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A Review of Antecedent- and Consequence-Based Interventions for Vocal Stereotypy

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by

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TABLE OF CONTENTS

Abstract ii

Chapter One: Introduction 1

Chapter Two: Antecedent-Based Interventions 7
- Single Component Interventions 7
  - Noncontingent Reinforcement (NCR) 7
    - Matched Stimulation 8
    - Unmatched Stimulation 10
- Multicomponent Interventions 10

Chapter Three: Consequence-Based Interventions 12
- Single Component Interventions 12
  - Differential Reinforcement of Other Behavior (DRO) 12
  - Response Interruption and Redirection (RIRD) 13
    - Vocal Demands 13
    - Motor Demands 14
- Multicomponent Interventions 16

Chapter Four: Antecedent- and Consequence-Based Interventions 18
- Single Component Interventions 18
  - Discrimination Training 18
  - RIRD 19
  - DRO 20
- Multicomponent Interventions 21

Chapter Five: Conclusion 23

References 26

Appendix A: Antecedent-Based Interventions 39

Appendix B: Consequence-Based Interventions 41

Appendix C: Antecedent- and Consequence-Based Interventions 44

ABSTRACT

The exact prevalence of vocal stereotypy within individuals diagnosed with ASD in currently unknown. In a 2011 study on symptoms of ASD by Mayes and Calhoun, 85% of parents reported their child engaged in repetitive, atypical speech or vocalizations. While there is a plethora of research on behavioral interventions to reduce levels of vocal stereotypy in individuals diagnosed with Autism Spectrum Disorder, at the time this review was written there is only one published review of the literature written by Lanovaz and Sladeczek in 2011. Therefore, the purpose of this paper is to extend and update the 2011 review conducted by Lanovaz and Sladeczek. Like the former article, this paper describes and compares various antecedent-based interventions and consequence-based interventions. NCR appears to be the most studied and effective antecedent-based intervention to lessen immediate engagement in VS. RIRD (both motor and vocal demands) and differential reinforcement appear to be the most studied consequence-based interventions. Though RIRD is labor intensive for the individual implementing the procedure and can be disruptive, it appears to be the most effective consequence-based intervention for lowering levels of VS. Unlike the Lanovaz and Sladeczek (2011) article, this paper also examines studies which utilize both antecedent- and consequence-based interventions. While RIRD + antecedent-based interventions and DRO + antecedent-based interventions appear to be the most researched multicomponent interventions, other combinations of antecedent- and consequence-based interventions should be examined due to the results of the interventions discussed appearing to be very specific to each individual.

CHAPTER ONE:

INTRODUCTION

In today's society, the prevalence of Autism Spectrum Disorder (ASD) is rapidly increasing. Currently, about 1 in 54 children are diagnosed with ASD. ASD affects all ethnic, racial, and socioeconomic groups (Centers for Disease Control and Prevention [CDC], 2020a). ASD can cause significant difficulties with social interactions, communication, and behavioral challenges (CDC, 2020b). Individuals diagnosed with ASD encompass a wide spectrum of abilities ranging from severely impeded to gifted. Some individuals may require intensive daily support while other individuals may not need any support (CDC 2020b). While there are often no physical differences between a typically developing person and a person diagnosed with ASD, there is often a vast difference in the way in which he or she thinks, learns, problem-solves, and behaves (CDC, 2020b).

One of the key diagnostic elements for ASD is a deficit in communication. Individuals with ASD have difficulties deciphering body language, gestures, or tone of voice (CDC, 2020a). While individuals with ASD have difficulties in interpreting another individuals' communication, they also have trouble conveying their wants and needs (CDC, 2019). Some examples of such communication issues are repeating words or phrases, using limited gestures, delayed language skills, and speaking in a flat tone of voice (CDC, 2019). Additionally, roughly 40% of individuals diagnosed with ASD do not speak at all (CDC, 2019).

In addition to issues with social communication and relationships, repetitive and restricted interests, activities, interests, and patterns of behavior are also an essential diagnostic element for ASD (CDC, 2020c). These can be manifested in multiple ways: stereotyped or repetitive speech, movements, or use of objects; inflexible routines or ritualized patterns of behavior; fixed interests that are unusual in content or intensity; or hyper- or hyposensitivity to sensory elements in the environment (CDC, 2020c). This paper will focus on aspects of the first criterion listed: stereotyped or repetitive speech, movements, or use of objects. The encompassing term for said criterion is stereotyped behavior or stereotypy. In a systematic review of the literature, Chebli and fellow authors (2016) found that 88% of research participants diagnosed with ASD engage in stereotypic behavior. A behavior is considered stereotypy when it is repetitious, rigid, and uniform (Turner, 1999). Stereotypy is not exclusively exhibited by individuals with ASD. Typically developing children and adults engage in stereotyped behavior. Examples of this include smoking, nail biting, hair twirling, and watching television (Cunningham & Schreibman, 2008). The difference is stereotyped behavior displayed by individuals with ASD tend to be socially, naturally, and developmentally inappropriate (Cunningham & Schreibman, 2008; Turner, 1999). Individuals who engage in high rates of stereotypy can experience difficulties interacting with family members, learning in vocational and school settings, and social interactions within their community (Wilke et al., 2012).

Currently, stereotypy is classified into three main typographies: stereotyped or repetitive motor movements, stereotyped or repetitive use of objects, or stereotyped or repetitive speech (American Psychiatric Association, 2013). This paper will focus on vocal stereotypy (VS) exclusively. VS is a heterogenous behavior that can manifest in many different ways: unintelligible speech (Rapp et al., 2009), non-conversational speech (O'Connor et al., 2011),

non-contextual sounds or words (Cook et al., 2014; Falcomata et al., 2004) and continual sounds (Anderson & Le, 2011). The exact prevalence of VS within individuals diagnosed with ASD in currently unknown. In a 2011 study on symptoms of ASD, 85% of parents reported their child engaged in repetitive, atypical speech or vocalizations (Mayes & Calhoun, 2011). For each individual with ASD exhibiting VS, the topography of his or her atypical speech or vocalizations may vary greatly. Scripting (also referred to as echolalia) involves the individual repeating phrases they have previously heard (Stone & Church, 1957). The individual may script names, part of a song, or lines from a movie (Stone & Church, 1957). The script may be repeated continuously throughout the day, or emitted as a response to an environmental stimulus (Stone & Church, 1957). Delayed echolalia occurs when the script is repeated after time has elapsed, whereas echolalia is when the script is repeated immediately after the individual hears the phrase (Wolf & Chess, 1965). Another topography of VS is non-contextual speech or sounds (Ahearn et al., 2007). These can vary in duration, intensity, and clarity (Ahearn et al., 2007). In addition, non-contextual speech or sounds often do not resemble comprehendible speech and are not the repetition of vocalizations (Falcomata et al., 2004). For the sake of cohesiveness within this paper, VS will be used as an umbrella term for numerous topographies listed in the research articles.

According to Cunningham and Schreibman (2008), stereotypies not only vary in form, but also in "environmental determination- across individuals, context, setting, and time." (p. 472). The most notable maintaining reinforcement contingency of stereotypy is the sensory function or automatic reinforcement (Lovaas et al., 1987; Rapp & Vollmer, 2005; Rincover, 1978; Rogers & Ozonoff, 2005). Behavior under this function is commonly referred to as self-stimulatory behavior and is automatically maintained by the reinforcing sensory stimuli the

behavior produces (Lovaas et al., 1987). Prizant and Duchan (1981) found that VS controlled by the sensory function is likely to appear nonfunctional in the present environmental context. The individual is not seeking to gain the attention of another person (e.g., making eye contact with another person or orientating body towards another person). According to the authors, it is assumed the VS itself is not being comprehended by the individual due to the lack of change in behavior (e.g., echoing the request of giving a high-five without engaging in any behavior to give a high-five). The authors also stated the VS might occur during states of high arousal (Prizant & Duchan, 1981). VS may also serve to manage one's own behavior (Prizant & Duchan, 1981). In a study by Prizant and Duchan (1981), VS was shown to either assist the individual to rehearse a task or regulate his or her behavior. Rehearsal is demonstrated when the individual is engaging in the activity while simultaneously engaging in VS about the activity. Self-regulatory VS occurs when the individual is vocalizing to govern his or her behavior. According to the authors, rehearsal and self-regulatory prompts seem to serve a cognitive function rather than for attention or communicative purposes. That is, rather than attempting to be communicative, these topographies of VS were non-interactive with the communication partner and were often uttered below speaking volume.

While the most prominent function of stereotypic behavior is automatic, there is an expanding body of literature that suggests stereotypy may be maintained by other reinforcing properties (Kennedy et al., 2000; Repp et al., 1988). For instance, stereotypy has been shown to function as a means to gain access to attention (Lancaster et al., 2004) or tangible items (Ahearn et al., 2003) and to escape task demands (Durand & Carr, 1987). VS can be a method of communication for individuals with ASD (Tager-Flushberg et al., 2005). Even when the individual appears to not comprehend the VS, the VS is still used as a way to prolong social

interactions (Fay, 1973). This can be observed by the individual attempting to gain the attention of another person by engaging in eye contact or orientating their body towards another person (Prizant & Duchan, 1981). While typically developing individuals utilize more advanced skills, VS may be the only strategy an individual with ASD has to communicate and engage in social interactions (McEvoy et al., 1988). In a study by Lancaster and colleagues (2004), the highest rates of VS were observed during the attention function of the functional analysis. During the NCR phase of the intervention, attention by means of brief social praise were delivered on a fixed interval. For both participants, providing attention on a fixed interval schedule lessened the rate of their VS.

While VS serves a function for the individual engaging in the behavior, it is still an aberrant behavior (Rapp & Volmer, 2005). For most individuals diagnosed with ASD, stereotyped behavior encompasses the vast majority of their behavior repertoire (Rapp & Volmer, 2005). Stereotypy can be a socially stigmatizing behavior that is seen as not age-appropriate (Cunningham & Schreibman, 2008). This often restricts the individual's interaction with peers and adults, educational setting, and community involvement (Cunningham & Schreibman, 2008). As a result, they often encounter difficulties establishing and maintaining relationships, as well as difficulties in learning new skills (Cunningham & Schreibman, 2008). A study conducted by Koegel and Covert (1972) found that children who engaged in high rates of stereotypy had difficulties acquiring simple discrimination skills. However, when rates of stereotypy were lowered via punishment procedures (i.e., verbal reprimands and "if necessary slapping the subject briskly on the hands"), correct responding subsequently increased (p. 383). Follow-up studies demonstrated a similar effect with play skills; lower rates of stereotypy were associated with an increased rate of spontaneous play skills (Koegel et al., 1974). These studies

suggest high rates of stereotypy are not only associated with lower rates of skill acquisition, but also the degree in which individuals engage in more appropriate alternative behaviors. To avoid such adverse outcomes, it is important to create and implement interventions to decrease VS.

While there is a plethora of research on behavioral interventions to reduce levels of VS in individuals diagnosed with ASD (see Appendix A-C), at the time this review was written there is only one published review of the literature written by Lanovaz and Sladeczek in 2011. Such reviews are vital to the research community, especially when dealing with a large body of research. Literature reviews provide an overview of past and current studies, provide recommendations for practitioners, and aide in identifying gaps in the current literature (Lanovaz & Sladeczek, 2011). The purpose of this paper is to extend and update the review conducted by Lanovaz and Sladeczek (2011). Like the former article, this paper will describe and compare various antecedent-based interventions and consequence-based interventions. However, this paper will also examine studies which utilize multicomponent interventions (i.e., both antecedent- and consequence-based interventions). This paper also aims to suggest future directions for VS behavioral interventions based on limitations of the current literature.

CHAPTER TWO:

ANTECEDENT-BASED INTERVENTIONS

Antecedent-based interventions involve manipulation of the environment or circumstances that precede the target behavior (Wong et al., 2015). This paper will discuss some studies on decreasing VS using antecedent-based interventions; however, for a more comprehensive list please refer to Appendix A. The subsequent sections will discuss either the effects of a single antecedent-based intervention and its effects on VS, a comparison of different antecedent-based interventions and their subsequent effects on VS, or a combination of antecedent-based interventions (i.e., multicomponent) and their effects on VS.

Single Component Interventions

The following sections will discuss either the effects of a single antecedent-based intervention and its effects on VS or a comparison of different antecedent-based interventions and their subsequent effects on VS.

Noncontingent Reinforcement (NCR)

Providing continuous access to a stimulus with known reinforcing properties regardless of the presence of the target behavior is referred to as NCR (Vollmer et al., 1993). In a review of the literature, LeBlanc and colleagues (2000) found these stimuli were most effective when identified via an empirical preference assessment. Overall, NCR has been found to decrease immediate engagement in VS (Ahearn et al., 2005; Lanovaz & Argumedes, 2009; Lanovaz et al., 2009; Lanovaz et al., 2011; Rapp, 2007). In regards to automatically reinforced behavior, the

chosen stimuli are broken into two main categories: matched stimulation and unmatched stimulation (Lanovaz et al., 2009). Noncontingent physical exercise (Levinson & Reid, 1993) and noncontingent singing (Thomas et al., 2020) are additional examples of NCR. While noncontingent singing lessened levels of VS during and after the singing intervention sessions, noncontingent physical exercise had no effect on two participants and actually increased levels of VS in the third participant.

Matched Stimulation. It is hypothesized that by engaging in automatically reinforcing behavior, an individual is receiving sensory input (Lovaas et al., 1987). Matched stimulation interventions attempt to match the sensory input that an individual is receiving in the hopes it will correlate with a reduction in the motivating operation (MO) to engage in VS (Piazza et al., 1998; Piazza et al., 2000). In a dissertation by Russo (2020), the author examined the effects of multiple forms of auditory matched stimulation on VS. The auditory stimuli used in this study were white noise, a recording of the participants' VS, a book on tape (child participants), talk radio (adult participants), and a preferred song. There was also a fifth condition in which there was no auditory stimulus and the participant wore headphones. For two out of the three participants, none of the conditions yielded a socially significant decrease in levels of VS when compared to the baseline phase. Interestingly, the recording of their own VS led to the highest levels of VS for one participant while inversely showed the second lowest levels for the other participants. For the one participant whose levels of VS were affected by the auditory stimulation, the lowest levels were in the preferred music condition. During the demand condition, the participant performed at the same rate as baseline levels. This suggests that while listening to preferred music, and subsequently lowering levels of his VS, did not improve his work performance, it also did not hinder it.

Like the previously discussed article, preferred music was also shown to lessen levels of VS in a study by Lanovaz, Rapp, and Ferguson (2012). In this study, the authors examined whether listening to highly preferred music yielded lower rates of VS compared to low preference music. The preference assessment used was similar to that of Horrocks and Higbee (2008) which utilized a paired stimulus preference assessment (Fisher et al., 1992) of music. After the pair of songs were played, the participant was asked to select the one they liked the most by touching a card in front of the corresponding speaker. Once the highest and lowest preferred songs were identified, the participant was provided noncontingent access to each. For three out of four participants, noncontingent access to high preference music resulted in lower rates of VS than did low preference music. These findings emphasize the importance of ensuring the stimuli selected to compete with automatically reinforcing stereotypy are highly preferred for that individual.

While many studies have shown that matched stimulation results in immediate lower levels of VS (Enloe & Rapp, 2014; Groskreutz et al., 2011; Lanovaz, Rapp, & Ferguson, 2012; Lanovaz & Sladeczek, 2011a; Lanovaz et al., 2011; Lanovaz, Sladeczek, & Rapp, 2012; Rapp, 2007; Rapp et al., 2012; Russo, 2020; Saylor et al., 2012), it does not always result in subsequent lower levels of VS after matched stimulation is removed. In a study by Lanovaz and colleagues (2009), matched stimulation was shown to decrease subsequent levels of VS in only one out of three participants. These findings suggest that auditory stimulation is only effective while it is being administered. While lowering levels of VS is a desirable outcome, it is not always feasible to use matched stimulation in the school and community settings. Also, as shown in Russo (2020), while matched stimulation did not hinder levels of task completion, it also did not

increase levels of task completion which is preferable. Therefore, other methods to reduce levels of VS need to be explored.

Unmatched Stimulation. As described in the previous section, matched stimulation often lowers immediate levels of VS. Researchers have also examined whether unmatched stimulation, particularly high preference items, result in decreased levels of VS (Groskreutz et al., 2011; Lanovaz et al., 2009; Rapp, 2005; Rapp, 2007; Rapp et al., 2012). In a study by Groskreutz and colleagues (2011), the authors investigated whether high competition matched stimulation items and/or high preference items resulted in a decrease in VS. The two items that were selected most frequently during the paired stimulus preference assessment (Fisher et al., 1992) were selected as the participant's highly preferred items (i.e., slinky and frisbee). Subsequently, the items that correlated with lowest levels of VS were selected as high competition matched stimulation items (i.e., microphone and guitar). Before each session, the participant was given the choice between either of the two high preference or high competition matched stimulation items and was provided noncontingent access to the selected item on a fixed-time interval of 30 s. Using an ABCBC experimental design, the results demonstrated that high competition matched stimulation items correlated with the lowest levels of VS when compared to baseline and high preference items. While results are unique to each individual, overall results of current research suggest matched stimulation is more effective in reducing levels of VS in comparison to unmatched stimulation (Groskreutz et al., 2011; Lanovaz et al., 2009; Rapp, 2005; Rapp, 2007; Rapp et al., 2012).

Multicomponent Interventions

This section will discuss the effects of a combination of antecedent-based interventions (i.e., matched and unmatched stimulation) and their effects on VS. The effects of visual

stimulation (unmatched stimulation), audio stimulation (matched stimulation), and audio + visual stimulation (matched + unmatched stimulation) on VS were examined in a study by Rapp (2005). A television (TV) was used as the stimuli in this study. During the continuous TV condition, a preferred video was played and both the audio and visual aspects were turned on. In the TV visual phase, the audio on the TV was muted and only the visual aspects of the TV were presented to the participant. Contrastingly, during the TV audio phase, the visual aspects of the TV were turned off and the audio was turned on. For the two participants whose target behavior was VS, levels of VS were lowest during the audio + visual stimulation phase of the study. While VS was lowered, it is important to note that this phase also correlated with an increase in various topographies of motor stereotypy. Based on the current literature (refer to Appendix A), NCR appears to be the most studied and effective antecedent-based intervention to lessen immediate engagement in VS.

CHAPTER THREE:

CONSEQUENCE-BASED INTERVENTIONS

Consequence-based interventions involve manipulation of the environment or circumstances contingent on whether the target behavior occurred or did not occur (Lanovaz & Sladeczek, 2012). This paper will discuss some studies on decreasing VS using consequence-based interventions; however, for a more comprehensive list please refer to Appendix B. The subsequent sections will discuss either the effects of a single consequence-based intervention and its effects on VS, a comparison of different consequence-based interventions and their subsequent effects on VS, or a combination of consequence-based interventions (i.e., multicomponent) and their effects on VS.

Single Component Interventions

The following sections will discuss either the effects of a single consequence-based intervention and its effects on VS or a comparison of different consequence-based interventions and their subsequent effects on VS.

Differential Reinforcement of Other Behavior (DRO)

DRO is an intervention that entails reinforcing the absence of the target behavior for a predetermined period of time (Mazaleski et al., 1993). In a dissertation study by Kim (2012), DRO was utilized to decrease levels of VS. For this study, a token economy had already been introduced and deemed an effective visual aide for the participant. At the end of each 6 min interval, the child earned a token if he did not engage in VS during that particular interval. He

needed five tokens to earn the backup reinforcer that he selected before each session. The results of the intervention demonstrated that DRO was effective in decreasing the participant's level of VS; the last three data points of the intervention showed VS was 29% lower than the first three data points during baseline.

Response Interruption and Redirection (RIRD)

RIRD is a form of response blocking and is often used to treat automatically reinforced stereotypic behavior (Colón & Ahearn, 2019). RIRD entails interrupting each occurrence of the target behavior and redirecting the individual to a more functionally appropriate behavior (Ahearn et al., 2007). In a review of eight RIRD studies from 2007-2012, Martinez and Betz (2013) found that RIRD consistently lowered levels of automatically maintained stereotypy. RIRD can be broken up into two procedures: vocal demands during RIRD and motor demands during RIRD (Shawler & Miguel, 2015).

Vocal Demands. RIRD using vocal demands was first shown to be an effective intervention for lowering rates of VS by Ahearn and colleagues in 2007. In this pioneer study, instances of VS were interrupted by the teacher by stating the child's name and gaining his or her attention. Subsequently, the teacher redirected the child to engage in appropriate vocalizations in the form of social questions or echoics depending on the child's current skill level. Once the child engaged in three consecutive correct responses without engaging in VS, the teacher provided social praise for engaging in appropriate vocalizations. Using an ABAB empirical design, the authors demonstrated that RIRD reduced level of VS in all of the participants and increased levels of appropriate vocalizations in three out of the four participants.

While studies have demonstrated that vocal RIRD demands result in an immediate decrease in VS levels (e.g., Ahearn et al., 2007; Ahrens et al., 2011; Cassella et al., 2011; Liu-

Gitz & Banda, 2010; Miguel et al., 2009) the lasting effects of RIRD have not been extensively examined (Schumacher & Rapp, 2011). In a study by Schumacher and Rapp (2011), the authors examined whether vocal RIRD decreased immediate levels of VS as well as if the removal of RIRD resulted in a subsequent increase in levels of VS. This study used the same protocol as the Ahearn et al. (2007) study in which, contingent on the occurrence of VS, the therapist presented vocal prompts that required a vocal response from the participant (e.g., social questions, labeling actions and body parts, identifying animal sounds). The therapist kept presenting the prompts until the participant correctly answered three consecutive vocal demands in the absence of VS. The results of this study showed that RIRD resulted in an immediate reduction in VS and that the removal of VS did not result in a subsequent increase in levels of VS when compared to the no-interaction phase. These results differ in comparison with studies that show the removal of response blocking and verbal reprimands results in a subsequent increase in the levels of stereotypy (e.g., Rapp, 2006, 2007). However, the effects of RIRD were not maintained when the intervention was removed. This suggests that RIRD needs to be consistently implemented which can prove to be taxing for individuals implementing the procedure outside of the controlled clinical setting (e.g., teachers, caregivers, paraprofessionals) (Colón & Ahearn, 2019). For example, if a child engages in VS 30 times per hour, then the teacher needs to implement RIRD 30 times per hour to ensure treatment integrity (Colón & Ahearn, 2019). This is not always feasible in the natural environment such as classrooms because the teacher has to attend to other students, follow the classroom schedule, and collect accurate data (McIntyre et al., 2007).

Motor Demands. Because response blocking vocalizations is not feasible, the authors in the Ahearn et al. (2007) study presented demands that required a vocal response. This was chosen because it was assumed having the participant engage in appropriate vocalizations would

be temporarily incompatible with the VS. However, the authors also noticed the participants had lower rates of VS during the demand condition of the functional assessment. During this condition, all of the demands that were presented were non-vocal demands. The authors hypothesized the same effects as vocal demands RIRD could be achieved via non-vocal demands.

In a study by Ahrens et al. (2011), the authors set out to examine that hypotheses: could the results of vocal RIRD be achieved with motor RIRD. In this study, the authors used a multielement and reversal empirical design to compare the results of vocal RIRD and motor RIRD. The results showed that both motor and vocal RIRD were equally effective at lowering the levels of VS. These findings are particularly important because they suggest the topography of the demand does not need to match the topography of the target behavior (Ahrens et al., 2011). Also, these findings suggest motor RIRD could be a viable intervention even if the participant does not have a wide vocal repertoire or is often noncompliant (Ahrens et al., 2011). Motor RIRD avoids these issues due to the availability of physical prompting to gain compliance that is not possible during vocal RIRD (Ahrens et al., 2011). However, Ahrens and colleagues (2011) also point out that appropriate vocalizations that are prompted during vocal RIRD serve as a competitive behavior for VS because the two behaviors cannot simultaneously occur.

One of the unfavorable aspects of both vocal and motor RIRD is that it is quite time consuming to implement, interrupts access to reinforcement for appropriate behavior, and interrupts ongoing activities (Saini et al., 2015). To circumvent these adverse aspects of RIRD, Saini et al. (2015) set out to see if using just one motor demand during RIRD would be as effective as using the standard three motor RIRD demands. A combined multielement and reversal demand was used in this study. Results for the participant who engaged in VS showed

that one motor RIRD demand was as effective as three motor RIRD demands at lowering levels of VS. These results showed it was possible to reduce levels of VS using less demands overall which correlated with shorter implementation time. These results suggest RIRD with one motor demand is a less intrusive and equally effective intervention for lowering rates of VS.

Multicomponent Interventions

The following section will discuss the effects of a combination of consequence-based interventions (i.e., differential reinforcement and various consequence-based interventions) and their effects on VS. A study by Shillingsburg and colleagues (2012) showed similar results in which tokens were earned for completing demands without engaging in VS. The number of tokens needed to earn the backup reinforcer (i.e., computer time) gradually increased from one token to 15 tokens as the participant demonstrated mastery at the current level. However, this study also implemented a response cost (RC) procedure in which if the participant engaged in VS, he lost a token for each occurrence of VS. Also, if VS occurred during his computer time, he lost the opportunity to play on the computer. The results of this study demonstrated that the use of DRO and RC was an effective intervention in lowering levels of VS. While this paper discusses DRO, there are many other differential reinforcement interventions for lessening VS. One example is differential reinforcement of alternative behavior (DRA). A study by Cividini and colleagues (2019) examined the effects of DRA, RIRD (motor demands), and RIRD + DRA. In a reversal and multielement design, the authors found that both RIRD and RIRD + DRA were effective at lowering levels of VS, but DRA alone was not effective for the participant whose target behavior was VS. Another consequence-based strategy is differential reinforcement of incompatible behavior (DRI) (Dickman et al., 2012). This study examined the effects of RIRD (vocal demands) and RIRD + DRI on VS. RIRD alone increased appropriate vocalizations and

decreased VS, but further increases in appropriate vocalizations and decreases in VS occurred when RIRD + DRI was implemented. As briefly discussed in the DRO section, RC is another consequence-based intervention for decreasing VS. A study by McNamara and Cividini (2019) examined the effects of RC, RIRD (vocal demands), and RC + RIRD on levels of VS. The authors found that all three phases were effective in lessening VS, but RIRD + RC resulted in a more immediate decrease of VS. Another consequence-based intervention for decreasing VS is verbal reprimands. Cook and colleagues (2014) found that delivering verbal reprimands contingent on the occurrence of VS resulted in a decrease of engagement in VS. Based on the current literature (refer to Appendix B), RIRD (both motor and vocal demands) and differential reinforcement appear to be the most studied consequence-based interventions. Though RIRD is labor intensive for the individual implementing the procedure and can be disruptive, it appears to be the most effective consequence-based intervention for lowering levels of VS.

CHAPTER FOUR:

ANTECEDENT- AND CONSEQUENCE-BASED INTERVENTIONS

Both antecedent- and consequence-based interventions have their beneficial aspects as well as their drawbacks, as mentioned throughout this paper. Because of this, researchers often choose to utilize both antecedent- and consequence-based interventions and compare their respective effects on VS. Please refer to Appendix C for a full of list multicomponent interventions that were examined for this paper. The subsequent sections will discuss either one intervention that contains both antecedent- and consequence-based qualities, a comparison of antecedent-based and consequence-based interventions, or a combination of antecedent- and consequence-based interventions (i.e., multicomponent) and their effects on VS.

Single Component Interventions

The following sections will discuss either one intervention that contains both antecedent- and consequence-based qualities or a comparison of antecedent-based and consequence-based interventions and their effects on VS.

Discrimination Training

As discussed by Wehmever (1995), stereotypy is an elaborate behavior that is unlikely to be entirely abolished. Taking this point of view into consideration, discrimination training might be a more reasonable intervention to lessen VS in some individuals. This is because, instead of focusing on decreasing the behavior overall, the primary focus of discrimination training is to

teach the individual when it is and is not appropriate to engage in vocal stereotypy (Haley et al., 2010). In a study by Haley et al. (2010), these effects were demonstrated in a general education classroom with a child diagnosed with ASD. Following a 10 min discrimination training, either a green card (signifying it is an appropriate time to engage in VS) or a red card (signifying it is an inappropriate to engage in VS) was placed on the corner of the participant's desk. The green card included the participant's name and the text "okay to speak out" while the red card included the participant's name and the text "quiet." Each card was presented for 15 min during the 30 min intervention phases. If the participant engaged in VS during the red card condition, the paraprofessional in the classroom picked up the card and held it roughly 6 in from his face.

The results of this study show the participant was able to discriminate between the two visual cues; levels of VS decreased during the red card condition when compared to baseline levels. Additionally, Haley and colleagues (2010) demonstrated the effects of discrimination training were able to generalize to different settings. Even though the participant's VS was greatly reduced, the target behavior still occurred approximately 20% of intervals during the red card condition. While the size of the cue cards was reduced and the textual prompts were faded, the cue cards were not able to be completely faded out (Haley et al., 2010). This suggests the individual may become dependent upon the discrimination training and unable to independently decipher when it is and is not appropriate to engage in vocal stereotypy.

RIRD

As previously discussed in chapter three, RIRD is a well-established intervention for decreasing levels of VS. However, RIRD is not without its faults. It can be time-consuming and effortful to implement (Cassella et al., 2011) and may evoke even more challenging maladaptive behavior (Cassella et al., 2011; Lerman & Vordran, 2002). Due to these shortcomings, many

studies have compared and contrasted RIRD with various antecedent-based interventions (Colón et al., 2012; Frewing et al., 2015; Gibbs et al., 2018; Gibney et al., 2020; Love et al., 2012; Miguel et al., 2009; Shawler et al., 2020; Sloman et al., 2017). One such study is by Shawler and colleagues (2019). In this study, the authors compared RIRD (vocal demands) with NCR (matched and unmatched stimulation). Using an ABAB and multi-element experimental design, the authors found that matched stimulation further reduced VS when compared to unmatched stimulation. This study also showed RIRD was more effective at lowering VS and increasing appropriate vocalizations when compared to NCR.

In a study by Colón and colleagues (2012), the authors examined the effects of verbal operant training (i.e., tact training and mand training) on VS and appropriate vocalizations. While verbal operant training increased appropriate vocalizations, it only slightly lowered levels of VS. Thus, vocal RIRD was implemented to further lower VS levels for two of the three participants. RIRD was effective in decreasing VS in these participants. This shows that while verbal operant training was effective in increasing appropriate vocalizations, RIRD was needed to produce clinically significant lower levels of VS for two of the three participants.

DRO

Also discussed in chapter three, were the pros and cons of utilizing DRO to lessen levels of VS. Many studies have compared and contrasted the effects of differential reinforcement and various antecedent-based interventions (Dounavi, 2011; Healy et al., 2019; Lanovaz & Argumedes 2009; Lanovaz et al., 2014; O'Connor et al., 2011; Scalzo et al., 2015). In a study by Lanovaz and Argumendes (2009), the authors examined the effects of DRO and matched stimulation on the immediate and subsequent engagement in VS. A three-component multi-element with brief reversals empirical design was used in this study. The results showed that

DRO did not decrease VS, but noncontingent access to matched stimulation resulted in lower immediate and subsequent engagement in VS. While DRO was unsuccessful in the Lanovaz and Argumendes (2009) study, DRO was successful at aiding participants to distinguish when VS was permissible in the Healy et al. (2019) study. In this study, the authors used DRO to condition an inhibitory stimulus (i.e., watch, wristband) for engaging in VS. Results showed that following discrimination training using DRO, VS fell to near zero levels when the participant was wearing the inhibitory stimulus.

Multicomponent Interventions

The following section with discuss the combination of antecedent- and consequence-based interventions (i.e., RIRD + antecedent-based interventions; DRO + antecedent-based interventions) and their effects on VS. Although this paper specifically discusses RIRD + antecedent-based interventions and DRO + antecedent-based interventions, there are numerous other multicomponent interventions for lessening VS. For example, Anderson and Le (2011) examined the effects of matched stimulation, response cost, DRO, differential reinforcement of alternative behavior (DRA), and overcorrection on levels of VS. The main form of overcorrection in this study entailed physically prompting the participant to engage in "shush" sign with his hand 100 times contingent on engaging in VS (p. 140). The results of this study showed that matched stimulation and overcorrection were effective in decreasing levels of VS. DRO and DRA were not effective at decreasing VS, but DRA + overcorrection (rebuilding the block tower contingent on VS) was not only effective on lessening VS, but the treatment package also increased engagement in the building block towers task. In this study, response cost was only moderately successful at reducing rates of VS. Another example of a multicomponent intervention is a study conducted by Miguel and colleagues in 2009. This study examined the

effects of medication (i.e., sertraline) and vocal RIRD on levels of VS. Sertraline is a serotonin reuptake inhibitor (SSRI) and it has been hypothesized that stereotypy is correlated with a serotonin dysfunction (McDougle et al., 1996). However, the results from the Miguel et al. (2009) study showed that sertraline did not have an effect on the participant's engagement in VS, but RIRD did decrease the participant's level of VS. While RIRD + antecedent-based interventions and DRO + antecedent-based interventions appear to be the most researched multicomponent interventions (see Appendix C), other combinations of antecedent- and consequence-based interventions should be examined due to the results of the interventions discussed appearing to be very specific to each individual.

CHAPTER FIVE:

CONCLUSION

Individuals with ASD engage in stereotypy which subsequently hinders an individual's interactions with peers, community involvement, and learning acquisition (Cunningham & Schreibman, 2008). Also, stereotyped behavior displayed by individuals with ASD tend to be socially, naturally, and developmentally inappropriate (Cunningham & Schreibman, 2008; Turner, 1999). To address this concern, various assessments and interventions have been implemented to decrease the levels of VS in individuals with ASD. VS is a heterogenous stereotypic behavior that can manifest in many different ways: unintelligible speech (Rapp et al., 2009), non-conversational speech (O'Connor et al., 2011), non-contextual sounds or words (Cook et al., 2014; Falcomata et al., 2004) and continual sounds (Anderson & Le, 2011).

While this paper examines various interventions to lessen VS (see Appendix A-C), the most common studies utilized were NCR and RIRD, whether independently or as a comparator to other antecedent- and consequence-based interventions. A dissertation in which the literature was reviewed by Royal (2018), the author found that NCR decreased levels of VS in 90% of the participants and that matched stimulation (i.e., music) yielded the largest reduction in VS. However, many studies have stressed the importance of conducting preference assessments prior to selecting the matched stimuli to be used in the intervention (Higbee et al., 2005; Lanovaz & Argumedes, 2010; Piazza et al., 2000; Rapp et al., 2007; Taylor et al., 2005). In the same dissertation by Royal (2018), the author reported RIRD resulted in a decrease in VS for 92% of

the participants and there were no significant differences between motor and vocal RIRD. However, as mentioned earlier, RIRD requires an abundance of prompting that may not be feasible in some environments (Miguel et al., 2009).

Although there has been an increase in multicomponent interventions since Lanovaz and Sladeczek's (2011) review of the literature, their suggestion of comparing different interventions directly together is still a relevant implication for future research. Although the majority of individuals engage in VS maintained by automatic reinforcement, it is still viable for future researcher to continue conducting a series of no-interaction phases or functional assessments or analyses. By comparing interventions and the functions/topographies of VS and their respective results, it will help create a hierarchy of treatments. This will reduce the trial-and-error process that comes with selecting and testing multiple interventions. Creating a treatment hierarchy will help reduce the amount of time needed to select an effective intervention, ensure the best treatment is selected for that particular individual, ensure a swifter introduction of the intervention, and aide with the selection of the treatment that will have the least undesirable side effects (Lanovaz & Sladeczek, 2012).

Another recommendation for future research is to conduct the interventions in a variety of settings to reach a greater population of individuals who engage in VS. Currently, the vast majority of the studies on decreasing VS take place in a controlled clinic, school, or home setting. It would be beneficial to conduct research in an assortment of settings to detect interventions that are effective in a more uncontrolled or naturalistic settings. The current interventions studied in the literature may prove to be too difficult to conduct with fidelity in these settings which may impact the effectiveness of the intervention (Royal 2018). Some possible settings are group homes, foster care agencies, and community activities, classrooms,

clubs. By increasing the variety of settings, the interventions are more likely to be successful in the desired setting and with the typical population that resides in the specific setting. Lastly, future research should examine the effects of these interventions on the adolescent and adult population of individuals who engage in VS. In the dissertation by Royal (2018), the author reported that half of the participants in the reviewed studies were 4 to 6 years old. As such, it is not known if these interventions will be effective with older children, adolescents, and adult population. By addressing these limitations, future research will subsequently increase the contextual fit of the interventions used to decrease levels of VS which may increase the social validity of these interventions.

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APPENDIX A:

ANTECEDENT-BASED INTERVENTIONS

Single Component Interventions			
Reference	Participants	Intervention	Results
Enloe & Rapp (2014)	1 F & 2 M; 6-13 yrs.	MS	Reduced immediate engagement VS
Groskreutz et al. (2011)	1 M; 4 yrs.	MS; UMS	MS items resulted in greater reductions of VS than UMS items
Lanovaz et al. (2009)	3 M; 5-7 yrs.	MS; UMS	MS & UMS reduced immediate VS for 2/3 participants; MS reduced subsequent VS for 1/3 participants
Lanovaz, Rapp, & Ferguson (2012)	4 M; 4-9 yrs.	MS	Highly preferred music resulted in reduced VS for 3/4 participants
Lanovaz & Sladeczek (2011a)	3 M; 6-9 yrs.	MS	Lower engagement in VS for 2/3 participants; considerable increase in inter-response time
Lanovaz et al. (2011)	1 F & 1 M; 5-6 yrs.	MS	Decreased immediate engagement in VS; did not reduce subsequent VS
Lanovaz, Sladeczek, & Rapp (2012)	4 M; 9-11 yrs.	MS	Decreased immediate VS for 3/4 participants; did not increase subsequent VS; novel toy manipulation observed for 2/4 participants
Levinson & Reid (1993)	1 F & 2 M; 11 yrs.	NCR: Noncontingent physical exercise	Walking condition: no effects for 2/3 participants & increase in VS for other participant; Jogging condition: decrease in VS for 1 participant, increase in VS for 1 participant, & no effect for 1 participant
Nikopoulos & Panagiotopoulou (2015)	2 M; 12 yrs.	Video self-modeling	One participant had large reduction in levels of VS
Experiment 1: Rapp (2007)	2 M; 9 yrs.	MS; UMS	Sound-producing toys decreased VS for one participant; Noncontingent

			music decreased VS for the other participant
Experiment 1: Rapp et al. (2012)	21 children (11 MS & 10 UMS); 6-17 yrs.	MS; UMS	MS decreased immediate engagement in VS for 8/11 participants; MS increased subsequent engagement in VS for 1/8 participants; UMS decreased immediate engagement in VS for 1/10 participants and did not increase subsequent engagement in VS for that participant
Russo (2020)	2 F & 1 M; 12-56 yrs.	MS	Preferred music decreased VS for 1/3 participants
Saylor et al., (2012)	1 F & 1 M; 5-6 yrs.	MS	Music condition resulted in the lowest levels of VS
Thomas et al., (2020)	4 M; 9-14 yrs.	NCR: Noncontingent singing	Lower levels of VS during and after noncontingent singing
Multicomponent Interventions			
Reference	Participants	Intervention	Results
Rapp (2005)	2 M; 9-11 yrs.	MS; UMS; MS + UMS	VS levels were higher during UMS

Note. MS = matched stimulation; NCR = noncontingent reinforcement; UMS = unmatched stimulation

APPENDIX B:

CONSEQUENCE-BASED INTERVENTIONS

Single Component Interventions			
Reference	Participants	Intervention	Results
Ahearn et al. (2007)	2 F & 2 M; 3-11 yrs.	RIRD (vocal demands)	Decrease in VS; increase in AV for 3/4 participants
Experiment #1: Ahrens et al. (2011)	2 M; 4-6 yrs.	RIRD (vocal demands); RIRD (motor demands)	Both decreased VS and increased AV
Experiment #2: Ahrens et al (2011)	2 M; 4-5 yrs.	RIRD (vocal demands); RIRD (motor demands)	Both decreased VS and increased AV
Cassella et al. (2011)	2 M; 4-7 yrs.	RIRD (motor demands)	Substantial decrease in VS
Experiment #1: Colón & Ahearn (2019)	1 F & 2 M; 15-21 yrs.	RIRD (vocal demands)	Decrease in VS
Cook et al. (2014)	2 F & 3 M; 5-18 yrs.	Verbal reprimands	Decrease in targeted VS
Kim (2012)	1 M; 4 yrs.	DRO	Decrease in VS
Lanovaz et al. (2013)	1 M; 6 yrs.	DRA	Decrease in VS
Experiment 2: Lanovaz et al. (2014)	1 F & 1 M; 7-63 yrs.	DRO	Reduced VS in the participants
Liu-Gitz & Banda (2010)	1 M; 10 yrs.	RIRD (vocal demands)	Decrease in VS

Saini et al. (2015)	1 M; 8 yrs.	RIRD (three motor demands); RIRD (one motor demand)	1 demand was just as effective as reducing VS as 3 demands
Schumacher & Rapp (2011)	1 F & 1 M; 5-8 yrs.	RIRD (vocal demands)	Immediate decrease in VS; withdrawal of RIRD did not produce subsequent increase in VS
Shawler & Miguel (2015)	1 F & 4 M; 5-12 yrs.	RIRD (vocal demands); RIRD (motor demands)	Both methods decreased VS and increased AV
Sivaraman & Rapp (2020)	2 M; 5-7 yrs.	RIRD (vocal demands)	5 min and 20 min components decreased immediate VS; Only 20 min component decreased subsequent VS
Taylor et al. (2005)	1 F; 6 yrs.	DRO	Decrease VS during session and across school day
Multicomponent Interventions			
Reference	Participants	Intervention	Results
Cividini et al. (2019)	1 M; 8 yrs.	RIRD (motor demands); DRA; RIRD (motor demands) + DRA	RIRD & RIRD + DRA decreased VS; No interventions increased appropriate responses
Dickman et al. (2012)	1 M; 5 yrs.	RIRD (vocal demands); RIRD (vocal demands) + DRI	RIRD slightly decreased VS and increased AV; RIRD + DRI significantly decreased VS and increased AV
McNamara & Cividini (2019)	3 M; 8-11 yrs.	RC; RIRD (vocal demands); RIRD (vocal demands) + RC	All 3 phases reduced VS; RIRD + RC yielded a more immediate decrease in VS
Shillingsburg et al. (2012)	1 M; 12 yrs.	DRO + RC	VS reduced to near zero levels
Toper-Korkmaz et al. (2018)	2 F & 1 M; 4-6 yrs.	RIRD (one vocal demand);	RIRD (one vocal demand) was as effective as the other interventions for decreasing VS; RC decreased VS in 2/3 participants

		RIRD (three vocal demands); RC + RIRD (one vocal demand); RC + RIRD (three vocal demands); RC	

Note. AV = appropriate vocalizations

APPENDIX C:

ANTECEDENT- AND CONSEQUENCE-BASED INTERVENTIONS

Single Component Interventions			
Reference	Participants	Intervention	Results
Anderson & Le (2011)	1 M; 7 yrs.	MS; RC; DRO; overcorrection	VS decreased while exposed to MS but returned to high levels once removed; DRO was not effective in reducing VS; RC was moderately effective at reducing VS; Overcorrection decreased VS by clinically significant levels
Bulla & Frieder (2017)	1 M; 8 yrs.	Self-monitoring	Significant reductions in VS
Colón et al. (2012)	1 F & 2 M; 8-10 yrs.	Verbal operant training; RIRD (vocal demands)	Verbal operant training increased AV, but did not decrease VS; RIRD decreased VS
Gibney et al. (2020)	1 F & 3 M; 12-16 yrs.	MS; RIRD (vocal demands)	RIRD was effective in decreasing VS in 3/4 participants; MS was effective in reducing VS in 2/4 participants
Haley et al. (2010)	1 M; 8 yrs.	Discrimination training	Average percentage of VS decreased when red card displayed
Lanovaz, & Argumedes (2009)	1 F; 6 yrs.	DRO; MS	DRO did not decrease VS; MS decreased immediate and subsequent VS
Experiment 1: Lanovaz et al. (2014)	3 F & 4 M; 4-63 yrs.	MS; DRA	MS decreased VS more than DRA
Mancina et al. (2000)	1 F; 12 yrs.	Self-monitoring	VS decreased during all tasks
Peña (2017)	3 M; 5-11 yrs.	RIRD (vocal demands);	VS lowest during RIRD condition

		MS; contingent MS	
Experiment 2: Rapp (2007)	2 M; 9 yrs.	UMS; MS; verbal reprimands	VS remained low following the removal of auditory stimulation; 1 participant's VS increased following the removal verbal reprimands
Scalzo et al. (2015)	1 M; 12 yrs.	MS; DRO; FCT	FCT significantly decreased VS
Shawler et al. (2020)	1 F & 1 M; 5-7 yrs.	RIRD (vocal demands); MS; UMS	RIRD resulted in gradual reductions in VS; MS resulted in immediate reductions in VS; UMS resulted in no consistent change in VS
Multicomponent Interventions			
Reference	Participants	Intervention	Results
Athens et al. (2008)	1 M; 11 yrs.	UMS + contingent academic demand + RC	Treatment package was effective at decreasing VS and remained effective after UMS was removed
Dounavi (2011)	1 M; 11 yrs.	DRO + sensory-integrative therapy; DRO	DRO + sensory-integrative therapy decreased VS; DRO remained effective when sensory-integrative therapy was removed
Falcomata et al. (2004)	1 M; 18 yrs.	MS; MS + RC	MS + RC yielded immediate decrease in VS when compared to MS alone
Frewing et al. (2015)	1 M; 19 yrs.	RIRD (vocal demands) + discrimination training	Immediate reduction in VS and did not increase subsequent VS when treatment removed
Gibbs et al. (2018)	1 F & 1 M; 4-7 yrs.	RIRD (vocal demands); RIRD (vocal demands) + MS	RIRD (vocal demands) + MS resulted in greater decrease of VS and increased on task behavior
Healy et al. (2019)	3 M; 7-11 yrs.	DRO + discrimination training; discrimination training	VS decreased VS in the presence of the visual cue even when DRO was removed

Experiment 3: Lanovaz et al. (2014)	2 F & 4 M; 4-36 yrs.	MS + prompting; DRA + prompting; MS + DRA + prompting	DRA + prompting results in immediate reduction of VS; MS + prompting reduced VS; MS + DRA + prompting produced even larger reductions in VS
Laprime & Dittrich (2014)	1 M; 4 yrs.	Discrimination training + social story + DRL + RC	Treatment package decreased VS
Love et al. (2012)	2 M; 8-9 yrs.	RIRD (vocal demands); RIRD (vocal demands) + MS	RIRD alone increased AV and decreased VS; RIRD + MS produced lower VS for one participant
Miguel et al. (2009)	1 M; 4 yrs.	RIRD (vocal demands); Sertraline	RIRD decreased VS and increased AV; Sertraline did not decrease VS
O'Connor et al. (2011)	1 M; 11 yrs.	Discrimination training + DRO; discrimination training	Discrimination training + DRO resulted in decrease of VS; Discrimination training continued to have effect even when DRO removed
Rapp et al. (2009)	3 M; 5-8 yrs.	Verbal reprimands + discrimination training; RC + discrimination training; discrimination training	Verbal reprimands + discrimination training decreased VS for 2/3 participants; Verbal reprimands not effective for one participant so RC was introduced and decreased VS; Discrimination training demonstrated inhibitory control for 1/3 participants
Sloman et al. (2017)	1 M; 13 yrs.	RIRD (vocal demands) + discrimination training; discrimination training; RIRD (vocal demands)	RIRD (vocal demands) + discrimination training and RIRD effective at decreasing VS; Discrimination training alone not effective in reducing VS

Watkins et al. (2011)	1 F & 1 M; 7-11 yrs.	RC + environmental enrichment	RC + environmental enrichment immediately reduced VS and eventually eliminated VS in 1/2 participants; RC + environmental enrichment reduced VS to near zero levels in 1/2 participants

Note. FCT = functional communication training; DRL = differential reinforcement of low rates of behavior