generalization probe.

Researchers scored a correct response if the participant responded the way the rule instructed when the antecedent specified in the rule was present, as well as if they did not respond when the antecedent was not present (Tarbox et al., 2011). For the procedure, a picture and the corresponding rule were shown to the participants. The picture either matched or did not match the stated rule. For example, the experimenter may hold up a picture of an orange and say, "If this is an orange, touch your head." Following an incorrect response, the experimenter provided neutral feedback. Most to least prompting was used and faded throughout the sessions. One rule was taught at a time. Generalization probes involved rules that the participants had not been taught. The rules were later altered to present the behavior first, then the antecedent. This format was repeated with generalization probes. This study showed that MET was effective for teaching children with autism to follow rules, although it only produced generalization in two of the three participants, and their second experiment, which provided only small differences from the first experiment, showed effective teaching for only one of three participants. However, this method required up to 11 examples of novel rules to reach mastery.

Wymer et al. (2016) replicated Tarbox et al. (2011) using MET to teach rules to children with autism. However, these rules described the behavior and the consequence, rather than the antecedent and the behavior, using preferred and nonpreferred items. In this study, the participants were three young boys with autism who were enrolled in a program for intensive language intervention and could not comply with if/then rules. The participants exhibited generalized symmetry and had emerging Level 3 scores on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008).

Wymer et al. (2016) used a nonconcurrent, multiple-baseline across participants. Generalization probes were conducted after the participants had mastered the rules. The dependent variable was the percent of correct, independent responses. The participants were presented with an instruction that stipulated access to either a preferred or nonpreferred item. When the consequence was preferred, the correct response was the one that accessed the consequence. When the consequence was not preferred, the correct response was any other than the response targeted in the rule. If they responded incorrectly, they were corrected in a neutral tone. If the initial independent opportunity yielded an incorrect response, the researcher provided error correction. Each session in training paired a nonpreferred and a preferred consequence with four different rules across eight trials (e.g., "Clap your hands if you want a ball."). Sessions continued until mastery. The generalization probes involved novel rules to evaluate generality. If the participants responded correctly on at least five trials, they had completed the study. Otherwise, they returned to training.

Participants correctly responded 50% of the time during baseline. During training, two participants met mastery within three to four sessions and responded correctly in two consecutive generalization sessions. After 15 training sessions, the third participant met mastery. Correct responding was obtained in only four of six trials in the generalization sessions, resulting in a return to training for three additional sessions until mastery. A return to the generalization probes yielded independent responding for two consecutive sessions.

Wymer et al. (2016) found that describing the behavior and consequences in the rule was much more effective than describing the behavior and antecedent in the rule, as this study required only one or two examples of novel rules to reach mastery. The authors posited that MET was an effective way of teaching rules to children with little to no rule-following repertoires. One prominent limitation of that study was that having the participants avoid a behavior that would lead to a nonpreferred consequence may require a self-control repertoire, which the study did not account for (Kanfer & Karoly, 1972). A more thorough analysis of how rule-governed behavior operates may be acquired by including two possible behaviors, each resulting in access to a different consequence.

The purpose of the current study was to systematically replicate Wymer et al. (2016) and examine how responding may be differentially affected by the incorporation of different response requirements for preferred and nonpreferred consequences. Instead of requiring one response to receive a preferred or nonpreferred item, this study instructed participants to engage in one behavior if they wanted the item and an alternative response if they did not. There has been very little research examining rule-following behavior in children with autism, which this study aimed to remedy, along with the added variable of an alternative response. The current study employed the use of rules describing behavior-consequence contingencies, as they have been shown to be more effective than using behavior-only or antecedent-behavior specifying rules (Wymer et al., 2016; Falcomata et al., 2008).

Method

Participants, Setting, and Materials

Three children diagnosed with autism spectrum disorder (ASD) were recruited through an early intervention program at a clinic for autism services that they attended. Each child was assessed using the VB-MAPP (Sundberg, 2008) during their time at the clinic. The VB-MAPP is an assessment tool designed for those with language delays (Sundberg, n.d.). It assesses skills already possessed and barriers to learning new skills, as well as requirements for transitioning to a less restrictive teaching environment. Some important skills included are social, mand, tact, visual perception, imitation, and echoics. The Milestones skills are divided into three levels akin to that of a typically-developing individual from 0-18 months (Level 1), 18-30 months (Level 2), and 30-48 months (Level 3).

Ava was four years old and demonstrated a majority of skills within Level 1 of the VB-MAPP as well as some emerging Level 2 skills. She showed deficits in listener responding, scoring only 2.5 out of 15 possible points within that domain, but scored above the minimum threshold on the assessments to participate in the study. This requirement was a repertoire consisting of at least 10 mastered listener responding skills. Kyle was two years old and demonstrated most Level 2 skills with some emerging Level 3 skills. Kyle scored 10 out of 15 possible points within the listener responding domain and was able to follow at least 50 simple, two-component instructions on command (e.g., touch nose). Henry was three years old and demonstrated most skills in Level 1 with some emerging Level 2 skills. He scored six points in the listener domain and was able to follow at least 10 motor commands (e.g., touch tummy). Participants were recommended by their case managers, exhibited nonresponding to if/then rules, and had repertoires somewhat similar to those in the original study.

Sessions were conducted in treatment rooms at the clinic the participants attended. Materials necessary were tangible stimuli or edibles that were preferred and nonpreferred for each child as determined by reports from therapists, caregivers, or the participant, as well as datasheets, a timer, and a pen.

Design

This study used a multiple-baseline across participants design (Kazdin, 2011). The design included a baseline phase, an initial prompt fading phase, and a constant time delay using 0 s, 2 s, and 5 s model prompts. A generalization phase was planned after the intervention phase. However, none of the participants mastered the skill.

Dependent Variable

The main dependent variable was the percentage of rules followed per session. This was defined as independently engaging in the correct behavior when the preferred items were available and the alternate behavior when the nonpreferred items were available. The researcher recorded the data after each trial. Each of the responses used during the study were mastered listener skills relatively equal in response effort (e.g., clap hands, touch ears).

Problem behavior data was also collected based on what was collected by the case manager and RBTs daily. Timers and tally marks were used to measure the behaviors. If problem behavior occurred during session, the researcher followed the reactive strategy detailed by the case manager. No high intensity/severe problem behavior was observed during sessions.

Interobserver Agreement and Treatment Integrity

Trial-by-trial interobserver agreement (IOA) was collected across at least 33% of sessions per phase. To collect IOA data, the observer was either seated in the observation room or scored a recording of the session. The observer scored a data sheet identical to the researcher's and the datasheets were compared to determine agreement between the researcher and the IOA collector. During baseline for Ava, IOA was collected across 33% of sessions at 100%. During the physical prompt phase, it was collected across 43% of sessions at 100%. During the 0 s model phase, it was collected at 100% across all sessions.

During the 2 s model phase, it was collected across 43% of sessions at 100%. During the 5 s model phase, it was collected across all sessions at 100%. During baseline for Kyle, IOA was collected across 33% of sessions at 100%. During the physical prompt phase, it was collected across 33% of sessions at 100%. During the 0 s model phase, it was collected across 50% of sessions at 100%. During the 2 s model phase, it was collected across 60% of sessions at 100%. During baseline for Henry, IOA was collected across 33% of sessions at 100%. During the physical prompt phase, it was collected across 50% of sessions at 100%. During the 0 s model phase, it was collected across 43% of sessions at 100%. During the 2 s model phase, it was collected across 33% of sessions at 100%. During the 5 s model phase, it was collected across 43% of sessions at 100%.

Treatment integrity was also measured to ensure the procedures were being run as consistently as written. As depicted in Figures 1 through 6, the observer followed a flowchart and recorded the number of steps completed correctly per trial and whether or not the instructions and feedback were delivered in a neutral tone, as well as if an MSWO was conducted before the session began. It was measured across at least 33% of sessions per phase. During Ava's baseline phase, treatment integrity was collected across 33% of sessions at 96.88%. During the physical prompt phase, it was collected across 43% of sessions at 100%. During the 0 s model phase, it was collected at 100% across all sessions. During the 2 s model phase, it was collected across 43% of sessions at 100%. During the 5 s model phase, it was collected across 50% of sessions at 100%. During baseline for Kyle, it was collected across 33% of sessions and had a mean of 98.44% (range: 96.88-100%). During the physical prompt phase, it was collected across 33% of sessions at 100%. During the 0 s model phase, it was collected across 50% of sessions at 100%. During the 2 s model phase, it was collected across 60% of sessions at 100%. During baseline for Henry, it was collected across 33% of sessions at 100%. During the physical prompt phase, it was collected across 75% of sessions had a mean of 97.6% (range: 96.3-100%). During the 0 s model phase, it was collected across 43% of sessions at 100%. During the 2 s model phase, it was collected across 33% of sessions at 100%. During the 5 s model phase, it was collected across 43% of sessions at 100%.

Procedure

Pre-Assessment

In the pre-assessment, a list of mastered tasks and possible preferred and nonpreferred items was gathered from the caregivers and daily therapists (see Table 1). The participant was instructed to engage in each mastered behavior one at a time (e.g., "clap your hands"). Responses were included in the study if the participant responded independently and correctly across three consecutive trials.

Baseline

Before the start of each session in baseline and treatment, a multiple stimulus without replacement (MSWO; DeLeon & Iwata, 1996) preference assessment was conducted to determine preference for tangible or edible stimuli that day. During an MSWO, all stimuli were arranged in an array. Once the participant chose one item, that item was delivered and removed from the array so only the remaining items were re-presented in the array. The procedure continued until all items were selected. If the participant chose a nonpreferred item over any preferred items or refused to choose a preferred item, that session was terminated and attempted again at a later time.

During each session, participants were presented with eight trials describing different behavior-consequence contingencies. Four trials of behavior-consequence contingencies described preferred consequences, and four trials described nonpreferred consequences. Each rule described two behaviors and the participants were given 5 s to respond. One response resulted in the delivery of the item, and the other resulted in the removal of the item (e.g., "If you clap hands, then you get pretzel. If you touch ears, then you do not get pretzel."). If the participant engaged in the behavior to access the item, the item was delivered. If they engaged in the behavior to avoid the item, the item was withheld and the next trial began. If the participant did not engage in any of the target behaviors (e.g., staring at the floor, playing with their fingers), the item was withheld and the next trial began. Incorrect responding and nonresponding were counted as errors. A new trial began after a 30 s reinforcement interval for items, the edible had been consumed, or the participant engaged in an avoidance response to the item (e.g., returned it to the researcher, disrupted with it, etc.). A block was used to prevent participants from responding before the entire rule could be delivered. This included holding the participants hands or hovering over their hands to block if they started to respond. The researcher interspersed mastered tasks and reinforced compliance using preferred items not available during the study.

Treatment

Treatment sessions were identical to baseline with the addition of error correction for incorrect responses. First, the researcher provided behavior-specific feedback in a neutral tone (e.g., If the preferred consequence required touching their ears to access the item, the researcher would say, "You want pretzel, so you should have touched your ears."). Following subsequent presentations of the rule, physical and model prompts were implemented and faded with each presentation of each rule (see Figures 1 and 2). To reach mastery criteria, participants needed to respond independently and correctly to seven of the eight trials across two consecutive sessions.

After Ava and Kyle went through treatment for twice as many sessions as baseline with no significant improvement, the error correction procedure was altered to establish stimulus control by including a constant time delay component (Carroll et al., 2015). Henry received the new procedure after four sessions in treatment due to a lack of improvement and challenging problem behavior exhibited during sessions. During the 0 s model phase, an immediate model prompt was delivered with the initial presentation of the rule. Once participants responded independently or prompted on seven of eight trials across two consecutive sessions, the time delay advanced to 2 s. The same criteria were used to advance from 2 s to 5 s. Independent and prompted responses were treated as correct according to the error correction and treatment integrity protocols, but only independent responses were reflected on the graph. If the participant errored with an initial 0 s model prompt, the error correction used a 0 s hand-over-hand prompt (see Figures 3 and 4). If the participant errored with a 2 s or 5 s model prompt, the error correction used a 0 s model prompt (see Figures 5 and 6). This decision was also made due to participants frequently responding correctly during the initial error correction procedure using physical and model prompts, but erroring during independent opportunities. This new procedure made for shorter sessions and resulted in decreased problem behavior (see Figure 8).

Results

Figure 7 depicts the percentage of rules followed independently and correctly per session across participants. During baseline, Ava responded correctly approximately 42% of the time. Kyle did not engage in any correct responses. Henry responded correctly approximately 15% of the time. During treatment, Ava responded correctly approximately 26.8% of the time, with no session resulting in better responding than baseline. Kyle responded correctly approximately 3% of the time. Henry responded correctly approximately 22% of the time, but was still switched to the constant time delay error correction method due to not responding better than baseline in any one session and high levels of problem behavior.

Across all phases, only independent responses were scored on the graph. During the 0 s model phase, each participant scored at zero due to the immediate model prompt. However, Ava and Kyle met criteria to advance to the 2 s model phase at the minimum of two sessions. Henry required seven sessions to move to the 2 s model phase due to noncompliance and a lack of attending. Ava required seven sessions to move from the 2 s model to the 5 s model due to responding incorrectly earlier than the prompt was given and only responded independently once across the seven sessions. During the 5 s model phase, Ava did not engage in any response until the prompt was delivered and appeared to be waiting for the model. Henry required nine sessions to move from the 2 s to 5 s model prompt and most consistently responded to only one of the eight rules, but was still similar to baseline and the original treatment.

Discussion

Inconsistent with results from Wymer et al. (2016), participants in the current study did not acquire rule-following during this study. None of the participants met mastery criteria during teaching. Generalization probes were planned to be introduced after participants met mastery, but as mastery did not occur, generalization was unable to be assessed.

There are a variety of potential reasons for the differences in results. There were significant differences between the ages and repertoires of the clients in this study and Wymer et al. (2016) based on their assessment scores. Participants in the original study ranged from four to five years old, while participants in the current study ranged from two to four years old. Participants in the current study had similar VB-MAPP scores to those in the original study, with some significant differences. In the original study, all participants exhibited most of the skills within Level 2 as well as some Level 3 skills. Similarly, Kyle demonstrated most Level 2 skills with some skills in Level 3. However, Ava and Henry demonstrated skills primarily within Level 1 and 2 with deficits in listener responding. It is possible that the established Level 2 repertoires of the participants in the original study contributed to the success of teaching rule-governed behavior with this protocol.

Another repertoire discrepancy that may have contributed to limited success was the absence of generalized symmetry. Wymer et al. (2016) required that participants exhibit generalized symmetry. Generalized symmetry is demonstrated when a child is taught to tact a picture and can then receptively identify it without further teaching (Greer et al., 2007). This skill has been suggested to be a necessary prerequisite for more complex skills such as rule following (Hayes et al., 2001). The current study did not formally assess generalized symmetry nor was it stipulated as inclusion or exclusion criteria.

Attending was also difficult to establish. None of the participants consistently attended to the verbal instructions delivered by the experimenter, as evidenced by orienting elsewhere, engaging in stereotypy, and/or avoiding eye contact. This made it more challenging to determine when the participants were attending. There was also evidence of emerging prompt dependency for Ava and Henry, who failed to independently respond during the 5 s prompt delay phase until the prompt was delivered.

There may also have been differences in rates of problem behavior with participants between the original study and the current study. Ava and Henry demonstrated high rates of noncompliance during both treatment sessions as well as their regular sessions in the clinical center. Noncompliance was also accompanied by aggressions, disruptions, and elopement for Henry who hit and kicked, threw items off the table, and attempted to leave the table or room between trials. These high rates of problem behavior likely interfered with attending and fluent execution of the protocol, but decreased with the introduction of the constant time delay procedure.

Another limitation of the current study was that nonpreferred items may not have functioned in the intended manner. For Ava and Kyle, items identified as nonpreferred by verbal reports and preference assessments were still interacted with when delivered during error correction. This could have been because there were no immediately available alternatives or preferred items during teaching, as each item was available one trial at a time. Additionally, sessions were terminated before running if the participants selected items that were previously identified to be nonpreferred or did not select items identified as preferred. Selecting a nonpreferred item occurred twice with Ava and three times with Kyle. On one occasion, Henry refused to select a preferred item. On the contrary, Henry often fixated on a specific item and, despite choosing multiple items during the MSWO, would engage in problem behavior when denied that item during the rest of the trials.

Similarly, another limitation was the lack of formal reinforcer assessments for each participant to ensure that the stimuli delivered functioned as reinforcers. This was due to time constraints as well as attempting to interfere with the participants' typical clinical sessions as little as possible. However, MSWO preference assessments were conducted before each session to determine what items were most preferred to find valuable and potentially reinforcing stimuli (Pace et al., 1985; DeLeon & Iwata, 1996).

Wymer et al. (2016) indicated that a potential limitation may have been the exclusion of a response to indicate when participants did not want an item, as that may have required an element of self-control. However, the added component from the original study may not have been well-suited for the current participants. The addition of a second rule indicating that the participants did not want the item likely required better attending and a more sophisticated receptive instruction repertoire. This advanced repertoire would likely require independent responding to multi-step instructions and/or conditional discriminations. However, Ava and Henry did not demonstrate sophisticated listener responding repertoires and were only beginning to learn multi-step instructions. Kyle did show a stronger listener repertoire, but had behavioral barriers that likely interfered with learning. The issue of attending was highly visible by distracted actions (e.g., fiddling with fingers, looking elsewhere) during teaching. The addition of the second rule also required that the participant respond appropriately under stimulus conditions using the phrase "not." Ava and Henry often demonstrated appropriate responding by saying "no" when they did not want something. However, this response was never observed with Kyle and he tended to interact with the nonpreferred items if they were all that were available. A direct replication of Wymer et al. (2016) with more similar participant repertoires may have yielded more favorable results.

The constant prompt delay procedure was added to the protocol to bolster transfer of stimulus control and limit errors, but increases in independent responding were not observed. However, session durations were shortened with the added prompt delay component and decreases in problem behavior were observed. Anecdotally, the problem behavior of Ava and Henry decreased significantly in intensity and magnitude. For example, during the initial teaching procedure, Ava would often crawl on the floor and under the table to escape desk time. Henry would also elope after each trial and required physical prompting to return to his seat. Once the protocol was modified to present a model prompt, those intensities decreased and sessions ran more smoothly. Additionally, upon the protocol modification to prompt delay, errors decreased immediately for Ava and Kyle (see Figure 8). Henry also showed a decrease in errors, but it was more variable and began increasing as the time delay increased. Ava only engaged in one to three errors each session, which continued to decrease. Kyle did not error during the 0 s model phase, and errored on four of eight trials in the first session with a 2 s model, but also showed a slight decreasing trend.

Future research should address the limitations of the current study. To teach rule-governed behavior using more complex rules with multiple components, participants should have a significant number of prerequisite skills in their repertoire, especially in the listener domain. It may also be imperative for participants to respond independently to multi-step instructions and/or conditional discriminations. For participants with issues attending, reducing the number of trials and running more frequent sessions may also improve results. As discussed in Wymer et al. (2016), learning rule-governed behavior directly may also require generalized symmetry. Additionally, it may be beneficial to ensure participants are already able to appropriately indicate when they do not want something. Formal reinforcer assessments could also be conducted during teaching to ensure that the preferred items used function as reinforcers.

Despite the limitations of current study, it is important to note that Wymer et al. (2016) has yet to produce a replication in a peer-reviewed journal. For this protocol teaching rule-governed behavior to be utilized across the clinical spectrum, it needs to be replicable. However, the current study was unable to replicate the results. In fact, there has recently been a replication crisis throughout the field of psychology in which replication studies are producing results inconsistent with the original studies (Maxwell et al., 2015). There are a variety of possible reasons for this such as statistical differences, dissimilar participant populations, and conceptual replications that intentionally alter some aspect of the original study. Even though ABA uses small sample sizes and visual analysis instead of statistical analysis, this crisis in psychology affects ABA as well. Replication strengthens confidence in results and is important for increasing external validity for studies with fewer participants. Inconsistent results should not automatically discount the original results, but rather encourage both direct and systematic replications to determine why the studies produced conflicting results. As discussed, the original study and the current study may been significantly different in terms of participant repertoires, challenging behavior, and the addition of a more complex, two-component rule. However, future replications are still important to develop effective protocols for teaching rule-governed behavior in clinical settings.

While the current study was unable to teach rule-following behavior, it provided additional insight toward discovering an effective procedure to do so. Rule-governed behavior is an important skill that can lead to generalization across a variety of other skills (Skinner, 1969). It can allow children to make more significant gains in acquisition and should be prioritized when they have the repertoire necessary to acquire it. The current study attempted to systematically replicate Wymer et al. (2016) using rules to indicate when a participant does and does not want an item. The limitations of the current study, from underdeveloped participant repertoires to barriers involving challenging problem behavior, provide more information on the complexity of teaching rule-governed behavior and the possible prerequisites required. As such, it remains difficult to directly establish rule-governed behavior in young children with autism.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Arntzen, E., Halstadtro, L. B., & Halstadtro, M. (2009). The “silent dog” method: Analyzing the impact of self-generated rules when teaching different computer chains to boys with autism. *The Analysis of Verbal Behavior, 25*, 51-66. https://doi.org/10.1007/BF03393069

Blakely, E. & Schlinger, H. D. (1987). Rules: Function-altering contingency-specifying stimuli. *The Behavior Analyst, 10*, 183-187. https://doi.org/10.1007/BF03392428

Cooper, J. O., Heron, T. E. & Heward, W. L. (2020). *Applied behavior analysis* (3rd ed.). Hoboken, NJ: Pearson Education, Inc.

Deacon, J. R. & Konarski, E. A. (1987). Correspondence training: An example of rule-governed behavior? *Journal of Applied Behavior Analysis, 20,* 391-400. https://doi.org/10.1901/jaba.1987.20-391

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

Falcomata, T. S., Northup, J. A., Dutt, A., Stricker, J. M., Vinquist, K. M., & Engebretson, B. J. (2008). A preliminary analysis of instructional control in the maintenance of appropriate behavior. *Journal of Applied Behavior Analysis, 41*, 429-434. https://doi.org/10.1901/jaba.2008.41-429

Fox, A. E. & Kyonka, E. G. E. (2017) Searching for the variables that control human rule-governed “insensitivity.” *Journal of the Experimental Analysis of Behavior, 108*, 236–254. https://doi.org/10.1002/jeab.270

Fox, A. E. & Pietras, C. J. (2013). The effects of response-cost punishment on instructional control during a choice task. *Journal of the Experimental Analysis of Behavior, 99,* 346-361. https://doi.org/10.1002/jeab.20

Greer, D. R., Stolfi, L., & Pistoljevic, N. (2007). Emergence of naming in preschoolers: A comparison of multiple and single exemplar instruction. *European Journal of Behavior Analysis, 8,* 109–131. https://doi.org/10.1080/15021149.2007.11434278

Hayes, S. C., Barnes-Holmes, D., & Roche, B. (Eds.). (2001). *Relational frame theory: A post-Skinnerian account of human language and cognition.* New York: Springer Publishing. https://doi.org/10.1007/b108413

Joyce, J. H. & Chase, P. N. (1990). Effects of response variability on the sensitivity of rule-governed behavior. *Journal of the Experimental Analysis of Behavior, 54,* 251-262. https://doi.org/10.1901/jeab.1990.54-251

Kanfer, F. H., & Karoly, P. (1972). Self-control: A behavioristic excursion into the lion's den. *Behavior Therapy, 3*, 398–416. https://doi.org/10.1016/S0005-7894(72)80140-0

Kazdin, A. E. (2011). *Single-case research designs: Methods for clinical and applied settings.* New York:Oxford University Press. https://doi.org/10.1080/07317107.2012.654458

Maxwell, S. E., Lau, M. Y., & Howard, G. S. (2015). Is psychology suffering from a replication crisis? What does “failure to replicate” really mean? *American Psychologist, 70*(6), 487–498. https://doi.org/10.1037/a0039400

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

Poling, A., Weeden, M. A., Redner, R., & Foster, T. M. (2011). Switch hitting in baseball: Apparent rule-following, not matching. *Journal of the Experimental Analysis of Behavior, 96,* 283-289. https://doi.org/10.1901/jeab.2011.96-283

Schlinger, H. D. & Blakely, E. (1994). A descriptive taxonomy of environmental operations and its implications for behavior analysis. *The Behavior Analyst, 17*, 43-57. https://doi.org/10.1007/BF03392652

Skinner, B. F. (1969). *Contingencies of reinforcement: A theoretical analysis*. New York: Appleton-Century-Crofts.

Skinner, B. F. (1974). *About behaviorism*. New York: Knopf.

Sundberg, M. L. (2008). *Verbal behavior milestones assessment and placement program: A language and social skills assessment program for children with autism or other developmental disabilities*. Concord: AVB Press. https://doi.org/10.1002/9781118660584.ese2479

Sundberg, M. L. (n.d.). VB-MAPP. Marksundberg. https://marksundberg.com/vb-mapp/

Tarbox, J., Zuckerman, C. K., Bishop, M. R., Olive, M. L., & O'Hora, D. P. (2011). Rule-governed behavior: Teaching a preliminary repertoire of rule-following to children with autism. *The Analysis of Verbal Behavior, 27*, 125-139. https://doi.org/10.1007/BF03393096

Torgler, B. (2003). Tax morale, rule-governed behaviour and trust. *Constitutional Political Economy, 14,* 119–140. https://doi.org/10.1023/A:1023643622283

Weiner, H. (1970). Instructional control of human operant responding during extinction following fixed-ratio conditioning. *Journal of the Experimental Analysis of Behavior, 13,* 391-394. https://doi.org/10.1901/jeab.1970.13-391

Wymer, S. C., Tarbox, J., Beavers, G. A., Yi, R., & Tullis, C. A. (2016). Teaching children with autism to follow rules specifying a behavior and consequence. *The Analysis of Verbal Behavior, 32*, 265-274. https://doi.org/10.1007/s40616-016-0059-1

Appendix

Figure 1

Initial Prompt Fading Sequence for a Preferred Consequence

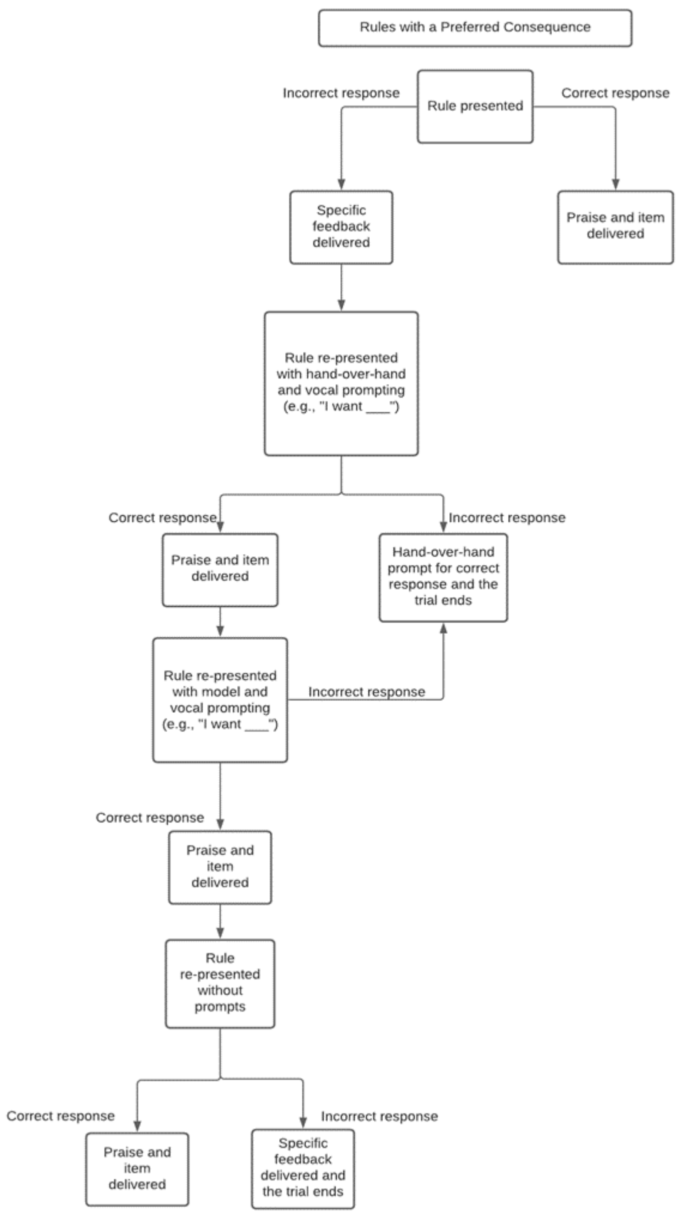

Figure 2

Initial Prompt Fading Sequence for a Nonpreferred Consequence

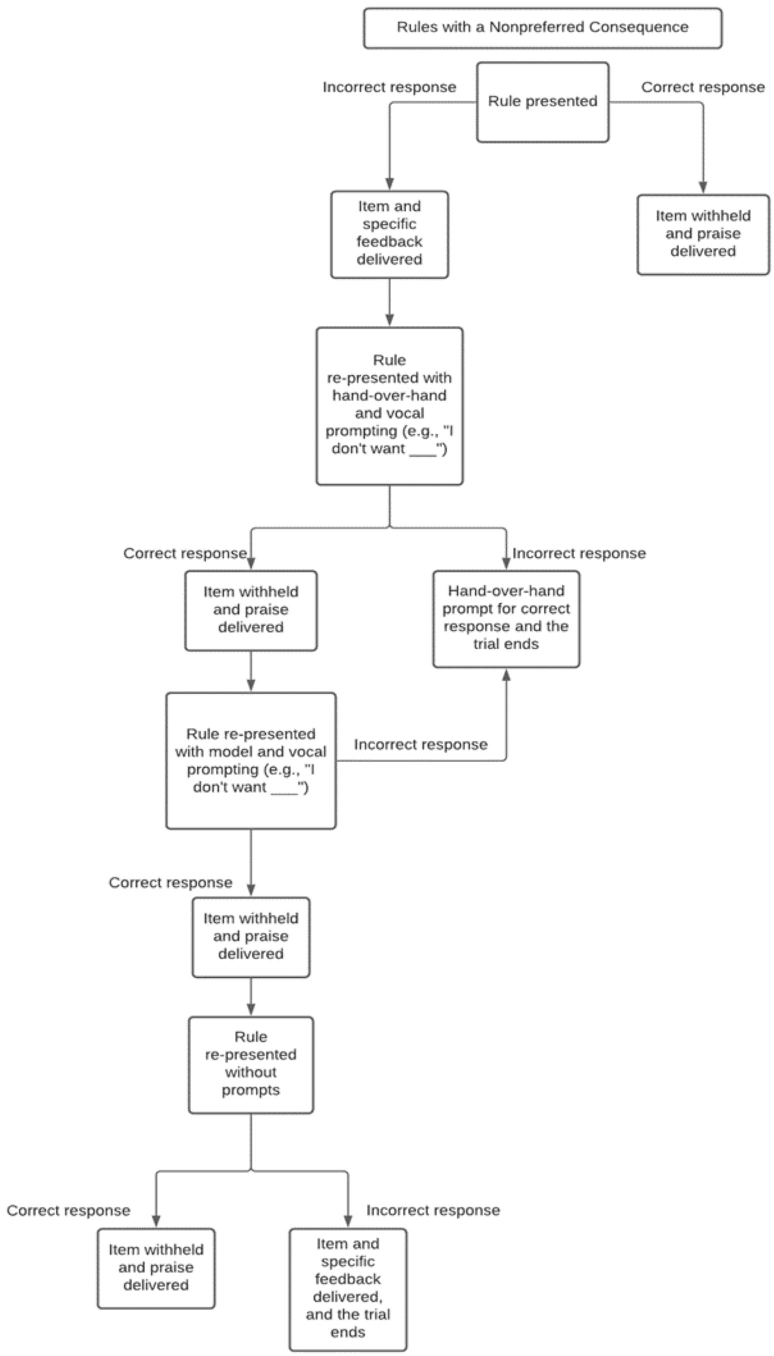

Figure 3

Constant Time Delay Sequence for a Preferred Consequence with a 0 s Model

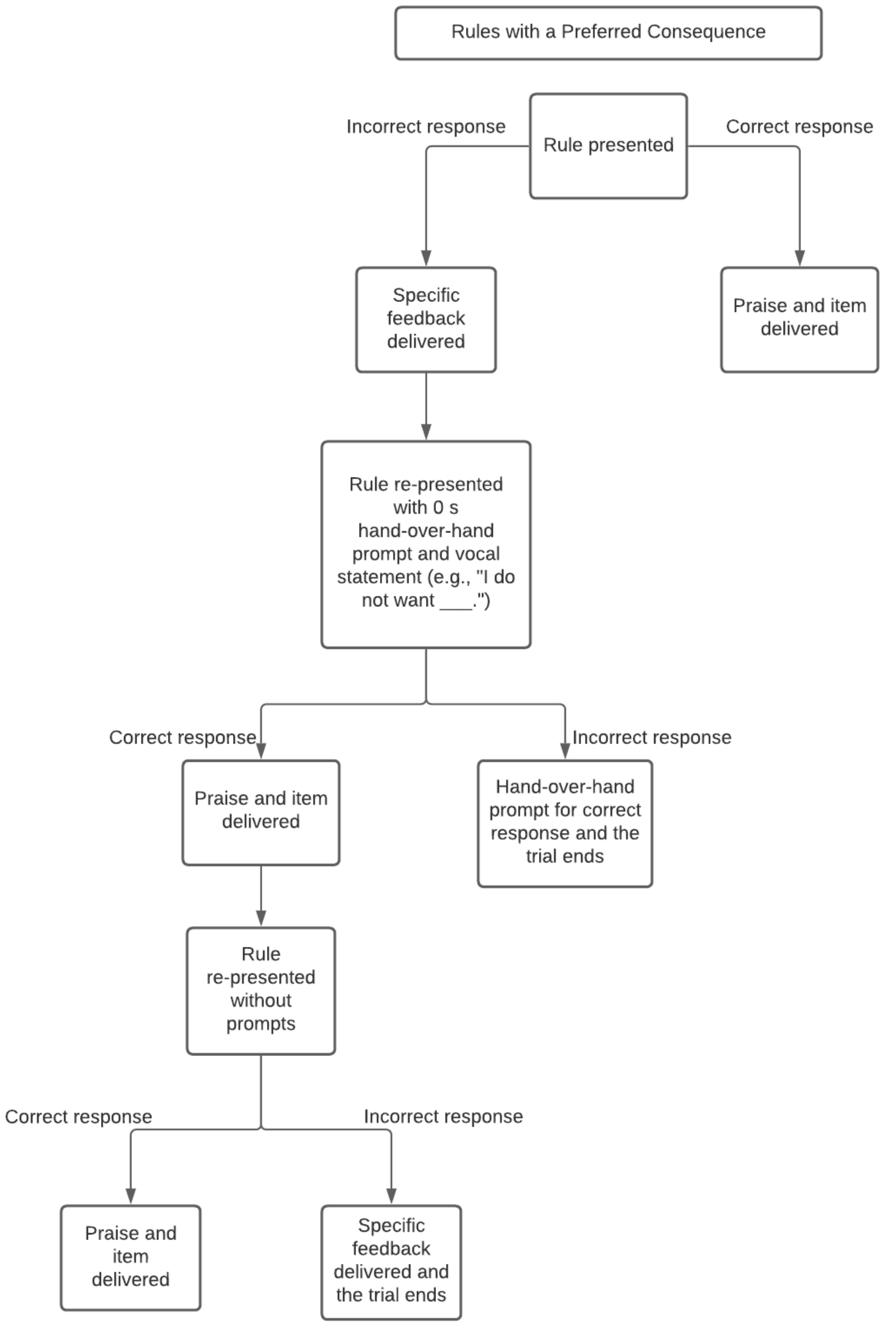

Figure 4

Constant Time Delay Sequence for a Nonpreferred Consequence with a 0 s Model

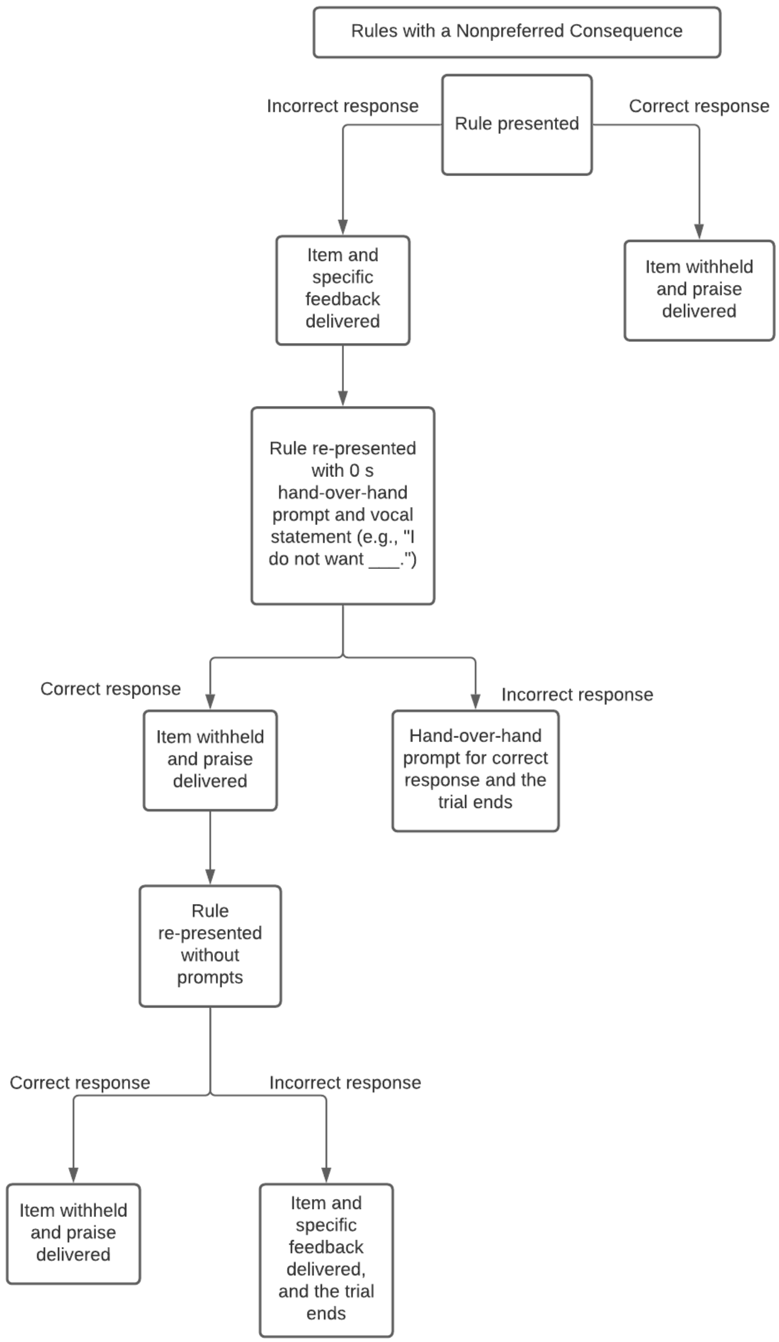

Figure 5

Constant Time Delay Sequence for a Preferred Consequence with a 2 s or 5 s Model

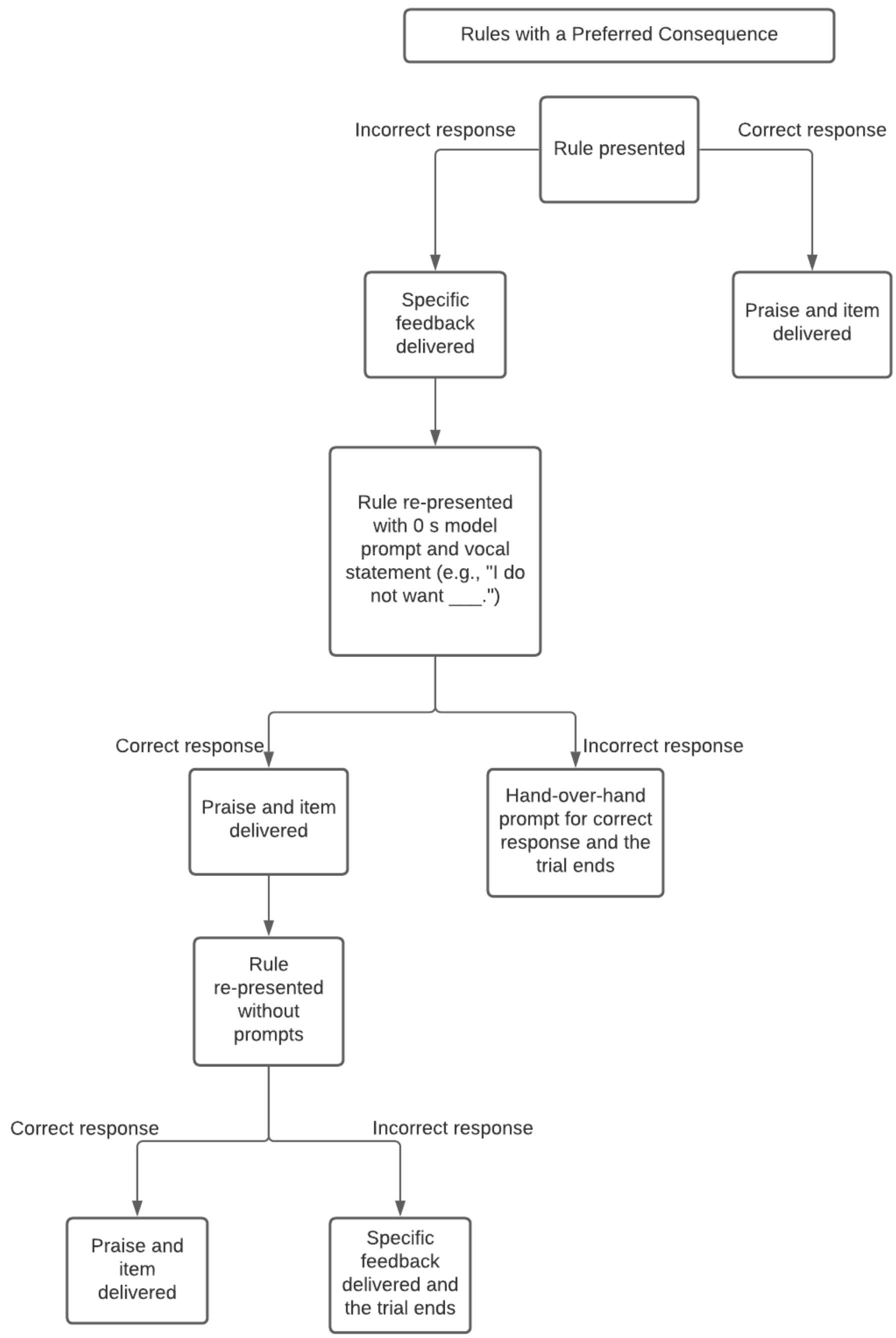

Figure 6

Constant Time Delay Sequence for a Nonpreferred Consequence with a 2 s or 5 s Model

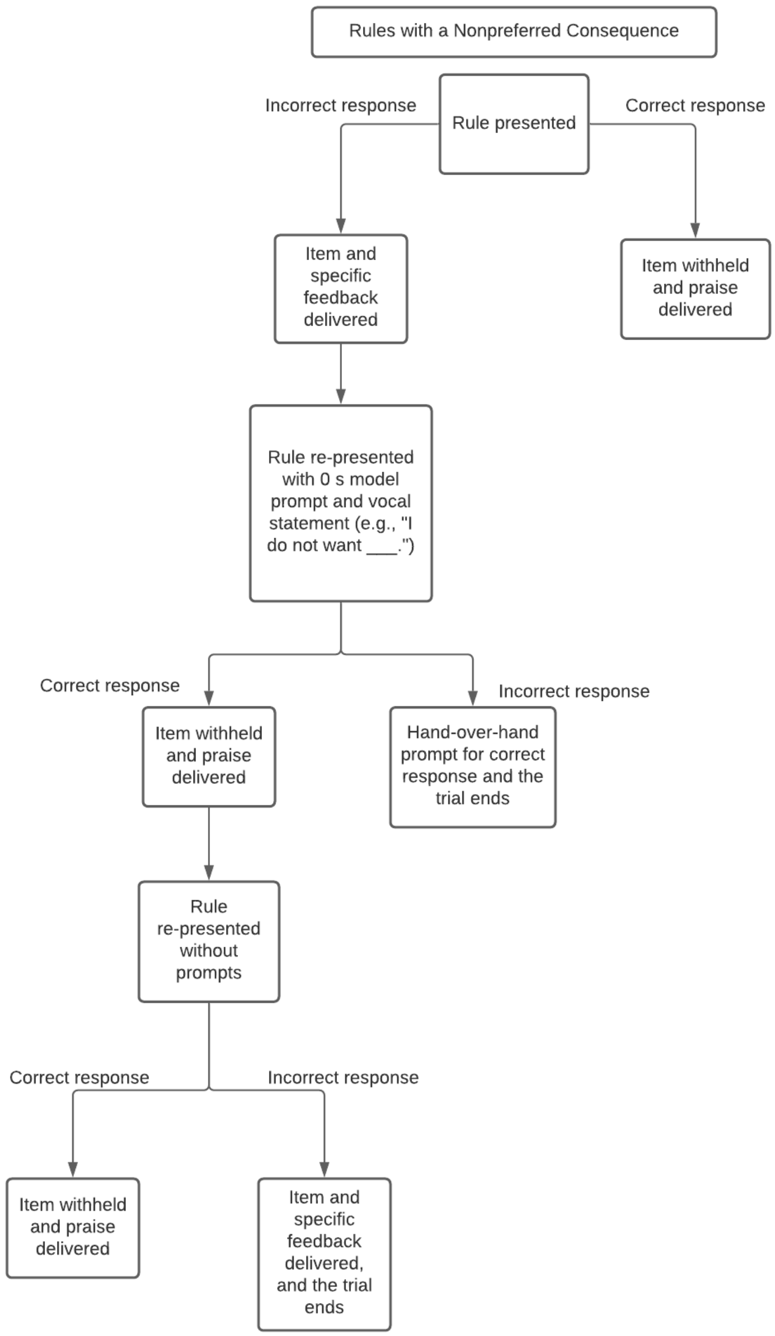

Figure 7

Percentage of Rules Followed per Session Across Participants

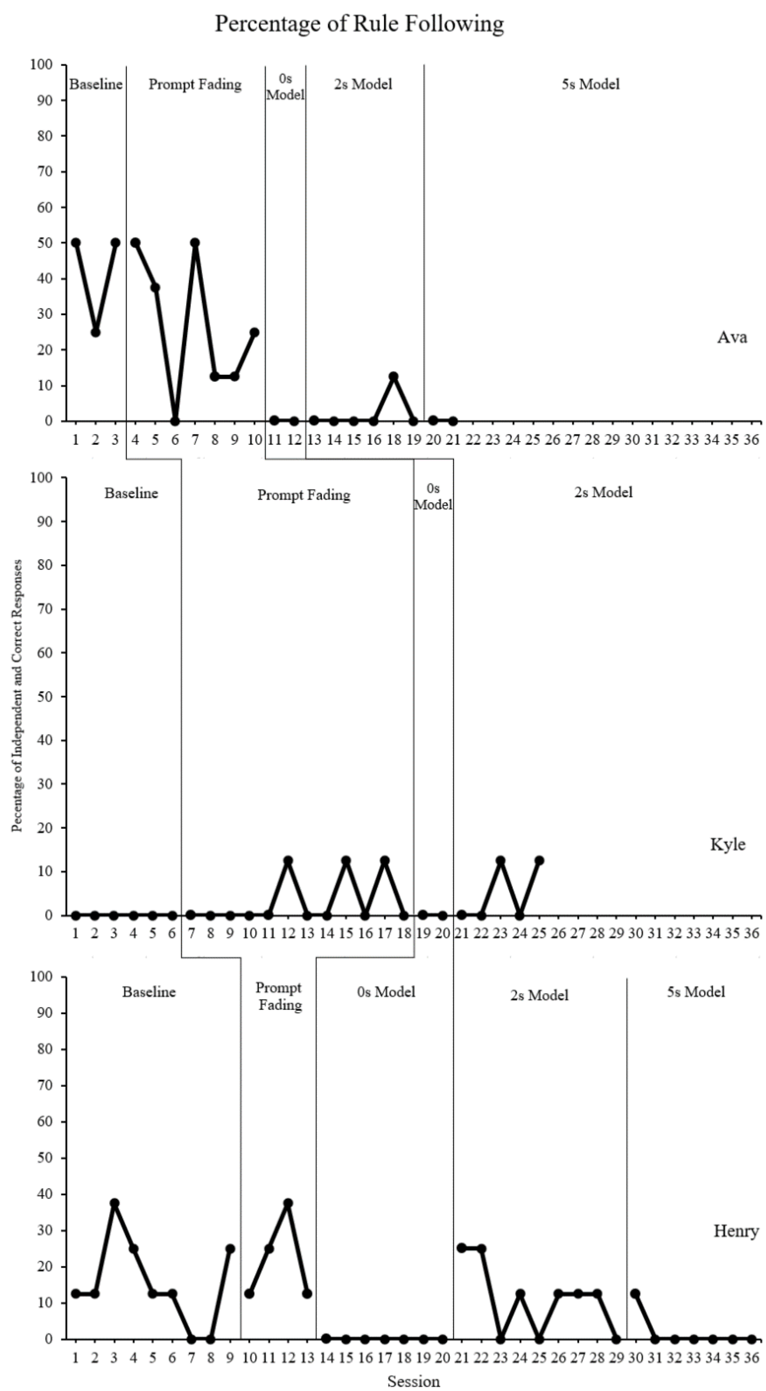

Figure 8

Percentage of Errors per Session Across Participants

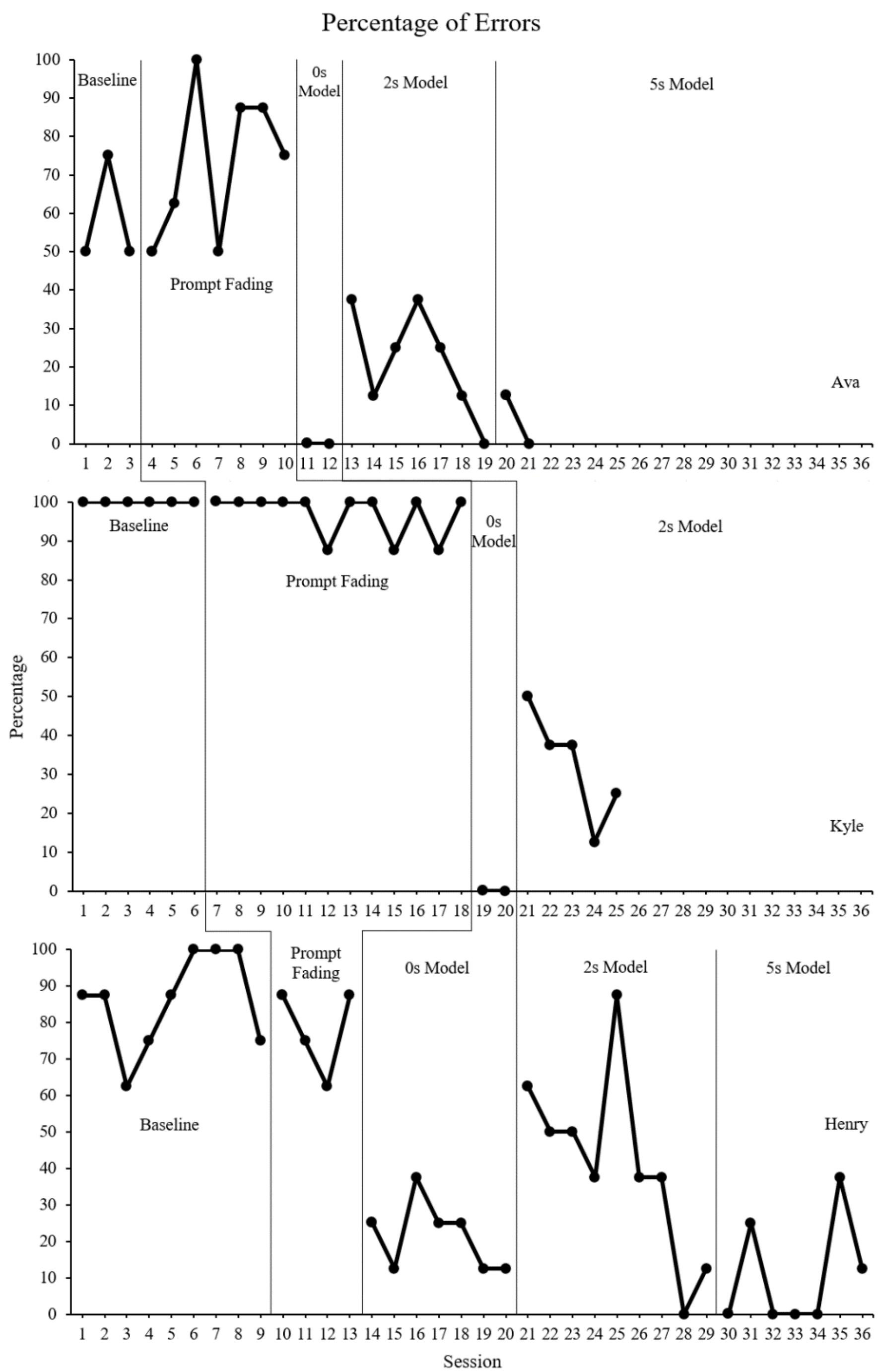

Table 1

Rules and Consequences Per Participant

Rule	**Participant(s)**	**Consequence**	**Participants(s) P/NP**
Stand up	Kyle, Henry	M&Ms	Ava (P), Kyle (P), Henry (P)
Sit down	Henry	Playdough	Ava (P)
Clap hands	Ava, Kyle, Henry	Pretzels	Ava (P), Kyle (P), Henry (P)
Touch eyes	Ava, Kyle, Henry	Goldfish	Ava (P), Kyle (P), Henry (P)
Touch ears	Ava, Kyle, Henry	Froot Loops	Ava (P), Kyle (P), Henry (P)
Touch teeth	Henry	Tiger Paw Cereal	Ava (P)
Touch nose	Ava, Kyle, Henry	Cap'n Crunch Berries	Henry (P)
Touch tummy	Ava, Henry	Cheese	Ava (P)
Touch head	Ava, Kyle	Muffin	Henry (P)
Wave	Ava, Kyle, Henry	Gummy	Henry (P)
Cover your mouth	Kyle	Paper towel	Ava (NP), Kyle (NP), Henry (NP)
Raise hand	Henry	Toy broccoli	Ava (NP), Kyle (NP), Henry (NP)
Turn around	Henry	Pen	Kyle (NP)
Stomp feet	Ava, Henry	Block	Ava (NP), Kyle (NP), Henry (NP)
Jump	Kyle, Henry	Bug	Ava (NP), Kyle (P)
Push in chair	Henry	Lizard	Kyle (P)
		Spoon	Ava (NP), Kyle (NP), Henry (NP)
		Book	Henry (NP)
		Blueberry	Ava (P)
		Animal crackers	Ava (P)
		Stick	Ava (NP), Kyle (NP)