1-1-2018

The Effects of Specific Behavioral Interventions on Vocal Stereotypy: A Systematic Review

Halee R. Royal
hroyal23@gmail.com

The Effects of Specific Behavioral Interventions on Vocal Stereotypy:
A Systematic Review

by
Halee R. Royal

An Applied Dissertation Submitted to the
Abraham S. Fischler College of Education
In Partial Fulfillment of the Requirements
For the Degree of Doctor of Education

Nova Southeastern University
2018

Statement of Original Work

I declare the following:

I have read the Code of Student Conduct and Academic Responsibility as described in the *Student Handbook* of Nova Southeastern University. This applied dissertation represents my original work, except where I have acknowledged the ideas, words, or material of other authors.

Where another author's ideas have been presented in this applied dissertation, I have acknowledged the author's ideas by citing them in the required style.

Where another author's words have been presented in this applied dissertation, I have acknowledged the author's words by using appropriate quotation devices and citations in the required style.

I have obtained permission from the author or publisher—in accordance with the required guidelines—to include any copyrighted material (e.g., tables, figures, survey instruments, large portions of text) in this applied dissertation manuscript.

Halee R. Royal

_____
Name

5-20-18

_____
Date

Acknowledgments

The phrase "it takes a village" is the most fitting description for the depth of my gratitude towards those who have supported me in this incredible journey. The instructors, advisors, and staff at Nova Southeastern University's Abraham S. Fischler College of Education have provided me with a rigorous program of study through which I gained an incredible amount of knowledge and experience to further my career in applied behavior analysis. Dr. Mayte Mourino and Dr. Christine Reeve, your guidance throughout this entire process has always been positive and will remain invaluable to me throughout my professional career.

None of this could have been possible without my amazing support system both in my professional career and personal life. Drs. Coby and Janet Lund, you two happen to live in both of those worlds and I consider it an honor and privilege to call you my friends and most valuable mentors. Thank you for believing in me from the start and encouraging me to make this degree a part of my journey. Dr. Parker Ellen, you may have won the race to "Dr.", but you never hesitated to encourage me to continue to run my own race in my own way. Thank you, dear friend. To my kitchen folk, my most treasured inner circle of loved ones both family and friends (you know who you are!), words cannot express how important you are to me. Thank you for believing in me, being my cheerleaders, dosing out the real talk when necessary, but above all else, loving me through this journey. Mom, Dad, and Sis. . .I love you to the moon and back.

Finally, to all of the individuals with special needs with whom I have worked, you are the reason I continue to do what I do. You have taught me so much more than I could have ever taught you and for that, I am eternally grateful.

Abstract

The Effects of Specific Behavioral Interventions on Vocal Stereotypy: A Systematic Review. Halee R. Royal, 2018: Applied Dissertation, Nova Southeastern University, Abraham S. Fischler College of Education. Keywords: autism, vocal stereotypy, noncontingent reinforcement, response interruption and redirection

Vocal stereotypy is a pervasively interfering behavior for many children with autism spectrum disorders. This behavior interferes with acquisition of new skills, language development, and social development. Researchers in the field of applied behavior analysis have examined and identified a variety of antecedent-based interventions and consequence-based interventions to treat vocal stereotypy either in isolation or as a part of a larger treatment package. Systematic reviews are an effective tool practitioners can use to access a large body of research in a condensed version that present the most critical information in a concise way. By using this tool, practitioners can be confident they are accessing evidence-based research in their field that allows them to make data-driven treatment decisions. The purpose of this systematic review was to present the reader with detailed information regarding the available antecedent-based and consequence-based interventions that have been identified in the literature and to present a focused summary on the evidence demonstrating the effectiveness of noncontingent reinforcement (NCR), and antecedent-based intervention, and response interruption and redirection (RIRD), a consequence-based intervention. Fourteen studies met the necessary inclusion criteria for the in-depth review and were analyzed according to the critical variables across the studies. The results of this review indicate highly favorable outcomes when NCR and RIRD are used either alone or as a part of a treatment protocol in order to reduce the problematic behavior of vocal stereotypy. Limitations of the systematic review, ideas for future research, and implications of this study's results were also discussed.

Table of Contents

Chapter 1: Introduction

Statement of the Research Problem

Stereotypy of motor and vocal behaviors are exhibited by typically developing children throughout their early years of development (Foster, 1998). These behaviors become problematic when their pervasiveness extends beyond that of expected developmental behaviors which is commonly the case in individuals with autism spectrum disorders and other developmental disabilities. There are several theories that seek to explain why individuals engage in stereotypic behavior (Halpenny & Patterson, 2014; Allport, 1937; Skinner, 1938). For the purposes of this review, stereotypical behavior will be examined through the lens of Skinner's operant learning theory, which is based in behavioral psychology and among the founding principles of behavior analysis.

For children with autism spectrum disorders, restricted or repetitive patterns of behavior, such as motor and vocal stereotypy, are one of the hallmark characteristics and diagnostic criteria for the disorder (Autism Speaks, 2004). In their systematic review of the literature, Chebli, Martin, and Lanovaz (2016) found that 88% of the research subjects with autism spectrum disorders exhibited stereotypical behaviors. For individuals who exhibit high rates of stereotypy, these behaviors can interfere with their ability to function and learn in multiple settings, such as within family interaction, educational and vocational settings, and social interactions (Wilke et al., 2012). Boyd, McDonough, and Bodfish (2012) also found evidence to suggest that restrictive and repetitive behaviors substantially impact the well-being and health of the family on an individual with autism spectrum disorders. While both forms of stereotypy can be

problematic, the focus of this systematic review will be on vocal stereotypy in children with autism spectrum disorders.

Systematic Reviews

Systematic reviews have been used in many fields of research for decades. After becoming widely used in the medical field in the 1970's for the purpose of examining effectiveness of health care interventions, the in-depth exploration and comparison method has become more popular in a wide range of disciplinary fields. These reviews depend on the use of an objective, transparent and rigorous approach for the entire research process in order to minimize bias and lead to the ability to be replicated by future researchers (Mallett, Hagen-Zanker, Slater, & Duvendack, 2012).

Systematic reviews can provide an efficient means of gathering evidence-based findings from a wide body of research that has posed the same or similar research question. While practitioners may be well-prepared for work in the field during their secondary educational programs, new findings and advancements in their field demand practitioners keep up with the industry's changing standards and introduction of new methodology or interventions. In order to accomplish this continuing education, practitioners can utilize systematic review techniques in order to gather their own research findings from a large body of research. They can also study systematic reviews published in peer-reviewed journals which have the highest standard of quality research criteria, largely because they have been thoroughly vetted by unbiased experts in the given field of study. Popular magazines or trade publications can also provide helpful information but are not peer-reviewed, often biased by the editors or stakeholders, and

not considered to be an authority on the academic—experimental or applied—research within a field (Geissinger, 2017).

Significance of the Systematic Review

The findings of this study provide practitioners, educators, and caregivers with a better understanding of what intervention method(s) may work to reduce their student's interfering behavior of vocal stereotypy. The more information one can extrapolate from peer-reviewed, evidence-based research regarding helpful interventions for this specific aberrant behavior, the quicker the interventions can be applied in treatment programs, which, in turn, aims to bring about improved behavior and availability for learning in the student. The demands on the individuals who provide care, support, interventions, and instruction are ever-growing. They do not have the luxury of time when it comes to wading through the expansive body of literature to find the answers they seek. This study's ambition was to provide a thoroughly examined summary and comparison of accepted interventions in the field of behavior analysis for treating the behavior of vocal stereotypy.

Justification of the Systematic Review

The prevalence of autism being diagnosed in children is increasing at an alarming rate. The latest statistics from the Center for Disease Control show one in 68 children are diagnosed with autism spectrum disorder and that boys are 4.5 times more likely to be identified with autism spectrum disorder than girls. The economic burden of caring for and educating a child with autism can weigh heavily on families. These costs can include intervention services and support, medical care, special education, and assistance well into adulthood (Christensen, Baio, Van Naarden Braun, et al., 2012). Autism Speaks

(2014) estimated the national costs of autism are around $137 billion each year. When averaged over a lifetime, this approximates $1.4 million for the care of an individual with autism who does not also have an accompanying intellectual disability. If the individual with autism has an intellectual disability, the average lifetime costs of care increase to $2.3 million.

Approximately 90% of individuals with autism are unemployed, and an estimated 500,000 more individuals with autism will join the workforce in the next decade (Rising Tide, 2014). Researchers and practitioners have a duty to gleam knowledge from one another to provide the highest standard of evidence-based practices in early intervention, educational years, and into adulthood. In order to gain employment or have a social structure that meets their needs, individuals with autism must overcome deficits in communication skills, social interaction, and interfering restricted or repetitive behaviors. Therefore, effective treatment for vocal stereotypy—a behavior that is incredibly interfering for the learning of communication skills and social skills—is an essential part of a comprehensive treatment regimen.

Deficiencies in the Evidence

The body of literature regarding the treatment of vocal stereotypy has grown significantly over the years. As more children are diagnosed with autism spectrum disorder, the need for effective treatment grows, too. However, there are some identifiable deficiencies in the research literature.

Vocal stereotypy is not a behavior unique to autism spectrum disorder. It can be exhibited by individuals with intellectual disabilities as well. Much of the research discovered on this subject that the participants of the studies tended to be younger

children between the ages of 5-12 years. It would be helpful to the variety of practitioners to access evidence-based interventions tested on individuals younger than and older than school-aged children. In particular, research involving the interventions of young adults that engage in vocal stereotypy as they look to potentially enter the workforce and how the interventions can be generalized to settings that may include coaches, mentors, or bosses with far less training than a skilled practitioner in changing behavior. Additionally, the majority of studies found in the literature base are conducted in highly controlled settings. Individuals' homes, classrooms, and habilitative programs will not be nearly as controlled and therefore, present different challenges that should be further researched.

Finally, most research done in the field of behavior analysis involved single-case experiments. It is not reasonable or appropriate to base the effectiveness on a few single-case experiments alone. But, how much is really enough to provide a solid base of evidence? Lanovaz and Rapp sought to address this issue in their 2016 study. They developed methodology that would allow practitioners to aggregate results from single-case experiments in order to estimate the probability of a successful outcome for a specific intervention and also use success rate as a decision point. The use of this type of methodology by practitioners throughout the psychological, behavioral, and educational fields would significantly assist in building an evidence-based practice from a large body of single-case experiments.

Definition of Terms

Autism Spectrum Disorder. A neurodevelopmental disorder characterized by differences in how a person perceives and socializes with others, which causes

difficulties in social and communication skills; includes repetitive or restrictive behavior patterns (MFMER, 2018).

Automatic Reinforcement. Reinforcement that occurs independent of the social mediation of others (Cooper, Heward, & Heron, 2007).

Functional Analysis. Experimentally designed systematic manipulation of environmental events that are believed to maintain problem behavior; sessions are repeated in small time increments within each test condition—attention, tangible, escape, alone, and play—until a pattern of responding is reached (Cooper, Heward, & Heron, 2007).

Matched Stimulation. Sensory stimulation that is the same or similar to that which is produced by the interfering behavior (Vollmer, 1994, as cited in Piazza et al., 2000).

Noncontingent Reinforcement (NCR). Procedure wherein the delivery of a known reinforcing stimuli is response-independent or time-based (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993).

Operant Conditioning/Learning Theory. A theory of learning introduced by B.F. Skinner that asserted learning is the change of overt behavior and those changes are the result of an individual's response to specific stimuli; the responses are either reinforced, causing them to reoccur, or punished, causing them to diminish (Culatta, 2015).

Response Interruption and Redirection (RIRD). Response interruption and redirection is a behavioral procedure often implemented as a consequence-based

intervention to treat stereotypic behavior and other responses thought to be maintained by the sensory consequences of the response (i.e., automatic reinforcement) (Ahearn, 2013).

Unmatched Stimulation. Sensory stimulation that is different from the stimulation produced by the interfering behavior (Vollmer, 1994, as cited in Piazza et al., 2000).

Vocal stereotypy. Defined as the repetitive demonstration of noncontextual sounds produced by the individuals' oral structures in the forms of humming, single-syllabic sounds, multi-syllabic sounds, approximations of words or phrases, repetitive song lyrics, repetitive phrases from a media source (e.g., TV, computer game, movies).

Purpose of the Study

The purpose of this systematic review was to conduct a focused examination of the reported effects of NCR (antecedent-based intervention) and RIRD (consequence-based intervention) as behavioral intervention methods for the vocal stereotypy of children with autism spectrum disorders. There are many examples of antecedent-based and consequence-based interventions within the literature. While some studies have pinpointed the effects of a singular treatment, many others have presented comparison studies in which the participants were subjected to two or more combinations of treatment methods in an effort to find the most effective formula.

Chapter 2: Literature Review

Introduction

The engagement of an infant in repetitive babbling or speech sounds at the regular onset of this developmental milestone has lead researchers to ascertain that this babbling likely represents the origin of human language acquisition and production (Pettito, 2000). This Canonical babbling typically begins around 6-10 months of age and can continue for many months as the child gains and expresses new sounds and starts to form words. However, the repetitive babbling and speech sounds should be replaced with consistent production of intelligible words between 18-24 months of age (National Institute of Health, 2010).

Repetitive speech sounds, jargon, or words—vocal stereotypy—are a common characteristic of children with autism and is a behavior that typically persists in the absence of social consequences. This behavior, from a behavioral perspective, is an operant behavior that is reinforced or maintained by the consequences that follow the exhibition of the behavior (Rapp &Voller, 2005). Currently, the prevalence of vocal stereotypy exhibited in individuals with autism spectrum disorders is unknown. In their 2011 study of autism symptomatology, Mayes and Calhoun (as cited in Lanovaz & Sladeczak, 2012) found that parents who were surveyed reported that more than 85% of children and adolescents with autism exhibited atypical, repetitive vocalizations or speech.

In their comparison study of typically developing children and children with autism, MacDonald et al. (2007) used direct observational measurement methods in order to assess the levels of vocal and motor stereotypy in 2-, 3-, and 4-year-old children

diagnosed with autism or pervasive developmental disorder-not otherwise specified (PDD-NOS) and same aged typically developing children. Results showed the level of stereotypic behavior in 2-year-old children with autism or PDD-NOS was somewhat higher than their same aged typically developing peers. However, the findings for 3- and 4-year-old children with autism or PDD-NOS demonstrated substantially higher levels of stereotypic behavior than the typically developing peers. The most significant differences in the behavior were found among the 4-year-old students. The typically developing children showed very low levels of vocal stereotypy at about 1-2% of the mean total observed duration, while the children with autism or PDD-NOS exhibited a mean total observed duration of 22%. The vocal stereotypy of the typical children was found to be contextually appropriate with clearly identifiable words and often referred to things within their environment. Conversely, the vocal stereotypy of the children with autism or PDD-NOS was observed to be mostly repetitive noises or noncontextual phrases and rarely did they reference their environment or the examiners. The results of this study suggest just how critical it is to reduce vocal stereotypy and focus on developing functional verbal behavior for young children with autism or PDD-NOS.

Vocal stereotypy is often described using its topography, the form: how it looks and sounds. While these descriptions are vital for the observation, measurement, and operational definitions of these behaviors, Cunningham and Schreibman (2008) argue that stereotypies should be described and categorized according to their function rather than just their form. In their study, the authors discuss stereotypy in five different ways: stereotypy as a diagnostic feature; stereotypy and its role in learning; stereotypy as an operant behavior; stereotypy as self-stimulatory behavior, and stereotypy as a socially

mediated behavior. Throughout earlier studies, stereotypical behaviors were often assumed to operate under sensory and automatic reinforcement contingencies. More recent research has clarified these behaviors may also be maintained by social or non-social positive or negative reinforcement. The authors conclude when stereotypic behaviors are examined and described in terms of their function instead of their form, "applied research and clinical applications will not only involve more accurate use of terminology, but also be more likely to influence positive behavior change through effective environmental manipulations" (Cunningham & Schreibman, 2008, p. 477).

Reasons for Stereotypy

Assertions regarding the reasons for vocal stereotypy in children with autism spectrum disorders are varied across the fields in which these disorders are examined. Some experts and researchers believe these behaviors serve as an 'automatic reinforcer' due to the sensory consequences these behaviors produce (Lovaas, Newson, & Hickman, 1987). Other studies indicate vocal stereotypy could function as a means to escape or avoid particular situations (Durand & Carr, 1987; Mace & Belfiore, 1990 as cited in Kennedy et al., 2000). Still others hypothesize these behaviors are sensitive to the social contexts and consequences surrounding them (Kennedy, Meyer, Knowles, & Shukla, 2000).

Intervention Strategies

There is a wide body of literature examining the efficacy of treatment methods for vocal stereotypy in children with autism (e.g., Ahearn, Clark, MacDonald, & Chung, 2007; Azrin & Wesolowski, 1980; Cassella, Sidener, Sidener, & Progar, 2011; Sprague, Holland, & Thomas, 1997; Taylor, Hoch, & Weisserman, 2005). The methods studied in

the literature include both antecedent-based interventions and consequence-based interventions. Antecedent-based interventions focus on the manipulation of the environment or circumstances that precede the interfering behavior and are constructed to bring about a reduction in the interfering behavior (Wong et al., 2015). Antecedent-based interventions include strategies such as NCR with and without matched or unmatched stimuli, and environmental enrichment. Consequence-based interventions intend to modify or address the environmental events or stimuli that occur after an interfering behavior is exhibited and aim to make it more or less likely that particular interfering behavior will happen again (Thomeer, McDonald, Rodgers, & Lopata, 2017). Consequence-based interventions include strategies such as RIRD, differential reinforcement of other behavior (DRO), and punishment procedures.

Antecedent-Based Interventions

   Noncontingent Reinforcement. Recent research has introduced the use of noncontingent auditory stimulation in multiple forms (e.g., music, white noise, sound-producing toys, recordings of participant's own stereotypy) in hopes of reducing the frequency of engagement in vocal stereotypy. For example, Saylor, Sidener, Reeve, Fetherston, and Progar (2012) found that of the three types of auditory stimulation used in the study—music, recordings of participant's own vocal stereotypy, and white noise— both participants demonstrated zero levels of vocal stereotypy during the music phase. The participants were a 6-year-old girl and a 5-year-old boy and were selected for the study based on caregiver reports of high levels of engagement in vocal stereotypy that interfered both in academic and social settings. Using a reversal design with an embedded alternating treatments design, the authors demonstrated that for both

participants, white noise was the least effective and had similar percentage of time spent engaging in vocal stereotypy as in the baseline phase. Voice recordings of the participants themselves showed significantly lower levels of vocal stereotypy, but for both participants, the music caused vocal stereotypy to drop to zero rates.

In another study utilizing music as a treatment method, Lanovaz, Sladeczek, and Rapp (2011) studied the effects of manipulating the volume of music on the vocal stereotypy of two children with autism, a 5-year-old girl and a 6-year-old boy. Before treatment sessions began, both children participated in a functional analysis of their vocal stereotypy. The analysis showed vocal stereotypy persisted in the absence of social consequences for both participants, which suggests the vocal stereotypy behavior was automatically reinforced (Lanovaz & Sladeczek, 2011). A reversal design was used in combination with a three-component multiple-schedule and a multi-element design in order to test the effects of changing the intensity of the music on vocal stereotypy. The authors found while noncontingent access to the music had a positive effect on the behavior, causing the rates of stereotypy to decrease, it produced negligible effects on the stereotypy when the music was removed. There were also no differential effects on the vocal stereotypy of the two participants when the intensity level of the music was manipulated. However, they asserted even small reductions in vocal stereotypy may give the child the ability to acquire new skills. The authors also pointed out the main advantage of using noncontingent music compared to other treatments, such as DRO or RIRD, is the trainer does not have to give undivided attention to the child's behavior as they do in previously mentioned treatments. This may make this treatment option more

generalizable across environments and trainers or caregivers who may not have the ability due to time or training level to implement more intensive treatments.

Adding the element of a paired-choice preference assessment, Lanovaz, Rapp, & Ferguson (2012) demonstrated the importance of establishing preferences when using noncontingent access to music as treatment for vocal stereotypy. The participants were four boys who had been diagnosed with autism and engaged in vocal stereotypy; a 4-year-old, 9-year-old, 6-year-old, and another 6-year-old. Each child's musical preference was evaluated using a modified paired-choice preference assessment based on the parental reports of preference. Using a brief comparison design followed with free-operant observation periods, the authors found three out of the four participants exhibited lower levels of vocal stereotypy when accessing highly-preferred music compared to less-preferred music. The treatment effects also extended to no-interaction conditions for the same participants by reducing vocal stereotypy overall. The results of the study further the support of utilizing preference assessments when identifying high and low preference music for treatment. However, the researchers noted the reductions in vocal stereotypy did not necessarily mean increases in appropriate behavior, such as functional play. Therefore, using noncontingent music with other behavioral interventions that are designed to bring about response reallocation towards more acceptable behaviors may be required for some participants.

Social interaction is often used as a means to deliver noncontingent reinforcement. Enloe and Rapp (2014) studied the effects of noncontingent social interaction on both immediate and subsequent engagement in vocal and motor stereotypy. The form of social interaction used was therapist social attention by reading aloud from

an e-reader to the individual. There were three participants: an 8-year-old girl, a 13-year-old boy, and a 6-year-old boy; all were diagnosed with autism. The researchers applied a multi-element research design combined with a three-component multiple schedule to assess the effects of social interaction on vocal and motor stereotypy. It was determined in brief observations prior to the treatment sessions that each child exhibited vocal stereotypy more often than motor stereotypy. The results showed continuous delivery of social interaction decreased immediate engagement in vocal stereotypy during the social interaction phase when compared to the baseline phase of no interaction for all three participants. Additionally, the social interaction did not increase subsequent vocal stereotypy for these participants. However, while the social interaction had a positive effect on two of the participants by also decreasing immediate engagement in motor stereotypy, the social interaction for the third participant actually increased the engagement in motor stereotypy, leading the researchers to conclude vocal and motor stereotypy may be equally problematic for that participant. The study did set itself apart by being one of the first studies to demonstrate that social interaction from reading books can decrease multiple forms of stereotypy.

Matched/Unmatched Stimuli. Another treatment method often used in conjunction with noncontingent reinforcement or access is matched versus unmatched stimulation. Piazza, Adelinis, Hanley, Goh, and Delia (2000) defined matched stimulation as stimulation that contains similar stimulation produced by the stereotypy and unmatched stimulation as stimulation that did not have similarities to that which was produced by the stereotypy. Rapp et al. (2013) used these specific types of stimulation to study their immediate and subsequent effects on targeted vocal stereotypy and untargeted

motor stereotypy. Twenty-two children with autism ranging in ages from 6 to 17 years of age participated in the study. The sessions took place in a specific room in each participant's school. Researchers documented preferences for leisure items by conducting three different 10 minute free-operant stimulus preference assessments across three separate days. Vocal stereotypy was evaluated for each participant during two conditions: a no-interaction sequence and one or two preferred stimulus sequences. The authors employed a combination of a two-component or a three-component multiple schedule and reversal research design in order to evaluate the effects of the matched or unmatched stimulus on vocal stereotypy. The findings of their first experiment showed matched stimulation decreased the immediate engagement of vocal stereotypy in 8 of 11 participants and only increased vocal stereotypy for one of the ten participants. Unmatched stimulation decreased the behavior for only one participant and did not increase subsequent engagement in vocal stereotypy. These results also suggest to practitioners who want to use NCR to decrease vocal stereotypy should also incorporate preferred items that generate auditory stimulation.

For the authors' second experiment, ten of the participants from the first experiment were chosen based on their engagement in forms of untargeted motor stereotypy and four participants from another study were included for a total of 14 participants. Overall, the results from the second experiment showed 8 of the 14 participants increased their immediate engagement in motor stereotypy, subsequent engagement in motor stereotypy, or both when a preferred stimulus was presented in an effort to use noncontingent reinforcement to decrease vocal stereotypy. As a result of these mixed findings and the reality that the participants' behaviors could be governed by

different operant processes, the researchers suggest practitioners should assess the immediate and subsequent changes in untargeted behavior when attempting to treat vocal stereotypy.

Similar results were discovered in the 2009 study by Lanovaz, Fletcher, and Rapp when they examined stimuli that altered immediate and subsequent levels of stereotypy in three children with autism. The three participants, all males, were ages 5, 7, and 7-years-old and each one was diagnosed with autism before the age of 29 months. Before beginning the formal assessment sessions of vocal stereotypy, the researchers conducted a free-operant stimulus preference assessment in order to identify the highest preferred stimuli for each boy. The design utilized was a three-component multiple-schedule combined with a brief reversal design for a total of four sequences; two sequences were alternated in pairs. This design was used so the effects of structurally unmatched and matched stimulation on vocal stereotypy could be measured. The results indicated the following: 1) overall, immediate vocal stereotypy was decreased when the structurally matched stimulation and music were used; 2) there were larger decreases in vocal stereotypy when structurally matched stimuli was used versus unmatched stimuli for two of the three participants; 3) two of the three participants had temporary decreases in immediate vocal stereotypy with structurally unmatched stimuli; and, 4) structurally unmatched stimuli did not bring about decreases in subsequent stereotypy for any of the participants even though preferences were shown for the unmatched stimuli. Only one participant accessing matched stimuli presented a clear abolishing operation for subsequent vocal stereotypy, but no other stimuli was able to sustain the abolishing effects for subsequent vocal stereotypy among the participants. While the authors

pointed out the behavior changes observed in this study were not necessarily statistically or socially significant in size, it is often the variables that initially bring about small behavior changes could serve as stimulus for larger changes in the future.

Environmental Enrichment. Reynolds et al. (2010 as cited in Aronoff, Hillyer, & Leon, 2016) described environmental enrichment as a state that includes both novel and diverse sensorimotor experiences. Environmental enrichment has been utilized as a stand-alone treatment for several exhibited characteristics of children with autism, including vocal stereotypy. For example, Vollmer, Marcus, and LeBlanc (1994) used environmental enrichment as an intervention for stereotypic behavior, giving the participants free access to highly preferred items. The participants were three children, two boys and one girl, ages 3, 3, and 4, respectively. Stimulus preference assessments were conducted with each participant and the stimuli identified as preferences were used in the relevant condition phases of the functional analyses for each participant. Each participant was analyzed using a slightly individualized research design: one was analyzed with an ABCBCB reversal design; another with an ABCAC reversal design; and, one with an ABCDEBE reversal design. The authors were able to demonstrate that even with inconclusive functional analyses, environmental enrichment can be included in treatment packages for individuals with aberrant or stereotypical behavior and can bring about significant decreases in these behaviors.

Likewise, Sidener, Carr, and Firth (2005) were able to show reduction of stereotypic behavior and increases in toy engagement for both of the participants by using environmental enrichment. The participants were two, 6-year-old girls diagnosed with autism. Functional analyses were conducted on both of the participants prior to

beginning the treatments. The researchers also utilized stimulus preference assessments to determine highly preferred foods that would be used as programmed consequences during specific conditions. Applying an ABA research design with the first phase being a baseline phase of no programmed consequences for the stereotypical behavior, the second phase being a period of continuous delivery, or superimposition, of the previously determined edible items, and the final phase being a return to baseline with edible items being withheld. When the superimposition with edibles treatment was not successful in satisfactorily reducing the stereotypic behavior, the researchers added a final phase to the treatment—environmental enrichment. The participants were provided free access to toys that had been previously established as preferred items. Not only did the added environmental enrichment lead to decreased stereotypical behavior, but it also showed increased appropriate toy engagement behavior.

Environmental enrichment has also been used in combination with other components, such as response-cost, a negative punishment procedure. The National Standards Project (2009) included environmental enrichment as part of the antecedent package of interventions that were considered "established" based on the wealth of evidence. However, more recent studies including environmental enrichment are using additional treatment components to combine efforts of decreasing vocal stereotypy.

Watkins and Rapp (2014) assessed the immediate and subsequent effects of environmental enrichment first as a stand-alone treatment for stereotypy. Then, they implemented environmental enrichment in combination with response cost for five participants with autism, ranging in ages 9-19, all attending the same private school, and all receiving behavior-analytic services. Functional analyses were conducted for each

participant, which determined the target behaviors for each participant continued in the absence of socially mediated consequences, suggesting automatic reinforcement as the maintaining function. The authors developed a combined two-component multiple schedule with an embedded multi-element design in order to assess the immediate and subsequent effects of environmental enrichment and environmental enrichment plus response cost on stereotypical behavior. Using environmental enrichment alone did not produce reductions in the engagement of stereotypy, but when the response cost element was added, immediate engagement in stereotypy was reduced for all five participants. Also, removal of the interventions did not cause immediate increases in stereotypy for three of the five participants.

Consequence-Based Interventions

      Response Interruption and Redirection. Historically, research surrounding the treatment method of 'response interruption and redirection' (RIRD) for vocal stereotypy has had potentially the largest presence in the field (e.g., Ahearn, Clark, & McDonald, 2007; Cassella et al., 2011; Liu-Gitz & Banda, 2010; Pastrana, S., Rapp, J., & Frewing, T, 2013; Shawler & Miguel, 2015; and Wunderlich & Vollmer, 2015). RIRD is a behavioral procedure implemented as a consequence-based intervention to treat stereotypic behavior and other responses thought to be maintained by the sensory consequences of the response (i.e., automatic reinforcement) (Ahearn, 2013). Behaviors maintained by automatic reinforcement can be exceptionally difficult to treat due to their reinforcing effect not depending on external stimuli. Using RIRD for motor stereotypy may seem a bit more practical because the mechanics of the stereotypy can be physically interrupted if necessary; however, preventing or intervening in order to stop and redirect

and individual's stereotypic vocalization often relies on methods that are not as physical in nature.

The work of William Ahearn and his colleagues (Ahearn, Clark, MacDonald, and Chung, 2007) is considered a seminal piece of research for RIRD methodology. Researchers in the field of applied behavior analysis have been using this study's established methodology as the basis for their research and replications for several years. In this methodology, the authors implemented the RIRD procedure, in this case vocal demands, within an ABAB reversal design to determine whether or not vocal stereotypy could be successfully redirected for four children with autism spectrum disorder. The four participants were a 3-year-old boy, 11-year-old boy, and 7-year-old fraternal twin girls. Functional analyses were performed for each participant with somewhat mixed results. For the two boys, their vocal stereotypy was demonstrated at the highest rates during the alone condition of the functional analysis. It was concluded for the twin girls that, while they demonstrated some variability, the researchers were eventually able to determine the girls' vocal stereotypy was not mediated by social consequences and was most likely maintained by the automatic reinforcement resulting from self-stimulation. The results from this study replicated previous findings that RIRD alone can bring about substantial behavior change. All of the participants exhibited lower levels of vocal stereotypy in the RIRD phase compared to the baseline phase. Additionally, the researchers discovered for three of the participants, this decrease in vocal stereotypy during the RIRD phase conversely lead to an increase in appropriate communication.

In 2011, Ahrens, Lerman, Kodak, Worsdell, and Keegan extended the Ahearn et al. (2007) study by using both vocal and motor RIRD in the experimental treatment of

vocal stereotypy. Four boys with autism participated in the study. Their ages ranged from 4 to 6 years old and they were eligible for the study due to their interfering behavior of vocal stereotypy. Functional analyses were completed for each of the participants prior to the beginning of this study. Results of these functional analyses suggested each participant's vocal stereotypy was maintained by automatic reinforcement. In the first experiment, a combined reversal and multi-element design was used to examine the effects of two specific RIRD techniques. During the RIRD phase of the first experiment, trials of vocal RIRD and motor RIRD were used within the same phase. Vocal stereotypy was interrupted by the therapist calling the student's name and immediately asking a social question that required a vocal response. Then, motor imitation behaviors were used for motor RIRD. The second experiment utilized a combined reversal and multi-element research design for two of the participants. The same procedures as found in experiment one were used with the exception of prompts being delivered between 2-3 seconds instead of 5 seconds. The results of both experiments conducted within the study found that RIRD was effective at reducing stereotypy regardless of the procedural variation or the topography of the stereotypy. In addition, the researchers found that vocal RIRD actually functioned as a punisher for the participants' stereotypy. The authors accomplished their purpose by replicating the findings of the Ahearn et al. (2007) study and additionally demonstrated that the RIRD treatment can be effective even when the participant does not have to comply with the requests to cease the RIRD sequences.

A 2010 study by Liu-Gitz and Banda used the Ahearn et al. (2007) RIRD methods for a 10-year-old boy with autism and successfully demonstrated the RIRD interventions led to decreases in the student's vocal stereotypy. They accomplished these results by

implementing an ABAB reversal design to determine the treatment effects of RIRD. A functional analysis was conducted and because there was little variation in the participant's vocal stereotypy across the assessment conditions, researchers concluded the behavior was most likely maintained by automatic reinforcement. During the RIRD intervention, the student was given behavior-specific praise following appropriate vocalizations and vocal RIRD in the form of a series of factual questions was used to interrupt the target behavior. The findings indicate clear significant treatment effects of RIRD on the vocal stereotypy behavior of this student. Furthermore, the RIRD led to increased appropriate verbal expression by the student, which replicates the findings in the Ahearns et al. (2007) study.

Comparably, Cassella et al. (2011) replicated previously conducted research on RIRD, doing so by assessing instructed responses that differed in their topography from the target behavior. They also examined the generalization of the behavior reduction. The participants of the study were two boys with autism, a 4-year-old and a 7-year-old. Three different functional assessments were conducted for each participant using the following assessment tools: Functional Assessment Interview (FAI; O'Neill et al., 1997), Functional Assessment Screening Tool (FAST; Iwata, DeLeon, & Roscoe, 2013), and the Motivation Assessment Scale (MAS; Durand & Crimmins, 1992). One participant's results showed automatic reinforcement was the most likely maintaining function followed by attention. For the other participant, all functional assessments pointed to automatic reinforcement being the maintaining function of the vocal stereotypy. Using an ABAB reversal design, the experimenter did not provide treatment during the baseline phase, but in the treatment phase vocal stereotypy was interrupted by the experimenter

giving the participant a simple, one-step direction that did not require any type of vocal response. The results demonstrated vocal stereotypy decreased with the implementation of the RIRD procedure. However, when the intervention was removed, the vocal stereotypy for both participants returned to baseline levels. These findings do replicate and extend the Ahearns et al. (2007) study, with the exception of two discoveries. Unlike the Ahearns et al. (2007) study, this study found appropriate vocalizations were not conversely related to a decrease in vocal stereotypy and the vocal stereotypy did not remain at low levels when RIRD treatment was removed.

Differential Reinforcement. The various types of differential reinforcement are frequently researched, well-established, and commonly used techniques for shaping behavior, whether the goal is reducing problem behavior or increasing appropriate behavior or skill acquisition. Differential reinforcement, no matter the type, involves reinforcing one response class and withholding reinforcement for another response class. There are four differential reinforcement variations that are considered the most researched for the reduction of inappropriate behavior: differential reinforcement of incompatible behavior (DRI); differential treatment of alternative behavior (DRA); DRO; and differential reinforcement of low rates (DRL). DRI procedures focus on delivering reinforcement to behaviors that are incompatible, or cannot occur concurrently, to the problem behavior and withdraw reinforcement for events of the problem behavior. DRA procedures give the individual reinforcement for occurrences of a different behavior that provides an acceptable or desirable alternative to the problem behavior. DRO procedures provide a reinforcer to the individual when the problem behavior has not occurred within a specific time period. DRL procedures are often used to reinforce lower rates of a

frequently occurring problem behavior that does not necessarily need to be completely extinguished (Cooper, Heron, & Heward, 2007).

In their 2012 study, Dickman, Bright, Montgomery, and Miguel used DRI as a component of a treatment package to examine the effects on the vocal stereotypy and the appropriate vocalizations of a five-year-old with autism. The researchers utilized an ABABCBC reversal design with A as baseline, B as response interruption and redirection (RIRD), and C as RIRD with the added DRI component of a token board. Prior to baseline and subsequent treatment sessions, a functional analysis was conducted of the participant's vocal stereotypy. This behavior occurred at high and variable rates across all testing conditions, therefore, it was concluded the behavior was most likely maintained by automatic reinforcement. During the baseline phase, there were no programmed consequences for vocal stereotypy. Once the RIRD phase began, if the participant engaged in vocal stereotypy, the experimenter placed demands on the participant in the form of asking questions that demanded a vocal response. This was the same method used in the original Ahearns et al. (2007) study. The RIRD plus DRI phases proceeded similarly to the RIRD only phase, but with the added DRI element of a token board. The participant was told if he used his 'nice words', he would earn a star on his token board and then at the end of the session, those stars could be traded for candy. The types of candy were established by using a preference assessment prior to the functional analysis. The findings of this study are aligned with previous research, which has shown RIRD can lead to increases in appropriate vocalizations (Ahearn et al., 2007; Ahrens et al., 2011; Cassella et al., 2011; Liu-Gitz & Banda, 2010). Even though the DRI procedure was not examined in an isolated condition and instead, added to the RIRD

procedures, the results of the study demonstrated DRI has an enhancing affect to the treatment effectiveness when paired with RIRD for the increase of appropriate vocalizations and decrease of vocal stereotypy.

Using a slightly different differential reinforcement approach, Lanovaz, Rapp, and Ferguson (2013) conducted a pilot study with a 6-year-old boy with autism and demonstrated that television was associated with an increase in vocal stereotypy and lower levels of vocal stereotypy were observed while engaging in the act of sitting. The participant engaged in higher levels of vocal stereotypy when the television was on compared to during other types of activities. Using an ABABA reversal design, the researchers concluded three main findings: 1) watching or listening to the television led to an increase in vocal stereotypy; 2) lower levels of stereotypy were observed when the participant was sitting; and 3) DRA of the acceptable behavior of sitting was effective in reducing the level of vocal stereotypy while the television remained on. While the DRA did produce changes in sitting and vocal stereotypy, the changes were not hugely significant and the vocal stereotypy never approached zero occurrences. Also, the treatment effects did not continue after the intervention was removed. These findings did replicate those of other studies, but probably most importantly these results emphasize the conceivable utility of using conditional probabilities in order to identify alternative behaviors that may be associated with lower levels of aberrant behavior.

Another example of the effectiveness of differential reinforcement is found in the 2012 study by Shillingsburg, Lomas, and Bradley where they used a DRO procedure of a token economy with a response cost component (negative punishment procedure) to treat the vocal stereotypy of a 12-year-old boy with autism. The participant was selected for

this treatment package within the study because his loud, disruptive vocalizations made it difficult for him to participate in less restrictive educational settings outside of his self-contained special education class, such as general education electives (e.g., physical education, art, and music). A functional analysis was conducted initially with five test conditions and then an extended alone condition where the highest frequencies of vocal stereotypy were observed. A preference assessment was also performed using a paired choice preference assessment and the results indicated the computer was a highly preferred activity for the participant. An ABAB reversal design was implemented during all three phases of the study. Phase 1 consisted of NCR with a response cost element and then NCR with response cost and added demands. Phase 2 introduced the DRO component of a token economy and combined it with response cost and reinforcement fading. Phase 3 continued with the DRO of the token economy and the added response cost. Phases 2 and 3 showed dramatic reductions in vocal stereotypy when compared to baseline conditions. The authors assert that while they were able to replicate and demonstrate the effectiveness of NCR and response cost to reduce vocal stereotypy, the treatment package can be challenging and cumbersome in an educational setting. Therefore, they introduced the DRO component of the token economy and combined it with response cost which is a more feasible approach for a classroom teacher. Significant reductions in vocal stereotypy remained with the implementation of this treatment package.

Punishment. Punishment tends to be perceived as only negative in some settings, but in the world of applied behavior analysis, punishment procedures can be very effective at reducing problem behaviors. Positive punishment is the addition of an

aversive consequence that immediately follows an undesirable behavior that decreases the likelihood the behavior will happen again in the future. Negative punishment is a procedure that involves removing a reinforcing stimulus after the undesirable behavior has been exhibited aiming to reduce the likelihood of future occurrences of the behavior (Prince, 2013).

Response Cost. Response cost is considered a negative punishment procedure as it is the removal of a specific amount of reinforcement when the problem behavior occurs and decreases the probability of the problem behavior occurring again in the future (Cooper, Heron, & Heward, 2007). There are several examples in the research where experimenters have studied the effects of response cost on vocal stereotypy in individuals with autism (Schillingsburg, Lomas, & Bradley, 2012; Watkins, Paananen, Rudrud, & Rapp, 2011; and Watkins & Rapp, 2014). As previously discussed, Schillingsburg et al. (2012) combined a DRO procedure and a response cost procedure with a token system to reduce vocal stereotypy and were successful doing so.

Watkins et al. (2011) was also able to demonstrate the effectiveness of response cost interventions, but needed to pair it with environmental enrichment. Two participants in the study, an 11-year-old girl and a 7-year-old boy, were both diagnosed with autism and exhibited significant levels of vocal stereotypy. The study did not indicate that formal functional analyses or even functional behavioral assessments were conducted in order to more accurately identify the maintaining functions of the participants' behavior. However, the researchers did use their informal observations and results of the baseline sessions to conclude both participants' vocal stereotypy was most likely maintained by automatic reinforcement. Prior to treatment sessions beginning, a multiple-stimulus

preference assessment without replacement procedure assisted the researchers in identifying preferred stimuli. A brief reversal ABABAB design was used to assess the effects of the response cost interventions for the young girl and a concurrent multiple baseline design across conditions with embedded probe reversals was implemented for the young boy. In the response cost phase for the girl, she was warned of the consequences of her vocal stereotypy and her highly preferred stimuli of a doll was taken away. For the young boy, he had a previously utilized token board that was used in this study with the additional response cost of removing a token for each instance of vocal stereotypy after an initial verbal warning was given by the experimenter. Results of the study demonstrated immediate reductions in vocal stereotypy and continued reduction over follow-up probes at one month and eight months post-treatment resulted from the use of response cost interventions with the two participants with autism.

Overcorrection. Another punishment procedure found in the literature is overcorrection, or 'positive practice.' This type of procedure is considered positive punishment because it involves the presentation of an aversive consequence (e.g., repetitive demands) that follows the occurrence of the undesired behavior. Anderson and Le (2011) used four different procedures to compare the treatment effectiveness on the vocal stereotypy of a 7-year-old with autism: matched stimulation, response cost, DRO, and overcorrection. A functional analysis of the boy's vocal stereotypy was conducted prior to treatment sessions. The results of the pairwise functional analysis were very clear in demonstrating the maintaining function of the behavior was automatic reinforcement. Initially, the researchers employed a series of reversals in an ABCACB research design where no-interaction phases were used and compared with two forms of

matched stimulation. Then, the effects of the music response cost, DRO, and DVD response cost were implemented before the researchers added an overcorrection procedure to the DVD response cost phase. The overcorrection procedure was implemented by the experimenter using physical guidance to assist the participant to make the 'shush' sign with his hand, extending his index finger over his mouth, 100 times after each occurrence of vocal stereotypy. Lastly, a DRA procedure of replicating Lego designs was studied alone and also combined with the overcorrection in order to assess the levels of task engagement and vocal stereotypy. Of the four procedures, the ones that brought about the most statistically significant change—reduction—of the vocal stereotypy was the response cost-DVD procedure and the overcorrection procedure.

Punishment procedures can be very useful in reducing problem behavior, but special considerations should be made before implementing them as a researcher or practitioner could do more harm than good. The Behavior Analyst Certification Board's (BACB) Professional and Ethical Compliance Code for Behavior Analysts specifies a behavior analyst's ethical duty regarding the use of punishment procedures. Behavior analysts should use reinforcement procedures whenever possible, and, if punishment procedures are deemed absolutely necessary, they should be done so with accompanying differential reinforcement procedures, increased level of training, supervision and oversight for the practitioner (BACB, 2014). Hanley, Piazza, Fisher, and Maglieri (2005) confirmed punishment procedures may be required when less aversive methods alone are not effective for behaviors that are particularly severe or harmful in nature to the individual or others.

Conclusion

Repetitive and restrictive behaviors are hallmark characteristics of autism spectrum disorders, and, just like the disorder as a whole can fall along a spectrum of severity, so can the defining characteristics. Vocal stereotypy can be a pervasively interfering behavior for children with autism spectrum disorders, often causing decreased availability for learning new skills, social isolation, and preventing them from participating appropriately in less restrictive educational and social settings. While the exact prevalence of vocal stereotypy among children with autism spectrum disorders is unknown, Chebli, Martin, and Lanovaz (2016) found that 88% of the research subjects with autism spectrum disorders who were included in their systematic review exhibited stereotypical behaviors. The significant barriers this behavior can present to a child's development and inclusion in society throughout educational years and beyond is more than enough justification for effective treatments to be included in a comprehensive treatment package for the child with autism who exhibits vocal stereotypy.

There is a large body of research examining the efficacy of treatment methodologies for inappropriate and interfering behaviors, including vocal stereotypy. These behavioral interventions include antecedent-based interventions and consequence-based interventions. Antecedent-based interventions are those that are put in place before the behavior occurs, aiming to prevent the behavior from occurring or establishing environmental contingencies where the behavior is less likely to occur. These interventions include noncontingent reinforcement, matched or unmatched stimuli, and environmental enrichment. Consequence-based interventions are utilized after the behavior occurs and seek to change the stimuli or environmental contingency that follows

the behavior in an effort to decrease the likelihood the behavior will happen again in the future. Some experimental studies have examined these methodologies in isolation, while others have researched the comparative effects of multiple treatments. This systematic review seeks to focus on the established effects of noncontingent reinforcement with and without matched and unmatched stimuli versus RIRD as treatments for vocal stereotypy.

Research Questions

In order to fully investigate the evidence found within the literature for these specific behavioral interventions, the following questions guided this systematic review:

1. What are the effects of noncontingent reinforcement on vocal stereotypy in children with autism spectrum disorders?

2. What effect does adding matched or unmatched stimuli to noncontingent reinforcement have when treating vocal stereotypy in children with autism spectrum disorders?

3. What are the effects of RIRD on vocal stereotypy in children with autism spectrum disorders?

4. What effects are reported when noncontingent reinforcement is paired with RIRD in a treatment package for vocal stereotypy in children with autism spectrum disorders?

Chapter 3: Methodology

Introduction

The use of systematic reviews can be a very powerful method for practitioners in applied behavior analysis and special education. These types of reviews allow quicker dissemination of evidence-based practices when time and access to full-text research may be barriers for the practitioner. This systematic review addressed vocal stereotypy and the treatment effects of two specific behavioral interventions that are present in the literature, NCR, an antecedent-based intervention, and RIRD, a consequence-based intervention. These interventions are both widely accepted as effective interventions for some problem behaviors within the applied behavior analysis realm, either as sole interventions or as a part of a larger treatment package. Even though both interventions have a substantial research base, the frequency with which they have been studied specifically for their effects on vocal stereotypy is limited, and comparisons of their effectiveness for the treatment of vocal stereotypy within the same study are rare in relation to other treatments or combinations of treatments for this behavior. This systematic review assists in filling that void in the literature.

Research Studies Eligibility Criteria

In order to narrow and determine which studies were included in this study, the method described by Boland, Cherry, and Dickson (2014) was employed. This method, called a PICOS table, helps to guide researchers in the formation of inclusion and exclusion criteria to determine an individual study's eligibility for being included in a review. PICOS stands for population, intervention, comparators, outcomes, and study design. Sometimes, researchers also include setting as one of the criteria categories, but

for the purpose of this systematic review, setting was not be a part of the eligibility criteria as the study allowed any studies to be included regardless of the setting of the study as long as the other inclusion criteria are met. Each study was assessed using the Research Screening and Selection Tool.

Inclusion-Exclusion Criteria

The Research Screening and Selection Tool was adapted by this reviewer from Boland, Cherry, and Dickson (2014) in an effort to effectively determine which studies would be included in this systematic review. This tool includes the research questions, PICOS table with the targeted inclusion criteria, and individual sections referencing each category within PICOS with the inclusion criteria, additional criteria that is accepted, and exclusion criteria. The Research Screening and Selection Tool can be found in Appendix A. The studies that met all of the inclusion criteria are contained in this systematic review for further data collection, analysis, and synthesis of relevant information in order for meaningful conclusions to be drawn from the literature.

Target Population

The target population of this systematic review, and, therefore, the studies chosen to be included in this systematic review, was children with autism spectrum disorders. There were two additional diagnoses allowed to be included for two of the chosen studies; one of the two participants in the Pastrana, Rapp, and Frewing (2013) study had a dual diagnosis of Down syndrome and autism and one of the seven participants in the Wunderlich and Vollmer (2015) study had Trisomy 9, a very rare chromosomal disorder that triplicates Chromosome 9, causing growth deficiency before birth, moderate to several intellectual disability, congenital heart defects, and distinctive abnormalities of

the skull and facial region according to the National Organization for Rare Disorders (NORD, 2003). Because vocal stereotypy is not a behavior exclusive to autism spectrum disorders and commonly occurs in children with intellectual disabilities due to their language deficits and cognitive and emotional self-regulation (Medeiros, 2015), exceptions for inclusion were made for these two studies as they added incredible value to the overall exploration of this study.

The targeted age range for the study was children ages 3 to 21 years, the age range in which federal special education law establishes a child's eligibility for special education services. Participants in the selected studies ranged in age from 3 to 20 years. While there was not a targeted gender for this systematic review, it is a reasonable expectation the studies had more male participants than females due to the incidence rate of autism spectrum disorders being four times higher for males (Autism Speaks, 2104). In total, there were 42 participants in the included studies, 31 males, which accounted for 74% of the participants, and 11 females, which accounted for 26% of the participants.

Comparisons

In single-subject experimental research, the researcher targets a dependent variable and an independent variable(s) for examination of the effects of the independent variable(s) on the dependent variable. Most often, the independent variables are a type of treatment or intervention seeking to change some or all topographies of the dependent variable. For this systematic review, selected studies included vocal stereotypy as the dependent variable and either/both NCR and RIRD as independent variables. Studies that use appropriate vocalizations as a targeted or untargeted secondary dependent variable were also included.

The designated studies for this systematic review used comparisons of baseline, or no intervention, phase to intervention phases that include NCR, RIRD, or both interventions compared to each other. This allowed for increased validity in demonstrating the intervention's level of effectiveness on vocal stereotypy, which, in turn, empowered this systematic review in becoming a meaningful contribution to the existing body of literature on the subject of behavioral interventions for vocal stereotypy.

Outcomes

Outcome measures for this review included both measures of time and frequency of vocal stereotypy and appropriate vocalizations. Of the studies selected, there were eight slight variations of measures, but all contained at least one quantitative measure of the target behavior; others had multiple measures. These measures included: percent of time vocal stereotypy is exhibited; frequency of appropriate vocalizations; percent of intervals with vocal stereotypy exhibited; percent of intervals with appropriate vocalizations; percent of sessions with vocal stereotypy exhibited; percent of time samples with vocal stereotypy; percent of intervention time with vocal stereotypy exhibited; and, percent of entire session with vocal stereotypy exhibited.

Study Design

This systematic review focused on single-subject experimentally designed research studies that met the criteria for inclusion. Single-subject research methodology is rooted in behavioral psychology and applied behavior analysis and its practitioners have been using this methodology for over 40 years to answer applied research inquiries (Gast, 2010). There are many types of single-subject experimental designs, but the ones used most frequently among this study's data set were ABAB (A = baseline; B =

intervention) reversal design, ABAB reversal with embedded alternating treatment design, and multi-element design combined with a three-component multiple schedule.

Information Sources

Single-subject experimental research studies were identified by conducting broad and targeted searches through online databases, such as PsycINFO, EBSCO Host, ERIC, SAGE Journals Online, ScienceDirect, SpringerLink, Wiley Online Library, and through online academic journals, such as *Journal of Applied Behavior Analysis, Journal of Experimental Behavior Analysis, Behavioral Interventions, Behavior Modification, and Journal of Autism and Developmental Disorders.* Searches were also conducted utilizing Google Scholar and articles accessed via the Nova Southeastern Online Library system. Full-text articles were preferred and were accessed via open access journals or through the Nova Southeastern Online Library system.

Instruments

There are many resources available to assist researchers in the identification and quality assessment of appropriate literature for the inclusion into a systematic review. The first instrument utilized for this review was the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA; Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group, 2015). This instrument allows the researcher to flow through a structured search methodology when navigating the vast body of literature available within online databases, journals, and other periodicals. The PRISMA process flows through identification, screening, eligibility, and inclusion using the following steps: 1) number of records identified through database searching; 2) number of additional records identified through other sources; 3) number of records after duplicates are removed; 4)

number of records screened; 5) number of records excluded after initial screening; 6) number of full-text articles assessed for eligibility; 7) number of full-text articles excluded; and, 8) number of studies included in quantitative/qualitative synthesis (Moher et al., 2015).

The quality assessment that was used for this review is The Single-Case Reporting Guideline In Behavioral Interventions (SCRIBE; Tate et al., 2016). SCRIBE was developed in order to support researchers and readers of single-case experimentally designed studies in assessing the completeness, clarity, transparency, and accuracy of the individual studies. SCRIBE consists of a 26-item checklist that explains what authors need to address when studying or writing about single-case experiments and what evaluators of this research need to attend to in order to assess the quality of the research. These items include the title, abstract, scientific background, purpose for the research, design, procedural changes, replication, randomization, blinding, selection criteria, participant characteristics, setting, ethics, measures, equipment, intervention, procedural fidelity, analyses, sequence completed, outcomes and estimation, adverse events, interpretation, limitations, applicability, protocol, and funding (Tate et al., 2016).

Procedures

This systematic review began with the PRISMA (Moher et al., 2015) process of identifying, screening, and assessing eligibility of the studies. This particular instrument is an evidence-based minimum set of items used in critical appraisals of systematic reviews and meta-analyses. It should be noted, however, this particular instrument was not meant to be an assessment to measure the quality of research studies themselves.

Therefore, a separate tool called the SCRIBE (Tate et al., 2016) was used to assess the quality of the chosen studies included in this systematic review.

Next, the Research Screening and Selection Tool complemented the PRISMA tool by outlining the specific inclusion and exclusion criteria by which each study was considered. The final identified group of single-case experimental research studies then went through the data extraction process to identify the critical information from each study and prime this data for comparisons. This data was compiled using an Excel spreadsheet with the following data: authors, title, year of publication, number of participants, gender of participants, age of participants, target population, setting, assessments used, comparisons, outcomes/measures, procedures, and study design. Finally, the results of this data collection were presented and synthesized conclusions with important findings, along with limitations of the current study and recommendations for future directions within the research were discussed.

Data Collection and Analysis

The data collected from the final group of identified single-case experimental research studies was housed within an Excel spreadsheet using a personal computer of this researcher with password-protected login credentials and stored on a password-protected cloud storage system. The Excel spreadsheet included the following data categories that were used for comparisons: authors, title, year of publication, number of participants, gender of participants, age of participants, target population, setting, assessments used, comparisons, outcomes/measures, procedures, and study design.

The data analysis focused on the assessments used (e.g., stimulus preference assessment, functional behavior assessments, or functional analyses), the specific

comparisons between baseline phases and intervention phases, what outcome measures were used to demonstrate the magnitude of effectiveness of the interventions, the types of procedures utilized within the studies, and the types of single-case experimental research designs used in each study.

Chapter 4: Results

Overview

Given the prevalence of autism, there is an exceptionally wide body of literature

contributing to the investigation of all aspects of the disorder and viable treatments of the

characteristics demonstrated by individuals with autism. In fact, conducting a search

within Google Scholar without filters and using the keyword "autism" returned over 1.2

million results. However, when diving down into the literature by applying search words

and techniques relevant to this systematic review, the results grew thinner and thinner.

The same search using the keywords "vocal stereotypy" resulted in only 883 studies and

as those keywords are combined, the ocean expanse of research more closely resembled a

small pond. However, using careful consideration and critical examination of the

remaining articles, strong evidence emerged for the effectiveness of the two specific

behavioral interventions, NCR and RIRD, on the vocal stereotypy exhibited by children

with autism.

Study Retrieval

The retrieval method used for this systematic review was the PRISMA process

(Moher et al., 2009) of identifying, screening, and assessing eligibility of a group of

research articles and comparing them to the inclusion criteria established in a PICOS

table (Boland et al., 2014). The 14 studies in this systematic review were chosen after

extensive searches through multiple electronic databases, including Google Scholar,

ProQuest/PsycINFO, ERIC, and Wiley Online Libraries. (See Appendix E "Research

Study PRISMA Diagram). Using Boolean search strategies, the keywords of *vocal*

stereotypy AND *autism* were used to narrow the listings into a more relevant, yet still

broad, grouping. The filter of years published was applied to the studies using articles published from 2007 to present. This left a group of 834 articles across all four of the databases searched. After removing 695 duplicates, the number of records screened dropped to 139. The next level of searching involved title and abstract reading to taper the results even further. Of the initial screened records, 120 were excluded, leaving 19 full-text articles to be assessed for eligibility to be included in the study. It was at this point in the extraction that The Research Screening and Selection Tool (See Appendix A) was used in order to assess the full-text articles' eligibility. This screening tool was adapted from the screening tool presented in Boland et al. (2014). After this final sifting step, five articles were excluded and 14 articles remained for this systematic review.

The articles that were excluded during the full-text assessment did meet several of the inclusion criteria, but they either did not meet all of them or their difference in eligibility variables was not significant enough to lend further insight into the study's purpose. For example, Miguel et al. (2009) examined the effects of RIRD, but the researcher used the medication, sertraline (commonly known as Zoloft), a selective-serotonin reuptake inhibitor, as a comparator. The study met the population, intervention, and outcome criteria but not the comparator criteria. Other studies (Dickman et al., 2012; Lanovaz & Argumedes, 2010; Lanovaz et al., 2013; Rapp et al., 2017) were excluded because they also did not meet the comparator criteria as these studies examined comparisons of either NCR or RIRD to DRO/DRA/DRI strategies for treatment of vocal stereotypy. While DRO/DRA/DRI consequence-based interventions are evidence-based solutions backed by a wealth of research in applied behavior analysis (e.g., Dickman et

al., 2012; Lanovaz, & Argumedes, 2010; Lanovaz, Rapp, & Ferguson, 2013; Rapp et al., 2017) they did not meet the chosen purpose of this study.

Continuing with the assessment of the chosen data set, a quality appraisal was conducted on the eligible studies in order to determine the magnitude at which the studies followed scientific research guidelines for best practice and reporting. There are a multitude of tools available for assessing research quality. The nature of this study required a tool that was tailored to single-subject design research as this is the most prevalent type of research design within the field of applied behavior analysis. Therefore, the SCRIBE (Tate et al., 2016) Checklist was employed for this study as it was developed specifically to evaluate single-subject experimentally designed research (See Appendix B). The results of this evaluation are seen in Appendix C.

All of the studies met criteria for the most relevant clinical research features including title, abstract, scientific background, aims, design, participants' characteristics, setting, measures, equipment, intervention, procedural fidelity, analysis, sequence completed, outcomes and estimation, interpretation, limitations, and applicability. Only one study reported necessary procedural changes after the study began, and only three studies reported the designated funding sources who backed each of those studies. No study reported plans for replication of their own study, but many studies' results replicated previous research in the field. Randomization and blinding techniques were not applicable to any of the studies.

Ethical practices are of critical importance in the field of behavior analysis. The BACB has specific ethical practices surrounding the area of research, and, while it can be assumed the studies' researchers followed those guidelines and gained informed consent

of the participants, none of the studies spoke in detail about this or about their selection criteria. Adverse events were not explicitly stated within any of the studies. Each of the studies went into great detail to describe their experimental procedures; however, no study discussed where the study protocol could be located if it was available. Most studies did include, though, contact information for the authors.

Finally, the most pertinent data from the studies was extricated and organized within an Excel table for comparison (See Appendix D). The data presented includes the authors, year published, number of participants, assessments used, intervention used, and results for each study. This particular data resulted in a streamlined presentation of the factors that researchers, practitioners, and other professionals in the fields of special education and applied behavior analysis would likely be most concerned with when it comes to the efficacy of these treatments.

Systematic Review Results for the Research Questions

The first research question addressed the effects of noncontingent reinforcement on vocal stereotypy in children with autism spectrum disorders. Five (Enloe & Rapp, 2014; Lanovaz, Rapp, & Ferguson, 2012; Lanovaz, Sladesczek, & Rapp, 2011; Lanovaz, Sladesczek, & Rapp, 2012; and Saylor et al., 2012) of the 14 studies in this systematic review used NCR as the intervention to examine its effects on vocal stereotypy and compared it to baseline phases where no intervention took place. Of the five studies, four (Lanovaz, Rapp, & Ferguson, 2012; Lanovaz, Sladesczek, & Rapp, 2011; Lanovaz, Sladesczek, & Rapp, 2012; and Saylor et al., 2012) of them used music or different types of auditory stimulation as the noncontingent reinforcer, and one study used noncontingent social interaction as the reinforcer. Enloe and Rapp (2014) used NCR in the form of

social interaction by reading a book to the three participants of their study. During the social interaction phase, the researcher not only read to the participants but also frequently made eye contact and commented on a specific detail of the book. The researcher also gave near continuous social attention to the participant within this phase. The authors found that this type of social interaction brought about immediate decreases in vocal stereotypy of all three participants and did not show subsequent increases in vocal stereotypy for two out of the three participants. The authors noted that this intervention demonstrated decreases in two of the participants' motor stereotypy, as well.

Lanovaz et al. (2012) studied the utility of assessing music preference and using these identified preferences as NCR to find the effects of this intervention on four participants' vocal stereotypy. Using a modified paired-choice preference assessment originally designed to identify auditory preferences in individuals with developmental disabilities by Horrocks and Higbee (2008), the authors identified the preferred songs and their preferential ranking order for each participant. The results of the study indicated three out of the four participants demonstrated lower levels of vocal stereotypy during high preference music compared to low preference music. Also, three out of four participants demonstrated lower levels of vocal stereotypy during NCR when compared to baseline. Not only did the authors find NCR in the form of preferred music was effective at decreasing vocal stereotypy, they also extended prior research that showed the multiple-choice preference assessment was helpful in accurately determining music preference and choice.

Previous to their aforementioned 2012 study, Lanovaz et al. (2011) used high intensity and low intensity music as NCR to judge the potential effects on the vocal

stereotypy of two participants. The results of this study stated both participants decreased the percentage of time engaged in vocal stereotypy and that changes in volume did not produce significant differences in the punishing effects of the intervention. Similarly, another study by Lanovaz et al. (2012) found noncontingent music decreased the immediate engagement in vocal stereotypy for three out of the four participants. Additionally, the researchers noted toy manipulation increased for two out of the four participants, suggesting the noncontingent music might have acted as an abolishing operation for vocal stereotypy or toy manipulation might have provided a replacement for the automatic reinforcing effects of vocal stereotypy.

In another study demonstrating the beneficial effects of NCR on vocal stereotypy, Saylor et al. (2012) used three distinct types of auditory stimulation: music, audiotapes of the participants' own vocal stereotypy, and white noise. The white noise had little effect on the percentage of time the participants engaged in vocal stereotypy. While the audiotapes of the participants' own stereotypy did not yield as high of social validity ratings as the researchers likely desired, this form of NCR did lead to significantly lower levels of vocal stereotypy. Though, as has been demonstrated in other studies (Lanovaz, Rapp, & Ferguson, 2012; Lanovaz, Sladesczek, & Rapp, 2011; and Lanovaz, Sladesczek, & Rapp, 2012), music was the chosen NCR that proved to have the largest effect on the percentage of time the participants engaged in vocal stereotypy. In fact, the behaviors dropped to near-zero levels during the intervention phases when music was used, providing strong evidence in this case for the effectiveness of NCR in the form of music.

The second research question asked what effect does matched or unmatched stimuli noncontingent reinforcement have on the treatment of vocal stereotypy in children

with autism spectrum disorders. The previously mentioned Saylor et al. (2012) study employed matched stimuli as a part of their experiment for treating vocal stereotypy by using audiotapes of the participant's own vocal stereotypy and allowing the participant to listen to those tapes. Providing this matched stimulus did bring about positive results by reducing the percentage of time the participants engaged in vocal stereotypy; however, it was not as powerful a reinforcer as the music was. The authors asserted that the exact automatic reinforcers for vocal stereotypy are unknown due to their innate nature, leading most researchers to rely on hypotheses and preference assessments to provide potentially effective matched stimuli that could assist in treating this behavior.

Love et al. (2012) also used matched stimuli within NCR in a comparison study with RIRD. The authors compared baseline to matched stimuli NCR paired with RIRD, baseline to matched stimuli NCR alone, and RIRD alone. For the two participants, the overall results indicated decreases in vocal stereotypy and increases in appropriate vocalizations when RIRD was utilized. They also observed that the levels of vocal stereotypy for both participants were lower during conditions that included matched stimuli NCR.

The third research question inquired about the effects of RIRD on vocal stereotypy in children with autism spectrum disorders. A significant amount of literature regarding the treatment of vocal stereotypy focuses on the use of RIRD as a primary modality. Nine of the 14 studies within this review utilized RIRD within their experimental research. Of these studies, three used two different forms of RIRD, motor RIRD (MRIRD) and vocal RIRD (VRIRD). MRIRD interrupted instances of vocal stereotypy by requiring the participants to comply with a motor instruction or task, such

as "stand up", while VRIRD interrupted vocal stereotypy by asking the participant a question or giving an instruction that required some type of vocal response, such as "What is your telephone number?"

In a study that is referenced as a seminal piece of literature in this subject area, Ahearn et al. (2007) chose to use RIRD in efforts to test the effectiveness of the intervention on the vocal stereotypy of four participants with autism. The authors cited this response blocking method had evidence to support its effectiveness for treating motor stereotypy, but little had been assessed about its potential for treating vocal stereotypy. The results of their study showed all four participants demonstrated significant decreases in the percentage of intervals in which vocal stereotypy was exhibited. Additionally, three out of the four participants exhibited sizeable increases in frequency of appropriate vocalizations. Likewise, Liu-Gitz and Banda (2010) replicated the Ahearn et al. study by using RIRD to decrease the vocal stereotypy of their participant. By implementing this treatment in the participant's classroom, the researchers presented strong results that showed their participant's vocal stereotypy significantly decreased—over 40%—along with his appropriate verbal expressions increasing.

Several studies within this review sought to replicate and extend the findings of Ahearn et al. (2007), including Cassella et al. (2011), Pastrana et al. (2013), and Wunderlich and Vollmer (2015), who not only aimed to replicate Ahearn et al. findings but also extend the findings of Carroll and Kodak (2014). Cassella et al. (2011) affirmed the Ahearn et al.'s results of using RIRD to decrease vocal stereotypy in both of their participants by at least 50% of measured intervals. However, in the Pastrana et al. (2013) study, untargeted immediate engagement in vocal stereotypy only decreased for one of

the two participants. The other participant showed a temporary increase before demonstrating a decreasing trend. The Wunderlich and Vollmer (2015) study also had mixed results. While all seven participants showed reduction in their percentages of intervention time with vocal stereotypy, only two of the seven proved to show reduction in vocal stereotypy for the percentage of entire sessions where vocal stereotypy was exhibited.

The last three studies utilized the RIRD strategy established by Ahearn et al. (2007); however, they did not seek to directly replicate it. Ahrens et al. (2011) used both MRIRD and VRIRD as treatment interventions for the vocal stereotypy of all four participants with autism. The results revealed RIRD is highly effective for reducing vocal stereotypy regardless of the requested response and regardless of whether the participant is required to engage in vocal or motor responses during RIRD sequences. Interestingly, the authors expressed individuals may not need to possess a specific vocal repertoire or be compliant to benefit from this type of intervention. Moreover, the intervention also showed its effectiveness at increasing appropriate vocalizations for all participants.

In like fashion, Shawler and Miguel (2015) also wanted to investigate the same scenario Ahrens et al. (2011) implemented to find out if the topography of the response interruption needed to match the stereotypy itself in order to be an effective punisher of the interfering behavior. The researchers implemented both VRIRD and MRIRD with five participants with autism. The results displayed reduction in the percentage of vocal stereotypy for four of the five participants, with three of the participants showing significant decrease and one of the participants only resulting in minimal reduction of

vocal stereotypy. The same four out of five participants also exhibited increased frequency of appropriate vocalizations. The authors replicated the findings of the Ahrens et al. study by proving the topography of the response interruption is not a critical variable for the intervention and that this type of positive punishment seems to be effective at decreasing the targeted vocal stereotypy of the participants.

Lastly, Schumacher and Rapp (2011) were not only interested in studying the effectiveness of RIRD on immediate vocal stereotypy, they also desired to learn the potential residual effects of the intervention when the RIRD treatment was removed. The results disclosed a very similar set of findings to those in the original Ahearn et al. (2007) study and the Liu-Gitz and Banda (2010) study in that both participants showed decreased immediate vocal stereotypy. Then, the results extended to show the two participants did not exhibit increases in subsequent vocal stereotypy once the RIRD treatment was removed.

The fourth and final research question examined the reported effects when NCR is paired with RIRD in a treatment package for vocal stereotypy in children with autism spectrum disorders. Of the 14 articles included in this systematic review, only one article explicitly studied the comparative effects of NCR and RIRD—the Love et al. 2012 study. Not only did the results demonstrate validity for using matched stimuli NCR, they also showed the RIRD alone and matched stimuli NCR alone conditions led to similar outcomes for both participants. This study's outcomes contribute to the literature that has found the addition of NCR to procedures designed to suppress problem behavior increase the effectiveness of the interventions, specifically evaluating matched stimuli NCR used in conjunction with response blocking. While the results of this study are positive, it is

clear further research needs to be conducted with these two comparators to build the evidence for their combined effectiveness.

Summary

The search for the appropriate data set for this systematic review began with a promising large amount of information. Nonetheless, when The Research Screening and Selection Tool (adapted from Boland et al., 2014) was used to sift through the research, the qualifying number of articles decreased significantly and revealed a surprisingly small subset with which to work. The data set verified the quality of the research studies by including the most critical scientific components when assessed with the SCRIBE Checklist (Tate et al., 2016). Only 14 articles met the full inclusion criteria, with almost twice as many employing RIRD compared to NCR (with or without matched stimuli) as the intervention in the experiments. Amount notwithstanding, each group of literature provided substantial evidence for the effectiveness of their intervention. Both NCR and RIRD brought about huge differences, some as much as 50% or more, in the percent of time the participants engaged in vocal stereotypy while, in some cases, also increasing appropriate verbal expressions or vocalizations.

Chapter 5: Discussion

Introduction

Vocal stereotypy is often classified as a self-stimulatory behavior that is automatically reinforced and persists in the absence of social mediators. Researchers have yet to be able to pinpoint the exact reinforcing mechanism for vocal stereotypy. Perhaps, that is because reinforcement is different for every individual, even between different behaviors exhibited by the same individual. There have been discussions and research across the behavior analytic literature that have presented theories for the origins and purposes of vocal stereotypy ranging from the hypothesis that vocal stereotypy is sensitive to social consequences (Kennedy et al., 2000) to the assertion that vocal stereotypy is an operant behavior that is automatically reinforced by the perceptual stimuli, or sensory consequences, that it produces (Iwata, 1999; Lovass et al., 1987). As Cunningham and Schreibman (2008) asserted, it is shortsighted to predetermine sensory stimulation as the only function of stereotypy. Therefore, stereotypy ought to be described by its function rather than only its form in order to appropriately treat these behaviors with function-specific interventions.

The purpose of this study was to examine the effects of two specific behavioral interventions present within the literature on the treatment of vocal stereotypy exhibited by children with autism spectrum disorder. Even though vocal stereotypy is not a behavior exclusive to those in the autism population, a significant amount of the autism population exhibits stereotypy of vocal or motor topographies that greatly interfere with their availability to learn across their environments. Of the number of interventions cited

within the research, NCR with matched and unmatched stimuli and RIRD were chosen

for closer comparisons for this systematic review.

Principle Findings

The body of research literature on vocal stereotypy is not limited to the autism

population; there is also evidence of these studies with the population affected by

intellectual disabilities. Nonetheless, the concentration of this literature was found to be

the autism population due to the hallmark diagnostic characteristic of repetitive, restricted

behaviors as described in the American Psychiatric Association's Diagnostic and

Statistical Manual, 5th edition (DSM-5; 2013) and to the significantly interfering nature

the behaviors can present. Considering this concentration, it was surprising to find the

relatively small number of articles that met the necessary inclusion criteria for this study.

Further, the amount of research that compared the effects of NCR to RIRD directly was

limited to only one of the 14 eligible studies for this review. This was incredibly

surprising knowing the rich history of NCR and RIRD and their place within applied

behavior analytical research and methodology as effective treatments for interfering

behaviors. Within the research process for this systematic review, it was more common

to find studies that used either NCR or RIRD as comparators with other types of

interventions, both antecedent-based and consequence-based. Some of these

comparisons included environmental enrichment, identification and effects of matched

versus unmatched stimuli, differential reinforcement, and other punishment procedures,

such as response cost and overcorrection. Given this circumstance, all of the research

questions were able to be answered, particularly the first three questions that queried the

effectiveness of the singular interventions.

In the studies evaluating the effects of NCR on vocal stereotypy, 90% of the participants within these studies demonstrated noticeable decreases in the amount of time they exhibited vocal stereotypy behavior when types of NCR were used. Music was the most commonly found agent used for the NCR intervention phases in the studies. Results indicated that among the study participants, high preference music brought about more favorable results than low preference, but when the volume of music was manipulated, it did not demonstrate any significant change in vocal stereotypy engagement. These studies furthered the evidence found in previous research that NCR can have positive reduction effects of vocal stereotypy.

Another interesting finding among this review's data set was when the utility of specifically matched stimuli was incorporated, the results of its effectiveness were promising, but there was a noteworthy finding in the Saylor et al. (2012) study. While the authors hypothesized the participants' own vocal stereotypy might act as matched stimuli and, therefore, potentially be shown preference, the recordings of their own vocal stereotypy did not produce nearly the desired effect on reduction of vocal stereotypy. The music was the highest preferred competing agent with the vocal stereotypy and brought about the largest reduction in the problem behavior for both participants. Several researchers have documented similar findings when using matched stimuli, but most of those authors also pointed to the necessity of conducting stimulus preference assessments to more carefully and accurately identify potential matched stimuli for use in treatment protocols (Higbee et al., 2005; Lanovaz & Argumedes, 2010; , Piazza et al., 2000; Rapp et al., 2007; and Taylor et al., 2005). While the authors stood behind the empirical support already in the literature for utilizing matched stimuli, Rapp et al. (2012),

however, warned of the potential collateral behavior changes that providing matched stimuli could bring for some participants as in their study where only four of the 15 participants across both experiments demonstrated decreased immediate vocal stereotypy without increasing subsequent vocal stereotypy.

The largest amount of research by far found in general searching and within this review's data set was of that regarding the effectiveness of RIRD on reducing vocal stereotypy. RIRD has a wealth of backing for its effectiveness in treating and reducing motor stereotypy, but its presence in the vocal stereotypy literature is relatively young. Of the total participants within these reviewed studies, 92% of them displayed reductions in the amount of time when vocal stereotypy was exhibited. Another remarkable finding of this particular data set was the use of vocal RIRD compared to motor RIRD. Three of the nine studies differentiated their interventions between vocal RIRD and motor RIRD and, surprisingly, no significant differences between the two topographies of the treatment were established. That is to say, the studies demonstrated vocal RIRD and motor RIRD had similar effects on reducing the vocal stereotypy of the participants. Ahrens et al. (2011) claimed vocal RIRD functioned slightly better as a punisher for all four participants in the study and asserted that individuals may not need to possess a specific vocal repertoire or be compliant to benefit directly from the intervention. This review's findings further the research that has provided an evidence base for the effectiveness of RIRD as an appropriate treatment strategy for vocal stereotypy.

Lastly, Love et al. (2012), the lone study in this review that used both targeted behavioral interventions as comparators, found that by combining the interventions both participants showed decreases in vocal stereotypy and increases in appropriate

vocalizations. Additional findings indicated that not only did the participants emit higher frequencies of appropriate vocalizations during the RIRD phase, but also decreased levels of vocal stereotypy were noted during the conditions in which NCR matched stimuli were used. This study joined the literature already present that have demonstrated it is often a combination of antecedent-based and consequence-based interventions that give individuals the best possible treatment to reduce problematic vocal stereotypy and increase appropriate vocalizations and other alternate replacement behavior (e.g., Ahearn et al., 2007; Miguel et al., 2009; Lanovaz & Sladesczak, 2012).

Relevant Factors

There are several relevant factors that contribute to the validity of the collective findings of this systematic review. First, as is considered best practice and a hallmark of behavioral assessment (Hanley, Iwata, & McCord, 2003), the use of functional analysis or functional behavior assessment tools within the majority of the studies—10 out of the 14 studies—within this review's data set helped to establish higher confidence in the researchers' findings because they were acting with the known maintaining functions of the vocal stereotypy when they implemented treatment strategies in their experiments. Researchers of two of the studies that did not implement formal functional analysis or functional behavior assessment tools stated their reason for not including them was variables that supported the hypothesized function of the vocal stereotypy behavior were already present.

Another commonly used tool in applied behavior analytic treatments that was utilized was the stimulus preference assessment. Although only three (Lanovaz, Rapp, & Ferguson, 2012; Love et al., 2012; and Shawler & Miguel, 2015) of this review's studies

cited specifically using a type of stimulus preference assessment, all three studies demonstrated the usefulness of employing this tool in order to more accurately determine higher preference stimuli that assisted in bringing about reductions in the vocal stereotypy of the participants. These studies extend an already existing plethora of evidence that support the utility of several types of stimulus preference assessments, namely the work of DeLeon and Iwata (1996) examining the uses of the paired stimulus, multiple-stimulus format in which selections were made with replacement, and a multiple-stimulus format in which selections were made without replacement.

The single-subject experimental designs in this systematic review took place in a variety of controlled settings, some with more controllable variables than others. The most frequently occurring setting among the studies was the child's home, typically within a private therapy room or the child's bedroom. The next most frequently occurring setting was a treatment room in a specialized clinic or treatment center. Other studies took place within the children's schools, within their classroom or an empty classroom, or within other social settings. While it is necessary to conduct these types of experimentally designed research studies in controlled settings in order to increase the validity of their findings of the independent variable's effect on the dependent variable, it may also be difficult for those working in *typical* or *authentic* community settings to replicate those exact conditions with great fidelity, which could impact the effectiveness of the intervention. This is the reason Ledford and Gast (2018) declared the necessity of applied researchers' collaboration with therapists and teachers to "increase the probability that instructional strategies and interventions under study will improve practice as

delivered by other teacher and therapists working in community schools and clinics" (p. 23).

Lastly, the age of the participants should be given consideration as an important factor within the studies in this systematic review. Half of the participants in these studies ranged from 4 to 6 years of age. This finding's significance speaks to the emphasis on providing effective interventions for interfering behaviors as early as possible because repetitive and stereotypical behaviors have been shown to increase with age (MacDonald et al., 2007). This is not to insinuate the behaviors cannot be changed for individuals older than this age range. Quite the contrary is indicated within the field's research. However, as with any exhibition of interfering problem behavior, the preferential treatment is to extinguish and/or replace it quickly so that its level of interference is lowered, allowing the individual to be available for skill acquisition, effective communication, and socialization.

Limitations of Systematic Review

This systematic review had a wide variety of strengths as evidenced within the discussions thus far. The data set presented was the result of extensive methodical research through appropriate databases to find the single-case experimentally designed studies that assisted this researcher in answering the research questions determined at the outset of the review. Not only were those questions answered, but the results of the review also presented highly favorable proof that the specific behavioral interventions of NCR with and without matched stimuli and RIRD both had significantly high effectiveness rates for decreasing the participants' vocal stereotypy as singular interventions and as interventions that were a part of a larger treatment package. The

data set also proved to be a quality body of scientific literature that met the necessary quality appraisal requirements presented in the SCRIBE Checklist Study Quality Appraisal (See Table 1).

As positive as the results of this study were, this systematic review is not without its limitations. First, the review chose to compare only one antecedent-based strategy and one consequence-based strategy and the extent to which they affect vocal stereotypy. Both strategies have significant evidence in past literature for their efficacy of the treatment of motor stereotypy, but only in the last decade has the research for these particular behavioral interventions and their usefulness on vocal stereotypy begun to expand. What was most often discovered within the literature was the pairing of these interventions within a treatment package that incorporated a combination of multiple antecedent-based strategies, multiple consequence-based strategies, or a mixture of both. It would be useful for researchers to further explore the combination of NCR and RIRD specifically and how they might collectively affect the vocal stereotypy of individuals with autism.

Another potential limitation of this review was the selected target population: children with autism ages 3-21. Because this age range presented only a portion of the lifespan of an individual with autism and because individuals with autism are not the only people to exhibit the behavior of vocal stereotypy, future research should aim to address these behaviors across different populations, perhaps even distinguishing any factors that may influence the effectiveness of specific interventions within homogenous and heterogeneous groups. There should also be research conducted with individuals outside of the age range—above age 21, particularly as this is a behavior that could interfere with

an individual's ability to be employed or participate in normative social activities as an adult.

Conclusions

Vocal stereotypy is often a highly interfering problem behavior exhibited by individuals with autism that causes decreases in skill acquisition, appropriate social skills, and often increases the already sizeable burdens within the family structure. The role of evidence-based, effective behavioral intervention strategies is paramount to the individual with autism and to all caregivers and practitioners that care for and work with these individuals. However, the family members, teachers, and therapists of these individuals with autism unfortunately do not always have the luxury of free time to devote to researching effective treatment methods. Systematic reviews can help to bridge the knowledge gap for these professionals and make applied research more accessible by presenting a comparative collection of research studies on a given topic.

This systematic review fulfilled its purpose of identifying the effects of two certain behavioral interventions, NCR with and without matched stimuli and RIRD, on the vocal stereotypy of individuals with autism ranging in age from 3-21. The effects on the reduction of vocal stereotypy with NCR (with and without matched stimuli) alone, RIRD alone, and NCR with matched stimuli paired with RIRD are incredible and certainly noteworthy among the field. These findings further enhance the body of literature on the behavioral treatment of vocal stereotypy. The implications of the findings of this systematic review are substantial for practitioners in the fields of special education and applied behavior analysis, along with the caregivers of individuals who exhibit this problematic behavior because it presents a collection of scientifically and

socially valid evidence for the use of NCR and RIRD within an appropriate treatment protocol for the complex behavior of vocal stereotypy.

References

Ahearn, J. M., Clark, K. M., MacDonald R. P. F., & Chung, B. I. (2007). Assessing and treating vocal stereotypy in children with autism. *Journal of Applied Behavior Analysis, 40,* 263-275. doi:10.1901/jaba.2007.30-06

Ahrens, E., Lerman, D., Kodak, T. Worsdell, A., & Keegan, C. (2011). Further evaluation of response interruption and redirection as treatment for stereotypy. *Journal of Applied Behavior Analysis, 44*(1), 95-108. doi:10.1901/jaba.2011.44-95

Allport, G. W. (1937). *Personality: A Psychological Interpretation.* Oxford, England: Holt. doi:10.2307/1416626

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders, 5th edition. Arlington, VA: American Psychiatric Association. Retrieved from https://dsm.psychiatryonline.org/pbassets/dsm/update /DSM5Update2016.pdf#page=7

Anderson, J., & Le, D. D. (2011). Abatement of intractable vocal stereotypy using an overcorrection procedure. *Behavioral Interventions, 26,* 134-146. doi:10.1002/bin.326

Aronoff, E., Hillyer, R., & Leon, M. (2016). Environmental enrichment therapy for autism: outcomes with increased access. *Neural Plasticity, 2016,* 2734915. doi:10.1155/2016/2734915

Autism Speaks. (2014). DSM-5 diagnostic criteria. Retrieved from http://www.autismspeaks.org/what-autism/diagnosis/dsm-5-diagnostic-criteria

Azrin, N. H., & Wesolowski, M. D. (1980). A reinforcement plus interruption method of

    eliminating behavioral stereotypy of profoundly retarded persons. *Behavior*

    Research and Therapy, 18, 113-119. Retrieved from

    https://pdfs.semanticscholar

    .org/f7aa/b420bbe9f7c8ca7221102b6289873de2d900.pdf

Behavior Analyst Certification Board. (2014). *Professional and Ethical Compliance*

    Code for Behavior Analysts. Retrieved from https://www.bacb.com/wp-

    content/uploads/2017/09/170706-compliance-code-english.pdf

Boland, A., Cherry, M. G., & Dickson, R. (2014). *Doing a Systematic Review: A*

    Student's Guide. Thousand Oaks, CA: SAGE Publications, Inc.

Boyd, B., McDonough, S., Bodfish, J. (2012). Evidence-based behavioral interventions

    for repetitive behaviors in autism. *Journal of Autism and Developmental*

    Disorders, 42(6), 1236-48. doi:10.1007/s10803-011-1284-z

Carroll, R. A., & Kodak, T. (2014). An evaluation of interrupted and uninterrupted

    measurement of vocal stereotypy on perceived treatment outcomes. *Journal of*

    Applied Behavior Analysis, 47(2), 264-276. doi:10.1002/jaba.118

Cassella, M. D., Sidener, T. M., Sidener, D. W., & Prograr, P. R. (2011). Response

    interruption and redirection for vocal stereotypy in children with autism: a

    systematic replication. *Journal of Applied Behavior Analysis, 44,* 169-173.

    doi:10/1901/jaba.2011.44-169

Chebli, S., Martin, V., & Lanovaz, M. (2016). Prevalence of stereotypy in individuals

    with developmental disabilities: a systematic review. *Journal of Autism and*

    Developmental Disorders, 3(2), 107-118. doi:10.1007/s40489-106-0069-x

Christensen, D. L., Baio, J., Van Naarden Braun, K., et al. (2012). Prevalence and

    characteristics of autism spectrum disorder among children aged 8 years. *Autism*

    and Developmental Disabilities Monitoring Network. Retrieved from:

    https://www.cdc.gov/ncbddd/autism/documents/comm-report-autism-full-

    report.pdf

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

    edition. New York, NY: Pearson.

Culatta, R. (2015). Operant Conditioning. Retrieved from

    http://www.instructionaldesign.org/theories/operant-conditioning.html

Cunningham, A., & Schreibman, L. (2008). Stereotypy in autism: the importance of

    function. *Research in Autism Spectrum Disorders, 2*(3), 469-479.

    doi:10.1016/j.rasd.2007.09.006

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation

    format for assessing reinforcer preferences. *Journal of Applied Behavior*

    Analysis, 29(4), 519-533. Retrieved from https://www.ncbi.nlm.nih.gov

    /pmc/articles/PMC1284008/pdf/8995834.pdf

Dickman, S. E., Bright, C. N., Montgomery, D. H., & Miguel, C. F. (2012). The effects

    of response interruption and redirection (RIRD) and differential reinforcement on

    vocal stereotypy and appropriate vocalizations. *Behavioral Interventions, 27,* 185-

    192. doi:10.1002/bin.1348

Durand, V. M., & Carr, E. G. (1987). Social influences on self-stimulatory behavior: analysis and treatment application. *Journal of Applied Behavior Analysis, 27,* 279-289. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles /PMC1285962/pdf/jaba00100-0011.pdf

Durand, V. M., & Crimmins, D. B. (1992). *The Motivation Assessment Scale (MAS) administration guide.* Topeka, KS: Monaco and Associates.

Enloe, K., & Rapp, J. (2014). Effects of noncontingent social interaction on immediate and subsequent engagement in vocal and motor stereotypy in children with autism. *Behavior Modification, 38*(3), 374-391. doi:10.1177/0145445513514081

Foster, L. G. (1998). Nervous habits and stereotyped behaviors in preschool children. *Journal of American Academy of Child and Adolescent Psychiatry, 37*(4), 711-717. doi:10/1097/00004583-199807000-00010

Gast, D. (2010). *Single Subject Research Methodology in Behavioral Sciences.* New York, NY: Routledge.

Geissinger, B. (2017). What does peer review mean? San Diego State University Library. Retrieved from https://library.sdsu.edu/reference/news/what-does-peer-review-mean

Halpenny, A. M., & Patterson, J. (2014). *Introducing Piaget: A Guide for Practitioners and Students in Early Years Education.* New York, NY: Routledge.

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis, 36*(2), 147-185. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1284431

/pdf/12858983.pdf

Hanley, G. P., Piazza, C., Fisher, W., & Maglieri, K. (2005). On the effectiveness of and

preferences for punishment and extinction components of function-based

interventions. *Journal of Applied Behavior Analysis, 38,* 51-65. doi:10.1901

Higbee, T. S., Chang, S., & Endicott, K. (2005). Noncontingent access to preferred

sensory stimuli as a treatment for automatically reinforced stereotypy. *Behavioral*

Interventions, 20, 177-184. doi:10.1002/bin.190

Horrocks, E., & Higbee, T. S. (2008). An evaluation of a stimulus preference

assessment of auditory stimuli for adolescents with developmental disabilities.

Research in Developmental Disabilities, 29(1), 11-20. doi:10/1016/J.RIDD

.2006.09.033

Iwata, B. A., DeLeon, I. G., Roscoe, E. M. (2013). Reliability and validity of the

Functional Assessment Screening Tool. *Journal of Applied Behavior Analysis,*

46, 271-284. doi:10/1002/jaba.31

Kennedy, C. H., Meyer, K. A., Knowles, T., & Shukla, S. (2000). Analyzing the multiple

functions of stereotypical behavior for students with autism: implications for

assessment and treatment. *Journal of Applied Behavior Analysis, 33,* 559-571.

doi:10.1901/jaba.2000.33-559

Lanovaz, M. J., & Argumedes, M. (2010). Immediate and subsequent effects of

differential reinforcement of other behavior and noncontingent matched

stimulation on stereotypy. *Behavioral Interventions, 25,* 229-238.

doi:10.1002/bin.308

Lanovaz, M. J., Rapp, J. T., & Ferguson, S. (2013). Assessment and treatment of vocal stereotypy associated with television: a pilot study. *Journal of Applied Behavior Analysis, 46*(2), 544-548. doi:10.1002/jaba.35

Lanovaz, M. J., Fletcher, S. E., Rapp, J. T. (2009). Identifying stimuli that alter immediate and subsequent levels of vocal stereotypy: a further analysis of functionally matched stimulation. *Behavior Modification, 33*(5), 682-704. doi:10.1177/0145445509344972

Lanovaz, M. J., & Rapp, J. T. (2016). Using single-case experiments to support evidence-based decisions: how much is enough? *Behavior Modification, 40*(3), 377-395. doi:10.1177/0145445515613584

Lanovaz, M. J., & Sladeczak, I. E. (2012). Vocal stereotypy in individuals with autism spectrum disorders: a review of behavioral interventions. *Behavior Modifications, 36*(2), 146-164. doi:10/1177/0145445511427192

Lanovaz, M. J., Sladeczak, I. E., & Rapp, J. T. (2011). Effects of music on vocal stereotypy in children with autism. *Journal of Applied Behavior Analysis, 44*(3), 647-651. doi:10.1901/jaba.2011.44-647

Ledford, J. R., & Gast, D. L. (2018). S*ingle-Case Research Methodology: Applications in Special Education and Behavioral Sciences, 3rd edition.* New York, NY: Routledge.

Liu-Gitz, L., & Banda, D. R. (2009). A replication of the RIRD strategy to decrease vocal stereotypy in a student with autism. *Behavioral Interventions, 25*(1), 77-87. doi:10.1002/bin.297

Lovaas, I., Newsom, C., & Hickman, C. (1987). Self-stimulatory behavior and

    perceptual reinforcement. *Journal of Applied Behavior Analysis, 20,* 45-68.

    doi:10.1901/jaba/1987.20-45

MacDonald, R., Green, G., Mansfield, R., Geckeler, A., Gardenier, N., Anderson, J.,

    Holcomb, W., & Sanchez, J. (2007). Stereotypy in young children with autism

    and typically developing children. *Research in Developmental Disabilities, 28,*

    266-277. doi:10.1016/j.ridd.2006.01.004

Mace, F. C., & Belfiore, P. (1990). Behavioral momentum in the treatment of escape-

    motivated stereotypy. *Journal of Applied Behavior Analysis, 23,* 507-514.

    Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1286266/pdf

    /jaba00090-0118.pdf

Mallett, R., Hagen-Zanker, J., Slater, R., & Duvendack, M. (2012). The benefits and

    challenges of using systematic reviews in international development research.

    Journal of Development Effectiveness, 4:3, 445-455. doi:10.1080/19439342.2012

    .711342

Mayo Foundation for Medical and Educational Research. (2018). Autism Spectrum

    Disorders. Retrieved from https://www.mayoclinic.org/diseases-

    conditions/autism-spectrum-disorder/symptoms-causes/syc-20352928

Mays, S. D., & Calhoun, S. L. (2011). Impact of IQ, age, SES, gender, and race on

    autistic symptoms. *Research in Autism Spectrum Disorders, 5*(2), 749-757.

    doi:10.1016/j.rasd.2010.09.002

Medeiros, K. (2015). Behavioral Interventions for Individuals with Intellectual

    Disabilities exhibiting automatically-Reinforced Challenging Behavior:

    Stereotypy and Self-Injury. *Journal of Psychological Abnormalities, 4*(141).

    doi:10.4172/2329-9525.1000141

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., The PRISMA Group. (2009).

    Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The

    PRISMA Statement. *PLoS Medicine, 6*(7). Retrieved from

    http://journals.plos.org/plosmedicine/article/file?id=10.1371/journal.pmed.100009

    7&type=printable

National Autism Center at May Institute. (2009). National Standards Project. Retrieved

    from http://www.nationalautismcenter.org/national-standards-project/

National Institute of Health: National Institute on Deafness and Other Communication

    Disorders. (2010). *NIDCD Fact Sheet: Speech and Language Developmental*

    Milestones. Retrieved from https://www.nidcd.nih.gov/sites/default/files

    /Documents/health/voice/NIDCD-Speech-Language-Dev-Milestones.pdf

O'Neill, R. E., Horner, R. H., Albin, R. W., Sprague, J. R., Storey, K., & Newton, J. S.

    (1997). *Functional Assessment and Program Development for Problem*

    Behavior. Pacific Grove, CA: Brooks/Cole Publishing. Retrieved from

    http://www.txautism.net/assets/uploads/docs/FAI-ed-KS-AK.pdf

Pastrana, S., Rapp, J., & Frewing, T. (2013). Immediate and subsequent effects of

    response interruption and redirection on targeted and untargeted forms of

    stereotypy. *Behavior Modification, 37*(4), 591-610.

    doi:10.1177/0145445513485751

Petitto, L. A. (2000). On The Biological Foundations of Human Language. In K.

    Emmorey and H. Lane (Eds.) *The signs of language revisted: An anthology in*

    honor of Ursula Bellugi and Edward Klima. Mahway, N.J.: Lawrence Erlbaum

    Assoc. Inc. Retrieved from https://books-googlecom.ezproxylocal.library.nova

    .edu/books?hl=en&lr=&id=xrKOOslc2LgC&oi=fnd&pg=PR2&dq=Petitto,+L.+

    A.+(2000).+On+The+Biological+Foundations+of+Human+Language.+In+K.+E

    mmorey+and+H.+Lane+(Eds.)+The+signs+of+language+revisited:+An+antholog

    y+in+honor+of+Ursula+Bellugi+and+Edward+Klima.+Mahwah,+N.J.:+Lawrenc

    e+Erlbaum+Assoc.+Inc.&ots=8wxPPVSeO2&sig=OxDnMvHpSI4NFNVfm8pnP

    o6afgk#v=onepage&q&f=false

Piazza, C., Adelinis, J., Hanley, G., Goh, H., & Delia, M. (2000). An evaluation of the

    effects of matched stimuli on behaviors maintained by automatic reinforcement.

    Journal of Applied Behavior Analysis, 33(1), 13-27. Retrieved from https://www

    .ncbi.nlm.nih.gov/pmc/articles/PMC1284219/pdf/10738949.pdf

Prince, K. (2013). The Difference between Positive/Negative Reinforcement and

    Positive/Negative Punishment. [Blog post]. Retrieved from https://bcotb.com/the-

    difference-between-positivenegative-reinforcement-and-positivenegative-

    punishment/

Rapp, J., Cook, J., McHugh, C., & Mann, K. (2017). Decreasing stereotypy using NCR

    and DRO with functionally matched stimulation: Effects on targeted and non-

    targeted stereotypy. *Behavior Modification, 4*(1), 45-83. doi:10.1177/14544455

    16652370

Rapp, J., Swanson, G., Sheridan, S., Enloe, K., Maltese, D., Sennott, L. …Lanovaz, M. (2013). Immediate and subsequent effects on matched and unmatched stimuli on targeted vocal stereotypy and untargeted motor stereotypy. *Behavior Modification, 37*(4), 543-567/. doi:10.1177/0145445512461650

Rapp, J. T., & Vollmer, T. R. (2005). Stereotypy I: a review of behavioral assessment and treatment. *Research in Developmental Disabilities, 26,* 527-547. doi:10.1016/j.ridd.2004.11.005

Reynolds, S., Lane, S. J., & Richards, L. (2010). Using animal models of enriched environments to inform research on sensory integration intervention for the rehabilitation of neurodevelopmental disorders. *Journal of Neurodevelopmental Disorders, 2*(3), 120-132. doi:10.1007/s11689-010-9053-4

Rising Tide. (2014). Only one year after launching, award-winning Rising Tide Care Wash has made unprecedented strides in empowering young adults with autism [Blog Post}. Retrieved from: http://risingtidecarwash.com/only-one-year-after-launching-award-winning-rising-tide-car-wash-has-made-unprecedented-strides-in-empowering-young-adults-with-autism/

Saylor, S., Sidener, T. M., Reeve, S. A., Fetherston, A., & Progar, P. R. (2012). Effects of three types of noncontingent auditory stimulation on vocal stereotypy in children with autism. *Journal of Applied Behavior Analysis, 45,* 185-190. doi:10.1901/jaba.2012.45-185

Shawler, L., & Miguel, C. (2015). The effects of motor and vocal response interruption and redirection on vocal stereotypy and appropriate vocalizations. *Behavioral Interventions, 30*(2), 112-134. doi:10.1002/bin.1407

Shillingsburg, M. A., Lomas, J. E., & Bradley, D. (2012). Treatment of vocal stereotypy in an analogue and classroom setting. *Behavioral Interventions, 27*(3), 151-163. doi:10.1002/bin.1340

Sidener, T. M., Carr, J. E., & Firth, A. M. (2005). Superimposition and withholding of edible consequences as treatment for automatically reinforced stereotypy. *Journal of Applied Behavior Analysis, 38,* 121-124. doi:10.1901/jaba.2005/58-04

Skinner, B. F. (1938). *The Behavior of Organisms: An Experimental Analysis.* New York, NY: Appleton-Century-Crofts, Inc. Retrieved from https://books-google-com.ezproxylocal.library.nova.edu/books?hl=en&lr=&id=S9WNCwAAQBAJ&oi=fnd&pg=PT20&dq=Skinner,+BF+1938+The+behavior+of+organisms&ots=Llssanx ACY&sig=cdr_eGt3yo0eNwGYdtXVl9hAI7k#v=onepage&q=Skinner%2C%20BF%201938%20The%20behavior%20of%20organisms&f=false

Sprague, J., Holland, K., & Thomas, K. (1997). The effect of noncontingent sensory reinforcement, contingent sensory reinforcement, and response interruption on stereotypical and self-injurious behavior. *Research in Developmental Disabilities, 18,* 61-77. doi:10.1016/S0891-4222(96)00038-8

Tate, R. L., Perdices, M., Rosenkoetter, U., McDonald, S., Togher, L., Shadish, W., ... Vohra, S. (2016). The Single-Case Reporting Guideline In Behavioral Interventions (SCRIBE) 2016: Explanation and Elaboration. *Archives of Scientific Psychology, 4,* 10-31. doi/10.1037/arc0000027

Taylor, B. A., Hoch, H., & Weissman, M. (2005). The analysis and treatment of vocal stereotypy in a child with autism. *Behavioral Interventions, 20,* 239-253. doi:10.1002/bin.200

Thomeer, M. L., McDonald, C. A., Rodgers, J. D., & Lopata, C. (2017). High-functioning autism spectrum disorder: A framework for evidence-based practices. *School Mental Health.* doi:10.1007/s12310-017-9236-1

Vollmer, T. R. (1994). The concept of automatic reinforcement: Implications for behavioral research in developmental disabilities. *Research in Developmental Disabilities, 15,* 187–207. doi:10.1016/0891-4222(94)90011-6

Vollmer, T. R., Iwata, B. A., Zarcone, J. R., Smith, R. G., & Mazaleski, J. L. (1993). The role of attention in the treatment of attention-maintained self-injurious behavior: noncontingent reinforcement and differential reinforcement of other behavior. *Journal of Applied Behavior Analysis, 26,* 9-21. Retrieved from https://www-ncbi-nlm-nih-gov.ezproxylocal.library.nova.edu/pmc/articles/PMC1297716/pdf/jaba00011-0011.pdf

Vollmer, T. R., Marcus, B. A., & LeBlanc, L. (1994). Treatment of self-injury and hand mouthing following inconclusive functional analyses. *Journal of Applied Behavior Analysis, 27,* 331-344. doi:10.1901/jaba.1994.27-331

Watkins, N., Paananen, L., Rudrud, E., & Rapp, J. (2011). Treating vocal stereotypy with environmental enrichment and response cost. *Clinical Case Studies, 10*(6), 440-448. doi:10.117/1534650111429377

Watkins, N., & Rapp, J. T. (2014). Environmental enrichment and response cost: immediate and subsequent effects on stereotypy. *Journal of Applied Behavior Analysis, 47,* 186-191. doi:10.1002/jaba.97

Wilke, A. E., Tarbox, J., Dixon, D. R., Kenzer, A. L., Bishop, M. R., & Kakavand, H. (2012). Indirect functional assessment of stereotypy in children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 6,* 824-828. doi:10.1016/j.rasd.2011.11.033

Wong, C., Odum, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., … & Schultz, T. R. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of Autism and Developmental Disabilities, 45,* 1951-1966. doi:10.1007/s10803-014-2351-z

Wunderlich, K. L., & Vollmer, T. R. (2015). Data analysis of response interruption and redirection as a treatment for vocal stereotypy. *Journal of Applied Behavior Analysis, 48,* 749-764. doi:10.1002/jaba.227

Appendix A

The Research Screening and Selection Tool

Appendix A. The Research Screening and Selection Tool.

Review Questions: What are the effects of noncontingent reinforcement on vocal stereotypy in children with autism spectrum disorders? What effect does adding matched or unmatched stimuli to noncontingent reinforcement have when treating vocal stereotypy in children with autism spectrum disorders? What are the effects of RIRD on vocal stereotypy in children with autism spectrum disorders? What effects are reported when noncontingent reinforcement is paired with RIRD in a treatment package for vocal stereotypy in children with autism spectrum disorders?		
Inclusion Criteria (based on PICOS): Population = children with autism spectrum disorder Intervention = NCR, RIRD, or combination of both Comparators = NCR, RIRD, or combination of both Outcomes = % of sessions or time vocal stereotypy was exhibited Study Design = any single-subject experimental research design		
SCREENING AND SELECTION TOOL		
Population	**Include:** Children w/ASD ages 3-21 **May include**: Children with ID as long as majority of participants have ASD	**Exclude:** Children younger than 3 or older than 21 Children not diagnosed with ASD
Interventions	**Include:** NCR RIRD Combination of both	**Exclude:** NCR and/or RIRD combined with other interventions Studies without NCR or RIRD
Comparators	**Include:** NCR RIRD Combination of both	**Exclude** NCR and/or RIRD compared to other interventions
Outcomes	**Include:** % of sessions/time vocal stereotypy was exhibited **May include:** % of sessions/time engaged in alternative/appropriate behavior	**Exclude:** No % or amount of sessions/time vocal stereotypy was exhibited
Study Design	**Include:** Any single-subject experimental study design	**Exclude:** Any research designs that were not single-subject experimental designs
Overall Decision	**Include**	**Exclude**

Appendix B

The SCRIBE Checklist

Appendix B. The SCRIBE Checklist.

The Single-Case Reporting guideline In BEhavioural interventions (SCRIBE) 2016 Checklist

Item number	Topic	Item description	Notes
TITLE and ABSTRACT			
1	Title	Identify the research as a single-case experimental design in the title	
2	Abstract	Summarise the research question, population, design, methods including intervention/s (independent variable/s) and target behaviour/s and any other outcome/s (dependent variable/s), results, and conclusions	
INTRODUCTION			
3	Scientific background	Describe the scientific background to identify issue/s under analysis, current scientific knowledge, and gaps in that knowledge base	
4	Aims	State the purpose/aims of the study, research question/s, and, if applicable, hypotheses	
METHODS			
	DESIGN		
5	Design	Identify the design (e.g., withdrawal/reversal, multiple-baseline, alternating-treatments, changing-criterion, some combination thereof, or adaptive design) and describe the phases and phase sequence (whether determined *a priori* or data-driven) and, if applicable, criteria for phase change	
6	Procedural changes	Describe any procedural changes that occurred during the course of the investigation after the start of the study	
7	Replication	Describe any planned replication	
8	Randomisation	State whether randomisation was used, and if so, describe the randomisation method and the elements of the study that were randomized	
9	Blinding	State whether blinding/masking was used, and if so, describe who was blinded/masked	
	PARTICIPANT/S or UNIT/S		
10	Selection criteria	State the inclusion and exclusion criteria, if applicable, and the method of recruitment	
11	Participant characteristics	For each participant, describe the demographic characteristics and clinical (or other) features relevant to the research question, such that anonymity is ensured	
	CONTEXT		
12	Setting	Describe characteristics of the setting and location where the study was conducted	
	APPROVALS		
13	Ethics	State whether ethics approval was obtained and indicate if and how informed consent and/or assent were obtained	
	MEASURES and MATERIALS		
14	Measures	Operationally define all target behaviours and outcome measures, describe reliability and validity, state how they were selected, and how and when they were measured	
15	Equipment	Clearly describe any equipment and/or materials (e.g., technological aids, biofeedback, computer programs, intervention manuals or other material resources) used to measure target behaviour/s and other outcome/s or deliver the interventions	
	INTERVENTIONS		
16	Intervention	Describe intervention and control condition in each phase, including how and when they were actually administered, with as much detail as possible to facilitate attempts at replication	
17	Procedural fidelity	Describe how procedural fidelity was evaluated in each phase	
	ANALYSIS		
18	Analyses	Describe and justify all methods used to analyse data	
RESULTS			
19	Sequence completed	For each participant, report the sequence actually completed, including the number of trials for each session for each case. For participant/s who did not complete, state when they stopped and the reasons	
20	Outcomes and estimation	For each participant, report results, including raw data, for each target behaviour and other outcome/s	
21	Adverse events	State whether or not any adverse events occurred for any participant and the phase in which they occurred	
DISCUSSION			
22	Interpretation	Summarise findings and interpret the results in the context of current evidence	
23	Limitations	Discuss limitations, addressing sources of potential bias and imprecision	
24	Applicability	Discuss applicability and implications of the study findings	
DOCUMENTATION			
25	Protocol	If available, state where a study protocol can be accessed	
26	Funding	Identify source/s of funding and other support; describe the role of funders	

Appendix C

The SCRIBE Checklist Study Quality Appraisal

Appendix C. The SCRIBE Checklist Study Quality Appraisal.

	Study	Ahearn et al., 2007	Ahrens et al., 2011	Cassella et al., 2011	Enloe & Rapp, 2014	Lanovaz et al., 2012	Lanovaz et al., 2011	Lanovaz et al., 2012	Liu-Gitz & Banda, 2010	Love et al., 2012	Pastrana et al., 2013	Saylor et al., 2012	Schumacher & Rapp, 2011	Shawler & Miguel, 2015	Wunderlich & Vollmer, 2015
Title & Abstract	Title	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Abstract	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Introduction	Scientific Background	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Aims	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Design	Design	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Procedural Changes	NA	✓	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Replication	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Randomization	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Blinding	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Participants	Selection Criteria	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Participants' Characteristics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Context	Setting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Approvals	Ethics	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Measures & Materials	Measures	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Equipment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Interventions	Intervention	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Procedural Fidelity	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Analyses	Analysis	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Results	Sequence Completed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Outcomes & Estimation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Adverse Events	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Discussion	Interpretation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Limitations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Applicability	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Documentation	Protocol	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Funding	NS	NS	NS	NS	✓	NS	NS	NS	NS	✓	NS	NS	✓	NS

Note. ✓ = yes (item adequately addressed); x = no (item not adequately addressed); NS = Not stated; NA = Not applicable.

Appendix D

Studies Comparison Results

Appendix D. Study Comparison Results.

Authors	Year	N =	Assessments	Intervention	Results
Ahearn et al.	2007	4	FA	RIRD	4 participants showed decrease in % of intervals VS was exhibited; 3 out of 4 showed significant increases in AV
Ahrens et al.	2011	4	FA	Motor RIRD & Vocal RIRD	4 participants showed decrease in % of intervals VS was exhibited; frequency of AV increased for all participants; Motor RIRD & Vocal RIRD equally effective
Cassella et al.	2011	2	FAI, FAST, & MAS	RIRD	Both participants showed significant decrease in % of intervals VS was exhibited
Enloe & Rapp	2014	3	Brief FA	NCR (Social Interaction)	3 participants showed immediate decrease in % of time with VS & did not show subsequent increases in VS
Lanovaz et al.	2012	4	Modified Paired-Choice Preference Assessment	NCR (Music)	3 out of 4 participants showed lower % of time engaged in VS during high preference music compared to low preference and when compared to baseline
Lanovaz et al.	2011	2	FA	NCR (Music)	Both participants showed decrease in % of time engaged in VS during HI and LI music; changes in volume did not produce significant differences
Lanovaz et al.	2012	4	FA	NCR (Music)	3 out of 4 participants showed decreased in % of time engaged in VS
Liu-Gitz & Banda	2010	1	FA	RIRD	Participant showed significant reduction in % of occurrences of VS & increased AV
Love et al.	2012	2	FA, SPA (MSWO), Matched Stimuli assessment, RIRD probes	RIRD	Both participants showed decreases in % of session time with VS & increases in frequency of AV
Pastrana et al.	2013	2	None	RIRD	1 out of 2 participants showed decrease in % of time exhibiting VS
Saylor et al.	2012	2	None	NCR (Auditory stimulation)	Both participants showed decreases in % of time engaged in VS (largest decrease with music, followed by audiotaped self stereotypy)
Schumacher & Rapp	2011	2	No interaction sequence	RIRD	Both participants showed decreases in % time engaged in VS
Shawler & Miguel	2015	5	FA, SPA (MSWO)	Motor RIRD & Vocal RIRD	4 out of 5 participants showed decreases in % of VS and increases in AV
Wunderlich & Vollmer	2015	7	FA; Demand assessment	Motor RIRD & Vocal RIRD	All 7 participants showed reduction in % of intervention & non-intervention time with VS; only 2 out of 7 participants showed reduction in % of entire session with VS; VRIRD & MRIRD were equally effective

Note. VS = Vocal Stereotypy; AV = Appropriate Vocalizations; VRIRD = Vocal RIRD; MRIRD = Motor RIRD; FA = Functional Analysis; SPA = Stimulus Preference Assessment.

Appendix E

Research Strategy PRISMA Diagram

Appendix E. Research Strategy PRISMA Diagram.