An Evaluation of the Effects of Stimulus-Stimulus Pairing Trial Densities on the Rate of Vocalizations of Nonvocal Children

Lyret Carrasquillo

A Dissertation Submitted to the Faculty of

The Chicago School of Professional Psychology

In Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy in Applied Behavior Analysis

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Abstract

Research on stimulus-stimulus pairing to induce vocalizations in nonvocal children has yielded mixed results, and more research is warranted to identify the key components necessary to produce an effect. The current study compared three variations of the stimulus-stimulus pairing (SSP) procedure on novel and infrequent vocalizations of three children with autism. The procedural variations consisted of presenting SSP trials with an intertrial interval density of 5 s, 15 s, and 30 s. Our results were that the target sounds increased across these densities, indicating that SSP was an effective procedure for increasing the rate of vocalizations across multiple densities. However, the results do not provide definitive evidence that one density is more effective than another.

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Chapter 1: Nature of the Study

Learning to speak and communicate vocally is a complex process that involves multiple behavioral events, and researchers have spent decades examining the acquisition of language skills. The central controversy about how children acquire vocal behavior surrounds the competing theories of human-biological structure, genetic endowment (Chomsky, 1965), and the influence of environmental variables (Skinner, 1957). Language and communication impairments are among the defining features of autism spectrum disorder (ASD) and are of interest to researchers studying language acquisition (American Psychiatric Association, 2013). Few behavioral researchers have examined the efficacy of interventions for children who fail to develop a vocal repertoire and produce frequent speech sounds.

The degree of language impairment varies across individuals with ASD, but at one extreme, vocal language may be absent and other forms of communication minimal. Language interventions for individuals who fail to establish a vocal repertoire are limited and often consist of alternative communication systems such as Picture Exchange Communication Systems (PECS; Bondy & Frost, 1994) or American sign language (ASL) that do not require vocal production of sounds. Stimulus-stimulus pairing (SSP) is a behavior-analytic procedure used to increase vocalizations in children with marked language delays, as is often the case with children diagnosed with autism spectrum disorder (ASD), by pairing speech sounds with highly preferred items (Petursdottir & Lepper, 2015; Shillingsburg, Hollander, Yosich, Bowen, & Muskat, 2015). SSP consists of repeatedly, temporally arranged presentations of adult-emitted speech sounds immediately followed by a preferred item or activity. The preferred stimulus is delivered independently of the child's response to establish the sound as a conditioned reinforcer (Lepper & Petursdottir, 2017). Following successful SSP interventions, children emit more frequent vocalizations which can then be brought under stimulus control. In their review of the literature on SSP, Stock, Schulze, and Mirenda (2008) suggested three reoccurring components in the successful applications of SSP: (a) the participants were younger in age, (b) procedures had more trials per minutes and fewer sounds per trial, and (c) procedures used socially mediated reinforcers (e.g., tickles).

The purpose of this study was to extend the research on SSP procedures by investigating one component of the procedure. The experimenter investigated the effects of an SSP procedure in which the number of pairings per minute was compared across three densities (i.e., 5 s, 15 s, and 30 s). In addition, the study compared the effects of each density on the rate of vocalizations. Examining the effects of conducting pairing trials every 5 s, every 15 s, and every 30 s on vocalizations can guide best practices for using SSP as a clinical tool for individuals with low vocal repertoires.

This study investigated four questions:

1. How many pairings per minutes are necessary to demonstrate an effect on vocalization rate?
2. What are the effects of conducting pairing trials with an intertrial interval of 5 s on vocalization rate?
3. What are the effects of conducting pairing trials with and intertrial interval of 15 s on vocalization rate?
4. What are the effects of conducting pairing trials with and intertrial interval of 30 s on vocalization rate?

Chapter 2: Review of the Literature

Skinner's (1957) approach to verbal behavior defined language by its function, meaning that the environmental variables prior and contingent on the utterance define the verbal response, as opposed to the traditional topographical and structural views of language. The traditional view of language in concern with the form, content, and grammatical structure to assign meaning to the words (Baum, 2005). Chomsky (1959) argued that language acquisition is an innate brain function that determines linguistic rules and modes of interactions. Skinner (1957) defined verbal behavior as behavior that is shaped and maintained by socially mediated reinforcement. Verbal behavior is further classified into verbal operants that are under the control of an antecedent stimulus which evoke a response that is followed by reinforcement. Verbal behavior may occur in the form of vocal responses, gestures, or sign language, but requires the presence of a speaker and a listener who mediates reinforcement.

Once babbling begins at about 5 to 6 months, several vocal characteristics change, supporting a strong causal relationship between the productions of speech sounds and environmental variables (Skinner, 1957). For example, the intonation and segmentation of infant babbling begins to match the language of others in their environment (Bates, Thal, Whitesell, Fenson, & Oakes, 1989). Also, the phonemes of the native language become more prevalent in the infant's vocal repertoire (Schilinger, 1995). For example, children learn to speak with the accent or dialect of their parents without direct reinforcement. These changes in the infant's vocal behavior suggest that infant vocalizations resemble the child's phonological environment and are shaped by the consequences provided by the listener or audience (Schilinger, 1995). The acquisition of vocal-verbal behavior involves social contingencies yet, not all forms of vocal responses may be considered verbal behavior. An infant's vocal responses that are acoustically similar to previously heard sounds become automatically reinforced due to the pairing history between sounds and primary reinforcers. In this way, emitting sounds may function as a conditioned reinforcer to produce more speech-like sounds. This may explain the ease and speed in which typically developing children acquire vocal behavior (Sundberg, Michael, Partington, & Sundberg, 1996).

Sundberg et al. (1996) pointed out that an infant's first vocal responses (e.g., crying, coughing, screaming) are respondent behaviors that may have a phylogenic function of strengthening the vocal muscles and improving the chances of the infant contacting reinforcement (Pelaez, Virues-Ortega, & Gewirtz, 2011; Sundberg et al., 1996). The infant's respondent vocalizations become operant when these are shaped by the verbal community through reinforcement. For example, crying may initially be part of a fear reflex, but once the behavior is followed by reinforcement (e.g., being picked up by caregiver), the behavior may transfer from the control of the unconditioned stimuli to the control of a discriminative stimuli. This interaction teaches the infant that emitting certain sounds influences their surroundings. An infant's vocal behavior includes the production of cooing (i.e., vowel-like sounds such as "ooo" or "aaa") and babbling (consonant-vowel combinations such as "ma ma" or "baba"). The infant learns to emit these sounds from interacting with caregivers. For example, when the infant says "mama," their mother will play or talk to the infant. Continued development of these sounds may be automatically reinforced.

From birth, the infant hears sounds produced by those around them when they are fed, caressed, and played with; these events teach the infant to associate speech sounds with primary reinforcers. Hearing these sounds while the caregiver delivers numerous forms of primary, previously neutral reinforcers may establish specific sounds as conditioned reinforcers

(Petursdottir & Lepper, 2015). The association between the vocal sounds emitted by caregivers and reinforcement increase the likelihood of the infant reproducing similar sounds in the future as a result of automatic reinforcement (Sundberg et al., 1996). Automatic reinforcement refers to a type of reinforcement in which the act of engaging in the behavior is in and of itself reinforcing. The behavior is strengthened without direct-observable consequences mediated by another person (Skinner, 1957; Sundberg et al., 1996; Vollmer, 1994). For example, the infant engages in a range of vocalizations when alone or without contacting social reinforcement, or a person may sing or hum a song after hearing it on the radio without direct-observable reinforcement for singing or humming. The role of automatic reinforcement in the acquisition of vocal behavior may explain why typically developing infants vocalize in the absence of socially mediated reinforcement and why children may begin to develop vocal behavior from the moment they are born. Function based language interventions have led to improvements in the communication skills of children with language delays; however, some individuals with autism do not emit frequent vocal behavior or fail to develop a vocal repertoire.

Use of SSP for Language Acquisition in Children with Language Delays

Children with ASD show an early onset of deficits in communication, social interactions, and restrictive repetitive interest and stereotypic behaviors (American Psychiatric Association, 2013). SSP connects the vocal sounds of others with access to highly preferred items. The goal of the procedure is to increase vocal behavior which can subsequently be brought under stimulus control to produce functional language and verbal behavior training (Miliotis et al., 2012; Lepper & Petursdottir, 2017). The literature on SSP shows discrepant findings on its effectiveness. For example, Sundberg et al. (1996) demonstrated that SSP was effective in increasing vocalizations in five children; however, Stock et al. (2008) found that echoic training produced a higher vocalization rate than SSP in two out three participants. Nonetheless, SSP did produce a change in the number of vocalizations for one participant. This leads to the question: What are the participant characteristics that make SSP effective? Researchers have agreed that the many variables involved in SSP may influence the variance of results (Lepper & Petursdottir, 2015; Miliotis et al., 2012; Shillingsburg et al., 2015; Stock et al., 2008).

Future researchers should continue to separate the features of SSP to identify the patterns and components that might minimize the variance of results. SSP components that may be responsible for such outcomes included the number of presentations of the target sounds per pairing trial (Miliotis et al., 2012). For example, the experimenter may present the target sound once (e.g., "buh") or multiple times (e.g., "buh, buh, buh") during each pairing trial. In addition, pairing ratios have been inconsistent across studies. That is, some studies presented the targeted sound once with the delivery of the preferred item (Miliotis et al., 2012; Sundberg et al., 1996; Yoon & Bennett, 2000; Yoon & Feliciano, 2007), wherein other studies, the target sound was presented three (Esch, Carr, & Grow, 2009; Esch, Carr, & Michael, 2005; Lepper, Petursdottir, & Esch, 2013; Lepper & Petursdottir, 2017; Rader et al., 2014), five (Carroll & Klatt, 2008; Miguel, Carr, & Michael, 2002; Stock et al., 2008), or seven (Normand & Knoll, 2006) times prior to the delivery of the preferred item.

A limitation in the current literature relates to the lack of diversity in the participants' diagnosis (i.e., most participants in SSP studies have a diagnosis of autism). Thus, it is possible that stimulus-stimulus pairing is less reliable for children with autism than for children with other developmental profiles. Examining the developmental profile of the participants selected for SSP may provide child-related factors about the effects of pairing. Addressing the procedural variability of SSP procedures may have clinical importance for children with limited vocal skills as well as provide evidence for best practices. The lack of research on how pairing trials should occur during SSP sessions will cause indecision about which intervention is best and most likely to benefit children with limited vocal behavior.

SSP has been found to increase the rate of vocalizations in children with language acquisition delays, but effects may be immediate and temporary. Sundberg et al. (1996) conducted the seminal-empirical study establishing new vocal responses in children with delays in language acquisition with SSP, or pairing a sound, word, or phrase with an unconditioned or previously conditioned reinforcer. The participants in the study were five children between the ages of 2 and 4. Four of the participants were diagnosed with an intellectual disability with severe-to-moderate language delays and one participant was a typically developing child with appropriate verbal behavior. Each participant had a unique set of three new targeted vocal responses.

Sundberg et al. (1996) conducted two experiments. Experiment 1 focused on establishing new forms of vocal behavior through SSP and Experiment 2 examined the length of time newly an established vocal response remained in the participants vocal play repertoire. The pairing procedure was identical in both experiments and involved a prepairing, pairing, and postpairing condition. The results showed that all participants emitted the targeted response and an increase in vocalizations in the postpairing condition. The participant's overall number of vocalizations increased from 0 to an average of 10 vocal responses per minute during postpairing sessions. The authors noted that targeted vocal responses appeared within a minute after the pairing session and that the effects of the pairing procedure were temporary. In Experiment 2, the postpairing condition was extended to examine the number of minutes the new word remained in the participant's immediate vocal play repertoire (Sundberg et al., 1996). The results showed that participant's frequency of vocal responses increased following pairing sessions; however, this effect was temporary and vocalization rate returned to prepairing levels after about 9 min of the postpairing condition.

The results of Sundberg et al. (1996) suggest that pairing sounds with highly preferred items may be an effective intervention for children who fail to acquire language. For example, a major problem faced by children with autism is that their vocalization rate is too low to acquire the muscle control necessary to emit echoic responses. In addition, the results from the postpairing sessions indicated that new vocal responses were acquired without the use of direct reinforcement, direct echoic training, or prompts to respond (Sundberg et al. 1996). The authors proposed that the vocal responses increased in frequency because the auditory stimuli of these responses functioned as a form of conditioned reinforcement and automatically strengthened the participant's responses. Therefore, caregivers should make every attempt to pair their own vocalizations with the delivery of items and actions that are highly preferred by children who have limited vocal responses.

Sundberg et al. (1996) empirically demonstrated that an important variable in language acquisition is the frequency of verbal stimuli emitted by caregivers in the presence of their children. The authors demonstrated that new vocal responses that are acoustically similar to a model can be acquired through pairing and that this may facilitate future vocal-verbal behavior training (Sundberg et al., 1996). However, this study had various limitation. First, the frequency of pairing trials necessary to produce these results was not calculated. Second, the authors did not evaluate the value of a reinforcer after pairing trials or the existence of competing establishing operations. Future researchers should investigate the variables that may be relevant to why pairing does not always produce an increase in vocal responses.

Effectiveness of SSP Delivery

Previous research has demonstrated varying degrees of validity and effectiveness of SSP procedures in establishing vocalizations in children with language acquisition delays in addition to inconsistent methods of evaluation of SSP procedures. Shillingsburg et al. (2015) conducted a meta-analysis of the studies that used SSP procedure to increase vocalizations in children with language delays and found that, overall, there were moderate to high effects for increasing vocalizations. Studies with children aged 5 or younger showed higher treatment effects (Carroll & Klatt, 2008; Esch et al., 2009; Lepper et al., 2013; Miguel et al., 2002; Normand & Knoll, 2006; Sundberg et al., 1996; Yoon & Bennett, 2000; Yoon & Feliciano, 2007), as compared to children over the age of 5 (Esch et al., 2005; Milliotis et al., 2012; Lepper & Petursdottir, 2017; Rader et al., 2014). Additionally, a higher percentage of children without functional language (67%) showed stronger effects compared to those with functional language skills (33%). Miguel et al. (2002) suggested that pairing procedures may work differently depending on the participant's preexisting verbal repertoire. Carroll and Klatt (2008) also found that pairing procedures may work better for children with limited vocal imitation. For practitioners to effectively implement SSP procedures, researchers must identify the specific characteristics of participants. Future research should focus on developing a comprehensive learner profile for individuals whom SSP appears most effective and refining the procedural components that make SSP an effective intervention.

Variation in SSP Procedures Among Studies

Although all studies reviewed used SSP to increase vocalizations in children with language delays, Shillingsburg et al. (2015) detailed multiple variations in the procedures. These variations included participant characteristics (i.e., age, diagnosis, and language skills) or a comprehensive learner profile describing the characteristics of participants for whom SSP was most effective in increasing vocal sounds. The majority of the participants across studies included preschool children diagnosed with autism (Carroll & Klatt, 2008; Esch et al., 2009; Lepper et al., 2013; Miguel et al., 2002; Normand & Knoll, 2006; Sundberg et al., 1996; Yoon & Bennett, 2000; Yoon & Feliciano, 2007) as compared to children over the age of 5 (Esch et al., 2005; Lepper & Petursdottir, 2017; Milliotis et al., 2012; Rader et al., 2014). All studies provided a description of each participant's preexisting language skills; however, there was not a uniform assessment tool used across studies. Across the studies reviewed, there was a total of 28 participants with no functional language skills and 11 participants were classified as having some functional language. The participants with functional language skills had varying degrees of language abilities (i.e., some had a few vocal mands while others could emit hundreds of mands, tacts, and intraverbals). The influence preexisting language skills had on the effectiveness SSP was not specified in the studies.

Shillingburg et al. (2015) indicated that additional procedural variations included the number of experimenter-emitted sounds per pairing trial (i.e., the number of sounds per trials ranged from 1 to 7), the type of pairing (i.e., trace, delay, and simultaneous conditioning), and the intertrial interval or pairing densities (i.e., time between trails ranged from 0 to 30 s). Four studies exposed the participants to novel-sounds during pairing conditions (Lepper et al. 2013; Sundberg et al., 1996; Yoon & Bennett, 2000; Yoon & Feliciano, 2007), whereas eight studies targeted sounds that were in the participants' current vocal repertoire (Carroll & Klatt, 2008; Esch et al., 2005; Esch et al., 2009; Miguel et al., 2002; Miliotis et al., 2012; Normand & Knoll, 2006; Rader et al., 2014; Stock et al., 2008). Shillingsburg et al. (2015) pointed out that all the studies reviewed targeted sounds with the lowest frequencies during baseline.

Another procedural variation was the number of experimenter-emitted sounds per pairing trial (Shillingsburg et al., 2015). In some studies, the experimenter emitted the target sound once with the delivery of the preferred item (Miliotis et al., 2012; Sundberg et al., 1996; Yoon & Bennett, 2000; Yoon & Feliciano, 2007), wherein other studies, the target sound was presented three (Esch et al., 2005; Esch et al., 2009; Lepper et al., 2013; Lepper & Petursdottir, 2017; Rader et al., 2014), five (Carroll & Klatt, 2008; Miguel et al., 2002; Stock et al., 2008), or seven (Normand & Knoll, 2006) times prior to the delivery of the preferred item. The timing of when the preferred item was delivered in relation to the presentation of the experimenter-emitted sound also varied across studies. The type of pairing used included simultaneous (i.e., the preferred item and the sound were delivered at the same time), delay (i.e., the preferred item briefly overlaps with the sound), and trace (i.e., the preferred item is delivered after the entire sound) conditioning. Also, discrimination training (i.e., the preferred item is contingent upon a response in the presence of the target sound and not in its absence) was used in one study to compare its effects to SSP (Lepper et al., 2013). The exact number of pairings per minute was reported in four studies; however, the remaining studies did not specify (Shillingsburg et al., 2015). If the exact number of pairings per minutes was not reported, Shillingsburg et al. (2015) estimated this information based on the number of trials per sessions, duration of sessions, reinforcement intervals, and duration of sound production or calculated a range of pairings per minutes. The authors recommended that future researchers record and report the number of pairings per minute. A direct comparison of varying pairing per minute may help identify best practices for SSP.

Another variation of SSP procedures was the type of pairing used across studies. Vocalization rate appeared to be higher when delay conditioning and edible reinforcement were implemented during SSP (Carroll & Klatt, 2008; Lepper & Petursdottir, 2017; Miliotis et al., 2012). According to Shillingsburg et al. (2015), the number of experimenter-emitted sounds per pairing did not affect the effectiveness of SSP; however, given the variations in participant characteristics and procedural differences, it is difficult to determine for whom and under what conditions SSP is most effective. Shillingsburg et al. suggested that the analysis of the review may have been hampered by the limited details provided by previous researchers, as well as the limited availability of research conducted using SSP. Further research is needed to determine which variables of the SSP procedure are responsible for its effect.

Evaluating the Structure of SSP Delivery

Although SSP procedures are used to increase vocalizations in children with language acquisition delays, the effectiveness of variations in the structure of SSP delivery are not well established in the literature. For example, recent research has investigated the influence of the frequency of sound presentations and changes of vocalization rate during pairing conditions. Miliotis et al. (2012) evaluated the effects of presenting a sound one time versus three times during SSP. The purpose of this study was to examine the differential effects of an SSP procedure that varied only in the number of presentations of the target sound per pairing trial on the rate of vocalizations in two children with autism.

In the study by Miliotis et al. (2012), the dependent measure was the number of responses per minute for target and nontarget sounds. Miliotis et al. (2012) compared four SSP conditions on the number of vocalizations per minute using an alternating treatment design. Six items were identified as potential reinforcers via stimulus preference assessment. The first three items touched by the participant were ranked as preferred and rotated during SSP sessions. During the baseline condition, the experimenter presented an auditory model without pairing it with a preferred item. In the experimental conditions, the experimenter presented a target auditory model followed by a preferred item or a nontarget auditory model without a programmed consequence. Target sounds were followed by a preferred item overlapping with the model (i.e., delay pairing).

Trials for nontarget sounds were identical to baseline; the experimenter presented an auditory model without the delivery of a preferred item after the sound (Miliotis et al., 2012). Four experimental conditions were examined. During the first condition, there was one presentation of the target sound (e.g., “dee”) per trial (1:1 S+). During the second condition, there was one presentation of the nontarget sound (e.g.,”ba”) per trial (1:1 S-). During the third condition, there were three presentations of the target sound (e.g., “dee, dee, dee”) per trial (3:1 S+). During the fourth condition, there were three presentations of the nontarget sound (e.g., “ba, ba, ba”) per trial (3:1 S-). To reduce temporal predictability, conditions were separated by an intertrial interval that varied between 5 s, 10 s, 15 s, and 20 s within a session (Miliotis et al., 2012). Each session was approximately 5 min and all four conditions were presented in random order, but with no more than two consecutive trials of target or nontarget sounds. Between sessions, participants had access to free play with low-preference toys. The results were an increase in the rate of target vocalizations when the experimenter emitted the sound one time before delivery of a reinforcer (i.e., 1:1 S+ condition); however, in the 3:1 condition, the target vocalization showed a slight increase compared to both nonpairing conditions (i.e., 1:1 S- and 3:1 S-). These results demonstrated that programmed reinforcement for target vocalizations can immediately increase the rate of vocalizations.

The results from Milliotis et al. (2012) support the findings from the study by Esch et al. (2009) in which pairing of an auditory stimulus with preferred items increased target over nontarget vocalizations of three children diagnosed with autism. However, Miliotis et al. (2012) was the first empirical study that compared the effect of the number of presentations of target sounds per trial during SSP. The practical applications of this study are that pairing sounds with highly preferred items can increase the vocalizations of children with autism. In addition, the number of experimenter-emitted sounds may influence the effectiveness of SSP. The authors indicated that one possible advantage of presenting a sound one time per pairing trial is that the likelihood of the participant repeating the sound in a sequenced pattern (e.g., "dee, dee, dee") is reduced. This eliminates the need to alter the response topography during subsequent verbal behavior training (Miliotis et al., 2012). Carroll and Klatt (2008) demonstrated that vocalizations established though SSP can be brought under echoic control.

Miliotis et al. (2012) proposed that changes in vocalization rate during pairing conditions (S+) may be attributed to the ratio of pairing to reinforcement and/or the strength of the conditioned reinforcer used during trials. Future research should examine the value-altering effect of a stimulus after it has been presented consequently during multiple pairing trails. The repeated presentation of preferred stimuli may weaken its effectiveness as a conditioned reinforcer. Some other variables future researchers could evaluate include the perceived difficulty of the target sound (e.g., "ma" vs., "ka"), the pairing method (e.g., delay, trace, simultaneous), the characteristics of the modeled sound (e.g., exaggerated pitch or intonation, motherese), and temporal relation between pairing trials. The temporal relation between pairing trials or intertrial interval (ITI) is a variable that may influence the efficacy of SSP procedures. Comparing the effects of various pairing densities can be valuable for practitioners considering SSP as an intervention for increasing the number of vocalizations of children with speech delays.

To date, no articles have been published evaluating the effects of various densities of SSP on vocalization rate.

Comparison of SSP Procedures to Other Vocalization Trainings

Standard Echoic and Operant Discrimination Trainings

SSP procedures have been examined within multiple contexts in the literature; however, researchers are also interested in the efficacy of SSP procedures as compared to other types of vocalization training. Stock et al. (2008) and Lepper et al. (2013) compared two different types of vocalization training to SSP. Stock et al. compared the effects of SSP and standard echoic training (SET) on the vocal behavior of children with autism, while Lepper et al. compared the effects of SSP and operant discrimination training (ODT) on the rate of vocalizations of three boys diagnosed with autism. Both studies conducted a preference assessment for each participant to identify potential reinforcers and used an alternating-treatment design to evaluate the effects of the conditions on vocalization rate.

Stock et al. (2008) conducted a SET condition in which the experimenter-emitted target sound was followed by a preferred edible item contingent on the production of the target sound within 5 s. If the participant did not emit the target sound, the experimenter did not deliver the preferred item and moved away from the participant until the next scheduled interval. A digital timer was used to visually cue the experimenter when to deliver each trial. All target sounds were delivered by the experimenter in a monotone fashion with no facial expression or emotional affect (Stock et al., 2008). All edible items used as reinforcers were delivered by the experimenter in the participants hand or directly into their mouth, and then the experimenter immediately walked away.

Lepper et al. (2013) conducted an operant discrimination training condition (ODT). The ODT condition consisted of training the participants to discriminate between the presence of a target and nontarget auditory stimulus by engaging in a motor response (i.e., raising arms). All target stimulus trials involved the delivery of a preferred item. If the participant did not respond to the target discriminative stimulus during the ODT condition, the experimenter physically prompted arm raising prior to the delivery of a preferred item (Lepper et al., 2013). Nontarget trials were identical in the ODT and SSP condition and consisted of presenting a nontarget auditory stimulus with no consequence. In the control condition, the target stimulus was presented but the preferred item was delivered with a 20-s delay after the last syllable presentation. Discrimination training was terminated once responding was more likely in the presence of the discriminative stimulus (Lepper et al., 2013). Comparing stimulus pairing against the effects of echoic training and discrimination training on vocal behavior can inform which variables may be related to the research outcomes of SSP.

The SSP sessions for both studies differed in the number of experimenter-emitted sound presentations during the SSP. Stock et al. (2008) presented the sound five times before a preferred edible was delivered; in contrast, Lepper et al. (2013) presented the sound three times and delivered a preferred edible or toy with the last syllable presentation. Pairing trials were the same as in previous studies where the target auditory sound was followed with the delivery of a preferred item. Stock et al. (2008) found no difference in the frequency of target and non-target sounds during echoic training; furthermore, echoic training was more effective than SSP for two out of the three participants. The third participant's vocalization rate increased during SSP and not during echoic training. This effect could be a byproduct of echoic training functioning as a conditioned aversive stimulus, either because of the child's reinforcement history during previous unsuccessful echoic training or the demand inherited in the condition (Stock et al., 2008).

Lepper et al. (2013) found that ODT did not produce more robust effects than SSP. Moreover, the rate of vocalizations across target sounds in the SSP and ODT condition were undifferentiated. The results were that ODT and SSP were equally effective at increasing target vocalizations compared to nontargets and control targets. Lepper et al. suggested that the effectiveness of both interventions may have been influenced by the discrimination training conducted during the ODT condition, which led to carryover effects in the SSP condition. That is, the ODT sessions may have produced an observing behavior that generalized to the SSP session producing a similar effect in that condition (Lepper et al., 2013).

The relationship between SSP and other types of vocalization training are important for objectively determining the value of one procedure over another. Stock et al. (2008) and Lepper et al. (2013) demonstrated that numerous procedural variations may contribute to the inconsistent effect of SSP. Given the potential of SSP for solving the problem of a lack of vocal sound production and clinical importance, continuing research examining all the relevant independent variables is warranted (Stock et al., 2008).

The results from Stock et al. (2008) and Lepper et al. (2013) suggest that SSP may be as effective as other forms of vocalization training (e.g., echoic or ODT). SSP is an antecedent intervention that merits further investigation due to its potential effect on increasing and conditioning vocal sounds as reinforcers. Isolating the key elements of previous SSP research can provide practitioners with a guide of the participants characteristics (e.g., age, preexisting vocal skills), number of pairing trials required, manner of target sound presentation, the number of times the experimenter-emitted sound should be presented, and reinforcement variables

(Lepper et al., 2013; Stock et al., 2008). One critical recommendation regarding the use of edibles involved the concept of motivating operations (MO; Michael, 2004 and controlling access to food items prior to each experimental session. In addition, the vocalization increases were small compared to those of previous SSP studies, possibly due to multiple interventions occurring simultaneously on the same dependent variable and differences in procedural variations. Therefore, a components analysis of the variables involved in SSP may yield a better understanding of the conditions necessary for its effect.

It is important to note that the participants' preexisting skills were evaluated in these two studies using different tools. Stock et al. (2008) used the Behavioral Language Assessment (BLA) form (Sundberg, 2008) while Lepper et al. (2013) used the Early Echoic Skills Assessment (EESA; Esch, 2008). Different assessment tools may assess different skills and yield different results on preexisting language skills. Hence, assessment variations across studies may be a confounding variable for the efficacy of SSP. Pairing procedures may work differently depending on the participant's preexisting verbal repertoire (Miguel et al., 2002). Future researchers should identify the characteristics of learners that can benefit from SSP.

Response Pairing Procedures

A recent study examined the effect of conditioning speech sounds as reinforcers using two types of response pairing procedures: response-independent pairing (RIP) procedure and response-contingent pairing (RCP) procedure (Lepper & Petursdottir, 2017). The researchers used an alternating treatment within multiple baselines across participant designs to compare the effects of RIP and RCP on vocalizations per minute of three boys with autism. The BLA was used to assess preexisting language skills and was conducted over the phone with the parents of potential participants. In addition, the EESA was used a direct assessment for echoic skills. A paired-stimulus preference assessment was used to identify highly preferred items for each participant. The dependent variables were the frequency of one target and one nontarget vocalization. The target and nontarget auditory stimulus were different for each participant and condition. The target and nontarget vocalization were defined as a vocalization that matched or approximated the experimenter-emitted model during stimulus presentation or within 5 s of its offset. For example, a target vocalization was recorded if the target sound was "moo" and the participant said "moo." The difference between target and nontarget sounds was that target sounds were followed by a preferred item, while nontarget sounds had no consequence. Hence, target sounds were paired as conditioned reinforcers. The order of target and nontarget sounds were randomized, so the same sound was not presented more than three times in a row.

During the RCP procedure, Lepper and Petursdottir (2017) waited for the participant to press a button before presenting the target or nontarget sound. The experimenter trained the participant to press the button prior to implementing the RCP condition. The button-press response in the RCP condition demonstrated that the participant was attending and that an establishing operation was in effect for the preferred item. Immediately after the participant pressed the button, the experimenter presented the target or nontarget sound three times (e.g., "moo, moo, moo") with 1 s between presentations. Target sounds were followed by a preferred edible or 15 s access to a preferred toy regardless of the participant producing the vocal response. Upon presentation of the preferred item, the experimenter removed the button from reach. When the experimenter presented a nontarget sound, no preferred item was delivered and the intertrial interval (ITI) was initiated after the third syllable presentation. The button was represented 10 s into the ITI and the ITI ended when the participant pressed the button. The procedural arrangement of the RCP allowed the participant to access preferred items (delivered during pairing) at times when an establishing operation was likely to be in effect for a preferred item.

The RIP procedure was identical to the RCP, except the participant did not initiated the trial by pressing a button (Lepper & Petursdottir, 2017). During the RIP condition, the experimenter prompted the participant to attend (e.g., “look”) and then presented the target sounds (e.g., “day, day, day”) immediately followed by a preferred item regardless of the participant’s response or just the nontarget sound. The RIP has been used in the SSP literature as the main pairing strategy for increasing vocalizations; therefore, exploring alternative response-pairing strategies may shed light into the variables responsible for the success or failure of stimulus-pairing procedures.

Lepper and Petursdottir (2017) demonstrated that under the RCP condition, where the participant initiated each trail by emitting a button-press response, the rate of target vocalizations was higher compared to the rate of target vocalization in the RIP condition. Lepper and Petursdottir explained that RCP may be superior to the RIP procedures for three possible reasons. First, the momentary value of the preferred item fluctuated creating a stronger establishing operation for the item. Researchers often use the RIP procedure to examine the effects of SSP; therefore, examining different response-pairing procedures may provide knowledge about the contiguity between stimulus presentation and reinforcement (Lepper & Petursdottir, 2017). Furthermore, RCP may have more social acceptability as an intervention for children with ASD because it allowed the participant to choose when the preferred item was delivered. This may function as a communication strategy for children who lack vocal communication skills. Second, vocalization rate in the RCP condition may be higher than in the RIP because participants were required to engage in a prior response (i.e., button-pressing) before accessing the preferred item. This phenomenon relates to contrafreeloading (Lepper & Petursdottir, 2017). Contrafreeloading effects are demonstrated when the participant allocates a response to choices that require effort over choices that grant free access to reinforcers (e.g., noncontingent reinforcement). From the contrafreeloading perspective, RCP may have produced greater effects than the RIP because the participant had to work (i.e., press a button) for the preferred item. Third, the button press may function as an observing response that enhanced attention to the auditory stimulus presented by the experimenter. An observing prompt (i.e., "look") was used during the RIP prior to the onset of each auditory stimulus presentation; however, it is possible that the button press promoted greater attention than looking at the experimenter (Lepper & Petursdottir, 2017). One limitation of this study was that the RIP sessions always followed the RCP sessions, possibly producing a sequence effect.

These findings extended and supported the use of pairing interventions to increase the vocalizations of nonvocal children with autism. In addition, it suggested that pairing procedures may be enhanced by varying the way stimulus are presented. An implication for future research is to investigate the effect antecedent stimulus presentation has on SSP. A variable that might generate interesting results would be a comparison between multiple pairing densities or the number of pairings per minutes necessary to produce a change in the rate of vocalizations of children without a vocal repertoire. Miliotis et al. (2012) indicated that different findings across studies can be related to different pairing ratios and that the effect of several pairing ratios and densities on targeted vocalizations may be of paramount importance for practitioners.

Summary of Proposed Research

The purpose of this study was to compare the effects of SSP using three different intertrial intervals or pairing densities per minute (i.e.,5 s, 15 s, and 30 s) on the vocalizations of nonvocal children. This information can then be used to provide evidence-based practices to children who fail to develop a vocal repertoire. The participants' preference for a specific density was evaluated using a concurrent-chains arrangement (Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997; Hanley, Piazza, Fisher, & Magliere, 2005). During this evaluation, following the prepairing session and before the SSP session, three colored cards were presented to the participants. The experimenter prompted the child to select a color card and conducted a brief trail of the density associated with the selected color. The purpose of the concurrent-chain preference assessment was to evaluate the participants' preference for each pairing density.

When examining the nonvocal child's preference for a training program, difficulties arise because one cannot simply ask the child which training program they prefer. One strategy to solve this problem is to conduct a concurrent-chain preference assessment. In the concurrent-chain preference assessment, two or more responses are available to the participant, and each response is associated with a different approach to treatment. The benefit of this type of social validity measure is that it is tied to the actual behavior of the participant rather than to parent report or inference (Hanley et al., 2005). A learner's profile was developed to determine the characteristics of participants that may or may not benefit from SSP. Demographic information was collected by providing caregivers with a questionnaire about the participant's age, gender, diagnosis, age of diagnosis, past and current intervention services, problem behaviors, and current vocal and verbal communication skills. Comparing different densities of SSP will allow practitioners to understand which factors may contribute to the efficacy of SSP.

Chapter 3: Research Design and Method

The purpose of this study was to compare the effects of SSP using three different intertrial intervals or pairing densities per minute (i.e., 5 s, 15 s, and 30 s) on the vocalizations of nonvocal children. It was important to compare different pairing densities in order to determine if the number of pairings per minute had an effect on vocalization rate. This information can be used to provide evidence-based practices to children who fail to develop a vocal repertoire.

Research Questions

This study investigated four questions:

1. How many pairings per minutes are necessary to demonstrate an effect on vocalization rate?
2. What are the effects of conducting pairing trials with an intertrial interval of 5 s on vocalization rate?
3. What are the effects of conducting pairing trials with and intertrial interval of 15 s on vocalization rate?
4. What are the effects of conducting pairing trials with and intertrial interval of 30 s on vocalization rate?

Participants

The participants were recruited from a local clinic providing behavior analytic services to individuals with ASD and a school for children with intellectual disabilities. The participants for this study were two males (Craig and Jake) age 8 and a 4-year-old female (Jill). The participant's caregivers signed the informed consent and filled out a reinforcer survey. Two participants receive an average of 10 hr per week of intensive behavior intervention services and one participant was enrolled in the school for children with intellectual disabilities but did not receive individual behavior intervention services. Each participant demonstrated a low frequency of spontaneously vocalized sounds (i.e., less than five sounds per 20-min session or a rate of .25) and a history of unsuccessfully established a vocal-imitation repertoire. All of the participants mainly communicated by pulling, leading, or gestures; yet, one participant occasionally used a picture exchange communication system. The female participant communicated exclusively with gestures.

An individual copy of the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008) was used for each participant to evaluate the operant level of the participants' verbal behavior. The VB-MAPP is an assessment tool specifically designed for individuals with ASD and language delays. Vocal skills were assessed using the Early Echoic Skill Assessment (EESA; Esch, 2008), which is a subtest of the VB-MAPP. All participants scored on the VB-MAPP in Level 1 of the assessment and a 0 on the EESA.

Setting and Materials

The study took place in the children's homes. Sessions were conducted in a private room away from outside distractions and additional noises. The room size allowed for social physical interactions between the experimenter and the child (e.g., tickles) and was equipped with a table, chairs, a bed, and toys. The baseline and intervention phase occurred in the same setting and all sessions were video recorded using an iPad and a microphone to amplify sounds. A condenser microphone on a tripod stand was used to provide a clear sound and cancel outside noise. Each participant had a set of three preferred items and one targeted sound per density condition. The preferred items for Participant 1 included bubbles, playdough, and tickles. For Participant 2, the preferred items were small pieces of chips or pepperoni, bubbles, and squish balls. For Participant 3, the preferred items were playdough, slime, and sand. The target and control sounds were selected based on the participant's vocal repertoire.

Dependent Variable & Measurement

The primary dependent variable was the rate of vocalizations. A *vocalization* was defined as an auditory response emitted by the participant (not including screaming or crying) that resembles a phoneme (e.g., p, m, k), or consonant-vowel combination (e.g., mama, dada, woo, shee). Frequency of vocalizations were collected by the experimenter after presenting vocalizations and reinforcers using an electronic application (i.e., Countee). Data were collected on target and nontarget vocalizations. *Target vocalizations* were defined as the participant's production of any vocalization that matched or was acoustically similar to the vocalization modeled by the experimenter (i.e., "baa" and "baa"). Target sounds were selected by the experimenter based on parent report and vocal topography assessment. *Non-target vocalizations* were defined as the participant's production of a vocalization that did not match or was acoustically dissimilar to the vocalization modeled by the experimenter (i.e., "baa" and "dee"). *Control sounds* were defined as experimenter-emitted vocalizations that were not paired or followed by a preferred item. Data were collected on the number of targeted, nontargeted, and control sounds emitted by the participant before and after each pairing session. At the end of each session, the total count of vocalizations was divided by the number of minutes in the session to determine the rate of vocalizations. Vocalizations with a 3-s interval of silence between sounds will be counted as separate responses. Research assistants had a data sheet with sections to complete including date, session number, scorer's initials, condition, participant-specific target responses, and an area to tally the occurrence of the different response topographies. Data are reported in two ways: (a) as the overall rate of vocalizations per 5-min observation period during pre- and postpairing sessions, and (b) as the rate of target versus control vocalizations during pre- and postpairing sessions.

Interobserver Agreement

Reliability data were collected by a second trained observer during at least 30% of randomly selected sessions across baseline and experimental phases for each participant. Interobserver agreement (IOA) was calculated using a partial-agreement-within-interval method. Each session was divided into 10-s intervals, and a second observer was trained on the procedures and participant responses (i.e., target and nontarget vocalizations). An agreement was defined as each observer scoring the same number of responses for that interval. Intervals in which there is a partial agreement, meaning the observers both scored the behavior but disagreed on the amount, were assessed by dividing the smaller number of recorded responses by the larger number. The average IOA across all sessions was 88%, and data were collected at a later time by reviewing video recordings of the sessions. All agreements and partial agreements were summed, divided by the total number of intervals, and multiplied by 100% to yield the percentage of agreement.

For Craig, Topography 1 (tee) agreement was calculated for 80% of sessions; mean interobserver agreement was 89% (range, 60%–100%). Nontarget agreement was calculated for 81% of sessions and was 100%. On Topography 2 (go), agreement was assessed in 63% of sessions, and mean agreement was 88% (range, 80%–100%). Mean of nontarget agreement for Topography 2, calculated in 75% of sessions, was 82% (range, 50%–100%). The Topography 3 (ma) agreement was evaluated for 83% of sessions and was 96% (range, 91%–100%). Nontarget vocalizations was calculated in 33% of sessions and mean agreement was 97% (range, 88%–100%). For Jake, Topography 1 (ah) agreement was assessed across 35% of sessions and mean agreement was 98% (range, 83%–100%). Nontarget agreement was calculated in 38% of sessions and was 100%. For Topography 2 (oh) agreement was calculated in 72% of sessions, and mean agreement was 98% (range, 83%–100%). The mean agreement of nontarget was calculated for 40% of sessions, and was 99% (range, 95%–100%). Topography 3 (mmm) agreement was calculated for 25% of sessions, and mean agreement was 98% (range, 83%–100%). Mean of nontarget agreement was assessed in 35% of session, and mean agreement was 95% (range, 94%–100%). For Jill, Topography 1 (baby) agreement was calculated in 33% of sessions, and mean agreement was 82% (range, 75%–100%). Topography 2 (toy) was calculated in 40% of sessions, and the mean agreement was 80% (range, 0%–100%). For Topography 3 (yay) agreement was assessed for 60% of session and was 86% (range, 80%–100%). Nontarget agreement was assessed 50% of sessions, and mean agreement was 98% (range, 83%–100%).

Procedural Integrity

Procedural integrity data were collected for 30% of the sessions across baseline and experimental phases. The trained observer viewed previously recoded sessions and used a fidelity checklist to indicate the number of steps implemented correctly. Training for scoring treatment integrity for each session consisted of the observer watching previously scored videos and scoring them independently. Once an agreement scores of 95% or higher was achieved, the observer was permitted to collect treatment integrity data.

Data were collected on the experimenter's behavior of presenting pairing trials and delivery of reinforcers. *Presenting pairing trials* were defined as the experimenter getting the child's attention and modeling the target sound. *Delivery of reinforcer* were defined as the experimenter placing a tangible item on the participant's hand or in front of the participant's face. The experimenter's frequency of each behavior was recorded during randomly selected sessions. The observer was trained on the procedures, intervention steps, and data collection sheet. A procedural integrity task analysis was used to record the experimenter's behavior to ensure that all sessions were conducted as described. Table 3 shows the steps to be followed during each condition. The occurrence of steps from the task analysis were recorded as a correct response (+). Intervention steps missed were marked as incorrect (-). The proportion of steps delivered during intervals were assessed by dividing correct steps by the total number of steps, multiplied by 100%. The average procedural integrity score was 97% with a range of 70%–100%. For Craig, the mean integrity score was 98% (range, 96%–100%) for the three pairing densities across 80% of all sessions. For Jake, the mean integrity score was 100% for the three evaluations and was calculated for 50% of sessions. Jill's mean integrity score was 95% (range, 88%–100%) for the three conditions and was calculated for 30% of sessions.

Experimental Design

A multielement design embedded within a multiple baseline designs across participants was used to evaluate the effects of each pairing density during SSP. This design compared the results from each pairing density simultaneously while demonstrating experimental control for the treatment effects across participants. The main limitation of this design was that an interaction between treatments could influence the effect of the results similar to Lepper and Petursdottir (2017). Sessions were conducted two to three days a week. Each session consisted of a set of preselected target and control sounds for each pairing density for a total of 20 trials. Sounds and pairing conditions were presented in quasirandom order in which neither occurred more than twice consecutively.

Assessments

Prior to the start of the study, all participants were given two assessments. The first was a vocal topography assessment and the second was a preference assessment. The purpose of the vocal topography assessment was to develop a list of target sounds to use in the study, while the purpose of the preference assessment was to develop a list of preferred items that may have functioned as reinforcers during the study.

Vocal Topography Assessment

The topography and frequency of each participant's vocalizations were recorded in 30-s intervals from a recording of a 5-min free-play condition. During the free-play sessions, the participant had unobstructed access to toys for 5 min. The session began with the experimenter instructing the participant to go play. A timer was set to indicate when the play condition ended. The experimenter wrote down all the vocalizations emitted by the participants and their frequency. From the sound inventory generated, sounds that were in the participant's repertoire but occurred less than five times per 5 min session were selected as a target sound. Target vocalizations were selected from phonemes and vocalizations that occurred at a rate of .06 or less. *Phonemes* were defined as a single distinctive unit of speech (e.g., p, m, k); *vocalizations* were defined as consonant-vowel sounds (e.g., mama, dada, wo, shoo). The list of target and control sounds for each participants can be found in Table 5.

Preference Assessment

Each participant's caregiver completed the reinforcer assessment for individuals with severe disability (RAISD; Fisher, Piazza, Bowman, & Amari, 1996), and the items identified by caregivers as preferred were confirmed using a stimulus preference assessment procedure. A paired-stimulus (PS) preference assessment (Fisher et al., 1992) was conducted prior to the SSP sessions to ensure the participant preferred the item (Appendix D). The paired-stimulus preference assessment consisted of six to 10 stimuli, each with an assigned number. Stimuli were presented in pairs until each stimulus was presented with every other stimulus. All problem behaviors were ignored. Prior to beginning the PS assessment, the participant was seated in front of the experimenter on a kid size chair or on the floor and allowed to sample each stimulus. For a toy, the experimenter showed the participant how it worked (e.g., press buttons, flip pages, turn on) and placed the item in front of the child. If the participant approached the stimulus, they were allowed access for 10 s; edible items were provided in small pieces. The procedure was repeated until all of the stimuli were presented. If the participant did not approach the stimulus after 5 s, the experimenter prompted the participant to sample the item. After sampling the item (or consuming the edible), the stimulus was presented again for 5 s. If the item was approached, 10 s access was granted; if they did not approach the item, the next stimulus was presented. The PS procedure was repeated until all stimuli combinations were presented. The PS preference assessment was implemented as described by Fisher et al. (1996).

Each stimulus was ranked as having a low, moderate, or high preference. The PS preference assessment data sheet (Appendix D) was used for data collection. For each stimulus presented, the experimenter indicated whether the participant's response was to approach (AP), consume (C), avoid (AV), or no response (N). An approached response was defined as the participant moving toward the stimulus, with any part of the body, within 5 s of stimulus presentation, and included reaching, smiling, or leaning toward item. Consumption of an edible was defined as eating an item without spitting or taking any portion out of the mouth. An avoidance response was defined as pushing, throwing object, moving body away from the stimulus, or engaging in crying, screaming, or vocally protesting. No response was defined as no reaction to the stimulus within 5 s of presentation.

Items ranked as highly preferred were used as potential reinforcers during pairing sessions. To determine preference, the number of times a stimulus was approached or consumed was counted. That number divided by the total number of presentations and multiplied by 100% was used to obtain the percentage of trials in which the item was approached or consumed. The stimuli were sorted from high to low preference to depict a preference hierarchy. Each participant had three to four preferred items. The preferred stimulus for Participant 1 was tickles, playdough, and bubbles. For Participant 2, the items included spicy chips and pepperoni, bubbles, squish balls, and a light-up toy with music. For Participant 3, the items consisted of slime, playdough, and sand. All items were rotated across pairing trials and were accessible to the participant during the postpairing phase. Items ranked with a moderate preference were within the participant's reach during the baseline phase, pre-pairing, and between pairing sessions.

Procedures

During all sessions, the participant and experimenter sat in proximity, but not necessarily in the same position, meaning they were on the floor, in chairs, or standing next to each other. Other than pairing trials, the experimenter did not speak to the participant or make direct physical or eye contact. An omission contingency was used for problem behaviors, meaning that if the participant engaged in problem behaviors before or during the delivery of a preferred item, the trial was terminated. After 20 s elapsed without problem behaviors, the experimenter represented the pairing trial. A 20 s correction delay was used if the participant emitted the target vocalization between the experimenter's model and the delivery of the reinforcer during pairing trials. The purpose of this correction procedure was to control for adventitious reinforcement of echoic responses.

Baseline

Baseline sessions were 5 min and began by the experimenter telling the participant “go play.” The participant had free access to toys identified as low-to-moderate preference. The experimenter remained silent, observed the participant, and recorded the number of vocalizations emitted by the participant during the 5 min of free play. Frequency data on the number of target, control, or nontarget vocalization were collected. There were no programmed contingencies for vocalizations, and problem behaviors were ignored.

Stimulus-Stimulus Pairing

During the stimulus-stimulus pairing phase, each block of sessions included five sessions, a prepairing session, three pairing density sessions, and a postpairing session. The pre- and postpairing sessions were 5 min in length and the procedures were identical to baseline sessions. The density pairing sessions varied in length according to the condition presented (see below) with a total of 20 trails. All pairing trials commenced with the experimenter establishing eye contact and giving an observing prompt (e.g., “Look”). If the participant did not look at the experimenter, a highly preferred item was held in front of the participant until eye contact was established. Target sounds were presented one time per pairing trial as recommended by Miliotis et al. (2012). Similar to Esch et al.’s (2009) enhanced SSP procedure, the quality of the sound delivered by the experimenter consisted of “motherese” speech or exaggerated prosody and intonation, there was a 0-s delay between the conclusion of target sounds and preferred item, and target and control sounds were interspersed to make the paired sound more salient. Pairing sessions were between 5 to 15 min in duration and consisted of 10 trials of each target and control sounds (20 trials total). Following the experimenter-emitted auditory model, the participants could engage with the high-preference item for 10 s or until the edible item was consumed. The ITI for the pairing density began after access to the preferred item elapsed or the edible item was consumed. The preferred items were rotated between trials to prevent the effects of satiation due to repeated exposure to the same item. Various moderately preferred materials were placed around the room which the participant could engage (e.g., blocks, books, etc.), and these items remained in the room during the entire pairing session.

5-s pairing. During the 5-s condition, the target sound was presented every 5 s followed by access to a reinforcer for about 10 sec. The control sound was presented every 5 s without the reinforcer. The 5-s pairing sessions had an average duration of 5 min for a total of 20 trials.

15-s pairing. During the 15-s condition, the target sound was presented every 15 s followed by access to a reinforcer for about 10 sec. The control sound was presented every 15 s without the reinforcer. The 15-s pairing sessions had an average duration of 10 min for a total of 20 trials.

30-s pairing. During the 30-s condition, the target sound was presented every 30 s followed by access to a reinforcer for about 10 sec. The control sound was presented every 30 s without the reinforcer. The 30-s pairing sessions had an average duration of 15 min for a total of 20 trials.

Preference Evaluation

After training was completed, a concurrent-chains preference assessment (Hanley et al., 1997; Hanley et al., 2005) was conducted to evaluate the participants preferred SSP condition. The *initial link* for this evaluation was presented at the beginning of each SSP condition, as the participant was shown a colored card representing the condition (e.g., pink for the 5 s, blue for the 15 s, grey for the 30 s) about to take place. After collecting all data for each condition, the experimenter presented the participant with the choice to "pick one" of the three-color cards. The participant's selected a pairing density by pointing or touching a color card. The *terminal link* of the concurrent chain assessment consisted of the experimenter conducting the density associated with colored card selected by the participant. The participant had to select the same color card three times for that pairing density to be identified as preferred. For Craig and Jill, the preferred density was the 5-s pairing condition. For Jake, the preferred density was the 30-s pairing condition.

Social Validity

At the end of the study, the participant's caregiver completed a social validity questionnaire about their experience, the acceptability of the procedures, and if they considered the goal of the research to be important. The participant's caregivers were asked to rank each statement using a Likert scale ranging from strongly disagree, disagree, neutral, agree, and strongly agree. All of the caregivers strongly agreed that the SSP procedures were easy to learn and perform at home. They also strongly agreed that SSP increased their child's vocal behavior and that their child appeared to like the intervention. In addition, they all indicated that they would recommend SSP procedures to other parents. Two caregivers reported an increase in the number of vocalizations imitated by their child outside of the study. One caregiver reported an increase in their child's echoic and vocal mands after the study.

Ethical Assurance

To ensure the protection of the participants, the participants' names were kept confidential. Participants were recruited via a mass email. Participants' caregivers who contacted the researcher were scheduled to discuss the procedures and inform consent. All videos and data were always in the researcher's possession.

Chapter 4: Results

Figure 1 depicts the results for the target and control vocalizations emitted during baseline observation sessions and postpairing observation sessions across all participants. The top panel depicts responding for Craig. During baseline sessions, Craig did not emit any of the target or control vocalizations. After stimulus-stimulus pairing began, Craig began emitted target sounds at higher rates as compared to the control vocalizations, which were not emitted. Overall, there was a steady increasing trend in the rate of target vocalizations following the 5-s pairing density sessions, and variable but moderate increases in target vocalizations following the 15-s and 30-s pairing density sessions. The middle panel depicts responding for Jake. During baseline sessions, Jake did not emit any of the target or control vocalizations. After stimulus-stimulus pairing began, Jake began emitted target sounds at higher rates as compared to the control vocalizations which were not emitted. Overall, there was a moderate increase in the rate of target vocalizations following the 5-s pairing density sessions, a lower increase in target vocalizations following the 15-s pairing density sessions, and a substantial increase in target vocalizations following the 30-s pairing density sessions. The bottom panel depicts responding for Jill. During baseline sessions, Jill did not emit any of the target or control vocalizations. After stimulus-stimulus pairing began, Jill began emitted target sounds at higher rates as compared to the control vocalizations which were not emitted. Overall, there was a variable and increasing trend in the rate of target vocalizations following the 5-s pairing density sessions, and variable but low-to-moderate increases in target vocalizations following the 15-s and 30-s pairing density sessions.

Figure 2 depicts the rate of vocalizations during prepairing and postpairing observation sessions during the stimulus-stimulus pairing phase for Craig. Across all densities, there is an increase in the rate of vocalizations immediately following a density pairing session. Additionally, there is a fairly steady trend during the presession observations for the 5-s and 30-s pairing densities. There is more variability during the presession observations for the 15-s density. The post-session rate following the 5-s density shows a steady increasing trend, whereas the 15-s and 30-s densities have overall decreasing trends, with more variability observable in the 30-s postpairing sessions.

Figure 3 depicts the rate of vocalizations during prepairing and postpairing observation sessions during the stimulus-stimulus pairing phase for Jake. Across all densities, there is a general increase in the rate of vocalizations immediately following a density pairing session. There is an overall low rate of vocalizations during the presession observations for the 5-s and 30-s pairing densities. There is more variability during the presession observations for the 15-s density, but there is also a slightly decreasing trend. The postsession rate following the 5-s and 30-s densities show some variability, but an overall increasing trend, whereas the 15-s density shows a more stable and moderate level of vocalizations.

Figure 3 depicts the rate of vocalizations during prepairing and postpairing observation sessions during the stimulus-stimulus pairing phase for Jill. Across all densities, there is an increase in the rate of vocalizations immediately following a density pairing session. There is an overall low rate of vocalizations during the presession observations for the 5-s pairing density. There is more variability during the presession observations for the 15-s and 30-s densities, both with a slightly decreasing trend. The postsession rate following the 5-s density shows a steady increasing trend, whereas the 15-s density shows more variability with an overall moderate-to-high rate of vocalizations and the 30-s post-pairing sessions show more variability with a moderate overall level.

Figure 4 depicts the cumulative number of selections for each pairing density during the preference evaluation across participants. The top panel depicts Craig's selections. He consistently selected the 5-s pairing density over the 15-s and 30-s pairing densities. The middle panel depicts Jake's selections. He selected all densities at least once, with the most selections for the 30-s density. The bottom panel depicts Jill's selections. She selected the 5-s pairing density more often as compared to the 15-s and 30-s densities. During the 30-s postpairing condition, vocalizations were more variable and show a rapid downward trend after the fourth session. The rate of vocalization was observed to steadily increase after the fourth session during the 5-s condition, while the rate of vocalization decreased in the 15-s and 30-s conditions.

Chapter 5: Summary, Conclusions, and Recommendations

The purpose of the current study was to replicate and extend previous research by evaluating the stimulus-stimulus pairing procedure using different pairing densities. The results of this study were that the rate of all targets, regardless of the pairing density used, increased as compared to baseline levels and compared to control sounds which were not targeted during the pairing density sessions. Overall, the efficacy of the pairing densities was idiosyncratic across participants. The preferences of the participants for each density was also evaluated using a concurrent-chains arrangement and two of the three participants showed a preference for one of the three conditions.

Previously, there have been variations of the SSP procedure implemented with children diagnosed with ASD who exhibited a low vocal repertoire, one variation being the density in which pairing trial are presented. For the current study, procedural variations consisted of presenting SSP trials with an intertrial interval density of 5 s, 15 s, and 30 s. Our results were that the target sounds increased across these densities, indicating that SSP procedure is an effective procedure at increasing the rate of vocalizations across multiple densities. This provides clinicians with more flexibility in the schedule in which they conduct pairing trials, but still provides additional support that there should be increases in vocalizations, even at leaner densities.

The targeted vocal topographies were compared across three pairing densities, with the intention of finding the most effective density. However, the current results indicated that the efficacy of the density used during SSP may depend on idiosyncratic variables as responding varied across participants. The results for Craig's and Jill's vocalizations were increased to higher and more stable frequencies of the target sounds during the shorter intertrial intervals (i.e., 5s) than during the longer intertrial intervals (i.e., 30s); however, Jake showed an increase in target vocalizations during the longer intertrial interval (i.e.30s) as compared to the shorter intertrial intervals. Thus, the current study offers evidence that SSP strengthened the conditioned reinforcing value of vocalizations in speech-delayed children during postpairing sessions, but not definitive evidence that one density is more effective than another.

Although the results are not conclusive regarding efficacy, there is some evidence that the participants had a preference for one density over others. Two of the three participants showed a strong preference for the 5-s density, which happened to be the most effective density for those participants as well. The third participant did not show a strong preference, but a slight preference, for the 30-s density, which was also the most effective. There may be a relationship between preference and efficacy, particularly when discussing the possible conditioning of vocalizations. If there is a density which is more preferred, this may lead to a stronger conditioning and reinforcing value, which may, in time, effect the increases in vocalizations. It is possible that we may have observed stronger preferences and larger differences if we had continued the study longer and added in more vocalizations.

A limitation worth noting was that there was no attempt to reinforce vocalizations systematically or bring them under stimulus control. Future research should evaluate the effects of programmed reinforcement following SSP procedures. It is likely that programmed reinforcement is required for maintenance of vocalizations induced by SSP (Lepper et al., 2013). Additionally, researchers should seek to refine the SSP procedures to produce optimal and consistent results, such as the method of pairing (e.g. delay, trace, simultaneous) and using frequent preference sampling to verify the value of stimuli used during pairing, and the use of social versus tangible reinforcers.

The clinical utility of SSP may vary across individual participants; however, the goal of SSP is to generate enough vocal behavior such that it can come under the control of naturally occurring contingencies. Some of these are social contingencies (Skinner, 1957), but certain automatic reinforcers may be equally important for development of complex repertoires. The purpose of this study was to evaluate the effects of different pairing densities to employ more optimal SSP procedures to induce vocalizations in children who do not respond to verbal operant contingencies. The potential benefits of SSP were evident with the three participants in this study, whose overall rate of vocalizations increased during postpairings and target responses were strengthened differentially over nontargeted responses. Yet, the current data do not provide concrete evidence for a clear distinction favoring one SSP density over another. The three pairing densities were able to increase the target vocalizations over baseline levels; however, the ease of implementation was not as similar. That is, for the participants who preferred the 5-s pairing density session, the 30-s pairing density sessions were more effortful due to the number of problem behaviors during the longer intertrial interval than during the shorter intertrial intervals (5 s). Future researchers and practitioners may want to consider these effects when conducting pairing sessions.

The current study compared three variations of the SSP procedure on novel and infrequent vocalizations. Taken together, data were mixed as to which procedure was more effective but did provide evidence that all densities were effective. Despite these somewhat ambiguous findings, the consistent increases in responding are encouraging to the utility of SSP.

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Tables

Table 1

Stimulus-Stimulus Pairing Research Variations

Variable	Sundberg et al. (1996)	Yoon & Bennett (2000)	Miguel et al. (2002)	Esch et al. (2005)	Normand & Knoll (2006)	Yoon & Feliciano (2007)	Stock et al. (2008)	Carroll & Klatt (2008)	Esch et al. (2009)	Miliots et al. (2012)	Lepper et al. (2013)	Rader et al. (2014)	Lepper & Petursdottir (2017)
Age													
< 5 years	X	X	X		X	X	X	X	X		X	X	X
>5 years				X						X		X	X
Diagnosis													
Typically developing	X												
ASD	X		X	X	X		X	X	X	X	X	X	X
Other		X				X							
Pairings per trial													
1	X	X				X				X[a]			
3				X					X	X			
5			X				X	X					
>5					X								
Not described					X								
Inter-trial Interval (ITI)													
0s			X	X		X		X					
5 s	X	X							X[b]	X[b]		X[b]	X[c]
10 s									X	X	X[b]	X	X
15 s									X	X	X	X	
20 s							X		X	X		X	
30s									X			X	
Not described	X	X	X	X	X	X		X			X		X
Vocal Model Topography													
Monotone							X						
Motherese										X		X	
Pairing Procedure													
Simultaneous		X				X							
Trace	X			X					X			X	
Delay			X		X		X	X		X	X		X
Reinforcer Delivered													
Social	X	X				X							
Tangible			X	X		X	X	X	X	X	X	X	X
Unknown					X								

Note. Summary of procedural variations in stimulus-stimulus pairing (SSP) research. Adapted from "Inducing Novel Vocalizations by Conditioning Speech Sounds as Reinforcers," by A. I. Petursdottir and T. L. Lepper, 2015, *Behavior Analysis in Practice*, *8*, pp. 223–232. [a] Effect was greater with one sound presentation; [b] ITI varied to reduce temporal predictability; [c] ITI varied based on latency of button-response.

Table 2

Participant Characteristics

Name	Age/ Gender	Diagnosis	VB-MAPP level	Main mode of communication	Verbal Operants	Listener Behavior	Imitation Skills	Visual Performance	Learning Barriers	Preferred items
Craig	8/Male	ASD	One	Pulling, leading, and reaching toward preferred items PECS and 1 sign for all done	7 Mands 0 Tacts 0 Echoics 0 Intraverbals	10 one-step instructions Selects 20 common items from an array of 3	20 GMI 10 FMI	Puzzles Similar & identical match of pics and objects. Sorting colors	Self-Stimulation Tantrums Limited MOs OCD Failure to Generalize	Tickles Bubbles Playdough
Jake	8/Male	ASD	One	Pulling, leading, and reaching toward preferred items	1 signed mand (eat) 0 Tact 0 Echoic 0 Intraverbals	5 one-step instructions	5 GMI	Identical match (5 objects)	Self-Stimulation Prompt Dependent Weak MOs	Peperoni Spicy chips Bubbles
Jill	4/Female	ASD	One	Pulling, leading, and reaching toward preferred items	1 signed Mand (all done) 0 Tact 3 phonemic echoic (ah, eee, bu) 0 Intraverbals	Points to preferred item in various positions	3 GMI with objects	Identical match (8 objects)	Hyperactive Response requirement weakens MOs Atypical MOs	Slime Playdough Sand

Note. Table 2 shows the participants' basic characteristic including age, gender, diagnosis, VBMAPP level, mode of communication, verbal operants, listener responding, imitation skills, visual performance, and preferred items used as reinforcers during pairing. GMI: Gross Motor Imitation and FMI: Fine Motor Imitation.

Table 3

Procedural Integrity Steps

Phase	Description
Baseline	60 five second intervals (5 min) Partial interval recording Experimenter observed the participant for 60 five second intervals. A (+) was recorded if the student emitted the target model, a (-) was recorded if the participant emitted a non-target sound, and a (N) was recorded if the participant remained silent. No programmed consequences were delivered for vocalizing.
SSP (5 s interval)	Experimenter presents the colored card associated with pairing density. Pairing trial- Experimenter presents the target vocalization one time every 5 seconds. The quality of the vocal model was presented using "motherese" or exaggerated prosody. Preferred items are rotated within trials.
Postpairing	Same as baseline
SSP (15 s interval)	Experimenter presents the colored card associated with pairing density. Pairing trial- Experimenter presents the target vocalization one time every 15 seconds. The quality of the vocal model was presented using "motherese" or exaggerated prosody. Preferred items are rotated within trials.
Postpairing	Same as baseline
SSP (30 s interval)	Experimenter presents the colored card associated with pairing condition. Pairing trial- Experimenter presents the target vocalization one time every 30 seconds. The quality of the vocal model was presented using "motherese" or exaggerated prosody. Preferred items are rotated within trials.
Post-pairing	Same as baseline

Note. The above table describes the steps followed by the experimenter during for each phase and condition.

Table 4

Target and Control Sounds per Pairing Density

Participant	Density Condition	Target Sound	Control Sound
Craig	5 s	Tee	Ba
	15 s	Go	Ba
	30 s	Ma	Ba
Jake	5 s	Ah	Pop
	15 s	Oh	Pop
	30 s	Mmm	Pop
Jill	5 s	Baby	Icky
	15 s	Toy	Icky
	30 s	Yay	Icky

Note. This table shows the auditory stimuli presented during sessions. Target sounds were followed by reinforcers and the control sounds had no programmed contingency. Control sounds were followed by the corresponding ITI. Each pairing density had unique target sounds, but control sounds were the same across densities to make paired stimuli salient. Auditory stimuli were selected from group one from the Early Echoic Skill Assessment (EESA).

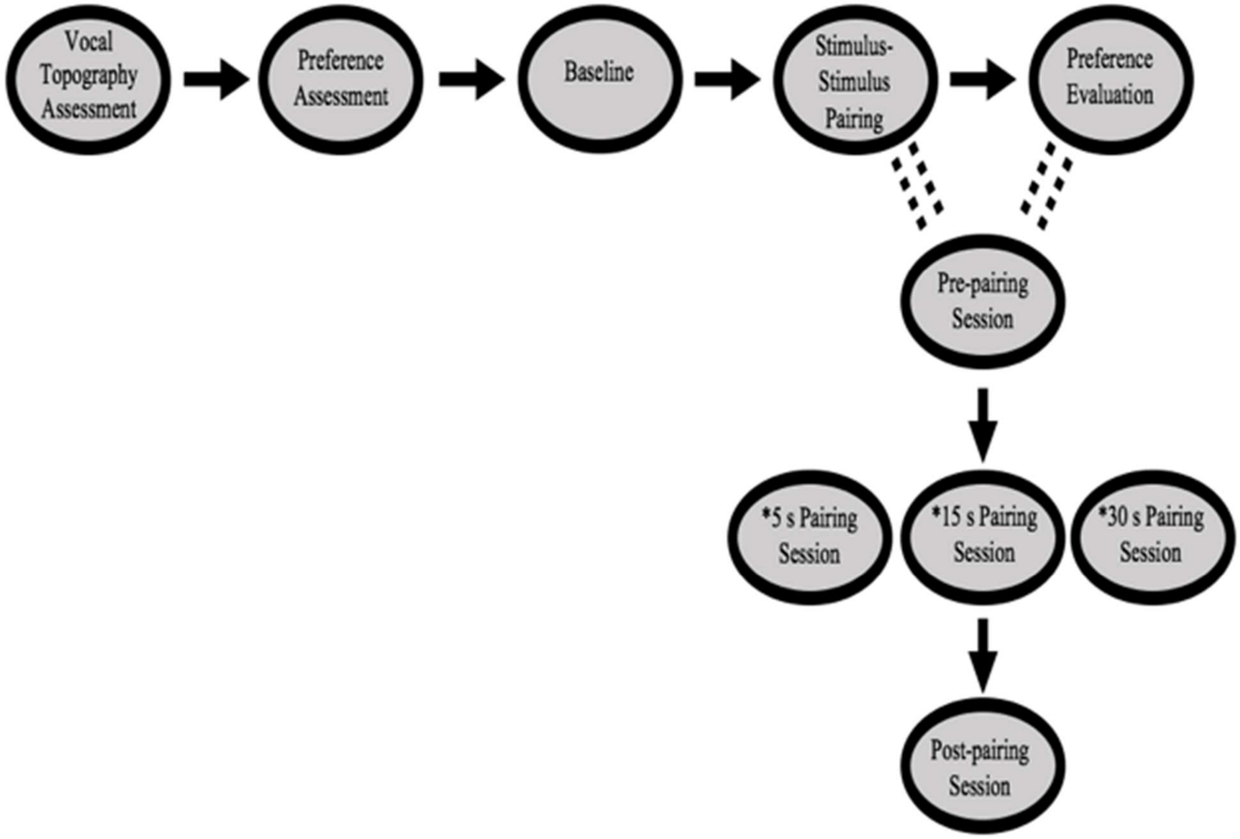

Figure 1. Design flow chart. Flow chart illustrates the design sequence. *Order of pairing sessions change based on randomization or child's choice depending on the phase.

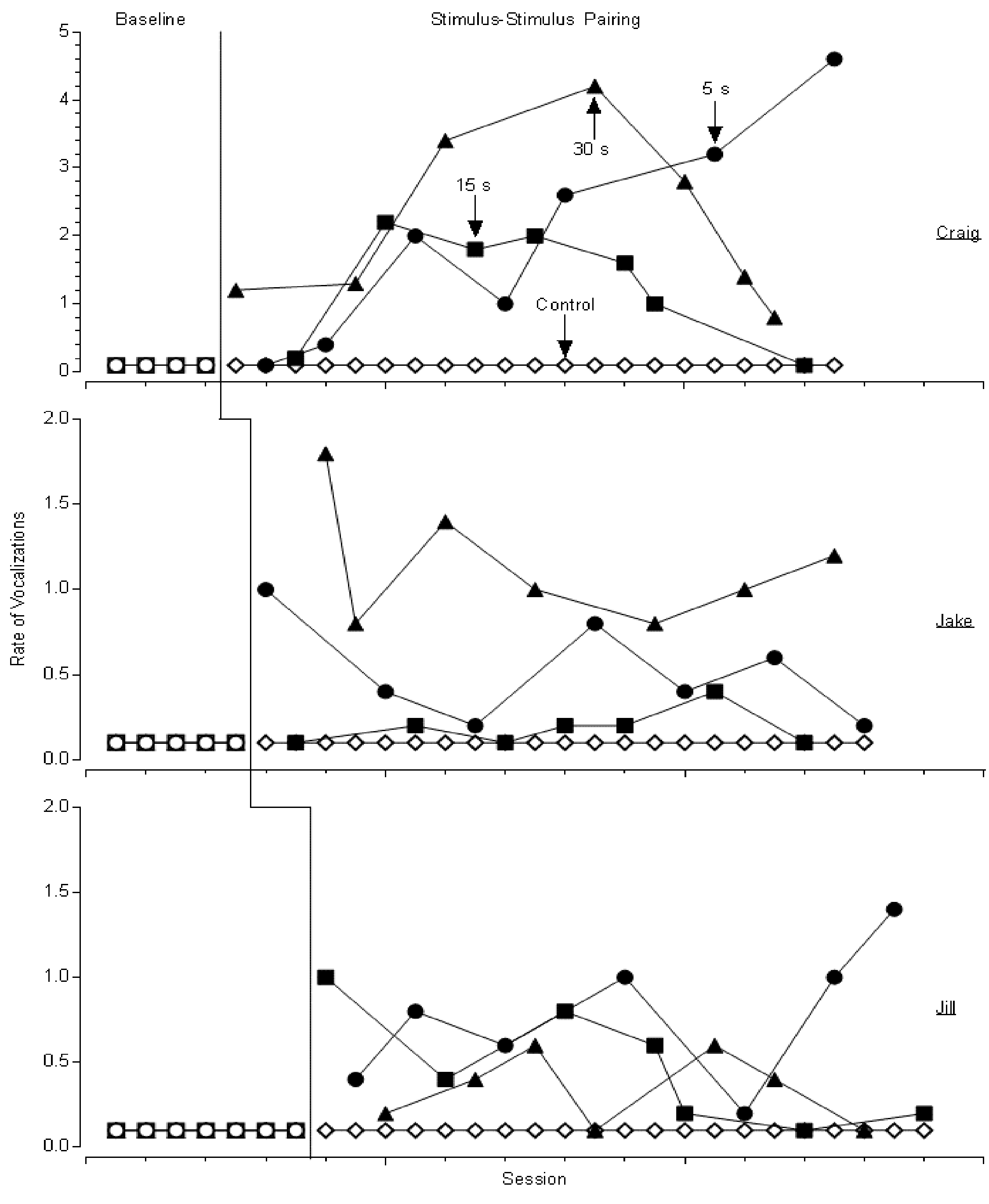

Figure 2. Multiple baseline design across participants. This figure illustrates the rate of target and control vocalizations for all participants during baseline and stimulus-stimulus pairing phases across pairing density conditions.

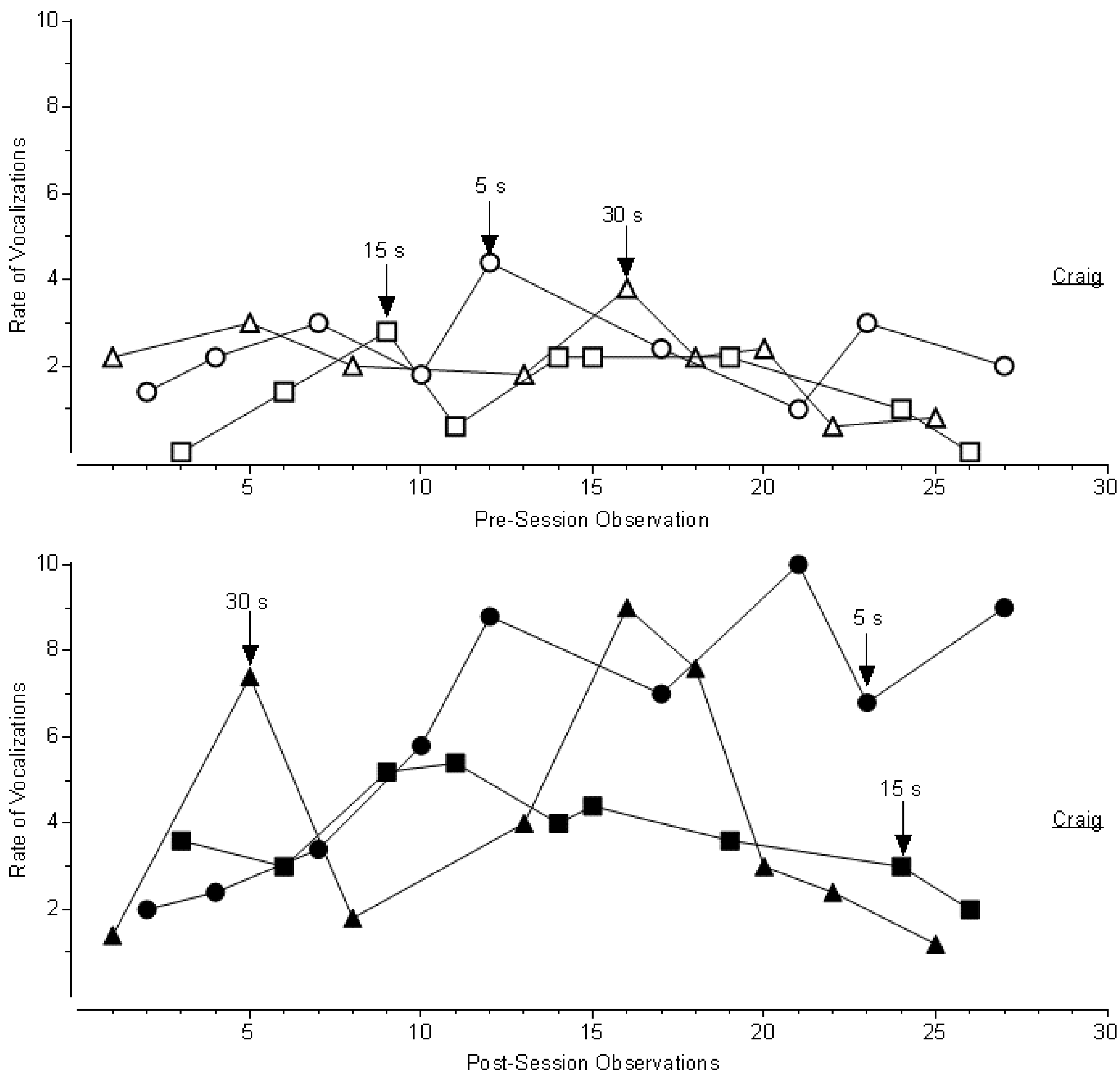

Figure 3. This figure depicts the rate of vocalizations for Craig during prepairing (top panel) and postpairing (bottom panel) observation sessions for the 5 s density (circles), 15 s density (squares), and 30 s density (triangles).

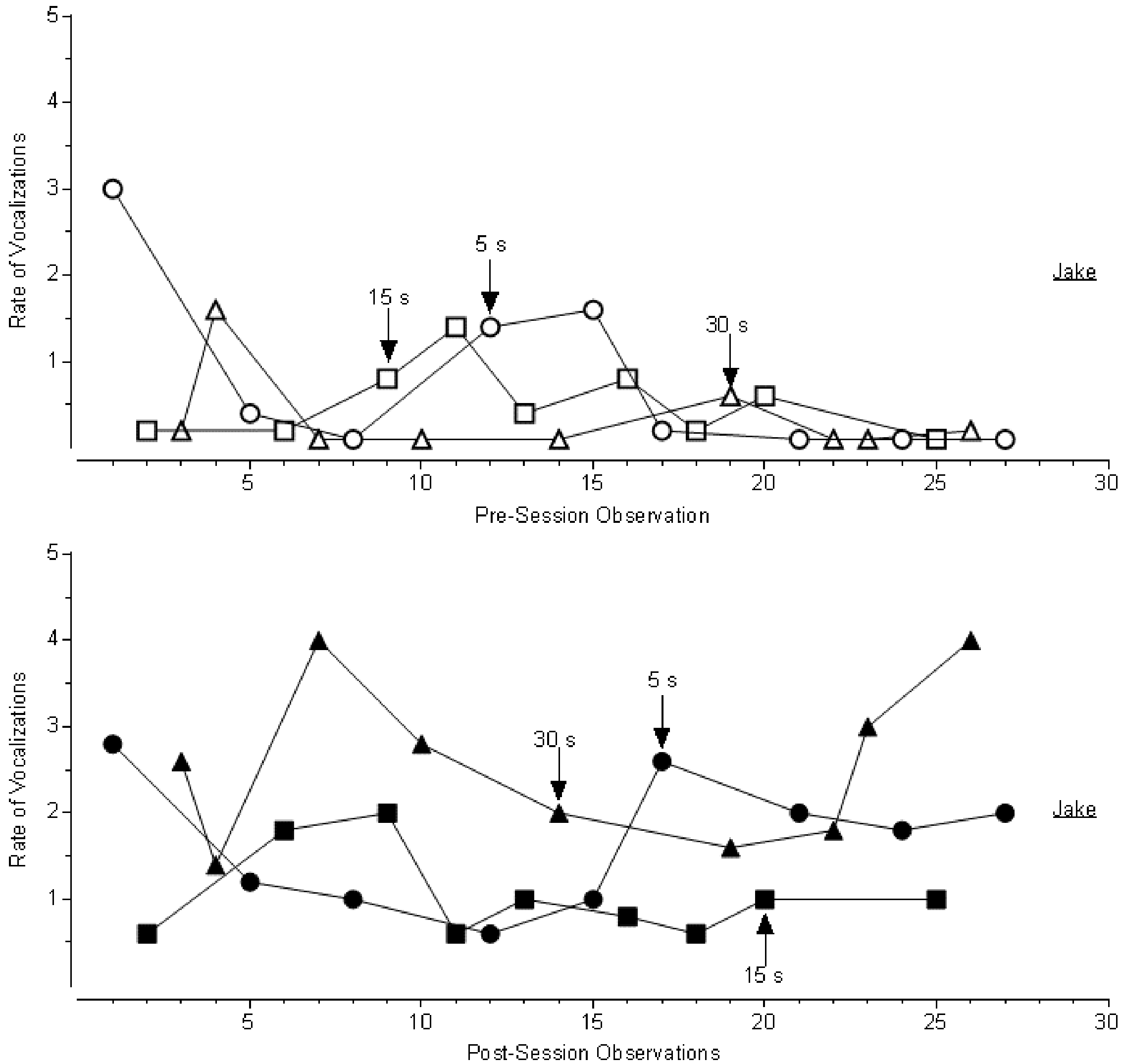

Figure 4. This figure depicts the rate of vocalizations for Jake during prepairing (top panel) and postpairing (bottom panel) observation sessions for the 5 s density (circles), 15s density (squares), and 30 s density (triangles).

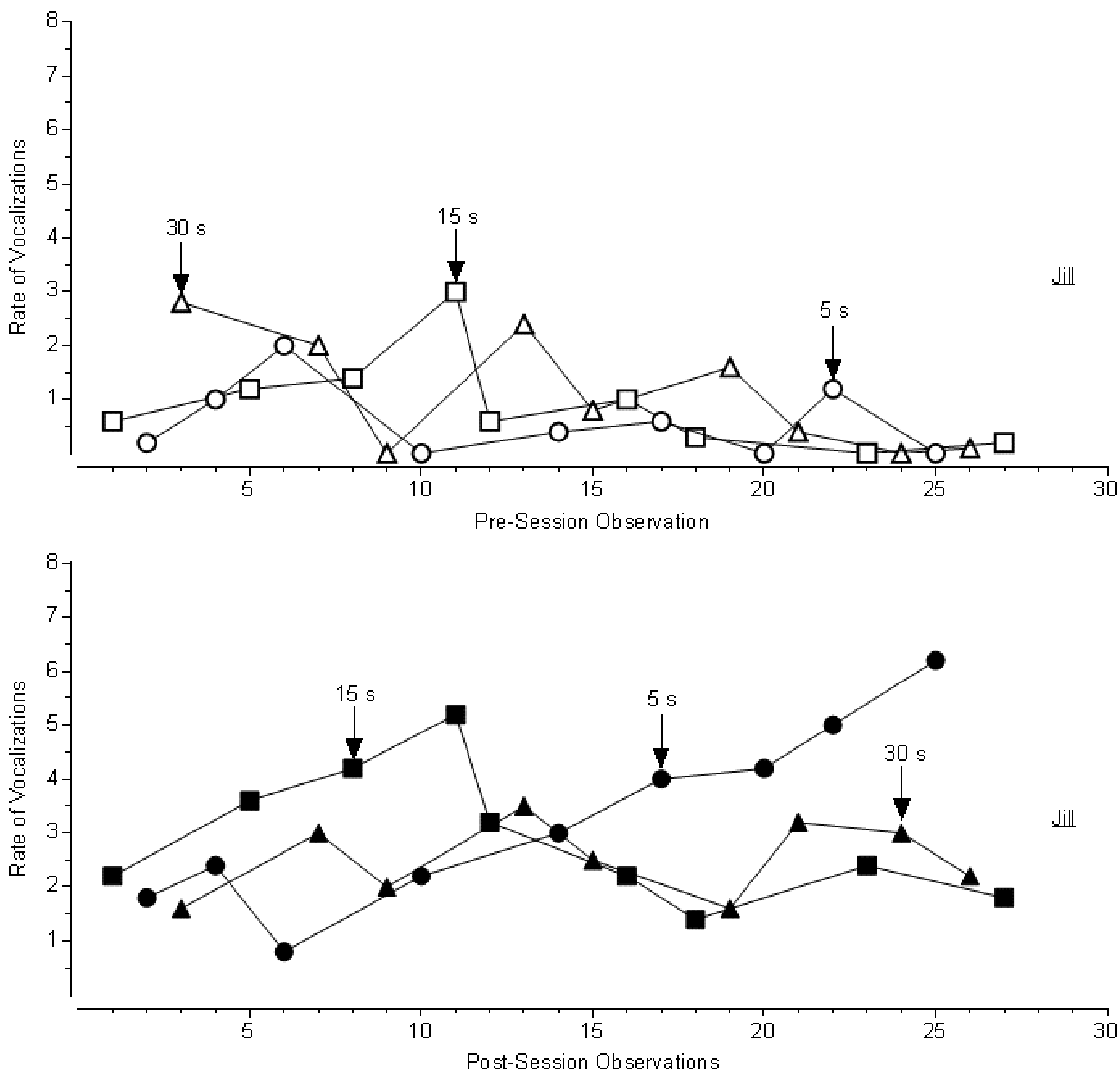

Figure 5. This figure depicts the rate of vocalizations for Jill during prepairing (top panel) and postpairing (bottom panel) observation sessions for the 5 s density (circles), 15 s density (squares), and 30 s density (triangles).

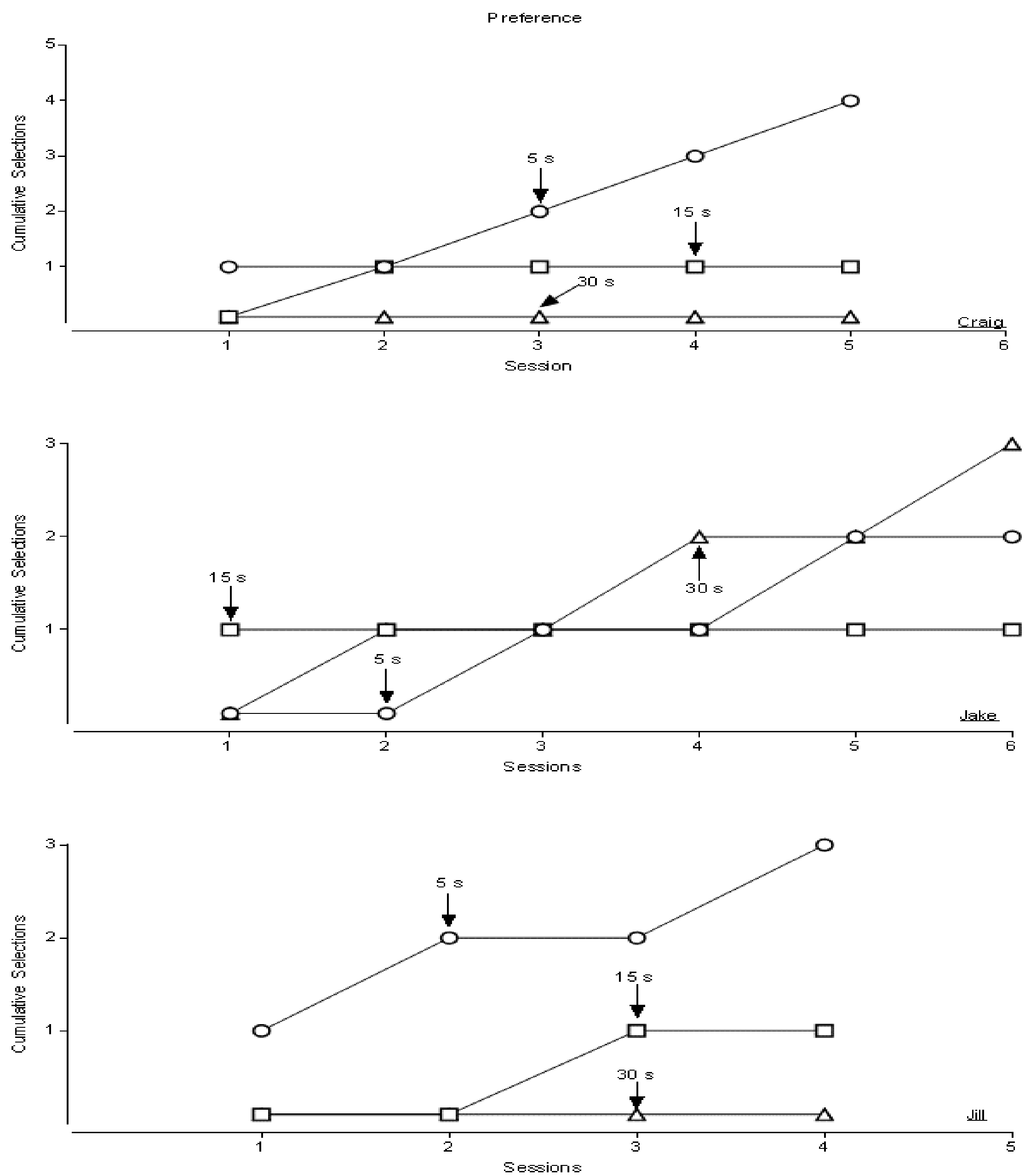

Figure 6. This figure depicts the cumulative number of selections for the 5 s density (circles), 15 s density (squares), and 30 s density (triangles) for Craig (top panel), Jake (middle panel), and Jill (bottom panel).

Appendix A

Letter of Permission

TheChicagoSchool®
of Professional Psychology

INSTITUTIONAL REVIEW BOARD
Expedited Approval

15-Nov-2018

IRB # :	IRB-18-06-0045
Study Title :	An Evaluation of Stimulus-stimulus Pairing Schedule Densities on the vocalizations of Non-vocal Children.
Principal Investigator:	Carrasquillo, Lyret
Study Team :	Carrasquillo, Lyret~Brandt, Julie~
Expiration Date :	14-Nov-2019

Dear Investigator,

This notification certifies that the above referenced study has been reviewed by The Chicago School of Professional Psychology IRB. The committee has determined that the study meets the requirements for approval by expedited review under category 7.

Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Documents approved for use include informed consent document(s) and advertising material.

Please note that investigators and study personnel must comply with all applicable Federal, State, and local laws regarding the protection of human subjects in research, as well as all TCSPP policies and procedures. This includes, but is not limited to, the following:

- **Conducting Research:** Ensuring that the research is conducted according to the IRB approved research protocol. Investigators are responsible for the actions of all co-investigators and research staff involved with this research as well as the confidentiality of data. Research may only be conducted using the IRB approved documents included with this approval notice.
- **Modifications:** Proposed changes to this study or related documents must be submitted to the IRB via an *Addendum Application*. All changes must be reviewed and approved by the IRB prior to implementation. Failure to obtain prior approval could result in suspension of the study and additional action as necessary.
- **Continuing Renewal:** Submission of a *Continuing Renewal Application* and any corresponding documents at least 30 days prior to study expiration to prevent a lapse in IRB approval.
- **Unanticipated Problems and Study Deviations:** Timely and accurate reporting of all study unanticipated problems. An unanticipated problem is any problem or event which was unanticipated, reflects new or increased risk

Appendix B

Informed Consent

TheChicagoSchool of Professional Psychology

Informed Consent

Investigator: Lyret Carrasquillo, M.S., BCBA

Study Title: An Evaluation of Stimulus Stimulus Pairing Densities on the Vocalizations of Nonvocal Children

I am a student at The Chicago School of Professional Psychology. This study is being conducted as a part of my dissertation requirement for the Degree of Doctor of Philosophy in Applied Behavior Analysis.

I am asking you to participate in a research study. Please take your time to read the information below and feel free to ask any questions before signing this document.

Purpose: This study has two purposes. First, evaluate if the number of times a sound is followed by a preferred item influences the vocalizations of young children. I will compare the effect of presenting a sound followed by a preferred item every 5 seconds, every 10 seconds, and every 15 seconds on your child's production of sounds. The second purpose is to identify the learning characteristics of children whom may benefit from the intervention.

Procedures: The first step of the study will be a vocal topography assessment. During this assessment, your child will have access to the toys for 30-minutes while I take notes on the sounds your child says and the number of times each sound is said.

The second step will be the choice preference assessment. You will help me identify the items your child may prefer. During this assessment, I will present six to twelve items in pairs and rank each item based on the number of times your child chooses an item. The item your child selects the most will be identified as highly preferred and used during trials.

Baseline and prepairing and postpairing intervention sessions will consist of 5-minute observations. These sessions will begin with me telling your child "go play." Your child will have access to all the toys used during the preference assessment and problem behaviors will be ignored unless there is a safety concern. I will remain silent and take notes on the sounds your child says while he/she plays.

During the intervention, I will model a sound and immediately give your child a preferred item or edible. Your child will have access to the item for about 10 seconds or until the edible is consumed. I will present a specific sound every 5 seconds, 15 seconds, or 30 seconds depending on the condition being conducted. A 5 minute postpairing session will occur after each condition to evaluate if there is a change in the number of vocalizations your child says or if the sound I modeled is repeated.

I will ignore problem behaviors unless there is a safety concern for the parties involved. After 20 seconds without problem behaviors, I will reintroduce the trial. If problem behaviors persist and occur during three consecutive trials, sessions will be terminated for the day. Your child may leave the area with adult supervision at any time during the study.

Participation will consist of 15 to 20 minutes per session, three to five days a week, for an average of eight weeks.

All sessions will be audio and video recorded using an iPad for data collection. All videos and filed will be deleted and destroyed after 5 years of the study.

Risks to Participation: This study has the risk of a loss of confidentiality. To minimize the limits of confidentiality, pseudo names will be used for all participants and documents and video recordings will be saved and stored in a password-protected secured electronic storage system. However, personal information transmitted electronically cannot be guaranteed to be secure or error-free as information could be corrupted or contain viruses.

Another risk of participation is that children may engage in problem behaviors during the study. Problem behaviors will be ignored unless there is a safety concern. After 20 seconds without problem behaviors, I will reintroduce the trial. If problem behaviors occur for longer than 5 minutes, sessions will be terminated for the day, and problem behaviors across three consecutive sessions will be result in participation exclusion. Your child may leave the area with adult supervision at any time during the study.

Benefits to Participants: A benefit to the participants is an overall increase in the number of vocalizations emitted. These vocalizations may result in the participant contacting social reinforcement more frequently in his/her natural environment. Additionally, caregivers may further shape the participant's vocalizations into sounds or words that can serve as a form of functional communication.

Alternatives to Participation: Participation in this study is voluntary. You may withdraw from study participation at any time without any penalty.

Confidentiality: During this study, I will collect information about you and your child. This includes name, telephone number, address, email address, and medical information. To prevent the possibility of you or your child to be identified, pseudo names will be used in all documents. Also, data sheets and audio and video recordings will be password protected and saved in a secure electronic storage system. The original signed consent form will be stored in a locked cabinet in my home. Electronic data will be stored in a secured password protected electronic storage system in my computer. Document and recording files will be kept for a minimum of 5 years as required by the American Psychological Association guidelines. After the 5 years, all files will be deleted.

Your research records may be reviewed by federal agencies whose responsibility is to protect human subjects participating in research, including the Office of Human Research Protections (OHRP) and by representatives from The Chicago School of Professional Psychology Institutional Review Board, a committee that oversees research.

Questions/Concerns: If you have questions related to the procedures described in this document please contact the lead researcher, Lyret Carrasquillo at 407-716-3643 or via email lxc8146@ego.thechicagoschool.edu or dissertation chair, Julie Brant at 715-456-1707 or via email jbrant@thechicagoschool.edu

If you have questions concerning your rights in this research study you may contact the Institutional Review Board (IRB), which is concerned with the protection of subjects in the research project. You may reach the IRB office Monday-Friday by calling 312.467.2343 or writing: Institutional Review Board, The Chicago School of Professional Psychology, 325 N. Wells, Chicago, Illinois, 60654.
Consent to Participate in Research
Parent/Guardian/Legally Authorized Representative:

I have read the above information and have received satisfactory answers to my questions. I understand the research project and the procedures involved have been explained to me. I give my permission for my child to participate in this research project. My child's participation is voluntary, and I do not have to sign this form if I do not want him/her to be part of this research project.

I will receive a copy of this consent form for my records.

____

Name of Child/Relative/Conservatee Participant (print)

____

Name of Parent/Guardian/Legally Authorized Representative (print)

____

Signature of Parent/Guardian/Legally Authorized Representative

Date: __________

____

Name of the Person Obtaining Consent (print)

____

Signature of the Person Obtaining Consent

Date: __________

Appendix C

Reinforcer Survey

TheChicagoSchool
of Professional Psychology

Reinforcer Questionnaire

Participant: ______________________________ Date: ________________

Person completing form: __________________ Relationship to the child: ____________

Instructions: Fill out according to your child's preferences. Indicate Slightly, Moderate, or Strongly for each of the following items. Please feel free to add items and make comments.

Reinforcer Profile			
Visual reinforcers	Slightly	Moderate	Strongly
Light up toys			
Spinning toys			
Jack in the box			
Crayons			
Flashlights			
Shiny stickers			
Glow in the dark toys			
Kaleidoscope			
Markers and white board			
Mirrors			
Puppets			
Pop-up toys			
Snow Globes			
Trains and train tracks			
View finder			
Video games			
TV/Movies			
Auditory Reinforcers	Slightly	Moderate	Strongly
Bells			
Books with sound effects			
Clapping			

Drums			
Microphone			
Piano			
Talking or singing toys			
Singing songs			
Animal sounds			
Therapist voice: High pitch			
Therapist voice: Low pitch			
Therapist voice: Whispering			
Other:			
Tactile Reinforcers	Slightly	Moderate	Strongly
Finger paint			
Bean bags			
Sand			
Books with textured illustrations			
Bubbles			
Clay or playdoh			
Goo or putty			
Lotion			
Hair brushing			
Koosh balls			
Potato head			
Pillow			
Shaving cream			
Silly string			
Liquid soap			
Tickles			
Stress balls			
Other:			
Kinetic (movement) Reinforcers	Slightly	Moderate	Strongly
Held upside down			
Bicycle			
Bouncing on therapy ball			
Climbing			
Jumping			
Dancing			
Piggyback rides			
Rocking horse or back and forth			
Rolling on the floor			

Running			
Going on walks			
Sit and spin			
Spinning			
Swinging			
Trampoline			
Other:			
Edible Reinforcers	Slightly	Moderate	Strongly
Apples			
Chez-it			
Chips			
Gummy bears			
Juice			
M & M			
Milk			
Nerd			
Skittles			
Smarties			
Teddy Grahams			
Oreos			
Sugar cookies			
Chocolate chip cookies			
Sprinkle cookies			
Cupcakes			
French fries			
Other:			
Additional Reinforcers	Slightly	Moderate	Strongly

Appendix D

VBMAPP Scoring Form

VB-MAPP Milestones Master Scoring Form

Child's name:	
Date of birth:	
Age at testing:	1 2 3 4

Key:	Score	Date	Color	Tester
1st test:				
2nd test:				
3rd test:				
4th test:				

Level 3

	Mand	Tact	Listener	VP/MTS	Play	Social	Reading	Writing	LRFFC	IV	Group	Linguistics	Math
15													
14													
13													
12													
11													

Level 2

	Mand	Tact	Listener	VP/MTS	Play	Social	Imitation	Echoic	LRFFC	IV	Group	Linguistics
10												
9												
8												
7												
6												

Level 1

	Mand	Tact	Listener	VP/MTS	Play	Social	Imitation	Echoic	Vocal
5									
4									
3									
2									
1									

Appendix E

Early Echoic Skill Assessment

Early Echoic Skills Assessment (EESA)

Barbara E. Esch, Ph.D., BCBA, CCC-SLP

Scoring Groups 1-3: For each item, score the best response of up to 3 trials

X = correct sounds and correct number of syllables (1 point)

/ = recognizable response, but incorrect or missing consonants or extra syllables (½ point)

Blank = no response, incorrect vowels, or missing syllables (0 points)

TOTAL RAW SCORE: *(Groups 1-5)* — ASSESSMENT 1st: 0

Group 1: Simple and reduplicated syllables
Targets: vowels, diphthongs, consonants p, b, m, n, h, w
Probe: t

☐ ah	☐ bye bye	☐ one	☐ moo	☐ we
☐ wow	☐ hop	☐ my	☐ up	☐ boy
☐ bee	☐ mama	☐ boo	☐ may	☐ wa wa
☐ knee	☐ papa	☐ no no	☐ pop	☐ toy
☐ oo	☐ me	☐ oh	☐ too	☐ baa

Sub-total Group 1 — ASSESSMENT: 0

Group 2: 2-syllable combinations
Targets: Add consonants k, g, t, d, f, y, ng

☐ baby	☐ window	☐ open	☐ taco	☐ icky
☐ go eat	☐ funny	☐ oh boy	☐ foo-ey	☐ too hot
☐ nighttime	☐ meow	☐ yumm-o	☐ hankie	☐ monkey
☐ bunny	☐ kitty	☐ potty	☐ too bad	☐ uh-oh
☐ my foot	☐ bow wow	☐ pay day	☐ cookie	☐ daddy
☐ yucky	☐ mommy	☐ pokey	☐ puppy	☐ hot dog

Sub-total Group 2 — ASSESSMENT: 0

Group 3: 3-syllable combinations

☐ tubby toy	☐ potato	☐ do high five	☐ tiny pan	☐ how many
☐ banana	☐ go bye bye	☐ oh foo-ey	☐ peek a boo	☐ potty time
☐ fee fi fee	☐ fat doggy	☐ binky boo	☐ teddy bear	☐ giddy-up
☐ yummy foo	☐ goofy goat	☐ one cookie	☐ doggy bone	☐ wet mitten
☐ daddy up	☐ hey me too	☐ open up	☐ funny king	☐ teepee boat
☐ in a boat	☐ my big toe	☐ peanut hat	☐ a hiccup	☐ puppet game

Sub-total Group 3 — ASSESSMENT: 0

Group 4: Prosody: spoken phrases (Model: Emphasize syllables in ***bold italics***)

X = emphasis on correct syllables (1 point)

/ = emphasis on non-target syllables (½ point)

Blank = monotone response (no emphasis) (0 points)

☐ no ***WAY***	☐ ***ONE*** bunny	☐ in a ***MIN***-ute	☐ ***TAKE*** it	☐ my ***MOM***-my
☐ bug-a-***BOO***	☐ ***UH***-oh	☐ ***MY*** mommy	☐ bow-***WOW***	☐ ***BUG***-a-boo

Sub-total Group 4 — ASSESSMENT: 0

Group 5: Prosody: other contexts

X = response correct or nearly so (1 point)

Blank = response does not closely match model (0 points)

Pitch

☐ Echoes pitch variations in 1-2 lines of a familiar song

☐ Echoes continuous warble (fire truck *OO-oo-OO-oo-OO*)

Loudness

☐ Echoes whispering

Duration

☐ Sustains *ahh* for 3 seconds, echoically

Sub-total Group 5 — ASSESSMENT: 0

Appendix F

Vocal Topography Observation Sheet

TheChicagoSchool of Professional Psychology

Observation Sheet

Participant: ____________________ Date: __________________ Observer: ________________

Part I. Participant will have free access to items for 30 minutes. Record the top 6 preferred items that were chosen (A-F).

Choices:

_____________ _____________ _____________ _____________

_____________ _____________ _____________ _____________

_____________ _____________ _____________ _____________

_____________ _____________ _____________ _____________

A.___________ C.___________ E.____________

B.___________ D.___________ F._____________

Part II. Write down the topography and frequency of the participant's vocalizations during free play

Ex. "dadada"				
||||| ||||| |||||				

Appendix G

Paired Stimulus Preference Assessment

TheChicagoSchool of Professional Psychology

Paired Stimulus Preference Assessment Data Sheet

Participant: __________________ Date: _________________

Data Collector: ___________________

Instructions: Fill the box using the code below

AP- approach	C-consume	N-no response	AV-Avoid

Item1:

1	2	1	3	1	4	1	5	1	6	1	7	1	8	1	9	1	10	1	11	1	12	1	13

Item 2:

2	3	2	4	2	5	2	6	2	7	2	8	2	9	2	10	2	11	2	12	2	13

Item 3:

3	4	3	5	3	6	3	7	3	8	3	9	3	10	3	11	3	12	3	13

Item 4:

4	5	4	6	4	7	4	8	4	9	4	10	4	11	4	12	4	13

Item 5:

5	6	5	7	5	8	5	9	5	10	5	11	5	12	5	13

Item 6:

6	7	6	8	6	9	6	10	6	11	6	12	6	13

Item 7:

7	8	7	9	7	10	7	11	7	12	7	13

Item 8:

8	9	8	10	8	11	8	12	8	13