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Comparing Operant Discrimination Training and Response Contingent Pairing for Eliciting Vocalizations

Jade Grimes
jgrimes@rollins.edu

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Jade E. W. Grimes

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Abstract

Delays to language acquisition can have negative impacts to a child's academic and social interactions. Stimulus-stimulus pairing (SSP) is a clinical procedure used to increase vocalizations by early language learners. Alternative interventions to SSP include response contingent pairing (RCP) and operant discrimination training (ODT). The results from previous research in RCP and ODT have limited benefit to clinical applications because verbal approximations were not reinforced, and they did not bring the vocalizations under stimulus control. The present study sought to evaluate the use of RCP and ODT to determine which intervention increased vocalizations. Two children aged 2- and 6-years-old, diagnosed with language delay and autism spectrum disorder, participated in each condition. The results were undifferentiated for both participants. Implications of this research are that some children may not immediately acquire the target vocal response at the start of the intervention. A potential reason why RCP worked for one participant over ODT may have been the response effort involved in ODT. Limitations include a lack of discrimination between conditions, the number of vocalizations presented in each trial, lack of EO, and allowing preferred items in the room. We also note that a lack of social interactions for the 2-year-old may have delayed language acquisition.

Keywords: autism spectrum disorder, language acquisition, operant discrimination training, response contingent pairing, stimulus-stimulus pairing

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Young children start to engage in verbal communication and language within their first year of life in the form of babbling, verbal approximations, and simple words. However, if preschool children are not reaching these developmental milestones before entering school, it can have a negative impact on their education and social interactions with their peers. Setting the occasion for instances of vocalizations is a two-stage respondent conditioning process that ends in vocalizations functioning as conditioned reinforcers. In the first stage, the caregivers' vocalizations (motherese) are paired with unconditioned reinforcement (i.e., food or warmth). In the second stage, similar vocalizations by the child are elicited that now serve as conditioned stimuli that automatically reinforce verbal behavior (Sundberg & Michael, 2001).

A clinical procedure theorized to replicate this natural process is stimulus-stimulus pairing (SSP), where practitioner-emitted sounds are paired with the delivery of an unconditioned or conditioned stimulus. It is hypothesized that the speech acquires properties of conditioned reinforcement through the pairing procedure, resulting in automatic reinforcement of future utterances (Sundberg et al., 1996). Even though there is no contingency for the child to speak, SSP often increases production of speech sounds (Lepper et al., 2013). Although some researchers have reported a positive impact on vocalizations of individuals with and without a diagnosis of autism spectrum disorder (ASD; Carroll & Klatt, 2008; Lepper et al., 2013; Rader et al., 2014), others have reported no effects on vocalizations (Esch et al., 2009; Normand & Knoll, 2006; Rader et al., 2014; Yoon & Feliciano, 2007).

Response-contingent pairing (RCP) is a procedure based on SSP to increase vocalizations and establish vocalizations as conditioned reinforcers. In RCP, the pairing of

the neutral stimulus (i.e., experimenter vocalizations) and the reinforcer is contingent on the response of the participant. Instead of using an observing prompt, as is often the case in SSP, a nonverbal response by the participant starts the pairing trials. Dozier et al. (2012) found that RCP was possibly more effective than response-independent pairing (RIP or SSP), but they did not compare results within participants. Lepper and Petursdottir (2017) found larger effects on target vocalizations and more reliable success of RCP than RIP. However, the researchers noted there was a potential sequence effect because RIP was always the second condition.

An alternative intervention to respondent conditioning procedures such as SSP and RCP is operant discrimination training (ODT), in which conditioned reinforcement is established when preferred stimuli are delivered contingent on a response when the discriminative stimulus (S^D) is present. Respondent conditioning is at work in establishing the reinforcer, but operant conditioning is the primary conditioning process (Lepper et al., 2013). Holth et al. (2009) found that when they established visual and auditory stimuli as conditioned reinforcers, ODT established the stimuli more strongly than SSP. In a study completed by Esch et al. (2005), neither ODT nor SSP increased the vocalizations of the participants.

Lepper et al. (2013) also compared the rate of vocalizations of three participants with ASD using SSP and ODT. They found that the effects of ODT were similar to SSP, as both increased the target child vocalizations, but the participants preferred ODT to SSP. However, Lepper et al. noted increases in vocalizations in the SSP conditions were small in comparison to prior studies. They hypothesized the small increase could have been from the strict operational definition of the nontarget and target stimuli, which excluded counting verbal approximations to syllables. These results are not helpful for clinical applications of SSP or RCP because the researchers did not reinforce any verbal approximations or bring the

vocalizations under stimulus control. Based on this limitation, the purpose of the current study is to systematically replicate the study by Lepper et al. by reinforcing verbal approximations and applying the RCP procedure used in Lepper and Petursdottir (2017). We propose that the methods in RCP should produce larger effects on child vocalizations than ODT because the participant must engage in an attending response before the experimenter vocalization is delivered (Hearst and Jenkins, 1974).

Method

Participants and Setting

The participants included two children between age 2 and 7 years who have a language delay diagnosis and scored between 0 and 19 on the Early Echoic Skills Assessment (EESA; Esch, 2008). This study excluded children over the age of 7 years, those that score above a 20 on the EESA, and/or those exhibiting severe problem behavior. The sessions took place in therapy rooms at a local clinic in central Florida with no other clients present.

Independent and Dependent Variables

Practitioner vocalizations were presented throughout the sessions. The participants were each assigned a total of six novel and developmentally appropriate vocalizations (Kids Sense, n.d.), such as “mah,” “boo,” and “pay,” presented in target trials or nontarget trials as described below. Table 1 includes the vocalizations that were included in the experiment. These vocalizations were chosen based on pre-experimental observations (see procedure below) and were developmentally appropriate based on the language developmental milestone of the child. In pre-experimental observations, the experimenter recorded the form and frequency of all the vocalizations emitted in each session to select the words or syllables to be presented in each condition for each child. The vocalizations selected were previously observed blends of words or vocal approximations from the observations.

The experimenter semi-randomly assigned the vocalizations for each participant in the target and nontarget trials (see Table 1). The dependent variable was the rate of child vocalizations that approximated the stimuli used in each condition. An example of an approximated vocalization is if the therapist presented the word “mah” and the participant said “mmm.” The target response for the ODT trials was the participant raising one arm and the target response for the RCP trials was the child’s vocalization(s) in the presence of the experimenter vocalization. Vocalizations were defined as the child opening their mouth and emitting sounds that had one-to-one correspondence to the vocalization by the therapist or sounds that had no one-to-one correspondence to the vocalization by the therapist. Vocalizations recorded throughout each condition included vocal protests, “ehhh,” “ahh,” different syllable and constant combinations, and ambulance sounds. Vocalizations were not recorded included responses made using an augmentative and alternative communication (AAC) device, laughing, coughing, sneezing, or screaming. Arm raising was defined as the child extending their arm and hand upwards into the air. This includes touching their head, patting their head, or extending their arm upwards. This does not include extending their arms to the right side near their hip and extending their arm to the left side near their hip.

Interobserver Agreement

The experimenter independently collected data on the frequency of verbal responses for at least 25% of the sessions for each participant. They only scored the first 10 min of each 20-min or longer session. Interobserver agreement (IOA) was calculated using frequency-within-trials agreement by recording vocalizations in intertrial intervals (ITIs). IOA was calculated by subtracting the number of ITI disagreements from the total number of ITIs. For each ITI with disagreement, the smaller frequency scored within that ITI was divided by the larger frequency and the quotient was added to the number of trials with agreement. The sum was divided by the total number of ITIs, and the quotient was converted to a percentage. The

researcher also collected point-by-point IOA data by on arm raising in ODT trials. This was calculated by dividing the number of intervals of agreement by the sum of intervals with agreement and disagreement and multiplying by 100. Mean IOA was 94% (range, 88% to 100%) for Aurora and 86% (range, 71% to 100%) for Jonah.

Procedure

Design

This study included an RCP condition, an ODT condition, and a control condition. The RCP and ODT conditions had a nontarget and target stimulus associated with the absence or delivery of reinforcement, respectively, but the control condition only had a nontarget condition. An adapted alternating treatments design (Sindelar et al., 1985) was used to compare the effects of RCP, ODT, and the control conditions.

Participants

Three participants were recruited for this research. One participant acquired an echoic repertoire before the start of the button press training and scored above a 19 on the ESSA. Therefore, he was disqualified from the study.

Aurora was a 2-year-old female diagnosed with ASD and language delay. She attended a local ABA clinic in Orlando, FL four times a week for two- to three-hour sessions. At the time of the research, her therapy goals included mand training in the form of sign-language. During the two observation periods, she emitted some spontaneous vocalizations that included “nonono,” “dadada,” “mmmm,” “nnnnn,” “bababa,” and glottal sounds. Her parents listed her preferred foods as dried mango, strawberries, peaches, candy, cookies, and other sweet foods. At the time of the experiment, her main form of communication was sign language and PECS. She was acquiring signs and PECS for edible items and tangible items such as bubbles and toys.

Jonah was a 6-year-old male diagnosed with ASD and language delay. He attended a local ABA clinic in Orlando, FL four times a week for five- to seven-and-a-half-hour sessions. At the time of the research, he used an iPad with an AAC program to communicate his needs. His treatment goals included mand training using the AAC software. He emitted a few spontaneous vocalizations that included “hihi,” “aye,” screams, imitating an ambulance siren, and “yeaaaaa”. Due to his limited history of early intervention and limited repertoire of skills, he was included in the research. His mother listed his preferred foods as pepperoni slices, salads, green peppers, Pez candy, and salad toppers from Chick-fil-a©. At the time of the study, his main form of communication was through an AAC device where he could request food, items, being picked up, and leaving an area.

Pre-Experiment Observation

Observation periods allowed the experimenter to gather information about the participant and to identify novel and possibly existing vocalizations for the RCP and ODT target and nontarget trials. Participants engaged in multiple activities and could interact with the experimenter if they were motivated to do so. During an observation period, the experimenter recorded the form and rate of each spontaneous vocalization emitted. This information was used to select novel target and nontarget vocalizations for each condition. The observation sessions were conducted in 10-30 min sessions for two days.

Preference Assessments

Before starting the next conditions, the researcher provided the caregivers with a Revised Reinforcer Assessment for Individuals with Severe Disability (RAISD; Fisher et al., 1996) to identify potential edible reinforcers in the preference assessment. After the revised RAISD was completed, we conducted either a forced-choice preference assessment (Derby et al., 1995) or a multiple stimulus with replacement assessment (DeLeon & Iwata, 1996) to identify the individual preferences of each participant. This was determined by the therapist

running the session based on what was available to the participant. The edible reinforcers were provided by the caregivers to be used for experimental and therapy sessions only.

Therapist Training

One board certified behavior analyst (BCBA), one registered behavior technician (RBT), and two board certified assistant behavior analysts, (BCaBAs) were trained on the procedures for target and nontarget ODT, RCP, and control conditions. Each BCBA, BCaBA, and RBT was trained using behavior skills training to 100% mastery for three trials. Supplementary videos were also created for Jonah's therapists.

Button-press Training

The purpose of this training was to teach the participants that pressing the button would deliver one of their preferred items. It was based on the procedure used by Lepper and Petursdottir (2017). The button-press response was used to indicate that the participant was attending to the environment. Before the training started, the experimenter placed the highest-preferred stimulus on the floor, out of reach but within the visual field of the participant. The button was placed on the floor or on a table, within reach of the participant. The participant initiated the trials by reaching for the button or the preferred item. If they reached for the item, the experimenter physically blocked them from accessing it. Each trial consisted of the participant either independently pressing the button or receiving a prompt to do so. The experimenter used most-to-least prompting if the participant did not independently respond within 10 s of the start of the trial. Independent and prompted responses resulted in the immediate delivery of the item. The mastery criteria to end button-press training was the participant engaging in 10 unprompted responses in a row for two successive sessions.

General Procedure

Each session lasted approximately 20 min and consisted of 10 target and 10 nontarget trials that were delivered in a semi-random order. The semi-randomization of trials limited presentations of the same vocalization to no more than three times in a row. Each session was ODT, RCP, or control. The order of the trials was determined using a random number generator. [The number that appeared the most often out of three trials was selected, along with the condition to which it corresponded.] The trials in all conditions included an ITI of between 40 to 80 s (see Table 2) to make the reinforcement rate equal and unpredictable across conditions. In the control condition, we provided reinforcement 20 s after the presentation of the experimenter vocalization. In the target trials, the participants had longer ITIs than those used by Lepper et al. (2013). da Silva and Williams (2020) recommended this as a best practice SSP because longer latencies between trials resulted in more conditioned responding in basic autoshaping research.

Target and non-target vocalizations were randomly assigned to each condition (see Table 2). The highest preferred reinforcer selected from the initial preference assessment results were delivered immediately after the experimenter vocalization. The participant received a small piece of an edible. After the participant received the reinforcer, the ITI started. In the nontarget trials, the experimenter vocalization was presented, and no consequences were delivered. The researcher advised the caregivers of the participants to exclude the use of the highest preferred reinforcers and target word outside of the protocol to maximize the effectiveness of the procedure. The rate of reinforcement was calculated to determine that reinforcement was being distributed equally across trials. Any verbal approximation to the target vocalization was recorded.

ODT

In ODT sessions, when the target vocalization was presented, if the participant engaged in the gross motor response of arm raising it was reinforced. If the participant performed this movement during the target auditory response, the participant received the reinforcer. If they did not complete the action during the target vocalization, then the experimenter provided a full physical prompt before delivering the reinforcer. The therapist ignored the gross motor response if it occurred in the nontarget vocalization trials but recorded it just the same.

RCP

In the RCP condition, the target vocalization was paired with the reinforcer and the experimenter vocalization. The trial started with the experimenter placing a button within reach of the participant and then waiting for the participant to press it. If the button was not pressed within 1 min, then the experimenter briefly removed the button and then placed it back in front of the participant. When the participant pressed the button, the experimenter presented the vocalization once, using motherese. In the target trials, the experimenter presented the target vocalization and immediately delivered the reinforcer on the last syllable/syllable combination presentation.

Control condition

The control condition was similar to the control condition implemented by Lepper et al. (2013). Experimenter vocalizations were emitted using the same ITIs as the other conditions, but the reinforcer was delivered 20 s after the experimenter vocalization. This was used to control for potential adventitious reinforcement (see Table 3). The nontarget control trials were conducted the same way as the nontarget trials in ODT and RCP. There were no contingencies for the vocalizations that occurred in the nontarget control trials.

Results

The results of the ODT, RCP, and control trials are displayed in Figures 1 and 2. Figure 2 is a subset of Figure 1. For each figure, the dependent variable was the rate of vocalizations for each participant. For Aurora in Figure 1, there was a highly variable responding in each condition. Target ODT (M = 0.32 responses per min) and nontarget ODT (M = 0.33 responses per min) produced a slight increase in vocalizations relative to the control condition. Target RCP (M = 0.49 responses per min) had a slightly larger effect on vocalizations than target ODT (M = 0.32 responses per min). However, rates of vocalizations in the target control condition (M = 0.58 responses per min) were higher relative to the target RCP trials (M = 0.49 responses per min). For Jonah, in Figure 1, there were lower rates of vocalizations in the target control (M = 0.29 responses per min) relative to the target ODT (M = 0.38 responses per min) and to the target RCP (M = 0.58 responses per min) conditions. Overall, the target RCP condition (M = 0.58 responses per min) had a higher rate of vocalizations compared to the target ODT condition (M = 0.38 responses per min). However, there was no consistent difference between the rate of responding in both conditions.

For Aurora in Figure 2, the nontarget RCP condition (M = 0.35 responses per min) had the highest average rate of vocalizations compared to the other conditions. The nontarget control (M = 0.14 responses per min) exceeded responding in the target ODT (M = 0.24 responses per min) but the target RCP (M = 0.07 responses per min) and the target control (M = 0.07 responses per min) was undifferentiated. Jonah's results in Figure 2 show there are similar rates of vocalizations relative to Figure 1 for the first two sessions of nontarget RCP (M = 0.49 responses per min), target RCP (M = 0.52 responses per min), nontarget ODT (M = 0.30 responses per min) and target ODT (M = 0.33 responses per min). The target control (M = 0.13 responses per min) was slightly higher than the nontarget control (M = 0.06 responses

per min) but the rate of vocalizations in session 7 and session 8 decreased to zero for target ODT and near zero for the nontarget ODT (0.04 responses per min).

Discussion

We questioned whether ODT or RCP would increase target vocalizations for the participants. The results do not support the hypothesis and the findings from previous research on RCP and ODT because it did not provide evidence that RCP was an effective procedure for some young children with limited echoic repertories. The ODT condition and the RCP condition did not consistently increase the target vocalizations for either participant. Also, the rate of vocalizations was not differentiated for each participant. For example, In Figure 1 and 2, while the average rate of responding was higher in the nontarget and target RCP compared to the nontarget and target ODT, Aurora did not show differentiation in the rate of responding between the ODT and RCP conditions. These results may have been due to overshadowing effects from the presence of highly preferred food and toys in the environment. While these results did not support previous findings that RCP could be an effective procedure, the results were similar to the results from Lepper et al. (2013) with one of their participants' rate of responding was not consistently different across conditions. For example, in their study, Jonas, had achieved discrimination between the conditions but there was no difference in the rate of responding between the ODT and SSP conditions.

The average rate of the vocalizations in the pre-session observations was higher than the average rate of vocalizations in the target RCP, nontarget RCP, target ODT, nontarget ODT, target control, and nontarget control for both participants. For Aurora, the average rate of vocalizations was 1.34 per min and for Jonah, the average rate of vocalizations was 1.03 per min. These observations occurred at different times of the day and both participants were allowed to leave their designated therapy room. This may have been due to mand training occurring during each observation session. It may also be due to access to other reinforcers

outside of the therapy room, such as access to other people and access to different locations in the clinic. Based on these average rates in these observations, cannot conclude that RCP and ODT had an effect on each participant's rate of responding.

The implications of these results are important to the growing body of research in RCP and ODT because it provides evidence some children do not immediately acquire the target vocalizations. Aurora and Jonah did not emit any target vocalizations in either the RCP, ODT, or control condition. Previous research has supported this as in Lepper et al. (2013), over 40 trials were necessary for the youngest participant, Jonas, to emit any target vocalizations. This was also found in the results from Lepper and Petursdottir (2017) as it took seven sessions for their participant Ken to engage in any echoic responses. These findings add to the relevance of using RCP and ODT as a clinical procedure that needs to be individualized to each participant and may take extra time for some children.

There is one potential reason that RCP produced slightly larger effects on vocalizations for Aurora than ODT based on the results from Figures 1 and 2. The reason could be that the attending response required in RCP was a less effortful response than ODT. The attending response in RCP was used as a contingency for the participant to respond to the experimenter's vocalization. Hand raising was more effortful for the learner, as evidenced by the number of prompts needed to raise their hand. In each session, therapists on both therapy teams had to use full-physical and partial-physical prompts to raise their arms. When the experimenter conducted a session for Jonah, he only patted his head. While this was counted as an independent trial for the sake of research purposes, there was no one-to-one correspondence to the imitative response.

It is important to note that problem behavior occurred during the experimental sessions and during his regularly scheduled therapy time for Jonah. He engaged in self-injurious behavior in the form of head hitting, negative vocalizations, vocal protests, and

elopement that was hypothesized to be maintained by negative reinforcement. This may have interfered with the acquisition of the target vocalizations because these behaviors had a longer history of reinforcement and had a lower response effort than emitting target vocalizations. These target behaviors also served as removing assent from participating in the experimental condition for the day.

It is also important to note that neither participant emitted the target or nontarget vocalization in either condition. Jonah had vocally approximated “hah” by saying “ahh” and Aurora had vocally approximated “mah” by saying “mmm.” This may have been due to the limitations presented below or due to the difficulty of the words that were selected. Lepper et al. noted that they did not observe any effect on the verbal behavior of their participant, Colin, and hypothesized that the words from Set 1 may have been too difficult for him to emit. This was supported by the effects they observed in Set 2, since the rate of target vocalizations did increase.

A limitation of this research includes the possible lack of discrimination by the participants between conditions. As evidenced by the results from both participants, the conditions were not easily discriminated by the participants. The presentation of reinforcement and the presence or absence of the button were not salient to the participants. It was also observed by the experimenter and other therapists that Jonah overgeneralized the button pressing response and hand raising to all the conditions.

Lepper and Petursdottir (2017) speculated that the target and non-target vocalizations served as discriminative stimuli indicating the presence or absence of reinforcement. However, vocalizations did occur in nontarget conditions and at higher rates than the target conditions for both participants. Jonah may have engaged in vocalizations because the presence of food during the nontarget trials may have served as an establishing operation for food that was not delivered. These responses, then, could have served as mands. For example,

it was observed that Jonah would mand for the highest preferred edible (i.e., green peppers or pepperoni) during the nontarget trials. For Aurora, her vocalizations during each condition may have been automatically reinforced while she was consuming the reinforcer. The therapist conducting most of her sessions did note that Aurora engaged in vocalizations while she was chewing the food.

Lepper et al. (2013) did present three to four different colored papers that were correlated to the ODT, SSP, and control conditions through discrimination aids. They used these colors to conduct a preference evaluation of each condition for the participants. Using this procedure enhanced discrimination between each condition as their results showed that two participants preferred the ODT condition over the control condition. Future research should focus on creating salient stimuli to discriminate each condition. This may help participants respond to each condition to decrease responding in nontarget conditions and increase responding in target conditions.

A limitation based on the clinic where the experimental sessions took place was that there was a potential lack of establishing operation in place during each session. In each experimental session, edible reinforcers were used but these edibles were also used during their therapy sessions. The experimenter did not have control over the edibles that were brought to the clinic and when they were presented. For example, cookies that were used in Aurora's mand training sessions were also used in her ODT, RCP, and control sessions. This may have created an abolishing operation to emit the target vocalization.

Another limitation from the clinical site was that multiple implementers were used for each participant. The people implementing each procedure were members of the participants' therapy team. The implementers also changed from session to session based on who was scheduled to be with the participants for that day. This may have caused a blocking effect as the mand training may have blocked the acquisition of the target vocalizations in each

condition. Before the start of the research, both Aurora and Jonah had started mand training with their respective BCBAs using either a PECS board (Aurora) or an AAC device (Jonah). Mand training was still in their therapy sessions, so the mand training and the RCP, ODT, and control conditions being run during the sessions may have caused the emitted vocalizations to remain ineffective as a conditioned stimulus even though the vocalizations and the mands had a contingent relation to the edible reinforcers. It was also noted that the implementers also did not run each session at the same time each day due to the availability they had each session. For example, one therapist may have had Jonah for only 30 minutes on one day, so a therapist that had him for 2 hours later in the day would have the time to run his RCP session for the day.

The last limitation based on the clinic setting was that no treatment integrity data were calculated. This type of data collection would have analyzed if the procedure was being performed correctly by each therapist and could have helped the experimenter correct any procedural drift. While there were contingencies for the behavior analysts at the clinic to collect treatment integrity, the contingencies in place for the experimenter to collect treatment integrity were lacking. As mentioned before, the experimenter was not on the therapy team of either participant. Treatment integrity could not be collected in-vivo nor after the session was completed. Researcher assistants and thesis committee chairs associated with the college were unable to score IOA or treatment integrity data from the recorded sessions. It was also logistically difficult for them to come in to collect the data as each session was conducted at different times for each participant. While the experimenter was able to collect IOA data, there was limited time to collect treatment integrity data as it was time-intensive to collect the IOA data.

The other limitation was that only one vocalization was presented in each trial. Presenting only one vocalization may have hindered the acquisition of the vocalization. da

Silva and Williams (2020) suggested that only one vocalization should be presented per trial because multiple vocalizations at once may produce the phenomenon of blocking, which may limit learning of the target vocalization. However, other researchers have suggested multiple presentations in each trial may have enhanced learning of the vocalization. Multiple presentations of the stimulus were successful for Lepper and Petursdottir (2017) as they presented vocalizations three times and observed the rate of vocalizations increased for each participant. This was also successful for Eberhardt (2019) as the pre-recorded auditory stimuli they used were repeated for 3, 6, 9, or 12 s and noted that rate of vocal responses increased in pairing sessions. If it is true, three vocalizations may be more salient than one. This is an open question for future research in these types of subareas of verbal behavior research.

An additional limitation was both participants' weak non-vocal imitation repertoires. This may have interfered with the acquisition of the target vocalizations because the hand-raising response may have overshadowed the target vocalization presented. Future researchers should select a response from their repertoires. For example, their respective BCBAs conducted assessments on their imitative responses. Aurora was only able to clap her hands and Jonah was only able to pat his head.

The last limitation was the presence of toys and other items in the room. The experimenter allowed for each participant to have preferred toys and items in their room. For example, Aurora had her backpack in her room during each session to buckle and unbuckle and Jonah had his iPad to listen to preferred videos on YouTube. The presence of these items may have interfered with emitting the target vocalization as interacting with these items has a lower response effort than vocalizing target responses. The presence of these items could have also been more salient to the participants than the vocalizations by the therapists. Lepper and Petursdottir (2017) removed or placed toys out of reach of their participants during each

session and found that RCP produced a higher rate of target vocalizations than the target and nontarget RIP conditions. Future research could consider if the presence of multiple preferred stimuli in the environment may affect the acquisition of the target vocalizations.

An important aspect to note about Aurora was that her social interactions with other people have been limited. This may have further delayed her acquisition of language because she did not have access to different social interactions that typical toddlers would. Her previous social interactions had to be condensed compared to children born before 2019-2020 due to the lockdowns/restrictions in place for 2019 Novel Coronavirus (COVID-19). Her age and her diagnosis of ASD puts her at a higher risk of contracting COVID-19 and potentially developing a post-COVID-19 condition. Before the start of COVID-19, young children had more access to various places that were enriched with numerous people with whom children could interact. For example, 2-year-olds typically accompany their caregivers to grocery stores where they can engage in or observe social interactions with workers, store patrons, and other children. It may be warranted those social interactions may be necessary for RCP or ODT to be successful.

Despite the limitations, this study extends the current literature on the use of RCP and ODT to teach echoic responses to young nonverbal children with ASD. While neither procedure produced target vocalizations, there is some evidence that RCP could increase overall vocalizations.

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Table 1

Target and Non-Target Vocalizations for Aurora and Jonah

Conditions	Target Words	Non-Target Words
ODT	Mah	Dun
RCP	Nun	Moe
Control	Doe	Nah

Conditions	Target Words	Non-Target Words
ODT	Yuh	Hah
RCP	Hut	Way
Control	Wah	Yet

Note. This table demonstrates the target and nontarget vocalizations for Aurora (top table) and Jonah (bottom table).

Table 2

ITI Values for Each Participant

Trial	ITI	Trial	ITI
1	60	11	60
2	50	12	55
3	70	13	40
4	65	14	80
5	80	15	50
6	75	16	55
7	60	17	60
8	40	18	50
9	55	19	65
10	70	20	75

Note. This table demonstrates the ITI values in RCP and ODT conditions.

Table 3

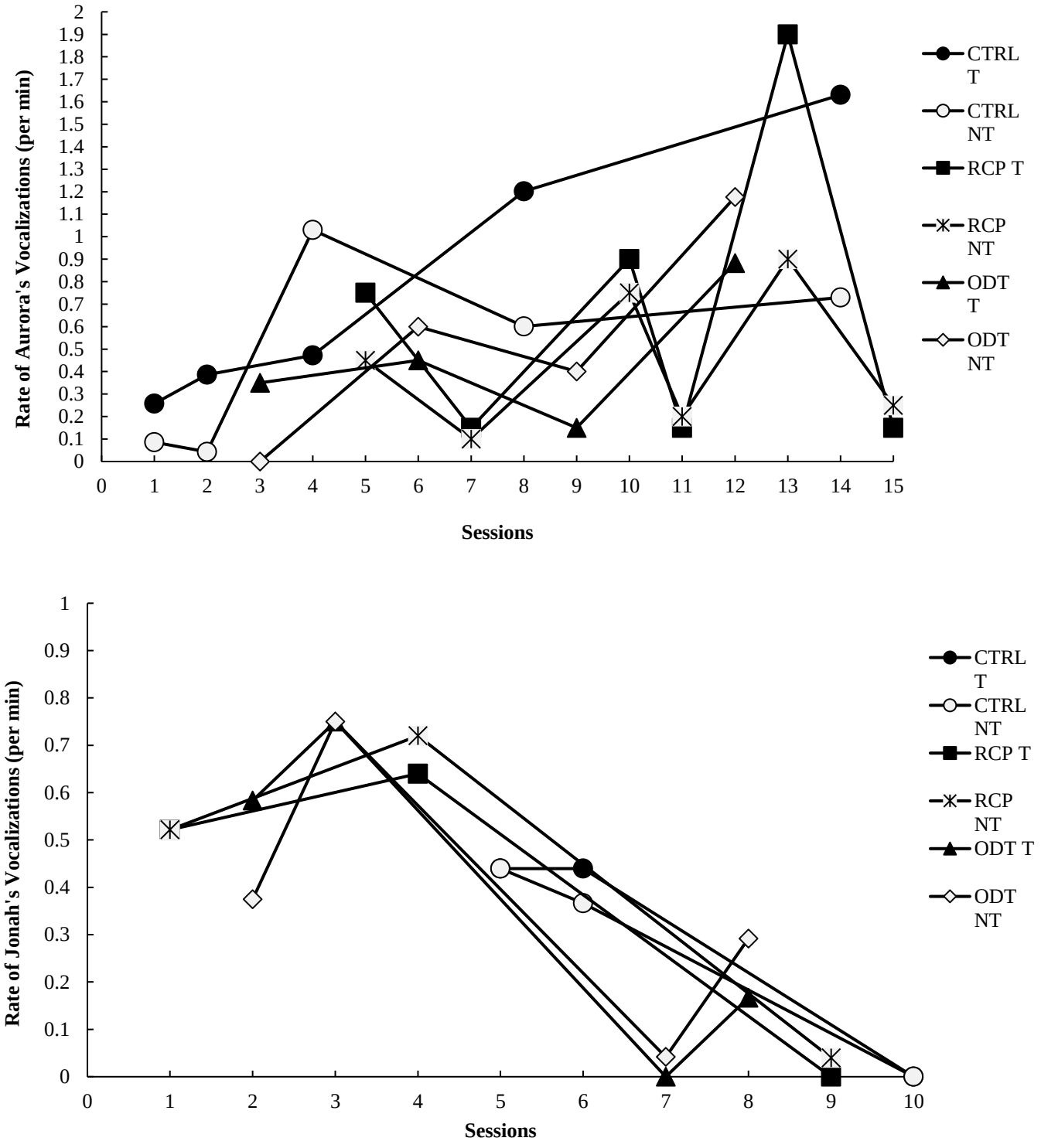
Control Condition

Trial	ITI	Delay to Reinforcer	Trial	ITI	Delay to Reinforcer
1	60	20	11	65	N/a
2	55	N/a	12	50	N/a
3	75	20	13	40	20
4	60	20	14	80	N/a
5	80	20	15	55	20
6	70	N/a	16	65	20
7	55	N/a	17	60	N/a
8	40	20	18	50	N/a
9	70	N/a	19	60	N/a
10	50	20	20	75	20

Note. This table demonstrates the duration of the SR delivery and the practitioner vocalizations in the control condition**.**

Figure 1.

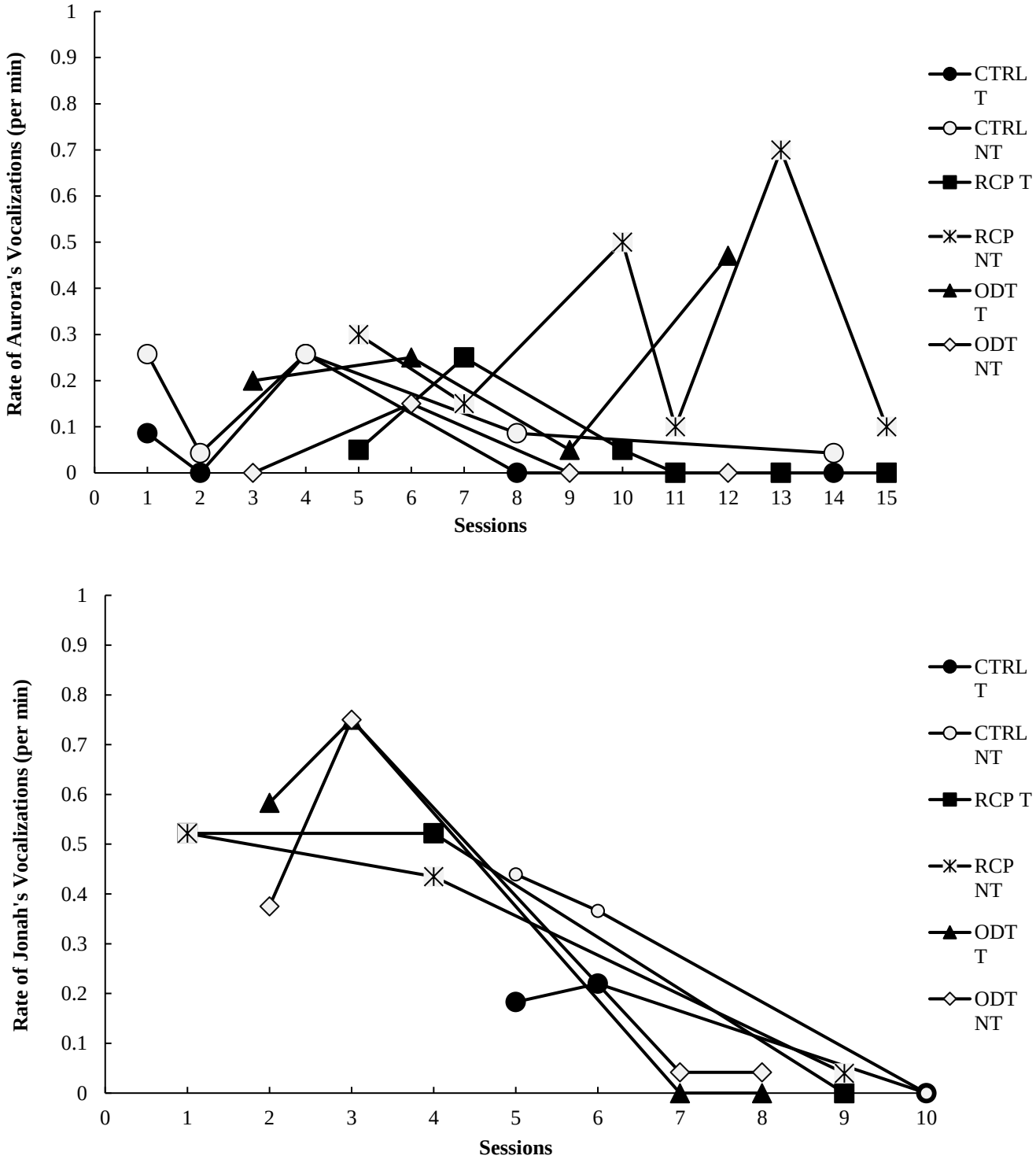
Rate of All Vocalizations During Control, RCP, and ODT Trials



Note. This figure demonstrates results from control (CTRL), RCP, and ODT trials with Aurora (top graph) and Jonah (bottom graph). NT = nontarget, T = target

Figure 2.

Rate of Vocal Approximations During Control, RCP, and ODT Trials



Note. This figure demonstrates results from control (CTRL), RCP, and ODT trials with Aurora (top graph) and Jonah (bottom graph). NT = nontarget, T = target