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Effects of a lag 3 schedule of reinforcement on the variability of tacting in individuals who engage in vocal stereotypy

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Effects of a Lag 3 Schedule of Reinforcement on the Variability of Tacting in Individuals Who Engage in Vocal Stereotypy

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Abstract

Individuals with autism spectrum disorder (ASD) or other developmental disabilities may experience rigid or repetitive behaviors, known as stereotypy. Current research determines effective interventions for increasing variability of vocal responding which effectively decrease stereotypic vocal responding. Lag schedules of reinforcement are a common theme among variability of vocal responding research. The purpose of this AB design study was to evaluate the effectiveness of a Lag 3 schedule of reinforcement in the teaching of variability of tacting. Results indicated that both variable and novel responses increased after the implementation of the Lag 3 schedule, but since these results are based off an AB design, further research that replicates effects needs to be done.

Keywords: autism, variability, stereotypy, lag schedules of reinforcement, echolalia, perseveration

Introduction

Autism Spectrum Disorder and Stereotypy

Autism spectrum disorder (ASD) is a developmental disability that is characterized by social communication deficits and restricted and repetitive behaviors or interests (American Psychiatric Association, 2013). According to *The Diagnostic and Statistical Manual of Mental Disorders Fifth edition* (DSM5; American Psychiatric Association, 2013), symptoms of ASD appear during early development, but might not be recognized fully until the child is older due to the limited demands placed on the child in early development. Further symptoms of ASD described in the DSM 5 include deficits in social development and impairments or delays in occupational skills. Another diagnostic criterion that the DSM 5 mentions is that the symptoms present are not explained by another diagnosis, such as an intellectual disability or developmental delay.

Individuals with ASD or other developmental disabilities may experience rigid or repetitive behaviors, known as stereotypy (Cooper, Heron, & Heward, 2007). Stereotypy encompasses a wide range of behaviors. These behaviors can be gross motor, fine motor, vocal, nonvocal, simple, or complex (Cunningham & Schreibman, 2008). However, for the purpose of this study, the research will focus on stereotypy of vocal behaviors. Three specific behaviors that will be further discussed are vocal stereotypy, echolalia, and perseveration.

Individuals who engage in stereotypic behaviors may face a variety of challenges. One challenge is socializing with peers (Radley, Dart, Moore, Battaglia, & LaBrot, 2017). Generally, children who demonstrate vocal stereotypy have a limited repertoire of topics of conversation or means of responding to peer social initiations (Radley et al., 2017). For example, children who engage in vocal stereotypy may repeat a word or phrases multiple times within one conversation,

struggle to transition from topics they have an interest in, and/or choose topics of conversation that may be inappropriate for the context of the situation they are in. These social deficits can be stigmatizing for a child and may result in reduced opportunities to make friends (Radley et al., 2017). A second challenge for individuals who engage in stereotypic vocalizations is their limited utilization of functional communication (Silbaugh, Facolmata, & Ferguson, 2018). In some cases, children's vocal stereotypy may prove functional, but in other situations, children engaging in vocal stereotypy may not be understood by peers or adults (Radley et al., 2017). Challenging behaviors are more likely to occur if the individual demonstrates difficulties in communicating their wants and needs to others. Finally, in most contexts, restricted social behaviors result in negative outcomes, such as not being able to appropriately and effectively adapt to the environment (Harris, 2014). Since change in the environment is inevitable, the inability to adapt can result in problem behaviors and distress for the family or others involved. For example, children who engage in these rigid behaviors may not react well to familiar items being moved from "their place" in the home or other familiar contexts (Harris, 2014).

Increasing the variability of vocal responding may be one such way of limiting vocal stereotypy. Researchers have studied and developed interventions that are effective in increasing the variability of vocal responding. In many cases, with this increase in variable vocal responding, the less socially acceptable behaviors, such as vocal stereotypy, echolalia, or perseveration on conversational topics, are decreased. One intervention that demonstrates evidence of effectiveness in increasing variability of vocal responding is the use of lag schedules of reinforcement (Heldt & Schlinger, 2012).

Lag Schedules of Reinforcement

The most cited intervention used for increasing variable behavior is the use of a lag schedule of reinforcement (Murray & Healy, 2013). A lag schedule of reinforcement makes reinforcement contingent on a response that is different from the predetermined number of previous responses emitted (Cooper, Heron & Heward, 2007). For example, a Lag 3 schedule delivers reinforcement contingent on the individual responding differently from the previous three responses emitted. Some ways that lag schedules of reinforcement have been used are in conjunction with functional communication training (Adami, Falcomata, Meuthing, & Hoffman, 2017), to increase vocal variability (i.e., phonemic variability; Koehler-Platten, Grow, Schulze, & Bertone 2013), to increase the variability of vocal responding (Silbaugh, Falcomata, & Ferguson, 2017), and to increase variability in tacting (Heldt & Schlinger, 2012).

Tacting

As defined by Skinner (1957), a tact is a verbal operant which follows the presentation of an object, event, or property of an object or event. Tacting is regarded as one of the most critical verbal operants, because of its social implications (Marchese, Carr, LeBlanc, Rosati, & Conroy, 2012). The use of tacts are central to social interactions and are maintained by social reinforcement (Marchese et al., 2012). Children who engage in repetitive vocal behavior may have a challenging time varying their tacting behavior. This could lead to further social deficits for these individuals since tacting central to social interactions.

Purpose of the Study

While there is extensive research on the use of lag schedules to increase variability of vocal responding, there is limited research regarding the effects of a lag schedule on increasing variability of tacting. The purpose of this study was to evaluate the effectiveness of a Lag 3

schedule of reinforcement in the teaching of variability of tacting. The study addressed the following question:

1. Do Lag 3 schedules of reinforcement increase variable responding, specifically tacting?

Literature Review

This literature review that follows focuses vocal stereotypy, echolalia, and perseveration, the problems associated with those behaviors, means of increasing variable behavior and their benefits, and lag schedules of reinforcement. The researcher focused her research on scholarly, peer-reviewed journal articles. The researcher found these articles on the Wiley Database, the JMU Library Catalog, and Google Scholar. The researcher also utilized Cooper, Heron, and Heward (2007) to assist in developing definitions and identifying search terms. The specific descriptors the researcher used while searching were *vocal stereotypy, perseveration, stereotypy, echolalia, autism, vocal variability, and variable responding*.

Problems Associated with Vocal Stereotypy, Echolalia, and Vocal Perseveration

As defined by Cunningham and Schreibman (2008), stereotypy or stereotypic behaviors are terms that encapsulate a wide range of behaviors that are topographically similar. Behaviors are considered "stereotypic" if they are repetitive, rigid, invariant, and generally inappropriate to the context (Cunningham & Schreibman, 2008). There are several problems that arise for individuals who engage in stereotypic behavior. Baruni, Rapp, Lipe, and Novotny (2014) discussed the negative consequences of repetitive and rigid behaviors in a play context. The authors reported that children who engage in stereotypy may not engage in age-appropriate play skills, which could negatively affect their peer-interactions (Baruni et al., 2014). For these individuals, having a limited repertoire of play behaviors along with engagement in stereotypy could lead to minimal access to or contact with social sources of reinforcement (Baruni et al.,

2014). Additionally, due to the rigidity of stereotypic behaviors, the individual may begin to fall behind peers academically (Contreras & Betz, 2016). Studies have shown that "stereotypy may interfere not only with initial learning acquisition, but also with the extent to which children engage in the learned and more appropriate alternative behaviors during free time" (Cunningham & Schreibman, 2008, p. 3). In a general social context, stereotypic behaviors have the potential to ostracize the individual who is engaging in the behavior. Other children may find the rigid and repetitive behaviors frightening, confusing, or aversive (Radley et al., 2017). Stereotypy also yields challenges for the individual when there are sudden changes that require the individual to adapt (Radley et al., 2017). Some specific types of stereotypy are vocal stereotypy, echolalia, and vocal perseveration.

Vocal stereotypy is defined by Taylor, Hoch, and Weissman (2005) as vocalizations emitted by an individual that are not related to the current context of conversation or the repeating of something the individual previously heard (e.g., a conversation, movies, TV shows, books). The same challenges arise for individuals who engage in vocal stereotypy as stereotypy in the general sense. Vocal stereotypy can lead to the child being stigmatized, falling behind academically, and/or having lower social skills (Lanovaz, et al., 2013). A more specific type of vocal stereotypy is echolalia.

Echolalia is defined by Charlop (1983) as speech in which an individual repeats words or phrases said by others. There are two divisions of echolalia: delayed and immediate (Charlop, 1983). Echolalia is considered "delayed" when the individual repeats a word, phrase, or sound that is unfitting for the context of the current situation, whereas "immediate" echolalia is the repeating of a word, phrase, or sound directly after another individual says that same word, phrase, or sound (Colon, Ahearn, Clark, & Masalsky, 2012). There are several problems

associated with echolalia. Echolalia can lead to problems in skill acquisition and learning (Charlop, 1983). If a child is engaging in echolalia during school instruction, the child may repeat back the instructions, but may not follow through on the task at hand (Charlop, 1983). Echolalia can also lead to children being ostracized by peers due to their lack of appropriate social skills (Charlop, 1983). Additionally, in a study conducted by Roberts (1989), echolalia negatively affected comprehension. The results of the study also concluded that with the reduction of echolalia, more age-appropriate skills surface (Roberts, 1989).

Another type of vocal stereotypy is vocal perseveration. Sandson and Albert (1984) define perseveration as the inappropriate reoccurrence or continuation of an activity. More specifically, vocal perseveration is defined as the repeated focus on a particular topic, or circumscribed interest (Lepper, Devine, & Petursdottir, 2017). Individuals who engage in perseveration experience similar problems to individuals who engage in vocal stereotypy and echolalia. They may fall behind socially and/or academically due to their consistent asking of the same question or continual focus on a specific topic (Harris, 2015). Individuals who engage in perseveration may also experience social stigmatization from peers and others who find the continuous focus on a specific topic unappealing.

The Importance of Increasing the Variability of Vocal Responding

Some individuals who experience vocal stereotypy, echolalia, and/or vocal perseveration may have rote or rigid vocal responses that sound robotic and unnatural (Contreras & Betz, 2016). By increasing variability in vocal responding, these individuals may communicate more effectively and fluently with others, and their behavior may provide more social opportunities to engage with their peers (Contreras & Betz, 2016). Additionally, increasing individuals' variability of vocal responding lends to shaping their behavior repertoires to be more complex

(Cammilleri & Hanley, 2005). Problem solving, adjusting to new environments and situations, and creativity are all complex behaviors that can result from increasing variable behavior (Dracolby, Dozier, Briggs, & Juanico, 2017). Not only does this improve socialization but can also help the individual academically and functionally.

Previous research on increasing variability of behavior heavily focused on the role on extinction of stereotypy (Dracolby et al., 2017). Dracolby et al.'s behavior variability research, found extinction to result in an increase in variability in several different dimensions of responding. However, the research also reveals that the response variability decreases as time goes on. They found that although extinction may increase the variability of vocal responding for an individual, it may not maintain and could result in adverse side effects (e.g., aggression). Alternative research suggests that instead of focusing on decreasing stereotypic and rote behaviors, or increasing variability through extinction, it is more successful and effective to put efforts towards increasing the variability of vocal responding through systematically reinforcing variable vocal behavior (Napolitano, Smith, Zarcone, Goodkin, & McAdam, 2010). A popular method of systematically reinforcing variability is the utilization of a lag schedule of reinforcement.

Lag Schedules of Reinforcement

Research concludes that variability is a reinforceable behavior (Neuringer, 2004). Several studies suggest that lag schedules of reinforcement are an effective intervention to increase variability of vocal responding. As defined by Cammilleri and Hanley (2005), a lag schedule of reinforcement is "characterized by the delivery of reinforcement for a response that is either different from the previous response or a number of previous responses," (p. 111). The use of lag schedules of reinforcement spans across various vocal behaviors, such as increasing novel

responses, mand variability, social skills variability, vocal variability, differing conversational topics, and variability of tacting.

Contreras and Betz (2016) researched the effectiveness of lag schedules of reinforcement in producing intraverbal responses already in the child's repertoire or novel responses. The researchers conducted a study with three children with ASD to examine the extent to which lag schedules of reinforcement, specifically Lag 1 and Lag 3, increased the vocal response variability of the children, whether they were producing responses already in their repertoire or producing new responses (Contreras & Betz, 2016). During the Lag 1 schedule, responses were reinforced if they differed from the previous response. For example, the experimenter delivered the discriminative stimulus by saying "tell me an animal," to which the participant was expected to name an animal. During the next trial for Lag 1, the participant was required to say a different animal than the previous trial to receive reinforcement. During the Lag 3 schedule, a response was reinforced if it differed from the previous three responses, which looked similar to the Lag 1, except the participant needed to vocalize the name of an animal that differed from the previous three responses emitted. The study produced results suggesting that lag reinforcement schedules are an effective intervention for increasing the variability of vocal responding (Contreras & Betz, 2016).

In a recent study done by Silbaugh, Falcomata, & Ferguson (2018), the researchers studied the combination of a lag schedule with a progressive time delay. They examined the effects of a lag reinforcement schedule paired with a progressive time delay on variability of manding in children with ASD. They used a Lag 1 schedule, in which the participant received reinforcement contingent on emitting a response that differed from the previous response, with the added aspect of a progressive time delay. The participants were provided a vocal prompt after

a predetermined amount of time of not engaging in a variant mand. The time delay began at 2 seconds (s), then increased to 4 s when the participants met criteria to move on to the larger time delay condition. The researchers found that the utilization of a lag schedule with the added element of a progressive time delay procedure increased variability of vocal mands for both participants during the study.

Radley, Dart, Moore, Battaglia, & LaBrot (2017) conducted a study using lag schedules in conjunction with the Superheroes Social Skills program (Jenson et al., 2011) on the acquisition of social skill variability. The Superheroes Social Skills program is a curriculum developed to teach social skills using multiple exemplars of behavior to model target skills and then generalize these skills appropriately (Radley et al., 2017). The Radley et al study utilized a Lag 2 and a Lag 4 schedule of reinforcement and the participants were children diagnosed with ASD reported to have limited social skills. During the Lag 2 phase, the participants were required to respond in a topographically different way than the previous two responses, and if they failed to do this, they were prompted to respond in a different way. During the Lag 4 schedule, the procedure was essentially the same, except the participants had to respond in a topographically different way than the previous four responses emitted. Results of the Radley et al study suggested that multiple exemplar training through the Superheroes Social Skills program alone was not enough to increase social skills variability. However, with the addition of the lag schedules, the participants' vocal response variability increased amongst most participants.

Susa and Schlinger (2012) evaluated the effectiveness of a Lag 1, a Lag 2, and a Lag 3 schedule of reinforcement on the vocal variability of a child with ASD. During the Lag 1 schedule, the researchers reinforced a response that differed from the previous response emitted. During the Lag 2 schedule, the researchers reinforced a response that differed from the previous

two responses. Lastly, during the Lag 3 schedule, reinforcement was contingent on the response differing from the previous three responses. The study utilized a changing criterion design to determine how the various lag schedules influenced the participant's verbal responding. The researchers also taught alternative responses to the participant until acquisition of these responses was met. From the study, the researchers determined that response variability was increased with the introduction of lag schedules of reinforcement.

Lepper, Devine, & Petursdottir (2017) evaluated the effectiveness of utilizing lag schedules to broaden the topics of conversation emitted by individuals with ASD who have been shown to perseverate on certain topics, or circumscribed interests (CIs). CIs are defined by Lam, Bodfish, and Piven (2013) as "behaviors such as intense, focused hobbies, strong preoccupations with off topics, and unusually strong attachment to certain objects" (p. 6). Lepper et al. used a Lag 1 and Lag 2 schedule to determine the effectiveness of using these schedules to reduce the amount of time the participants spent engaging in conversations about their CIs. Results of the study concluded that the conversational topics initiated by the participants shifted from solely the CIs of the participants to a variety of unrelated topics. This research illustrated that the use of the lag schedules to reinforce novel or different conversations shifted conversational topics to become more socially appropriate.

Finally, in a study conducted by Heldt and Schlinger (2012), a Lag 3 schedule was implemented to study the effects of a lag schedule on the variability of vocal responding as well as evaluate the maintenance of variable vocal responding following the removal of the lag schedule. They conducted the study with two participants, one who was diagnosed with an intellectual disability and the other was diagnosed with ASD and Fragile X syndrome. The researchers focused specifically on increasing variability of tacting in the participants. The study

concluded that the variability of tacting increased during intervention. It also concluded that variability of tacting was successfully maintained, as determined by the researchers' follow-up probe three weeks after intervention was terminated.

Research Gap

Although there is extensive research on the effects of lag schedules of reinforcement on the variability of vocal responding, each study has limitations and suggestions for future research. The researcher's study sought to expand the research on lag schedules of reinforcement to determine the effectiveness of these schedules in increasing the variability of vocal responding in the form of tacting in individuals who engage in vocal stereotypy, echolalia, or vocal perseveration.

Significance

The researcher hoped to determine if lag schedules of reinforcement are effective in teaching variability of responding, specifically tacting, for individuals who engage in vocal stereotypy, echolalia, and/or vocal perseveration. As previously discussed, vocal stereotypy, echolalia, and vocal perseveration come with several limitations for the individuals who engage in these repetitive behaviors. These individuals may fall behind academically, developmentally, and/or socially. Furthering research on how to help these individuals increase their variability of vocal responding is important, because it involves the well-being of individuals and their families.

Method

The researcher used a similar method to the method implemented by Heldt and Schlinger (2012). The Heldt and Schlinger study utilized lag schedules to increase variability of vocal responding, specifically in tacting. The researcher applied several of the same procedures implemented by the Heldt and Schlinger (2012) study, but adjusted the experimental design and method as needed based on the focus of the current study.

Participants

The target demographic for the study were children (between ages 3 and 16) who were diagnosed with ASD or another developmental disability, who were English speaking, and did not have sensory impairments such as visual or hearing deficits. These children also needed to show invariability of vocal behavior, such as engaging in perseveration, echolalia, and/or vocal stereotypy. Additionally, the participants were required to have the prerequisite skill of labeling pictures of common items, body parts, and pieces of clothing on the Assessment of Basic Language and Learning Skills – Revised (ABLLS-R; Partington, 2010). The mastery criterion of this skill, as defined by the ABLLS-R, is the "correct responding on 80% or more trials over three consecutive sittings," (Partington, 2010). Score reports were unavailable for the participant who was recruited, so the researcher tested the skill.

To recruit participants, information was sent by the director of a preschool in a mass email to all the staff and families. Participation was voluntary, and the participant was told that they could withdraw from the study at any point. Lack of participation did not affect any services that the individual received. One participant was recruited for this study. Jonah was a 3-year-old Caucasian male diagnosed with ASD. He was a friendly young boy who used consistent vocalizations to communicate his wants and needs. He engaged in echolalia and vocal stereotypy

in the form of vocalizing the same words/phrases repeatedly. Most of his perseverative behaviors were evoked by letters and numbers. Letters and numbers were also highly motivating to Jonah.

Setting and Preference Assessment

All sessions were conducted in the hallway outside of Jonah's classroom. Before each session, a paired stimulus preference assessment (Chazin & Ledford, 2016) was conducted to determine which stimuli may served as appropriate reinforcers for each participant. Preliminary information about what specific tangibles to include in the preference assessment was gathered from Jonah's teachers, parents, and observations by the researcher. Four of the recommended tangibles were included in the preference assessment during each session. Each item was given a letter, either A, B, C, or D. Based on the data sheet the items were placed in an array of two in front of the individual (Chazin & Ledford, 2016). The researcher asked the participant to "pick one" and the chosen item's corresponding letter was circled on the data sheet. Jonah was allowed to play with the item he chose for 30 s, which was displayed for him on the researcher's iPhone timer. Once the 30 s passed, the researcher asked for the item back and continued with the assessment. This continued until each item was compared. Data were recorded and the tangibles were ranked based on the results of the preference assessment. The tangible that ranked the highest was used as the reinforcer for that session. However, if Jonah requested a different, available tangible than the one that was determined by the preference assessment, the researcher allowed access to the requested tangible. The data sheet can be found in Appendix A.

Dependent Variables, Response Measures, and Data Collection

This study evaluated the variability of vocal responding before implementation of a Lag 3 schedule and during the Lag 3 schedule. The primary dependent variables in the study were the frequency of novel tacts emitted by the participant within 10 trials and the frequency of variable

responding. A novel tact was defined as the individual vocally identifying an image within a visual stimulus array of 11 other images that was not previously identified in the session (Heldt & Schlinger, 2012). Variable responding was defined as the individual vocally identifying an image within a visual stimulus array of 11 other images that was not previously identified in the previous 3 responses. Other dependent variables included in the data collection were incorrect responses, repeated responses, and instances of no responding. An incorrect response was defined as a response that did not answer the question. For example, if the individual responded to "what do you see?" with "a fish" and there was no fish in the array, that was considered an incorrect response. A repeat response was defined as a response that was said previously in the session. No response was defined as the individual failing to emit a response within 5 s to the instructional cue.

Each trial consisted of the presentation of 12 laminated 3" x 5" index cards with pictures glued onto them. The pictures of items are approximately 1" x 2". Additionally, the researcher systematically mixed in images that were intended to act as distractor items or distractors. The distractor items served the purpose of evoking vocal stereotypy. This was done to contrive a situation in which the participant engaged in the repetitive vocal behavior that the was targeted for reduction. The researcher based the selection of the distractors on caregiver report and previous observations of the individual. According to observations and reports, letters and numbers were the most common visuals that evoked Jonah's vocal stereotypy. Each array had two distractors, either letters or numbers, out of the 12 pictures in the array. Pictures for the arrays were taken by the researcher or found on copy-right free photograph websites (e.g., Pexels, Creative Commons search through Microsoft Word). The researcher created the arrays on a Microsoft Word document, printed them out, and laminated them.

Design and Procedure

The researcher planned to use a nonconcurrent multiple baseline design across participants. However, due to the difficulties recruiting participants, the researcher was only able to recruit one participant. With only having one participant, the researcher implemented a standard AB experimental design. The study evaluated the effectiveness of lag schedules in the teaching variability of vocal responding.

Procedure. All sessions were conducted 1-2 times a day, 2-3 times a week for 30 minutes (min) in the hallway outside of Jonah's classroom. At the beginning of the session, the researcher implemented the paired stimulus preference assessment to determine the reinforcer that would be provided to the individual during the session. Each session comprised of 10 trials in 15 min and data were collected on a trial-by-trial basis. The researcher and Jonah sat within one foot of each other on the floor.

Preassessment. To ensure that all the tacts were in Jonah's repertoire, the researcher implemented an assessment prior to beginning the sessions. The researcher created flashcards of all the images used in the arrays and presented them to the participant. Jonah was given the instructional cue "what is this?" and was given 3 s to respond. If he responded correctly, the researcher recorded a plus (+) on the data sheet. If he responded incorrectly (i.e., tacted something other than the item on the card) or did not respond within 3 s, the researcher recorded a minus (-) on the data sheet. Any images that participant scored a minus on were not included the arrays.

Baseline/Lag 0. Each baseline session entailed a Lag 0 schedule, meaning that any response the individual emitted was followed by the researcher thanking him neutrally. Each of the 10 trials during baseline began by the researcher securing Jonah's attention by saying his

name and delivering the instructional cue “what do you see?”, “tell me something you see,” or some other variation. The researcher scored whether the response was novel, variable, incorrect, a repeat, or if there was no response. A novel response was defined as a response that had not been emitted previously during the session. A variable response was defined as a response that differed from the previous 3 responses. An incorrect response was defined as a response that did not answer the question. A repeat response was defined as a response that was said previously in the session. No response was defined as the individual failing to emit a response within 5 s to the instructional cue. Following the completion of the 10 trials, the participant was enthusiastically praised by the researcher (e.g., “thank you for helping me!”, “you worked so hard!”) and provided with 5 min of free time with the reinforcer he worked for based on the results of the paired stimulus preference assessment implemented prior to the session.

Lag 3 phase. During the Lag 3 phase, the protocol was very similar, except with the addition of reinforcement for variable responding. To avoid extinction of responses leading up to the Lag 3 schedule response, the researcher utilized the Goetz and Baer (1973) “reinforcement of different forms procedure.” During this procedure, the researcher delivered praise to the individual for emitting a varying response for the first three responses (e.g., “that’s right, I see that too!”, “thanks for telling me something different!”, “you’re amazing!”; Goetz & Baer, 1973). Following three responses, the fourth response, if variable from the previous three, was given high-affect social praise paired with the Jonah’s preferred reinforcer determined by the preference assessment. The individual was provided with 2 min of free time with the reinforcer. These 2 min were displayed on a visual timer on the researcher’s iPhone for the individual to see. Once the 2 min ended, the reinforcer was put out of reach of the participant and trials continued. If Jonah engaged in repeated responding, incorrect responding, or failed to respond within 5 s of

the instruction, the researcher delivered a gestural prompt during the next trial by pointing to an image in the array that the participant had not yet tacted (Heldt & Schlinger, 2012). Variable and/or novel responses that were prompted were still followed by praise and access to the preferred item.

The researcher coded responses as N for novel, V for variable, I for incorrect, and NR for no response. These letters were circled on the data sheet during each trial, reflecting Jonah's responses. She also recorded if the response was prompted by circling Y for yes or N for no. All tacts were recorded on the data sheet under a column titled "tact used." If interobserver agreement (IOA) was conducted during the session, the researcher calculated the IOA and wrote it on the data sheet next to "IOA:". If IOA was not conducted during the session, the researcher wrote a dash (-).

Reliability, Limitations, and Social Validity

IOA was assessed by an additional graduate student. All observations occurred in person. Prior to conducting IOA, the researcher and second observer discussed data collection procedures and the researcher provided the second observer with a detailed explanation of the protocols. The researcher and second observer scored whether the response was novel, incorrect, a repeat, or if there was no response. Like in Heldt and Schlinger's article (2012), agreement was determined by both observers obtaining identical scores for the trial. The researcher calculated trial-by-trial agreement for each session by dividing the number of agreements by the sum of the agreements and disagreements. This number was then converted to a percentage by multiplying it by 100. The following formula was utilized to compute the percentage (Cooper, Heron & Heward, 2007): $\frac{\text{Number of trials (items) agreement}}{\text{Total number of trials (items)}} \times 100 = \text{trial-by-trial IOA \%}$

IOA was conducted for 33% of baseline sessions and 40% of intervention sessions. There was 100% agreement for all of Jonah's baseline sessions and 100% agreement for all of Jonah's intervention sessions. This high level of agreement suggests that the definitions of the behaviors recorded were clearly defined in observable and measurable terms.

Procedural fidelity was maximized by the explicit explanations of the procedures during each phase. The researcher developed a checklist, as shown in Appendix B, that described each phase in detail and had multiple copies available during the session for the second observer and the researcher herself. The researcher reviewed these procedures prior to each session to sustain procedural fidelity throughout the study. Additionally, with consent given by the school and family of the participant, a second observer was also provided with a copy of the procedural fidelity chart to assess procedural fidelity by referring to the chart and providing a plus (+) if the step was completed with fidelity and a minus (-) if it was not. Procedural fidelity was assessed during 67% of baseline sessions and 40% of intervention sessions. The procedures of the study were implemented with 100% fidelity across all sessions. The high level of procedural fidelity suggests that the procedures of the study were clearly outlined and implemented according to plan.

There were a few projected limitations to the current study. Firstly, due to the time-based nature of the study, potential absences of the participant on data collection days may have more of an impact on the data than it would have on a longer study. Secondly, this study sought to recruit a small number of participants. A larger sample size would be ideal in increasing experimental control, however, to add additional participants would have increased the complexity of the research and lengthen the timeline, which was not an option due to calendar constraints.

Social validity was determined by reporting on the three levels of social validity: goals, procedures, and outcomes (Ledford & Gast, 2012). The goals of the study were to evaluate the effectiveness of lag schedules in the teaching of variability of vocal responding. The procedures of the study consisted of paired stimulus preference assessments and a lag schedule of reinforcement. To assess social validity, the researcher developed a survey that targeted each of the three levels of social validity for each of the procedures as shown in Appendix D. Social validity was not assessed, however, because the participant's family went on vacation and were unable to be contacted before the researcher explained the results of the study and distributed the questionnaire.

Results

The research question that guided this study was *do Lag 3 schedules of reinforcement increase variable responding, specifically tacting?* The researcher also studied the effects of a lag schedule on reinforcement on the amount of novel responses emitted by the participant. This section provides a visual analysis of the baseline and intervention data and answers the research questions.

Lag 0

The Lag 0 phase consisted of three data points before Lag 3 was implemented. Jonah's Lag 0 data for variable responses (See Figure 1) were variable at a mid/low-level with no definitive trend. Lag 0 data for novel responses (See Figure 2) were slightly variable at mid/low-level with no definitive trend. Although the researcher should have waited for baseline to reach a steady-state, the time constraints of the study reduced the amount of time the researcher was able to keep the participant in the Lag 0 phase.

Lag 3

The researcher implemented seven intervention sessions with the Lag 3 schedule in place. The researcher graphed both independent and prompted results for variable (Figure 1) and novel responses (Figure 2). Independent variable responses show significant variability for sessions 4-8, but then show an increasing trend for sessions 9 and 10. By placing a trend line on the graph, there is an evident increasing trend occurring. The independent variable responding also appeared to be at mid-level. The prompted variable response data path presented a variable then steady decreasing trend. It also appeared to fall around mid-level.

The researcher also graphed novel responding with both an independent responses data path and a prompted responses data path. From the graph, it appears that Jonah's independent novel responses were fairly stable and slightly above baseline's mid/low level at mid-level. Session 10 revealed a significant increase in independent novel responses. The overall trend of the data path (as shown by the dotted trend line) appeared to be increasing. For his prompted novel responses, the data path was around mid/low level with stability and a decreasing trend.

Research Questions

The researcher's first research question sought to determine if a lag schedule of reinforcement is an effective way to teach variable responding while tacting pictures. This study produced inconclusive results regarding this research question, as only one subject participated. From the present data collected, there does appear to be a functional relation between a lag schedule of reinforcement and an increase in variable responding during tacting for this experiment. However, since there was only one participant, the results are inconclusive due to a lack of internal validity and replication of effects.

The second research question sought to determine if a lag schedule of reinforcement is an effective way to teach novel responding while tacting pictures. Similar to the first research question, this study cannot effectively answer this question. From the present data collected, there does appear to be a functional relation between a lag schedule of reinforcement and an increase in novel responding during tacting. As stated above, though, the results are inconclusive since having one participant does not provide adequate replication of effects.

Discussion

The purpose of this study was to evaluate the effectiveness of using a lag schedule of reinforcement to teach variability of responding to individuals who engage in stereotypic vocal responding. The study used a Lag 3 schedule of reinforcement to systematically reinforce variable responding for an individual who engages in echolalia and vocal stereotypy, specifically when he sees letters and numbers. The research sought to answer if this lag schedule of reinforcement affected the amount of variable responding the individual engaged in, as well as if the lag schedule affected the amount of novel responses the individual emitted.

The participant, Jonah, engaged in minimal problem behaviors during the study. None of the problem behaviors he engaged in affected the results of the study. For example, transitioning from reinforcement back to the task sometimes resulted in Jonah screaming or standing up (when he was expected to be sitting). However, each time he engaged in this behavior, he sat back down and lowered his vocal volume to a normal conversational level within one reminder from the researcher to stay sitting and use an “inside voice.” The researcher used a visual timer on her iPhone during Jonah’s reinforcement, so he knew how much time he had left. Allowing him to watch the timer reduced his screaming and standing up behaviors. This is anecdotal information and the researcher did not take data on his problem behaviors during the study.

Limitations

Due to the time constraints of the study, there were several limitations. The researcher was only able to recruit one subject to participate in the study. By only having one participant, there was no replication of effects. Behavior did appear to change for this participant (i.e., there was a slight increase in variable and novel responding during the tacting task) but having multiple participants would have been helpful to determine if the lag schedule was an effective intervention for other participants to increase their variable and novel tacting behaviors. Also due to the time constraint, the researcher ran out of time to conduct a maintenance probe to test if novel and variable responding maintained following the termination of the lag schedule of reinforcement. Without the maintenance probe, it is uncertain if the variability of tacting will maintain over time. Generalization was also not assessed, which could have been done through looking at an iSpy™ book or a random assortment of toys across different settings and people. The lack of assessment of generalization results in less comprehensive information regarding how variability of responding occurs across settings, people, and/or activities.

Contribution to Current Literature and Future Research

The visual analysis of the data collected illustrated that there was an increase in both variable and novel responding following the implementation of the lag schedule of reinforcement. The limited data here supports that lag schedules could be used to successfully increase variable responding for this participant, however, there is not enough information in the present study to make a significant contribution to the literature. Recruiting one participant puts the research at a disadvantage, because the lack of experimental control yields unreliable results. With the multiple limitations the study yields, this study does not add useful research to the current literature. However, if this study were to be replicated and the procedures implemented

across participants using a multiple baseline design, the study could yield results that contribute to the literature on lag schedules of reinforcement. Implementing this study for a longer amount of time could also help contribute to the current literature, because with additional data points comes more reliable and valid data. Extending the study also allows for more time to implement maintenance and generalization probes.

Beyond the need for replication, there are several future avenues this research can take. Future research can explore the effectiveness of a lag schedule of reinforcement paired with a token economy to present a visual to the participants. The visual of a token economy may help the participants see that they need to respond differently to earn a token and therefore earn reinforcement. Eventually, this token economy could be faded out. Another route future research can take is studying the maintenance of skills acquired by a lag schedule of reinforcement once the lag schedule is terminated. Generalization is another aspect that could be studied if this research were to be expanded upon. Lastly, future research could investigate effects on other verbal behavior, such as mands.

Figure 1. Jonah's Variable Responses.

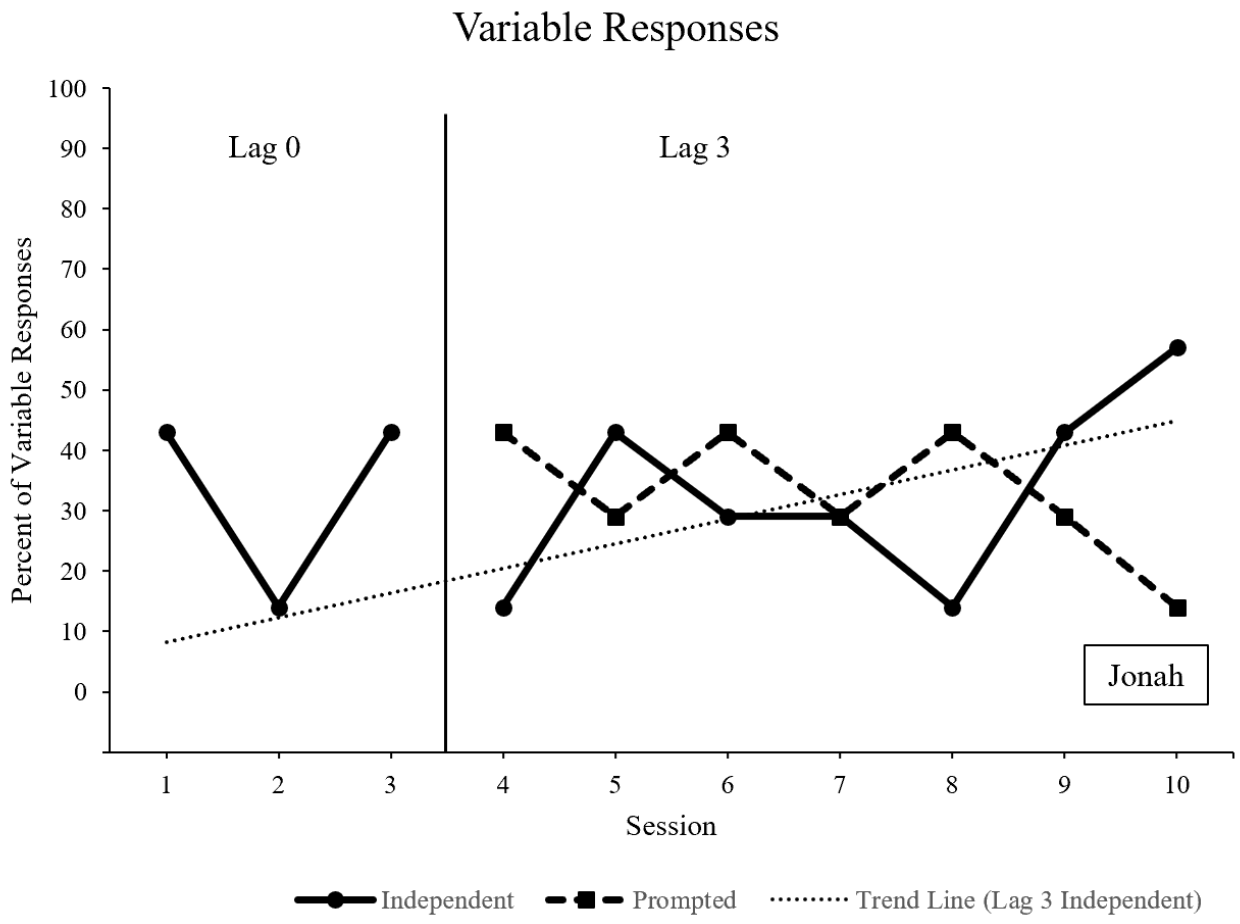
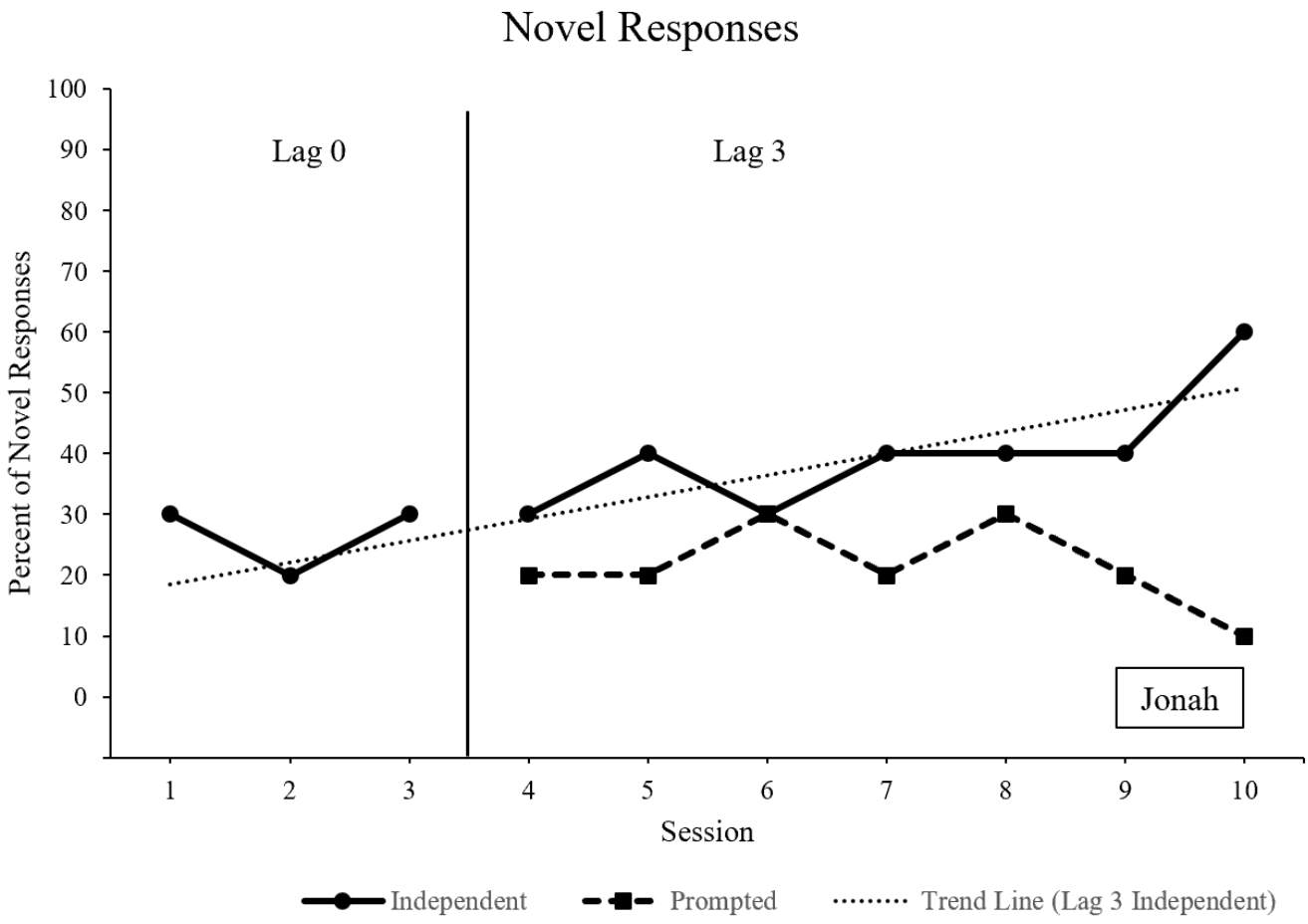


Figure 2. Jonah's Novel Responses.



Appendix A

Paired Stimulus Preference Assessment

Paired Stimulus Preference Assessment (4 items)

Date:		
Child:		
Teacher:		
Trial #	**Item selection**	
1.	A	B
2.	C	A
3.	A	D
4.	B	C
5.	D	B
6.	C	D

Date:		
Child:		
Teacher:		
Trial #	**Item selection**	
1.	A	B
2.	C	A
3.	A	D
4.	B	C
5.	D	B
6.	C	D

Date:		
Child:		
Teacher:		
Trial #	**Item selection**	
1.	A	B
2.	C	A
3.	A	D
4.	B	C
5.	D	B
6.	C	D

Date:		
Child:		
Teacher:		
Trial #	**Item selection**	
1.	A	B
2.	C	A
3.	A	D
4.	B	C
5.	D	B
6.	C	D

Date:		
Child:		
Teacher:		
Trial #	**Item selection**	
1.	A	B
2.	C	A
3.	A	D
4.	B	C
5.	D	B
6.	C	D

Date:		
Child:		
Teacher:		
Trial #	**Item selection**	
1.	A	B
2.	C	A
3.	A	D
4.	B	C
5.	D	B
6.	C	D

Date:		
Child:		
Teacher:		
Trial #	**Item selection**	
1.	A	B
2.	C	A
3.	A	D
4.	B	C
5.	D	B
6.	C	D

Adapted from Chazin & Ledford, 2016

Appendix B

Procedural Fidelity Checklists

PROCEDURAL FIDELITY	**Participant #:**	Definition of terms
Initials:	**Date**:	• Novel response: a response that had not been emitted previously during the session • Incorrect response: a response that did not answer the question • No response: failing to emit a response within 5 s to the instructional cue • Repeated response: a response that was said previously in the session • Variable: a response different than previous 3
Baseline ☐ Secure learner's attention ☐ Deliver cue: what do you see? / Tell me something you see. ☐ Participant responds or fails to respond ☐ Record: N (novel), I (incorrect), NR (no response), R (repeat), V (variable) ☐ Record: tact used ☐ Repeat for remaining trials ☐ Neutral praise delivered after each response ☐ No response was ignored ☐ Rich praise and 5 min of time with reinforcer after session		
Percent Completed:		

PROCEDURAL FIDELITY	**Participant #:**	Definition of terms
Initials:	**Date**:	• Novel response: a response that had not been emitted previously during the session • Incorrect response: a response that did not answer the question • No response: failing to emit a response within 5 s to the instructional cue • Repeated response: a response that was said previously in the session • Variable: a response different than previous 3 • Gestural prompt: pointing to an image in the array that the participant had not yet tacted
Lag 3 ☐ Secure learner's attention ☐ Deliver cue: what do you see? / Tell me something you see. ☐ Participant responds or fails to respond ☐ Deliver praise for variable responses ☐ If no response, incorrect response, or repeated response, prompt by gesturing to picture ☐ Record: N (novel), I (incorrect), NR (no response), R (repeat), V (variable) ☐ Record if prompted: Y (yes), N (no) ☐ Record: tact used ☐ Repeat for remaining trials ☐ Every 4th variable response receives rich praise and reinforcement (2 min)		
Percent Completed:		

Appendix C

Data Collection Sheets

Preassessment Data Collection
Date:
Participant #:

Picture on Card	+ / -	Picture on Card	+ / -	Picture on Card	+ / -	Picture on Card	+ / -

\+ correct
\- incorrect

Baseline Data Collection
Date:
Participant #:

Session ____	Response	Tact Used
Trial 1	N I NR R	
Trial 2	N I NR R	
Trial 3	N I NR R	
Trial 4	N I NR R	
Trial 5	N I NR R V	
Trial 6	N I NR R V	
Trial 7	N I NR R V	
Trial 8	N I NR R V	
Trial 9	N I NR R V	
Trial 10	N I NR R V	
Novel	/10	%
Variable	/7	%

N – novel
I – incorrect
NR – no response
R – repeat
V – variable

IOA:

Intervention Data Collection
Date:
Participant #:

Session ____	Response	Prompted	Tact Used
Trial 1	N I NR R	Y / N	
Trial 2	N I NR R	Y / N	
Trial 3	N I NR R	Y / N	
Trial 4	N I NR R V	Y / N	
Trial 5	N I NR R V	Y / N	
Trial 6	N I NR R V	Y / N	
Trial 7	N I NR R V	Y / N	
Trial 8	N I NR R V	Y / N	
Trial 9	N I NR R V	Y / N	
Trial 10	N I NR R V	Y / N	
Novel	/10		%
Variable	/7		%

N – novel
I – incorrect
NR – no response
R – repeat
V – variable

IOA:

Appendix D

Social Validity Questionnaire

SOCIAL VALIDITY QUESTIONNAIRE FOR CAREGIVERS Please rate the following on a scale of 1 to 4.				
	1 Strongly Disagree	**2 Disagree**	**3 Agree**	**4 Strongly Agree**
Goals				
Teaching a child who engages in repeating words and phrases out of context (repetitive vocalizations) to vary their vocal responses to the question "what do you see?" is important.				
It's important to learn strategies to help children who engage in repetitive vocalizations to increase the variability of their vocal responding.				
Procedures				
The paired stimulus preference assessment (comparing two preferred items at a time) was an appropriate way to determine motivating items for my child.				
Using lag schedules of reinforcement is a socially acceptable way to provide my child with teaching them increase variable vocal responding.				
The lag schedule sessions were not intrusive to my child's daily routine.				
Outcomes				
My child demonstrated an increase in his/her variability of vocal responding.				
Comments:				

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