A COMPARISON OF VOCAL AND MOTOR RESPONSE INTERRUPTION AND REDIRECTION (RIRD) ON VOCAL STEREOTYPY

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Department of Psychology
Abstract

of

A COMPARISON OF VOCAL AND MOTOR RESPONSE INTERRUPTION AND REDIRECTION (RIRD) ON VOCAL STEREOTYPY

by

Lesley Ann Macpherson

Stereotypy has been defined as repetitive vocal or motor behaviors that are noncontextual with invariant topographies. There is an extensive literature describing specific behavioral interventions to suppress and eliminate stereotypic behaviors. One of these interventions consists of the use of a response interruption and redirection (RIRD) procedure to successfully reduce vocal stereotypy, and increase appropriate vocalizations among children with autism. RIRD consists of demands that interrupt and redirect inappropriate vocalizations. The purpose of this study was to extend the research on RIRD by implementing vocal and motor RIRD contingent upon the occurrence of vocal stereotypy. Appropriate vocalizations were observed for concomitant increases as well. Data were examined using a reversal design to compare the effects of treatment to when treatment was removed. Results suggested that the RIRD package was an effective intervention to reduce stereotypy for three participants. More specifically, findings suggested that the topography of demands to interrupt stereotypy did not significantly differ, and that appropriate vocalizations increased for two participants.

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Date

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Chapter 1

INTRODUCTION

Stereotypic responding has been defined as repetitious acts, with invariant topographies, that have no apparent function (LaGrow & Repp, 1984). Stereotypic behaviors are highly idiosyncratic across individuals but may occur in the form of repetitive body or hand movements, vocalizations, and occasionally as different topographies of self-injurious behavior (SIB) (e.g., Goh, Iwata, Shore, DeLeon, Lerman, Ulrich, & Smith, 1995). Berkson (1983) described the defining features of stereotypy as behavior that (a) is operant, (b) lacks variability, (c) persists over time, (d) is resistant to environmental changes, and (e) is developmentally and age inappropriate. Stereotypy may occur in both children as well as adults with and without clinical disorders (Foster, 1998; Troster, 1994). However, it is most widely known as a characteristic of individuals with developmental disabilities, and more commonly, of those diagnosed with an Autism Spectrum Disorder (ASD) (DSM IV-TR; American Psychiatric Association, 2005).

Stereotypic behaviors have occurred as a variety of topographies (Berkson, Gutermuth, & Baranek, 1995), and may serve a variety of behavioral functions (Rapp & Vollmer, 2005). The main categories of stereotypy are motor and vocal stereotypy. Motor stereotypy is commonly exhibited as body rocking, hand flapping, and/or object manipulations. Vocal stereotypy may consist of repetitive sounds, words, breathing, and/or delayed echolalia of previously heard dialogues. Irrespective of topography, stereotypy tends to occur non-contextually and may be viewed as socially awkward or developmentally inappropriate (Rapp & Vollmer). Furthermore, these behaviors are thought to have a “compulsive-like” quality because some children have urges to perform and actively resist stopping stereotypic behaviors (Foster, 1998).

Although stereotypic behaviors may vary, it may be common for both typically developing and atypically developing individuals to engage in these behaviors. For instance, it has been reported that behaviors such as body rocking or head banging may be prevalent among typically developing infants
from one to 57-months olds (Kravitz & Boehm, 1971; Thelen, 1981; Werry, Carlielle, & Fitzpatrick, 1983). However, stereotypy among typically developing individuals is usually transitory, and of low intensity presenting little concern for parents (Troster, 1994). On the other hand, stereotypy among individuals with developmental disabilities may occur constantly, at very high rates. Specifically, stereotypy among individuals with developmental disabilities may occur from 7% to 47% of waking hours (Repp & Barton, 1980). This large frequency of stereotypy may produce many detrimental effects. For example, engaging in stereotypy has been shown to decrease task performance such as learning simple shape discriminations (Chock & Glahn, 1983) or decrease positive behaviors such as playing with toys appropriately (Koegel, Firestone, Kramme, & Dunlap, 1974). Furthermore, stereotypy may interfere with acquisition of new skills such as discrimination training (e.g., Koegel & Covert, 1972), decrease the likelihood of positive social interactions such as peer and adult relationships (Lovaas, Newsom, & Hickman, 1987) and finally, may stigmatize those individuals who exhibit it (Rincover, 1978; Wolery, Kirk & Gast, 1985). Thus, in order to alleviate such interference, it may be essential to reduce stereotypical behavior among these individuals. Therefore, correctly identifying the function(s) of stereotypy will contribute to appropriate treatment implementation.

Functions of Stereotypy

The use of functional analyses has contributed to determining the function(s) of various maladaptive behaviors (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). By manipulating the variable(s) that may be maintaining stereotypy, it can be logically concluded what function stereotypy serves. For example, stereotypy may function as a form of social interaction that mediates the behavior of others either to gain access to, or remove particular types of stimulation (Kennedy, Meyer, Knowles, & Shukla, 2000). Goh and colleagues (1995) conducted functional analyses on hand mouthing for 12 participants diagnosed with profound mental retardation. Results indicated that two participants’ hand mouthing were maintained by social reinforcement in the form of attention or access to materials. On the other hand, the remaining participants’ hand mouthing were not maintained by automatic reinforcement. In contrast, other studies have found that stereotypy may be maintained by negative
reinforcement, in order to escape demands (e.g., Durand & Carr, 1987; Kennedy et al.; Mace & Belfiore, 1990). Specifically, Durand and Carr evaluated the social influences of stereotypic behavior among children with developmental disabilities and discovered that participants engaged in stereotypy in order to escape from difficult tasks.

In addition, functional analyses may also reveal undifferentiated results with high prevalence of behavior across all conditions (LeBlanc, Patel, & Carr, 2000). LeBlanc and colleagues concluded that, in general, these results may suggest that stereotypy is multiply controlled by a range of behavioral functions or is maintained by automatic reinforcement. For instance, a stereotypical response may be reinforced by social interaction as well as sensory stimulation produced by the response. Identifying the variables maintaining stereotypical behavior helps to ensure that the correct and most efficient treatment will be implemented. Once the function of stereotypy is determined, an intervention(s) can be implemented to match the maintaining function(s) of behavior. Matching the function of behavior is an attempt to reduce aberrant behaviors by providing an alternative source of stimulation that affects the same sensory modality as the target response (Vollmer, 1994).

However, complications arise when a behavior exhibits multiple topographies, and ignoring one or more topographies of aberrant behavior may interfere with the effects of treatment. Derby, Wacker, Peck, Sasso, DeRaad, Berg, Asmus, and Ulrich, (1994) suggested implementing treatments based on the function(s) of behaviors as superior to treatments based on the topography of behavior. Similarly, Repp, Felce, and Barton (1988) reported the significance of applying treatments based on their hypothesized function(s) in order to successfully treat stereotypic behaviors. Specifically, in an attempt to successfully eliminate the behavior, treatment must be based on removing the variables maintaining the behavior, rather than focusing on topographical features. This ensures that treatment directly matches the function of the behavior. Moreover, the implications of providing the wrong intervention to treat aberrant behaviors may produce detrimental effects on the behavior (Goh et al., 1995).
Treating socially mediated aberrant behaviors involves extinguishing the reinforcement that is maintaining the aberrant behavior. Thus, automatically maintained behaviors are often more intricate to treat (Vollmer, 1994). Vollmer attributed this intricacy of treatment to the difficulty of finding a replacement or alternative response that will directly compete with the reinforcing value of sensory stimulation. In other words, engaging in the behavior directly produces reinforcement in the form of sensory stimulation; therefore, finding interventions that compete with and/or replace the sensory stimulation can be difficult.

One hypothesis is that stereotypy may be maintained by automatic negative reinforcement because it may reduce, delay, offset, or decrease aversive physiological stimulation (Iwata, Vollmer, & Zarcone, 1990). For example, a person who engages in repeated head scratching may be scratching simply to alleviate an itch. With this in mind, it may be that vocal stereotypy is automatically negatively reinforced if it results, for example, in drowning out background noise that the individual finds aversive. In contrast, Vollmer (1994) described another hypothesis that suggests that head scratching may occur because of a deprivation from auditory stimulation produced by the scratching. In other words, it may be that often times the exact sensory consequence maintaining the behavior is unclear.

Several studies have addressed the difficulty of treating behaviors maintained by automatic reinforcement, providing suggestions for the most effective methods to alleviate these behaviors.

**Automatic Reinforcement**

Automatic reinforcement seems to be the most common function of stereotypical behavior. For example, Hanley, Iwata, and McCord (2003) reviewed 31 functional analyses in which 61% of stereotypy cases were maintained exclusively by automatic reinforcement. The high prevalence of stereotypy occurring during the alone condition of functional analyses provides support for an automatic function based on the absence of social contingencies (Vollmer, 1994). Originally, Skinner (1957) proposed the notion of automatic reinforcement as not requiring mediation by another person. Later, Vaughan and Michael (1982) discussed automatic reinforcement as occurring in situations in which behavior directly produces reinforcing consequences outside of social contingencies. Moreover,
Vaughan and Michael described automatic reinforcement as a “natural” result of behavior from operating on one’s own body, or interacting with the surrounding world.

Vaughan and Michael (1982) described two classifications of automatic reinforcement, perceiving and producing. The classification of perceiving consists of reinforcement received directly from the behavior itself (e.g., not requiring environmental support). For example, a person who loves to pet soft, furry animals receives automatic reinforcement for petting a bunny or kitten. Feeling the fur is a natural result from touching a soft animal. Thus, the reinforcement for touching occurs automatically. Additionally, perceiving only requires the individual to engage in minimal behavior in order to receive reinforcement. On the other hand, the classification of producing consists of reinforcement produced from the interaction of the operant response and its interaction with its environment. Producing requires the individual to interact with his/her environment in order to receive some type of automatic reinforcement (Vaughan & Michael). For instance, a person who completes part of a crossword puzzle receives automatic reinforcement for completing each part of the puzzle. This is due to each part contributing to the creation of the finished puzzle. Thus, the reinforcement is a direct result of one’s own behavior that is produced prior to receiving the reinforcing stimulus.

Finally, Vaughan and Michael (1982) concluded that people who engage in behaviors to produce automatic reinforcement may engage in responses that operate on them directly. The problem arises when the behaviors they engage in to receive automatic reinforcement become maladaptive or inappropriate. The direct reinforcement they are receiving from the behavior makes it extremely difficult to interrupt and extinguish. Often the behavior has such a long history of reinforcement, that identifying alternative or competing responses may be challenging. Nevertheless, despite these limitations, interventions should still be designed to attempt to match the functions of automatic reinforcement. Repp and colleagues (1988) detailed the significance of matching the function of stereotypy to an intervention that attempts to control for those maintaining variables.
Treatment Interventions

*Antecedent Manipulations*

Antecedent manipulation has been shown to be an effective intervention for reducing stereotypical behaviors (Rapp & Vollmer, 2005). Antecedent manipulation includes manipulating antecedent events that may influence the occurrence of stereotypy. For instance, Rapp and Vollmer discussed how the environment may be contrived to produce an alternative or replacement response for stereotypy. Likewise, stimulus competition or substitution can be an effective method for providing incompatible responses for stereotypy (LeBlanc et al., 2000). Lastly, providing prior access to stereotypy may function as an abolishing operation for future engagement in stereotypy.

*Motivating operations.* Many antecedent manipulations involve the manipulation of motivating operations. Michael (2004) described a motivating operation (MO) as having both a value-altering and behavior-altering effect. More specifically, a MO may alter the current reinforcing effectiveness of some stimulus, object, or event. In addition, a MO may increase or decrease the current frequency of a behavior that has been reinforced by the same stimulus, object, or event in the past. For example, the use of food, drink, and attention may be more valuable as reinforcers when a brief period of deprivation from those items has occurred. Thus, this deprivation will increase the likelihood of engaging in all behaviors that in the past have led to consumption of food or drink or produced attention. Similarly, just being in a barren environment may function as a MO to engage in behavior that in the past has led to social interaction or stimulation (Vollmer, 1994). Therefore, it could be hypothesized that being in an environment free from stimuli may increase the reinforcing value of engaging in stereotypy. Thus, having a variety of items arranged noncontingently and accessibly may compete with the reinforcing efficacy of engaging in stereotypic behaviors. This competition may be created by enriching the environment with various competing stimuli. Specifically, environmental enrichment has been found as an effective intervention for suppression of stereotypy.

*Environmental enrichment.* As mentioned, stereotypy often occurs due to low environmental stimulation (Piazza, Adelinis, Hanley, Goh, & Delia, 2000; Rapp, 2005; Repp et al., 1988) Thus, Piazza
and colleagues suggested an increase in stimulation to compete with the reinforcing value of automatically reinforced behaviors. Environmental enrichment refers to manipulating antecedent events to assess potentially competing sources of stimulation that place an arbitrary stimulus in competition with the concurrently available functional reinforcer (LeBlanc et al., 2000). Previous studies have shown environmental enrichment to reduce several forms of automatically reinforced problem behaviors (e.g., Davenport & Berkson, 1963; Piazza et al.; Vollmer, Marcus, & LeBlanc, 1994). Creating an enriched environment is thought to create an abolishing operation for engaging in stereotypy (Laraway, Syncerski, Michael, & Poling, 2003). In other words, an environment filled with enriched stimuli may reduce the reinforcement efficacy, as well as the likelihood of engaging in automatically maintained behaviors. Rapp and Vollmer (2005) discussed two different approaches of environmental enrichment, both general and matched stimulation. Both have been shown to be effective methods for the reduction of automatically maintained stereotypy.

Vollmer, Marcus, and LeBlanc (1994) utilized the general stimulation approach as an attempt to reduce stereotypy for three participants. All three participants engaged in various topographies of SIB that were not maintained by social contingencies. Comparisons were made between non-enriched environments (no toys, no therapist present) with no programmed consequences for SIB, and enriched environments (with preferred and nonpreferred stimuli, based on a preference assessment). For two participants, contact with nonpreferred stimuli was combined with reinforcement for toy contact. For one participant, stimulus interactions were reinforced and hand mouthing was blocked. Subsequently, in one condition, mouthing for one participant resulted in a 5 s hands down time-out procedure. Specifically, the therapist blocked her responses and held her hands down at her side.

Consistent with previous results, Vollmer and colleagues (1994) reported an inverse relation between appropriate behavior and SIB. Specifically, the presence of preferred items in the environment reduced levels of SIB substantially, for two of three participants. However, when preferred stimuli were replaced with nonpreferred stimuli, SIB increased and appropriate behavior decreased. Lastly, for the third participant, an enriched environment produced only moderate reductions. Preferred items did
reduce SIB more than nonpreferred items, but only slightly. Moreover, additional reinforcement and timeout procedures were necessary before significant decreases in SIB were observed. These findings are significant because it was found that it wasn’t the availability of stimulation that resulted in a decrease in SIB, it was the presence of preferred stimuli (Vollmer et al., 1994).

Despite the success of some, environmental enrichment has been found to be only moderately effective (LeBlanc, Patel & Carr, 2000). This ineffectiveness may be due to preferred items that may not be potent enough to compete with the variables maintaining specific behaviors (Vollmer et al., 1994). Thus, it may be that an item is highly preferred, but is not preferred enough to replace the reinforcing value of sensory stimulation. Therefore, it may be essential to identify stimuli that are able to replace, or “match” the sensory stimulation of a behavior to fully compete with and replace undesirable behaviors.

**Matched stimulation.** Matched stimulation is the second form of environmental enrichment. Similar to environmental enrichment, certain items are identified to “match” the function of the problem behavior based on the sensory consequences maintaining the automatically maintained behavior. Thus, it is hypothesized that providing the same type of stimulation that is maintaining the problem behavior should compete with or substitute for the sensory stimulation produced from the stereotypic behavior. Fisher, Lindauer, Alterson, and Thompson (1998) hypothesized that matched stimuli would be more effective than unmatched stimuli because matched stimuli remove the MO for engaging in aberrant behavior (e.g., stereotypy). In other words, the matched stimuli may function as an abolishing operation (AO; Laraway et al., 2003).

A number of studies have utilized matched stimulation as a method to reduce both motor (e.g., Favell, McGimsey, & Schell, 1982; Fisher et al., 1998; Piazza et al., 2000) and vocal stereotypy (e.g., Rapp, 2007; Taylor, Hoch, & Weissman, 2005). Piazza and colleagues compared both unmatched and matched stimuli to determine the substitutability of the reinforcers to reduce automatically maintained dangerous behavior, saliva play and SIB in the form of hand mouthing for three participants. A preference assessment based on the procedures by Piazza, Fisher, Hanley, Hilker, and Derby (1996)
was conducted that selected items based on the extent to which they matched or did not match hypothesized sensory consequences of the participant’s behaviors. For example, matched items provided kinesthetic stimulation similar to jumping (e.g., green ball) side-to-side or circular movement (rocking on a dinosaur), visual or tactile stimulation (e.g., placing shaving cream on a mirror), and stimulation to the mouth (e.g., Twizzlers) or hand (e.g., hand massager). Unmatched items were those that provided sensory consequences (e.g., a radio) but did not match the hypothesized sensory consequences. Lastly, a comparison of matched and unmatched stimuli was conducted using a multielement design and a combination of a reversal (ABAB) and multielement design. The matched and unmatched conditions were identical except that either matched or unmatched stimuli were continuously and noncontingently available. Stimulation produced by stimuli was exclusive to one mode of stimulation (e.g., either visual or tactile) by blocking access to the other type of stimulation.

Results from the preference assessment suggested that items that appeared to match the hypothesized sensory consequence of aberrant behavior were associated with lower levels of aberrant behavior relative to unmatched stimuli. Furthermore, overall results indicated that the use of matched stimuli markedly decreased aberrant behaviors for all participants. Unmatched stimuli also decreased behaviors but only modestly. These results are significant because unlike previous studies, a functional analysis was conducted to show that the behaviors were not socially mediated.

More recently, Rapp (2007) and Taylor and colleagues (2005) examined the effects of matched stimulation on the reduction of vocal stereotypy. They found that toys that produced auditory stimulation decreased vocal stereotypy significantly more than non-auditory toys. More specifically, the stimulation provided from the auditory toys functioned as an abolishing operation for engaging in vocal stereotypy. Thus, it may be concluded that access to matched stimulation toys competed with the reinforcing value for engagement in stereotypy.

Limitations to matched stimulation may involve promoting socially inappropriate forms of play to replace the target behavior (Piazza et al., 2000). For example, replacing saliva play with a task such as playing with shaving cream may be deemed developmentally inappropriate. However, often
times it is debatable which of the two responses is socially more acceptable. Furthermore, the controlling mechanism behind stereotypy reduction is also unclear whether the matched items competed with or substituted for the stimulation. Therefore, further research is needed to examine significant differences between competitive and substitutable reinforcers.

Stereotypy as an abolishing operation. A final antecedent method for reducing stereotypy consists of providing pretreatment access to stereotypy in order to decrease the reinforcing value of stereotypy at a later time. More specifically, providing access to stereotypy prior to treatment may help to decrease the motivation to engage in stereotypy during treatment. Thus, stereotypy may function as an abolishing operation (Laraway et al., 2003) for later engagement in that behavior. Rapp (2004) was the first to examine whether prior access to an automatically reinforced behavior could function as an abolishing operation for later engagement.

Rapp (2004) examined the effects of prior access to stereotypy for a participant who engaged in object twirling stereotypy. During the first session, the participant was alone in a room for 30 min with stimuli he was known to twirl. No social consequences were provided for any of his behaviors. The second session was identical to the first, except that it was conducted approximately three hours later. Comparisons between sessions were made to assess whether levels of stereotypy in the first session were higher than levels of stereotypy in the second session.

Results indicated that object twirling occurred more frequently in the first session than the second session. Probes were conducted to alter the time of day sessions occurred, to ensure the time of day was not an extraneous variable for lower occurrences of stereotypy. Results suggested that early engagement of stereotypy might lead to decreases in future occurrences of stereotypy due to a decrease in reinforcing efficacy. Similarly, previous research (e.g., Vollmer & Iwata, 1991) has shown that prior access to a reinforcer may decrease subsequent responding in order to obtain it.

Consequent Manipulations

Despite the effectiveness of antecedent manipulation interventions, a significant limitation exists that those interventions may not completely eliminate the target behaviors. In fact, a review by
LaGrow and Repp (1984) concluded that antecedent based interventions were less effective at reducing stereotypy than consequent-based interventions. Thus, another alternative for treating stereotypy may be to implement consequent-based treatments. In contrast to antecedent manipulations, consequent based treatments produce a stimulus following the occurrence of the behavior. Specifically, consequences are altered to eliminate behavior. Common examples of this intervention include, sensory extinction, reinforcement based interventions such as a differential reinforcement of other (DRO) and alternative (DRA) behaviors, as well as a large variety of punishment-based procedures.

**Sensory extinction procedures.** Sensory extinction is significant to the treatment literature because it was one of the first interventions to address the specific reinforcers for automatically reinforced aberrant behavior (LeBlanc et al., 2000). If a behavior produces its own source of reinforcement, such as proprioceptive, auditory, tactile, or visual stimulation (Rincover, 1978; Rincover, Cook, Peoples, & Packard, 1979), extinguishing this stimulation will then likely reduce the behavior (Lovaas et al., 1987). Specifically, by masking or removing the consequences that maintain the sensory stimulation, the prevalence of stereotypy has been shown to significantly decrease. Significantly, Iwata, Pace, Cowdery, and Miltenberger (1994) and Richman, Wacker, Asmus, and Casey (1998) investigated the effectiveness of sensory extinction when applied to topographically similar but functionally dissimilar responses. More specifically, they applied three forms of extinction: attention, escape, and sensory extinction to SIB with varying functions. Results indicated there was only a reduction in SIB when the specific source of reinforcement maintaining the behavior was extinguished. The results provide further support for the significance of matching the function of behavior to a functionally similar intervention.

Rincover (1978) investigated the behavior of three children who frequently engaged in high levels of stereotypic behavior. One participant’s behavior was hypothesized to be maintained by auditory stimulation. To mask the auditory feedback for spinning plates on a table, Rincover carpeted the surface of the table so that plate spinning would no longer produce sounds. Likewise, other alterations such as placing small vibrators with low intensity pulsations on the back of two children’s
hands masked the proprioceptive stimulation of finger flapping and bead twirling. The effects of a blindfold were also assessed to mask the visual feedback from plate spinning, bead twirling, and finger flapping for all three children. Reversal designs compared the effects of sensory extinction on the hypothesized functions, as well as for visual stimulation. Results indicated that stereotypy was eliminated for two of the three participants, and reduced over 50% for the third. Because sensory extinction led to a decrease in behavior, results suggested that stereotypy is an operant behavior maintained by sensory reinforcement. Furthermore, because of the various sensory reinforcers maintaining behavior, Rincover found that the effects of sensory extinction are idiosyncratic across participants. However, as long as the reinforcing stimulation is identified, sensory extinction can be utilized. Furthermore, sensory extinction has also been found to effectively reduce the sensory reinforcement maintaining vocal stereotypy. Aiken and Salzberg (1984), for instance, used headphones playing white noise to mask the auditory stimulation for two children with repetitive vocalizations.

Although sensory extinction has demonstrated its effectiveness for the reduction of sensory stimulation, limitations of this procedure do exist. A common criticism of sensory extinction is it may only examine a limited number of sensory consequences. For example, a specific behavior may result in multiple sensory products (e.g., visual and tactile stimulation) but sensory extinction may address only one of these consequences (LeBlanc et al., 2000). Secondly, unlike some procedures, sensory extinction does not provide an alternative response to replace stereotypy. While eliminating inappropriate behavior is always desirable, it is also beneficial to teach new functional responses. Therefore, in order to alleviate this limitation, it is necessary to implement reinforcement-based interventions that may increase more appropriate responses.

Differential reinforcement interventions. Much research has examined the effectiveness of reinforcement-based interventions as a treatment for stereotypy. Unique to this intervention, reinforcement-based procedures provide reinforcement for alternative behaviors while extinguishing the target behavior. For example, procedures such as differential reinforcement of other (DRO) and differential reinforcement for alternative (DRA) behaviors have been shown to be effective for reducing
stereotypy. DRO procedures deliver a reinforcer in the absence of the target behavior for a specific interval of time (Cooper, Heron, & Heward, 2007). Similarly, DRA procedures deliver a reinforcer for engaging in an alternative behavior (Cooper et al). More specifically, this procedure requires the identification of reinforcers that are stronger than those reinforcers maintaining the inappropriate behavior (Repp & Deitz, 1974). Past studies have found that these reinforcers can be either arbitrary (e.g., Foxx & Azrin, 1973; Repp & Deitz, 1974; Repp, Deitz, & Deitz, 1976) or topographically similar (e.g., Taylor et al., 2005) to the function of the target behavior.

Taylor and colleagues (2005) utilized a reversal design to compare a fixed-time and a DRO procedure for reducing vocal stereotypy in one participant. During baseline, experimenters observed levels of vocal stereotypy while she engaged with non-auditory toys. No consequences were presented during baseline. Secondly, a fixed-timed schedule provided access to auditory toys with matched auditory stimulation at fixed 1-min intervals. Finally, the DRO procedure consisted of providing 30 s access to matching auditory toys contingent upon a 1-min interval with no vocal stereotypy.

Results indicated providing auditory toys on a fixed-time schedule did not reduce stereotypy while differentially reinforcing for the absence of stereotypy significantly reduced vocal stereotypy to a mean of 8%. Furthermore, this reduction of vocal stereotypy generalized across activities, settings, and instructors, and remained suppressed as the DRO interval was gradually thinned to 10 minutes. Overall, this study demonstrated that DRO was an effective procedure for reducing vocal stereotypy. Likewise, other studies have implemented DRO procedures to reduce other forms of stereotypy as well. For example, Shore, Iwata, DeLeon, Kahng, and Smith (1997) implemented a DRO procedure to reduce SIB by delivering a preferred item at the end of an interval contingent upon the absence of SIB.

However, while many studies have shown the effectiveness of DRO procedures, the procedure has warranted some criticisms. Several studies compared the use of a DRO procedure with various punishment procedures to find that DRO procedures were less effective at reducing stereotypy (e.g., Barrett, Matson, Shapiro, & Ollendick, 1981; Foxx & Azrin, 1973; Harris & Wolchik, 1979). Reasons for the lack of effectiveness may primarily be due to the ineffectiveness of an often times arbitrary
reinforcer to overcome a long reinforcement history of an inappropriate response (Repp, Barton, & Brulle, 1983). More specifically, the reinforcer must be strong enough to compete with, and overcome the reinforcing value of the stereotypic behavior. Secondly, Roscoe, Iwata, and Goh (1998) discussed DRO procedures as being less effective because the stimulation produced by the behavior is continuously available. In other words, by not blocking the occurrence of the behavior, the individual is able to produce continuous reinforcement from engaging in the behavior. Thus, alternative interventions may be necessary to block or punish engagement of inappropriate behaviors in order to decrease the amount of reinforcement they receive. To alleviate some of these limitations, Roscoe and colleagues suggested combining other interventions (e.g., noncontingent reinforcement or EXT) with DRO procedures when differential reinforcement alone does not seem to be effective.

Punishment-based procedures. A final approach to reduce stereotypy consists of the use of punishment-based procedures. Punishment involves the presentation of an aversive stimulus contingent upon stereotypy that competes with the automatic reinforcer produced by the response (Shore et al., 1997). There are several variations of punishment that have been applied to reduce stereotypy. Variations consist of physical forms of punishment such as electric shock (e.g., Baumeister & Forehand, 1982), overcorrection (e.g., Epstein, Doke, Sajwaj, Sorrell, & Rimmer, 1974; Foxx & Azrin, 1973; Ollendick et al., 1978), timeout from reinforcement (e.g., Pendergrass, 1972), response cost (e.g., Athens, Vollmer, & Sloman, 2008; Rapp, 2005), and response blocking (e.g., Lerman & Iwata, 1996; Reid, Parsons, Phillips, & Green, 1993; Smith, Russo, & Le, 1999). However, under much criticism are the ethical considerations that are evident for applying punishment to decrease behavior as well as the undesirable side effects it may produce (Risley, 1968). Thus, while punishment has been shown to be a fairly effective procedure, considerations for these types of procedures are necessary and are usually saved as a last resort.

While possibly the most controversial category of punishment due to ethical standards and the liability of inflicting harm to others, many of the original studies on reducing stereotypy included the application of physical punishment (e.g., Barkley & Zupnick, 1976; Risley, 1968). Physical punishment
consists of providing an aversive stimulus such as shocks, slaps, aversive sprays, etc., following the
occurrence of the undesired behavior. This may occur in a variety of forms, for example, Baumeister
and Forehand (1982) delivered electric shocks contingent upon stereotyped body rocking. Three males
who displayed frequent rocking behavior were strapped in a chair so that body rocking could occur, but
they could not escape. Shocks were then delivered contingent upon the occurrence of body rocking.
Results indicated that shocks significantly reduced body rocking for all three participants. Similarly,
another physical punishment procedure also reduced stereotypy by either slapping their thighs or hands
contingent upon stereotypy (Foxx & Azrin, 1973; Koegel & Covert, 1972; Koegel, Firestone, Kramme,
& Dunlap, 1974). Finally, Koegel and colleagues used a brief hand restraint along with slaps to the
hand paired with yelling, “No,” as a procedure to reduce stereotypy.

Another punishment method for reducing stereotypy is overcorrection. Foxx and Azrin (1973)
described two types of overcorrection as restitutional overcorrection and positive practice
overcorrection. Restitutional overcorrection requires the disrupter to correct the consequence of their
inappropriate behavior by having them restore the situation to a much greater state than existed before
the disruption. On the other hand, positive practice overcorrection requires the disruptor to intensively
practice overly correct forms of relevant behavior. The purpose of this is to suppress stereotypic
behavior as well as to teach and motivate the occurrence of more appropriate forms of behavior. A
substantial amount of research has been conducted evaluating the effects of both types of overcorrection
to reduce motor (e.g., Doleys, Wells, Hobbs, Roberts, & Cartelli, 1976; Foxx & Azrin, 1973; Ollendick,
Matson, & Martin 1978; Wells, Forehand, Hickey, & Green, 1977) and vocal stereotypy (e.g., Epstein
et al., 1974).

Foxx and Azrin (1973) conducted two studies to evaluate the use of an overcorrection
procedure to reduce several topographies of stereotypy for four children. Stereotypy consisted of
mouthing objects and body parts, head weaving, and hand clapping. Study 1 compared three
interventions: DRO, NCR and overcorrection to assess which would be most effective at reducing
mouthing. Based on Foxx and Azrin (1972), overcorrection consisted of a vocal reprimand, along with
an oral hygiene procedure of brushing her gums and teeth with a toothbrush from a container of mouthwash and then wiping her outer lips with a dampened washcloth from the mouthwash. Overall, overcorrection was found to be the most effective method for reducing stereotypy. Study 2 examined whether overcorrection would generalize to other forms of hand and head moving stereotypy. The mouthing overcorrection procedure was identical to Study 1, while head weaving and hand clapping were also both corrected. For head weaving and hand clapping, the positive practice overcorrection procedure was utilized. Contingent upon stereotypy, participants were immediately given Functional Movement Training for 5 min. Specifically, for head-weaving, the experimenter used her hands to restrain the participant’s head and delivered a random order of instructions to move her head in one of three positions: up, down, or straight. Similarly, the second participant was taught to hold his hands stationary and to only move them for functional reasons (e.g., when instructed to do so). He was given a random order of instructions to move his hands in one of five positions: above his head, straight in front of him, in his pockets, held together and behind his back. For both participants, manual guidance was provided for failure to respond to a given instruction. Similarly, assistance was gradually faded and participants were required to hold their heads or hands stationary for 15-s at which time another instruction was delivered.

When overcorrection procedures were introduced, all four participant’s rates of stereotypy reduced by half or more within four days, and to near zero levels within 10 days. Significantly, overcorrection procedures were taught to parents and teachers who implemented the procedures in home and school settings. Moreover, they reported all stereotypical behaviors as eliminated, or rarely occurred. In addition, while proving to be a successful intervention, overcorrection has also been found to be beneficial in promoting positive behaviors such as playing appropriately with toys (e.g., Doleys et al., 1976).

Furthermore, Ollendick and colleagues (1978) examined whether the topography of the overcorrection procedure needed to match the topography of the behavior. Results indicated that for dissimilar topographies of behavior, stereotypy reduced; however, it did in a slower and less drastic
manner. Moreover, it did not maintain when treatment was removed. Thus, providing further support for the necessity of treatment matching the function of the target behavior. These findings are significant for designing and implementing effective overcorrection treatments to reduce stereotypy.

Isolation timeout is another punishment technique that consists of removing an individual from a reinforcing situation contingent upon the occurrence of aberrant behaviors. Pendergrass (1972) evaluated the object stereotypy of two individuals. One participant banged toys or books, while the other participant engaged in string twirling. Both participants had other inappropriate behavior, but punishment was only implemented for the aforementioned target behaviors. Contingent upon the occurrence of stereotypic behaviors, participants were briefly reprimanded, removed from a group situation and taken to an isolation booth for 2 min. The isolation booth isolated participants so they could hear, but not see out. After 2 min had elapsed, participants were released back to the group. Overall, implementation of timeout reduced stereotypies for both participants, even though the isolation booth allowed stereotypical behaviors to occur without interruption. Thus, results suggested that removal from the group situation functioned as punishment. Moreover, experimenters found that other negative effects such as emotional responding and aggression were suppressed even without direct treatment.

Another form of punishment is response cost. Response cost consists of removing a preferred item contingent upon the occurrence of a target behavior. Thus, the removal of the item functions as the punishment for the occurrence of the undesirable behavior. Response cost has been found to be effective for reducing both motor (e.g., Rapp, 2005) and vocal stereotypy (e.g., Athens et al., 2008; Falcomata, Roane, Hovanetz, Kettering, & Keeney, 2004).

Rapp (2005) utilized a response cost procedure for one participant who displayed body rocking, vocalizing, hand flapping and bruxing. Rapp implemented two response cost procedures for two topographies of stereotypy: body rocking and hand flapping. The television was a highly preferred item and was used for both response cost conditions. Specifically, the removal of the television was contingent upon the occurrence of body rocking and hand flapping. In other words, the television was
turned off for 30s following the initiation of body rocking or hand flapping. No consequences were provided for the other forms of stereotypy. Results indicated that the removal of the television contingent upon body rocking reduced body rocking, but also produced concomitant increases in hand flapping, vocalizing, and temporarily, bruxing. Based on these results, response cost for hand flapping was also implemented. Response cost reduced hand flapping and vocalizing but produced little or no change in bruxing or body rocking. Interestingly, there seemed to be a shift in response allocation between different forms of stereotypies. Specifically, while the target topography of stereotypy reduced, non-targeted topographies of stereotypy increased. In another example, Falcomata et al. (2004) found a treatment package consisting of NCR and response cost to be the most effective for reducing vocal stereotypy. More specifically, the participant was given noncontingent access to a highly preferred radio and contingent upon inappropriate vocalizations, the participant lost access for 5 s. Lastly, for both studies, preference assessments validated both the television and radio as preferred items.

Response blocking consists of physically blocking access to an inappropriate response. This may result in blocking one’s hands, screening eyes, or holding legs or arms down. This procedure is especially appropriate for specific forms of stereotypy such as SIB, because of the feasibility and practicality to block the occurrence of the behavior (e.g., Reid et al., 1993; Smith et al., 1999). Moreover, for treatments of severe, injurious behaviors, some procedures would not be ethically accepted as appropriate interventions. In this case, it would be most advantageous to physically block the person from harming themselves or others.

Lerman and Iwata (1996) implemented response blocking for a man who engaged in automatically maintained chronic hand mouthing. During treatment, a therapist was seated behind him who blocked his hand from entering his mouth by placing her palm about 2 cm in front of his mouth. This procedure occurred throughout all treatment sessions. Results indicated that hand mouthing decreased rapidly to near zero levels when responses were blocked on every response. Subsequent conditions faded the number of blocked responses but responding still consistently remained low. Significantly, while response blocking has been shown to be an effective punishment procedure (e.g.,
Lerman & Iwata) there has also been evidence to suggest that intermittently blocking responses may function as intermittent reinforcement for responses (e.g., Smith et al., 1999). Thus, it has been suggested that response blocking functions as both a punishment and/or an extinction procedure (Smith et al.). Lerman and Iwata discussed the need for further research to examine the frequencies for which response blocking may function as an extinction or punishment procedure.

Overall, there are limitations that are common following the implementation of punishment procedures. Specifically, punishment procedures have been found to produce negative side effects such as an increase in other undesirable behaviors (Rapp, 2005; Hagopian & Toole, 2009). For example, Rapp implemented response cost to decrease body rocking, but it subsequently increased other forms of stereotypy. Moreover, often the “restrictedness” or aversiveness of the procedures may lead to an increase in “emotional” behaviors such as, screaming, pinching and scratching (Risley, 1968). Lastly, although punishment procedures have been found to have immediate effects, often the effectiveness may be limited and does not endure over time.

Sole interventions may not always be sufficient to suppress responding of problem behaviors. Results of functional analyses often suggest that stereotypy may be multiply controlled. In other words, there are multiple variables maintaining the occurrence of stereotypy. In this case, implementing only one treatment to reduce problem behavior may not provide sufficient results. It may be that the combination of multiple treatments is necessary to treat each hypothesized function (Repp et al., 1988). Thus, several studies have implemented treatment packages as a way to account for this ambiguity (e.g., Athens et al., 2008; Shabani, Wilder, & Flood, 2001). For example, Athens and colleagues implemented a treatment package consisting of noncontingent attention, contingent demand and response cost to suppress the occurrence of automatically maintained vocal stereotypy for one participant. Results indicated that the implementation of the treatment package was successful for reducing vocal stereotypy even with only the implementation of contingent demands and response cost. In other words, treatment packages may be necessary when a sole treatment is not sufficient to suppress responding, or to treat behaviors with varying functions.
More recently, a response blocking procedure that has been effective for reducing vocal stereotypy in children diagnosed with an autism spectrum disorder is Response Interruption and Redirection (RIRD, Ahearn, Clark, MacDonald, & Chung, 2007). RIRD consists of interruption and redirection of vocal stereotypy as well as reinforcement of incompatible responses. Thus, while stereotypy is restricted from occurring, the individual is also redirected and reinforced for engaging in more appropriate responses.

Ahearn and colleagues (2007) utilized an ABAB withdrawal design to implement RIRD to reduce automatically maintained vocal stereotypy among four children diagnosed with autism. During sessions, participants were seated at a desk and engaged with a highly preferred item. Contingent upon vocal stereotypy, the item was removed and the participant’s stereotypy was redirected. This consisted of vocal demands such as imitating three vocalizations from the experimenter (e.g., “Say ball”), and/or answering three social questions (e.g., “What’s your mom’s name?”) in the absence of vocal stereotypy. Appropriate vocalizations were also praised and honored when available (e.g., “I want ball”).

Ahearn and colleagues found this procedure to be effective for significantly reducing vocal stereotypy among all four participants. It was also reported that there were concomitant increases in appropriate vocal responses when the procedure was implemented. Similarly, Miguel, Clark, Tereshko, and Ahearn (2009) implemented RIRD with a 4-year old male diagnosed with Autism and a communication delay, taking 10 mg of sertraline (Zoloft), who engaged in motor and vocal stereotypy. Consistent with Ahearn et al., implementing RIRD reduced his vocal stereotypy to low levels. Significantly, even with the removal of sertraline, stereotypy maintained at reduced levels, and appropriate vocalizations increased. Follow up data also indicated that stereotypy remained low when RIRD was the sole intervention. Most recently, Liu-Gitz and Banda (2010) replicated and extended the RIRD procedure in an educational setting to decrease vocal stereotypy in a child with autism. Consistent with previous results, RIRD in the form of answering questions as well as praise for nice responding were found to effectively reduce his stereotypy. In addition, his appropriate vocalizations were also found to successfully improve.
Ahearn and colleagues attributed the effectiveness of this procedure to two possible explanations. Similar to previous research (e.g., Smith et al., 1999), stereotypy may have reduced because the sensory consequences maintaining vocal stereotypy were extinguished due to the incompatible responses. Secondly, stereotypy may have reduced due to the aversive procedure of blocking occurrences of stereotypy (e.g., Lerman & Iwata, 1996). However, the study by Ahearn and colleagues was not designed to differentiate between these controlling mechanisms and future research should evaluate this distinction further.

Currently, there has been limited research studying the reduction of vocal stereotypy (Ahearn et al., 2007). Likewise, only few studies (e.g., Fisher, Grace, & Murphy, 1996; Lerman & Iwata 1996; Reid et al., 1993; Smith, et al., 1999; Sprague, Holland, & Thomas, 1997) have assessed the effects of response interruption for reducing problem behavior, and only three (e.g., Ahearn et al., 2007; Liu-Gitza & Banda, 2010; Miguel et al., 2009) have assessed the effects of interruption as a procedure for vocal stereotypy. Despite the sparse research, previous results suggest that it is necessary for behaviors and interventions to be topographically and functionally similar in order to effectively reduce stereotypy (e.g., Ahearn et al.; Favell et al., 1982; Fisher et al., 1998; Ollendick et al., 1978; Piazza et al., 2000) While Ahearn and colleagues found that interrupting vocal stereotypy with vocal demands was effective, they discussed the significance of evaluating whether a different topography of demands (e.g., motor) would be equally, if not more effective.

Thus, the purpose of the current investigation was to examine whether the topography of demands to interrupt and redirect vocal stereotypy must match the sensory stimulation maintaining the behavior, in order to successfully reduce stereotypy. Increases in appropriate behaviors were also observed to determine whether providing incompatible responses would produce alternative positive behaviors. This increase would indicate that providing two competing responses may produce behavioral contrast (Reynolds, 1961). In other words, responding may reallocate to a more appropriate, functional response. If it is concluded that the function of the intervention need not match the topography of stereotypy, this may imply that punishment was the sole behavior mechanism for
reducing stereotypy. Whether or not the type of demand need to match the topography of the behavior would provide practical information when designing future interventions. Moreover, the findings would be significant because it would contribute to the stereotypy literature regarding the necessity of matched interventions as a method to reduce stereotypy. Either of these conclusions would provide many implications for practitioners who are attempting to successfully reduce various forms of stereotypy in a variety of settings.
Participants, Setting and Materials

Participants were four children diagnosed with an autism spectrum disorder (ASD) (*DSM IV-TR, 2005, American Psychiatric Association, 2005*) recruited from local agencies providing treatment services to families. Participants exhibited vocal stereotypy known to interfere with their educational activities or interrupt daily functioning. Their vocal stereotypy was also determined as automatically maintained by an experimental functional analysis. An automatic function was essential because providing RIRD contingent upon the occurrence of vocal stereotypy may inadvertently reinforce the behavior if it is socially mediated.

Sally was a 5-year old female diagnosed with Pervasive-Developmental Disorder who lived with her parents. She vocally requested for items and activities, and also labeled 1-2 word items and people around her. Charlie was a 12-year old male diagnosed with Autism who lived with his mother. His communication was primarily vocal and he requested for item/activities, as well as labeled items in his environment. Josh was a 7-year old male diagnosed with Autism who lived with his parents and older brother. His primary communication was vocal and he could request for and label items in his environment. Adam was a 6-year old male diagnosed with Autism who lived with his parents. He had a very low rate of independent vocalizations. All participants could sit in a chair for up to 10 minutes at a time. This skill was assessed via caregiver report as well as initially playing with participants when developing the operational definitions of stereotypy. Moreover, participants could follow simple 1-2 word instructions, as well as could vocally imitate. For three of the four participants, all sessions were conducted in a room (2.2 m x 3.3 m) on campus, equipped with a video camera, whiteboard, bookshelf and books, metal cabinet, and toys necessary to conduct the experimental conditions along with a table with two chairs. No other materials were included in the room that might have confounded the effects.
of treatment. For Sally, sessions were conducted in her home, in her daily therapy room. The room contained a video camera, whiteboard, closet covered with a sheet, lamp, mattress which was placed against the wall, and a table with two chairs.

Stimulus Preference Assessment

Prior to beginning the study, parents were asked to complete the modified Reinforcer Assessment for Individuals with Severe Disabilities (RAISD) form in order to allow the experimenter to select an array of potential reinforcers (Fisher, Piazza, Bowman, & Amari, 1996) (see Appendix A). A multiple stimulus without replacement preference assessment (MSWO) was conducted based on the procedures described by DeLeon and Iwata (1996). This procedure was selected because of the advantage of ranking reinforcers in a hierarchical manner as well as identifying reinforcers in a shorter duration of time.

The preference assessment began with an array of 10-12 different toys that were evenly spaced in a circle, and were reported by the caregivers as being preferred. At the start of the preference assessment, all ten items were presented simultaneously. The experimenter prompted participants to sample each item so they were familiar with the pool of items. Subsequently, the experimenter told participants to “Go play” at which time participants selected their desired item. Upon selection, participants had approximately 30 s to engage with the item while the experimenter randomly rearranged the remaining items to a new location to help control for location bias. Items were rearranged so that they were across the circle from their previous location every time. After the 30 s elapsed, the item was removed from the array. This process continued until only one item remained or no response occurred for 30 s. Items that were selected as highly or moderately preferred were chosen for the study’s purposes. Highly preferred items were those that were chosen first through third, on two out of three trials. Moderately preferred items were those that chosen fourth through seventh, on two out of three trials.
A brief MSWO was conducted (Carr, Nicolson, & Higbee, 2000), prior to the start of each treatment session. This MSWO assessed the preference of each item for that specific day. Items selected as highly preferred were items that were overall ranked first to third of the pool, while moderately preferred items were items that were overall ranked fourth through seventh. Moderately and highly preferred items were used during specific conditions of the functional analysis and treatment conditions. For Sally, items that were used during the brief MSWO were link beads, a kitchen play set, Mr. Potato Head™, Lucky Ducks™ game, a train set, baby dolls, and a doll house. For Charlie, items that were used during his first brief MSWO were Playdoh™, a whiteboard, a Blue’s Clues™ puzzle, Magnadoodle™, picture books, a floor puzzle, and bath toys. For his second brief MSWO, he chose Koosh™ balls, sports balls, a Rubik cube™, an ABC puzzle, a Koosh™ worm, blue foam, and blocks. For Josh, items that were used were Spongebob™ and Wall-E™ books, a Magnadoodle™, Playdoh™, character coloring sheets, a whiteboard, Spongebob™ coloring book, and a character paint set. For Adam, items used were ABC books, a squishy dolphin, a Koosh™ worm, a Koosh ball™, a Rubik cube™, Moon Sand™, and picture books.

Response Measurement

Sally’s vocal stereotypy was defined as any instance of repetitive phrases, sounds or syllables, prolonged enunciation of words, e.g., “doggggissss”, or syllables, e.g., “ckkkkk”, or “ssssss”, which were not contextually appropriate, delayed echolalia of previously heard dialogues that were noncontextual (e.g., “Hi big bird!”) while playing with beads, unintelligible speech, and/or noncontextual singing. Conversely, appropriate vocalizations included appropriate requests /mands (e.g., “I want house, please”) tacts (e.g., “The baby is sad”), intraverbals (e.g., “Hello baby, how are you?”), and singing that was contextually appropriate to the task at hand (e.g., singing “Ring around the Rosie” while playing with dolls in a circle).

Charlie’s vocal stereotypy was defined as any instance of noncontextual or nonfunctional speech/sounds, delayed echolalia of previously heard dialogues that were noncontextual, noncontextual repetitive phrases (e.g., “You need a haircut, a haircut!”), sounds, or oral motor movements (e.g.,
tongue clicking) and inappropriate and/or noncontextual laughing. Appropriate vocalizations included requesting (e.g., “One more?”) and/or tacting (e.g., “I made French fries”).

Josh’s vocal stereotypy was defined as any instance of unintelligible speech, whispering, delayed echolalia of previously heard dialogues that were noncontextual, noncontextual singing/talking, (e.g., “It’s spooky”), noncontextual laughing and/or repetitive humming. Appropriate vocalizations included requesting (e.g., “Where’s dad?”) and/or tacting (e.g., “It looks like a rainbow”).

Adam’s vocal stereotypy was defined as any instance of repetitive sounds and/or humming, unintelligible speech and/or sounds, whispering, noncontextual laughing, repetitive and/or isolated oral motor sounds (e.g., lip smacking, tongue clicking). Appropriate vocalizations were defined as requests (e.g., “Mommy, please”) and/or tacting (e.g., “A-B-C”).

Moreover, for all participants, repetitive mands (e.g., “I want to go, I want to go”), or tacts (e.g., “There’s a dog, There’s a dog”) were not scored as stereotypy unless the phrase was noncontextual (e.g., “Elephant, elephant” (when no elephant was present). In addition, immediate echolalia was not scored as stereotypy for any participant. Data on vocal stereotypy were collected using continuous duration recording (see Appendix B). This consisted of dividing the total number of seconds in which vocal stereotypy occurred by the total number of seconds in the session (300 s) multiplied by 100%.

Functional Analysis

In order to determine the function(s) of stereotypy, a functional analysis (FA) was conducted (Iwata et al., 1982/1994). Functional analyses have been found to produce confident conclusions about the effects of varying contingencies on behavior through highly controlled and systematic manipulation (Iwata et al.). More specifically, the purpose of the FA was to determine whether vocal stereotypy would persist in the absence of social contingencies. This was crucial because it provided support as to whether stereotypy was maintained by automatic reinforcement. For the purpose of this study, only participants who had automatically maintained vocal stereotypy were selected.
Assessment Design

An abbreviated FA was conducted based on the procedures described by Roscoe, Carreau, MacDonald, and Pence (2008). Specifically, conditions consisted of a no interaction or no consequence, attention, and demand. Roscoe and colleagues suggested that only these conditions are necessary to assess whether the participants’ vocal stereotypy is socially mediated. The FA was conducted using a multielement design and consisted of six 5-min sessions in the following order: no interaction (no consequence), no interaction (no consequence), attention, no interaction (no consequence), no interaction (no consequence) and demand. In other words, there was a 2:1 ratio of no interaction conditions per attention and demand conditions. According to Roscoe and colleagues, this series of conditions is sufficient when behaviors seem to be maintained by automatic reinforcement. In other words, this assessment was conducted to verify whether stereotypy persisted in the absence of social contingencies.

Because of the limitations of the room where the study took place, there was no possibility of observing the participants when the door was closed. Thus, a no interaction condition was used in place of the alone condition. Other studies have successfully used a no interaction condition to determine an automatic function (e.g., Carter, Devlin, Doggett, Harber, & Barr, 2004; Mace & Knight, 1986; Rapp, Dozier, Carr, Patel, & Enloe, 2000; Vollmer et al., 1994). More specifically, no interaction conditions have been used because they may create a parallel environment to resemble where the problem behavior occurs (Carter et al.; Mace & Knight) or because of observational constraints.

As previously mentioned, for Sally, a no consequence condition was conducted in place of a no interaction condition. Based on the procedures described by Athens and colleagues (2008), a no consequence condition was selected because it was reported that in the absence of tangibles the participant engaged in thumb sucking, which was an incompatible response with vocal stereotypy. For Charlie, Josh, and Adam, no interaction, attention and demand conditions were conducted. All other behavior excluding vocal stereotypy was ignored throughout the FA.
Assessment Conditions

No consequence. The purpose of the no consequence condition was to test for an automatic reinforcement function. During the no consequence condition, the participant was engaged with highly preferred toys (based on the results from the brief MSWO preference assessment), with the experimenter standing at least 4 ft directly behind the participant. Furthermore, there were no programmed consequences for vocal stereotypy.

No Interaction. The purpose of the no interaction condition was to determine whether stereotypy occurred in the absence of social contingencies. During the no interaction condition participants were seated in a room across from the experimenter or person filming, with no other materials present. No social consequences were delivered contingent upon the occurrence of stereotypy. For this condition, the motivating operation was lack of stimulation, which could increase the value of any form of stimulation as a reinforcer, including stereotypy. Therefore, if stereotypy was automatically reinforcing, participants would be more likely to engage in it throughout this condition.

Attention. The purpose of the attention condition was to test for a positive reinforcement function. The attention condition consisted of participants and an experimenter in the room with three moderately preferred items selected for participants to engage with. These toys were selected because moderately preferred items were less likely to compete with attention as a form of reinforcement. Upon starting the condition, the experimenter told participants, “Ok, I am going to do some work now, you can play with your toys.” Contingent upon vocal stereotypy, the experimenter briefly reprimanded participants by saying, “Don’t do that, it’s loud” or “Stop it!” along with a light physical tap to their shoulder or arm. All other behaviors were ignored.

Demand. The purpose of the demand condition was to test for a negative reinforcement function. During this condition, demands were presented every 15 s and contingent upon vocal stereotypy, demands were removed for a 15 s period. The experimenter removed the demands, while telling participants, “Ok, you don’t have to.” Demands were those reported by teachers or caregivers
that participants had a more difficult time with in their programmed curriculum, which could occasion an increase in stereotypy. Specifically, demands were selected as those that were typically encountered during the child’s instructional programming, had not been mastered (e.g., performance below 80% correct) and were nonvocal. Demands were nonvocal in order to allow the experimenter to physically prompt completion of the task in the absence of following instructions.

Demands for Sally included: zipping up a jacket, buttoning her pants, unzipping a jacket, cutting out shapes, and drawing a square. Demands for Charlie consisted of: tying a shoe, cutting out shapes, completing a 24-piece puzzle with no frame, buttoning a sweater, writing his name, and zipping up a jacket. Demands for Josh were: zipping up a jacket, cutting out a zig zag line, completing a 24-piece puzzle with no frame, and cutting out shapes. Lastly, demands for Adam consisted of: twisting off a water bottle lid, zipping up a jacket, coloring a picture, buttoning a jacket, and writing his name.

Treatment

Response Measurement

Overall, there were a total of five dependent variables in this study. Dependent variables included the duration of vocal stereotypy, frequency of appropriate vocalizations, total session length, number of RIRD implementations, and social validity scores. Vocal stereotypy was collected using continuous duration recording (see Appendix C), whereas, appropriate vocalizations were collected using frequency data because the nature of the response was relatively constant and discrete (Ahearn et al., 2007) (see Appendix C). For both variables, data were collected in both the baseline and treatment conditions. Vocal stereotypy was defined identically as in the functional analysis. Conversely, appropriate vocalizations were defined as any contextually appropriate vocalization and included requests for attention, breaks, or tangible activities and comments. Session length and number of RIRD implementations were recorded to assess whether decreases in both occurred in response to suppression of stereotypy. Session length and number of RIRD implementations were collected using cumulative frequency data. Finally, social validity scores were calculated by summing the total score for each
procedure (vocal and motor).

The percentage of stereotypy was calculated by dividing the total number of seconds in which vocal stereotypy occurred by the total number of seconds in the session (300 s) multiplied by 100. Data were also collected on frequency of appropriate vocalizations. The cumulative frequency of appropriate vocalizations was reported for each session.

Experimental Design and Order of Conditions

For all participants, an ABACA reversal design with the most effective treatment implemented in the last condition was conducted. Following baseline, two different conditions of RIRD, vocal (VRIRD) and motor (MRIRD) were compared. After identifying the most effective procedure, this procedure was implemented again in the last condition to further evaluate its effects. The conditions were counterbalanced across participants to control for sequence effects. More specifically, Sally and Josh were exposed to the VRIRD procedure then the MRIRD procedure, while Charlie and Adam were exposed to the MRIRD procedure then the VRIRD procedure. Counterbalancing conditions helped to determine whether it was the specific procedure that was effective, rather than attributing the effectiveness to the order of conditions. All sessions were videotaped for data collection purposes.

Due to Charlie’s increasing levels of stereotypy during both the second MRIRD and VRIRD conditions, changes to his procedure were made. Consequently, Charlie was exposed to a multiple-treatments design (Ulman & Sulzer-Azaroff, 1975), which alternated between novel vocal and motor demands. More specifically, a multiple-treatments design was utilized in order to compare two types of demands in a rapidly alternating fashion. It was also noted that Charlie’s session lengths were much longer than the other participants (see Figure 5, bottom panel) because of such high rates of vocal stereotypy. Thus, a multiple-treatments design could effectively compare two or more treatments in a more time efficient manner (Kazdin, 1982). To enhance discrimination between the two treatments, during the VRIRD condition only the experimenter wore a hat and sunglasses.
**RIRD probes.** Prior to treatment, probes were conducted to identify appropriate vocal and motor demands for use during both RIRD sequences. Vocal probes were conducted to assess fluency of vocal imitation of mastered words, or responding to social questions (depending on the existing repertoire of the child) to which participants could consistently respond. Specifically, vocal probes in the form of vocal imitation were conducted for all participants. Social question probes were also conducted for Josh for his VRIRD phase, as well. These skills were selected based on prior mastery as reported by teacher or caregiver report. Fluency was defined as responding correctly and independently (without prompts) to either vocal imitation or social questions, across at least two teachers. Likewise, motor probes were conducted to assess fluency in the form of either mimetic responding and/or compliance with instructions to engage in a motor response (depending on the existing repertoire of the child). For Sally, Charlie, and Josh, motor probes in the form of following instructions were conducted. On the other hand, motor probes in the form of gross motor imitations were conducted for Adam. These skills were also reported as mastered via caregiver or teacher report.

Prior to the start of the study, the experimenter probed both motor and vocal skills across two different experimenters to ensure at least 89% accuracy and fluency in responding. Consequently, for both types of probes, a list of 15 items was created. These items were identified as those that participants could emit both fluently and independently. Three lists containing 10 items were created and randomly rotated per day (see Appendices D and E). The order of items was randomly selected by assigning numbers to each item and then randomly drawing numbers from a hat. The chosen list was posted on the walls for the experimenter’s use throughout session. Moreover, the three lists were rotated so that a different list was used every day.

New demands were probed for Charlie during the multiple-treatments design. Specifically, Charlie was exposed to novel pictures and imitations of gross motor actions to assess items that he fluently responded to. These items were used to create several novel lists to be used for each session. Instead of having only three lists, a new list was created each session, to help decrease the likelihood that he could memorize the order of demands.
**Baseline.** During baseline, the experimenter sat at the table next to participants engaged in an activity. Four moderately preferred items (based on items four through seven from the brief MSWO preference assessment) were used for all baseline and treatment sessions. Participants engaged with one of the four items each session, while the remaining three items were on the table but out of reach. Items were out of reach in order to establish the motivating operation for participants to request for other preferred items. For each session, participants were engaged with a different moderately preferred item per each session. Rearranging the items every session helped to prevent abolishing effects, and allowed the items to maintain their reinforcing efficacy.

At the table, the experimenter ignored all occurrences of vocal stereotypy. Participants were praised for appropriate playing (e.g., “Great job playing!”) as well as appropriate vocalizations (e.g., “Nice job asking for a break!”). Participants could request for alternate items available on the table, but attempts to reach for the item were blocked and the experimenter waited for 3 s at which time they prompted participants with, “I want…” In order to prevent reinforcing a negative chain of behavior, a period of 3 s in the absence of grabbing or reaching elapsed before prompting for the item began. When participants requested, they were praised and delivered the item. If participants requested for something unavailable (e.g., videos, mommy) the experimenter said, “Nice job asking for mommy, we will see her soon.” Prompted and unprompted appropriate vocalizations were differentially reinforced, while only independent vocalizations were recorded to evaluate concomitant increases in appropriate, independent behaviors.

For all participants, sessions were defined as five minutes elapsing that did not include treatment time. More specifically, for both VRIRD and MRIRD conditions, a session clock that started at the beginning of each session was stopped each time the experimenter implemented RIRD. The time was restarted after the experimenter delivered praise following three consecutive instances of compliance. The session continued until the session clock indicated that five minutes had elapsed in which participants were not in treatment. Baseline sessions continued until stereotypic behavior reached stability or showed an upward trend. Stability was defined when the data remained constant and
there was no evidence of a downward trend. A trend consists of the data displaying an increase or decrease in direction or degree. Specifically, trend is used to predict future measures of the behavior under unchanging conditions (Cooper et al., 2007).

**Vocal RIRD (VRIRD).** The purpose of VRIRD was to evaluate the effects of providing vocal demands as incompatible responses for vocal stereotypy. Identical to baseline, there were four moderately preferred items available. All four items were randomly rotated across sessions, to prevent the items from losing their reinforcing efficacy. While engaged with one item, the remaining three items were available on the table, but out of reach. Participants were engaged while the experimenter sat next to them at the table to allow removal of the item when necessary. Contingent upon vocal stereotypy, the experimenter removed the item and gained attending by stating participants’ name in a neutral tone of voice while initiating eye contact and issuing vocal demands for appropriate language. Josh’s vocal demands initially consisted of social questions (e.g., “What’s your name?”; “Where do you live?”; “How old are you?”, etc.) but were changed after six sessions due to lack of fluency for responding to questions. For Sally, Charlie, Josh and Adam, vocal demands consisted of vocal imitation (e.g., “Say house,” “Say dog,” “Say red”). Charlie’s second set of vocal demands consisted of intraverbal responses to 2D label cards. All questions or words were asked in a systematic order from lists created during the probe session. This order was to ensure consistency across each session per day, for the order the demands were presented.

Correct responding was defined as responding to social questions or vocal imitations without prompts, within 3 s. By contrast, noncompliance was defined as failure to follow the experimenter’s instruction within 3 s. If physical noncompliance occurred such as running or turning away, displaying aggression, or engaging in more stereotypy, participants were reissued the demand until they independently complied (without prompts from the experimenter) and gestured to return to their seats, if applicable. Participants responded to each vocal demand independently (by themselves and without prompts) for three consecutive responses in the absence of vocal stereotypy. At this time the experimenter delivered social praise for nice talking (e.g., “Super job talking!”). If participants
manded during the RIRD sequence, the experimenter said, “Nice asking” but continued the sequence until three consecutive vocal imitations or responses to social questions occurred in the absence of stereotypy. If participants did not respond to the vocal demand, the instruction was repeated until participants complied independently with three consecutive vocal responses. Prompts occurred in the form of reissuing the vocal demand. All other occurrences of behavior were ignored (e.g., aggression, touching, etc.). In the event that participants left their seat, participants were nonvocally redirected back with a gesture prompt to continue the session.

Similarly to baseline, participants were able to gain access to an item when they appropriately requested for it. Attempts to reach for the items were blocked and the experimenter waited for 3 s at which time they prompted participants by saying, “I want…” When participants requested, they were praised and delivered the item, if possible. If participants requested for unavailable items such as tickles, mom/dad, etc. the experimenter said, “Nice job asking, we can have it later” Prompted and unprompted vocalizations were differentially reinforced and data were collected only on independent appropriate vocalizations. Lastly, participants received praise for appropriately engaging with toys (e.g., “Great job playing!”).

**Motor RIRD (MRIRD).** The purpose of MRIRD was to evaluate the effects of topographically dissimilar demands, on reducing vocal stereotypy. Identically to VRIRD sessions, four randomly selected moderately preferred items were available at a time, with participants engaged with one item at a time. Items were rotated randomly between sessions to help control for the loss of reinforcer efficacy. Sessions began with participants engaged with an item while the experimenter was seated next to them in order to remove the item when necessary. Contingent upon vocal stereotypy, the experimenter stated participants’ name in a neutral tone of voice, while removing the item concurrent with the implementation of a MRIRD sequence. After gaining attending similarly to the VRIRD condition, the MRIRD sequence consisted of either gross motor imitations or following instructions.

Sally, Charlie, and Josh’s demands consisted of following commands such as “Touch your nose; Clap your hands”, etc. Adam and Charlie’s second set of demands, their demands consisted of
following gross motor imitations. Specifically, the experimenter said, “Do this” and touched her head or “Copy me” while clapping her hands. Moreover, Charlie’s second set of demands were specifically designed to be more complex to increase the difficulty of responding and included more complex gross motor actions (e.g., crossing over the midline, fine motor actions).

Similar to VRIRD, participants responded to each motor demand independently (without prompts) for three consecutive responses in the absence of vocal stereotypy. Compliance followed with the delivery of praise for listening to the aforementioned demands (e.g., “Super job listening!”). If participants manded during the RIRD sequence, the experimenter praised by saying, “Nice asking” but continued the sequence until three consecutive imitations or instructions occurred in the absence of stereotypy.

Noncompliance was defined as failing to follow the experimenter’s instruction within 3 s. If noncompliance occurred such as running or turning their body away, displaying aggression, engaging in more stereotypy, or physically resisting, this behavior was ignored and participants were vocally prompted with the original instruction until they independently responded. Identically to the VRIRD condition, if participants left their seats, they were prompted back to their seat with a gesture prompt.

Appropriate vocalizations were followed by praise, as well as the delivery of the requested item, if possible. If the item was unavailable (e.g., candy, video) the experimenter said, “Nice job asking, we can have some later.” In addition, appropriate toy manipulations were also praised. All other occurrences of behavior (e.g., aggression, touching, etc.) were ignored. As in the VRIRD sequence, if participants were out of their seat and/or sitting on the floor, this behavior was ignored and participants were nonvocally redirected with a gesture prompt back to their original seats to continue the session.

Similarly to previous conditions, participants were able to gain access to an item when they appropriately requested for it. Attempts to reach for the item were blocked and the experimenter waited for 3 s at which time she prompted participants with, “I want….” When participants requested, they received praised (e.g., “Great asking!”), and were delivered the item. If participants requested for an
unavailable item such as edibles, videos, etc. the experimenter said, “Nice job asking, we can have some later.” Prompted and unprompted vocalizations were differentially reinforced and recorded similarly to previous conditions. Specifically, only independent vocalizations were recorded.

Sally’s sessions were conducted on an average of three days a week, 4-5 sessions a day. Charlie’s sessions were conducted on an average of three days a week, 2-3 sessions a day. Josh’s sessions were conducted on an average of two days a week, 2-3 sessions per day. Finally, Adam’s sessions were conducted on an average of two days a week, 4-5 sessions per day. Session times ranged from a minimum of 5 minutes to 50 minutes depending on levels of vocal stereotypy throughout the session. High rates of vocal stereotypy resulted in longer session lengths. Sessions were terminated if participants exhibited severe emotional responses such as crying with tears, yelling, flopping to the floor, etc., for a period longer than five minutes at a time. Only one session for Charlie met this criterion. The criterion for concluding treatment conditions were a stability criterion of a minimum of three consecutive sessions with levels at or below 10%, or a minimum of 10 completed sessions.

Significantly, for all sessions, no physical prompts were used to comply with demands and/or return participants back to their seats. Physical prompts were avoided to control for the possibility of an increase in rate of stereotypy due to physical guidance. Furthermore, neither vocal stereotypy nor appropriate vocalizations that occurred during the RIRD sequence were included in the reported data.

Following completion of both RIRD procedures, the experimenter visually inspected the data to compare which procedure appeared to be the most effective at reducing vocal stereotypy. Specifically, this consisted of comparing the trend and level exhibited by the data in each treatment condition to determine whether the trend and level found in the first treatment condition changed in direction or slope during the subsequent treatment condition (Cooper et al., 2007). The procedure that was the most effective at reducing stereotypy was reimplemented again in the last condition to further assess the effects of the blocking procedure.
Social Validity

Social validity was measured at the conclusion of the study to assess parent’s opinions regarding practicality and feasibility of each procedure. Social validity measures were given evaluating each RIRD procedure. Specifically, parents were asked to deliver feedback about each procedure using a 5-point Likert-scale. This survey consisted of a 10-item scale with 1 being strongly disagree to 5 being strongly agree. For example, responding to statements such as “I liked the vocal RIRD procedure”, or, “If trained, I could easily implement this procedure in my home”, etc. (see Appendices F and G). Scores were calculated to interpret the preference and agreeableness with each item for both procedures. Higher scores were more indicative of agreeableness and preference for a procedure; whereas, lower scores were indicative of less preference and agreeableness for a procedure.

Interobserver Agreement (IOA)

For both the functional analysis, and the experiment, a second observer reviewed and scored the previously recorded sessions for IOA. IOA was calculated by dividing the smaller percentage by the larger percentage and multiplying by 100%. IOA was assessed for an average of 43% of all sessions across all conditions during the FA. During the experiment, IOA was assessed for 43.8% of all sessions.

Results from the functional analysis indicated the mean IOA total for vocal stereotypy. Sally’s IOA averaged 93.8% (range, 82% - 100%) across conditions. Charlie’s IOA averaged 91% (range, 74% - 99%) across conditions. Josh’s IOA averaged 90.7% (range, 65% - 100%) across conditions. Lastly, Adam’s IOA averaged 91.2% (range, 86% - 94%) across conditions. The overall IOA for vocal stereotypy during the functional analysis was 91.7%.

Results from the experiment indicated the mean IOA for vocal stereotypy and appropriate vocalizations. Sally’s IOA for vocal stereotypy averaged, 86.8% (range, 50%-100%). Sally’s IOA for appropriate vocalizations averaged, 82.4% (range, 38%-100%). Charlie’s IOA for vocal stereotypy averaged, 89.4% (range, 63%-99%). Charlie’s IOA for appropriate vocalizations averaged 86.5% (46%-100%). Josh’s IOA for vocal stereotypy averaged 92.0% (range, 80% - 100%) across all conditions. Josh’s IOA for appropriate vocalizations averaged 95.1% (range, 67% - 100%). Adam’s IOA for vocal
stereotypy averaged 85.4%, (range, 60% - 100%). Adam’s IOA for appropriate vocalizations averaged 83.7% (range, 50% - 100%). The overall average IOA for vocal stereotypy was 88.3%. The overall average IOA for appropriate vocalizations was 87%.

Treatment Integrity

Treatment integrity was assessed for the experiment for an average of 39% of sessions across each RIRD condition. An independent observer recorded whether or not RIRD was implemented correctly throughout the experiment. Trial one was scored as correct if the experimenter delivered RIRD immediately (within 2 s) contingent upon vocal stereotypy. Likewise, trial two was scored as correct if the experimenter ensured that participants responded with three consecutive compliances in the absence of stereotypy. In contrast, trials were scored as incorrect if the experimenter did not deliver RIRD contingent upon stereotypy (within 2 s) or discontinued the sequence without three consecutive independent compliances without stereotypy. The total number of correct trials out of the total number of trials x 100 was calculated to determine the overall integrity of the independent variable. Overall, treatment integrity across all participants was 98.6% (range, 96.1% - 100%).
Chapter 3

RESULTS

Stimulus Preference Assessment

The results of Sally’s preference assessment yielded link beads, a Lucky Ducks game™, and baby dolls as highly preferred. While Mr. Potato Head™, a dollhouse, a toy kitchen set, and a train set were chosen as moderately preferred. The results of Charlie’s first preference assessment yielded bath toys, Blues Clues puzzle™, and a whiteboard, as highly preferred. Playdoh™, books, a floor puzzle, and a Magnadoodle™ were reported as moderately preferred. For his second preference assessment, sport balls, a Koosh™ worm, and blue foam were found to be highly preferred. Two Koosh™ balls, an ABC puzzle, a Rubik cube™, and blocks were found to be moderately preferred. The results of Josh’s preference assessment yielded a whiteboard, Magnadoodle™, and coloring sheets as highly preferred. A coloring book, paint set, Playdoh™, and, Spongebob/Wall-E™ books were found to be moderately preferred. The results of Adam’s preference assessment yielded ABC books, a Koosh™ ball, and a Koosh™ worm, as highly preferred. A Rubik cube™, Moon sand™, books, and a squishy dolphin were moderately preferred.

Functional Analyses (FA)

Figure 1 (top panel) displays the results from Sally’s functional analysis. Her FA showed clear differentiation between the no consequence and other conditions. Sally exhibited low rates of vocal stereotypy during the demand (mean of 12%) and attention conditions (mean of 15%). Moreover, Sally exhibited moderate rates of vocal stereotypy during the no consequence condition (mean of 33%), suggesting an automatic function for her vocal stereotypy.

Figure 1 (bottom panel) displays the results from Charlie’s functional analysis. His FA depicts a clear differentiation between the no interaction and other two conditions. Specifically, Charlie exhibited low rates of vocal stereotypy during both the demand (mean of 14%) and attention (mean of
Figure 1. The top panel depicts the functional analysis for Sally’s vocal stereotypy. The bottom panel depicts the first and post functional analysis for Charlie’s vocal stereotypy. Both graphs depict the percentage of occurrence that vocal stereotypy occurred.
41

8%) conditions. Conversely, he exhibited high rates of vocal stereotypy during the no interaction conditions (mean of 59%), suggesting an automatic function.

Figure 2 (top panel) displays the results from Josh’s functional analysis. His results did not show a clear differentiation between the three conditions. He exhibited low to moderate rates of vocal stereotypy during the no interaction (mean of 22%), attention (mean of 15%) and demand (mean of 26%) conditions. Thus, because of this undifferentiation, an extended no interaction condition was implemented to further assess for an automatic function. During the extended no interaction condition, Josh’s vocal stereotypy occurred at an average of 24%. Despite the low occurrence of stereotypy during the extended no interaction condition, stereotypy did persist in the absence of social contingencies suggesting that his stereotypy was maintained by automatic reinforcement.

Figure 2 (bottom panel) also displays results from Adam’s functional analysis. His results were also undifferentiated because there was not a clear distinction between the no interaction and two other conditions. He exhibited moderate to high rates of vocal stereotypy during the no interaction condition (mean of 39%) and low to moderate rates of vocal stereotypy during the attention (mean of 26%) and demand (mean of 30%) conditions. Therefore, an extended no interaction condition was conducted. During this condition, Adam’s stereotypy occurred at an average of 54%, suggesting that his stereotypy was maintained in the absence of social consequences.

Treatment

Figure 3 (top panel) depicts the percentage of vocal stereotypy for Sally during baseline and treatment. Sally’s vocal stereotypy occurred at a moderate to high level during the initial baseline phase at an average of 55%. VRIRD was implemented first and vocal stereotypy immediately reduced to near zero levels, at an average of 7%. During the return to baseline, stereotypy returned to original levels at an average of 60%. MRIRD was then introduced, and stereotypy reduced, but was slightly more variable than during the VRIRD phase to an average of 9.7%. The final return to baseline resulted in a moderate level of stereotypy, averaging at 36%. Because VRIRD had a slightly lower average of
Figure 2. The top panel depicts the functional analysis for Josh’s vocal stereotypy. The bottom panel depicts the functional analysis for Adam’s vocal stereotypy. Both graphs depict the percentage of occurrence that vocal stereotypy occurred.
stereotypy in the final condition, VRIRD was reintroduced. In this final treatment condition, stereotypy reduced almost consistently to zero levels, occurring at an average of 1.1%.

Figure 3 (top panel) also shows the frequency of appropriate vocalizations across baseline and treatment sessions for Sally. During baseline, appropriate vocalizations occurred at a low rate, showing a slight increase, followed by a downward trend at an average of 4.2 responses. During the initial VRIRD phase, appropriate vocalizations increased slightly, but remained variable throughout the phase with only a modest increase to an average of 5.6 responses. The return to baseline resulted in its lowest occurrences of appropriate vocalizations to an average of 1.5 responses, followed by a large increase during the MRIRD phase. Introduction of the MRIRD phase resulted in its highest frequency of appropriate vocalizations compared to previous baseline and treatment phases at an average of 14.7 responses. Reimplementation of baseline produced lower levels of appropriate vocalization at an average of 5 responses. Finally, VRIRD was reimplemented and appropriate vocalizations did not significantly increase compared to its previous baseline levels, occurring at only an average of 2 responses.

Figure 3 (bottom panel) shows the percentage of vocal stereotypy for Charlie during baseline and treatment conditions. Vocal stereotypy occurred at moderate to high levels during initial baseline levels at an average of 50.8%. During session four, Charlie was engaged with books, and was tacting pictures in the books. Thus, his levels of vocal stereotypy were significantly lower than the other sessions. Upon introduction of MRIRD, stereotypy levels significantly reduced to an average of 21.3%. Return to baseline resulted in higher than original baseline levels of stereotypy at 74.3%. Subsequently, VRIRD was introduced, and stereotypy levels reduced immediately to an average of 29.2%, with levels slightly higher than stereotypy levels during MRIRD. The return to baseline resulted in high levels of stereotypy at an average of 62.2%. Because MRIRD was slightly more effective at reducing stereotypy, MRIRD was reintroduced. However, stereotypy levels did not return to the original suppression rate, occurring at an average of 35.4%. In other words, the second MRIRD condition did not show the same reduction as in the original MRIRD condition. Because stereotypy did not reduce to low levels, a return
Figure 3. The top panel depicts Sally’s percentage of occurrence of vocal stereotypy and frequency of appropriate vocalizations. The bottom panel depicts Charlie’s percentage of occurrence of vocal stereotypy and frequency of appropriate vocalizations. Solid squares and triangles represent vocal stereotypy, open (and closed) circles represent appropriate vocalizations.
to baseline was implemented followed by a reintroduction of VRIRD, to reassess the effects of vocal demands on stereotypy. During the return to baseline, stereotypy occurred at a mean of 69%.

Reintroduction of VRIRD produced stereotypy levels that reduced to a moderate level at an average of 41.6%. This second VRIRD phase remained higher than all previous treatment phases. Thus, a final return to baseline was implemented along with the presentation of novel toys. Because novel toys have been found to suppress stereotypy, Charlie was exposed to the toys for five minutes prior to reintroduction to baseline. Preexposure to toys was implemented to control for novelty effects. During return to baseline, stereotypy levels showed an initial increasing trend and returned to original baseline levels at an average of 57%.

Because of the lack of effectiveness of the previous treatments, the last treatment phase consisted of rapidly alternating between novel gross motor imitations and intraverbals responses to 2D cards. More specifically, Charlie’s data demonstrate an ineffectiveness to the treatments over time, because his stereotypy levels increased in response to treatment, compared to when both VRIRD and MRIRD were originally implemented. Thus, new demands were presented to increase the difficulty of responding for Charlie, as well as prevent Charlie from memorizing specific demands. However, there was not found to be a significant differentiation in responding between the two treatments. Vocal stereotypy during the MRIRD phase occurred at an average of 33.6%, while stereotypy during the VRIRD phase occurred at an average of 38.2%. These stereotypy levels were higher than the average of each condition when presented alone (MRIRD = 28.4%, VRIRD = 33.3%). Thus, the original treatment effects did not emerge.

Figure 3 (bottom panel) also shows the frequency of appropriate vocalizations for Charlie. During baseline, appropriate vocalizations occurred at moderate levels at an average of 10.5 responses, with the exception of when he was engaged with books in session four. When MRIRD was introduced, appropriate vocalizations increased in frequency to an average of 27.2 responses. When treatment was removed, appropriate vocalizations decreased significantly to an average of 1.7 responses. Introduction of VRIRD demonstrated an increasing trend in appropriate vocalizations at an average of 45.4
responses. Removal of treatment again decreased appropriate vocalizations to an average of 4 responses. Subsequently, MRIRD was reintroduced, and appropriate vocalizations showed an increasing trend occurring at an average of 65.7 responses. Upon removal of treatment, appropriate vocalizations decreased to near zero levels at an average of 2 responses. VRIRD was then reintroduced but only increased appropriate vocalizations modestly but still less frequently than in the previous treatment conditions at an average of 22.4 responses. The final return to baseline resulted in a decreasing trend with an average of 6.3 responses. The introduction of the alternating treatments produced significantly high levels of appropriate vocalizations. For both treatments, appropriate vocalizations showed an increasing trend. More specifically, during MRIRD, appropriate vocalizations occurred at an average of 76.6 responses. The VRIRD condition produced slightly less appropriate vocalizations occurring at an average of 67.2 responses. For both treatments, appropriate vocalizations occurred more frequently than during all previous treatment and baseline conditions.

Figure 4 (top panel) shows the percentage of vocal stereotypy that Josh engaged in during baseline and treatment sessions. During baseline, vocal stereotypy occurred at moderate levels at an average of 30%. Unique to Josh, he was exposed to two different VRIRD conditions. More specifically, he was exposed to both redirections in the form of social questions, as well as vocal imitations. Initially, VRIRD reduced stereotypy to modestly lower levels at an average of 20% during social questions, but resulted in long session lengths due to lack of fluency to respond to social questions. Due to low fluency, the demands during the VRIRD phase were changed to vocal imitation. The change in demands produced similar stereotypy levels as the previous demands at an average of 18%. The return to baseline resulted in low to moderate levels of stereotypy similar to the VRIRD phase at an average of 22%. Initially, low levels of stereotypy may have carried over due to treatment effects. Thus, the initial reduction in stereotypy did not demonstrate experimental control. MRIRD was then implemented with similar levels of stereotypy as the previous treatment phase at an average of 18%. The final return to baseline resulted in slightly higher levels of stereotypy identical to the original baseline levels, at an average of 22%, but did not return to the original baseline levels. Finally, MRIRD was reintroduced
Figure 4. The top panel depicts Josh’s percentage of occurrence of vocal stereotypy and frequency of appropriate vocalizations. The bottom panel depicts Adam’s percentage of vocal stereotypy and frequency of appropriate vocalizations. Solid squares and triangles represent vocal stereotypy, open circles represent appropriate vocalizations.
because there were no significant differences in stereotypy levels between the VRIRD and the MRIRD phase; however, the MRIRD phase was reported to result in shorter session lengths (see Figure 7, bottom panel). The final MRIRD condition resulted in slightly lower levels of stereotypy compared to previous conditions at an average of 10%.

Figure 4 (top panel) also depicts Josh’s frequency of appropriate vocalizations during baseline and treatment sessions. During baseline, Josh engaged in a variable rate of appropriate vocalizations at an average of 17 responses. Appropriate vocalizations remained variable during the initial VRIRD phase with social questions, also occurring at an average of 17 responses. When the demands were changed to vocal imitation, there was an increasing trend in appropriate vocalizations occurring at an average of 33 responses. Removal of treatment resulted in a decrease in appropriate vocalizations to variable levels, occurring at an average of 9 responses. Introduction of the MRIRD phase resulted in an increase in appropriate vocalizations to an average of 31 responses. The final return to baseline resulted in a significant decrease in appropriate vocalizations to 1.5 responses. Finally, the reintroduction of MRIRD resulted in an increase in appropriate vocalizations to an average of 18 responses.

Figure 4 (bottom panel) depicts levels of vocal stereotypy for Adam that occurred during baseline and treatment. Vocal stereotypy occurred at high levels during the initial baseline at an average of 48%. Introduction of MRIRD resulted in an immediate and significant reduction of stereotypy to an average of 15%. A return to baseline was implemented and stereotypy increased to high levels at an average of 61%. Introduction of VRIRD immediately suppressed stereotypy to near zero levels, at an average of 2%. The final return to baseline resulted in variable levels of stereotypy, which were also lower than the previous baseline levels, occurring at an average of 26%. VRIRD was reimplemented because it showed much quicker suppression rates. When treatment was reimplemented, stereotypy levels reduced to near zero levels, occurring at an average of 2%.

Figure 4 (bottom panel) also depicts Adam’s frequency of appropriate vocalizations that occurred during baseline and treatment. During baseline, appropriate vocalizations occurred at variable
levels, depending on the specific toy he was engaged with. Overall, during baseline appropriate vocalizations occurred at an average of 4 responses. During the introduction of MRIRD, appropriate vocalizations remained low initially, but increased to higher levels at the end of the phase. More specifically, appropriate vocalizations occurred at an average of 4 responses. During the return to baseline, appropriate vocalizations reduced to near zero levels, occurring at an average of 1 response. Introduction of the VRIRD phase, resulted in an increase in appropriate vocalizations compared to the previous baseline, occurring at an average of 5 responses. The final return to baseline resulted in a variable level of appropriate vocalizations, occurring at an average of 3 responses. Lastly, in the final return to VRIRD, appropriate vocalizations occurred at an average of 4 responses. Exclusive to Adam, there were not found to be significant differences in appropriate vocalizations between the MRIRD and VRIRD conditions.

Figure 5 (top panel) displays the average number of RIRD implementations for each participant across both VRIRD and MRIRD conditions. Overall, Sally’s data depict there were a greater number of RIRD implementations in the MRIRD condition occurring at an average of 14.1 implementations, compared to the combined VRIRD conditions at an average of 4.8 implementations. Charlie’s data is depicted next. Overall, there were a greater number of RIRD implementations in the combined VRIRD condition (including the alternating treatments condition) occurring at an average of 63.3 implementations, compared to the combined MRIRD conditions (including the alternating treatments condition) at an average of 45.3 implementations. Also note that for three sessions of MRIRD, the frequency is an approximate number because those sessions did not last the entire five minutes due to equipment malfunctions. Josh’s data display that during the VRIRD conditions, there was an average of 24.5 RIRD implementations. More specifically, when social questions were delivered, there was an average of 25 RIRD implementations (not displayed). Likewise, when vocal imitations were delivered, there was an average of 24 RIRD implementations (not displayed). Similarly,
Figure 5. The top panel depicts the average number of RIRD implementations across both treatments for all participants. The average frequency of RIRD implementations was recorded. The bottom panel depicts the average length of session across both treatments, for all participants. The average length of session was recorded in seconds.
for the combined MRIRD conditions, there was an average of 25.2 RIRD implementations delivered. In
other words, the number of RIRD implementations was essentially identical between the VRIRD and
MRIRD conditions for Josh. Finally, Adam’s data is depicted. In total, there were more
implementations of RIRD during the MRIRD phase, as oppose to the VRIRD phase. Specifically, the
MRIRD phase resulted in an average of 27 RIRD implementations, while the VRIRD phase resulted in
an average of 4.3 implementations. Thus, MRIRD implementations were almost seven times as frequent
as during the VRIRD condition. In addition, during the MRIRD phase, there was also found to be a
decreasing trend of the number of RIRD implementations in each subsequent session (not displayed).
Lastly, note that one session during the MRIRD condition did not last the full five minutes due to
equipment malfunctions, so the number of RIRD implementations is approximated.

Figure 5 (bottom panel) depicts the average session lengths for each treatment condition for
all participants. Sally’s average session length for the MRIRD condition (775.8 seconds) was
significantly longer than the VRIRD condition (mean of 331.5 seconds) by more than two-fold.
Similarly, Charlie’s data depict that the average session length during the MRIRD condition (1104.8
seconds) was longer than the average session length during the VRIRD condition (987.3 seconds). In
contrast, Josh was the only participant who had longer sessions during the VRIRD conditions (697.5
seconds) than during the combined MRIRD conditions (506.8 seconds). For Josh, longer VRIRD
conditions were attributed to low fluency when responding to social questions. Finally, similar to the
first two participants, Adam’s data depict his session lengths as longer during the MRIRD condition
(508.6 seconds) than during the combined VRIRD conditions (330.1 seconds). Most notably, Charlie,
Josh (second part of VRIRD) and Adam’s second treatment conditions were shorter than the first
treatment condition, possibly due to the order in which treatment was implemented.

Social Validity

Social validity results were collected all four participants’ caregiver for each procedure. Scores ranged from 1 as strongly disagree to 5 as strongly agree, and 3 as neutral. Scores from the VRIRD procedure will be reported first. For the item, “I liked the vocal RIRD procedure”, parents
overall rated this item at an average of 3.5. For the item, “If trained, I could easily implement the vocal RIRD procedure in my home”, parents rated this item as a 4.5. For the item, “I am satisfied with my child’s response to the vocal RIRD procedure”, parents rated this at an average of 3.8. The item, “Vocal RIRD reduced my child’s stereotypy during the session” was rated at an average of 4. The item, “I thought the vocal RIRD procedure was intrusive”, parents rated at an average of 2. For the item, “Vocal RIRD is a socially appropriate intervention method for my child”, parents rated at an average of 3.5. For the item, “I think vocal RIRD improved my child’s rate of appropriate vocalizations during the session”, parents rated at an average of 3.8. The item, “My child will benefit in the long run from the procedures implemented in this study,” parents rated at an average of 3.5. The item, “Vocal RIRD produced negative emotional reactions in my child”, was rated at an average of 1.8. Lastly, the item, “I feel vocal RIRD produced little change in my child’s stereotypy rates during session”, was rated at an average of 2.3.

For the motor RIRD procedure, the item, “I liked the motor RIRD procedure”, parents rated this item at an average of 3.8. For the item, “If trained, I could easily implement the motor RIRD procedure in my home”, parents rated this at an average of 4.3. The item “I am satisfied with my child’s response to the motor RIRD procedure”, parents rated this at an average of 3.8. The item, “Motor RIRD helped to reduce my child’s stereotypy during the session”, was rated an average of 4. The item, “I thought the motor RIRD procedure was intrusive”, was rated at an average of 2. The item, “Motor RIRD is a socially appropriate intervention method for my child”, was rated an average of 4. The item, “I think motor RIRD improved my child’s rate of appropriate vocalizations during the session”, was rated at an average of 4. “My child will benefit in the long run from the procedures implemented in this study”, was rated at an average of 3.8. “Motor RIRD produced negative emotional reactions in my child”, was rated at an average of 1.8. Lastly, “I feel motor RIRD produced little change in my child’s stereotypy rates”, was rated at an average of 2.
Chapter 4
DISCUSSION

For all four participants, the combination of the treatment package consisting of RIRD that involved removal of preferred toys, in conjunction with either vocal or motor demands and differential reinforcement for appropriate play, was found to be an effective intervention for reducing vocal stereotypy. Consistent with previous studies (e.g., Ahearn et al., 2007; Liu-Gitz & Banda, 2010; Miguel et al., 2009), VRIRD was found to effectively reduce vocal stereotypy, as well as increase appropriate vocalizations for three out of four participants. In addition, MRIRD was also found to effectively reduce stereotypy as well as increase appropriate vocalizations for three out of four participants. There were no significant differences between the effectiveness of the two procedures.

The effectiveness of the treatment package could be attributed to several factors. It could be that during VRIRD, the vocal demands presented functioned as an incompatible response. Previous studies have found incompatible responses to successfully compete with problem behaviors (Ahearn et al., 2007; Athens et al., 2008; Miguel et al, 2009; Skiba, Pettigrew, & Alden, 1971; Wagaman, Miltenberger, & Arndorfer, 1993); therefore, blocking the inappropriate behavior from occurring while participants were engaged with a more functional response. An explanation for the effectiveness of the MRIRD condition may also be that the demands presented contingent upon vocal stereotypy functioned as a punisher in conjunction with the removal of the toy (e.g., Ahearn et al., 2007; Athens et al., 2008). Previous studies (Falconeata et al.; Rapp, 2005) have suggested that the loss of preferred stimuli may compete with engaging in automatically reinforced problem behavior. Lastly, providing differential reinforcement for appropriately engaging with toys (e.g., in the absence of stereotypy) may have also functioned to reduce engaging in stereotypy. Consistent with previous studies (e.g., Taylor et al., 2005), reinforcing appropriate behavior while extinguishing inappropriate behavior may result in a decrease in undesirable behavior.
Contradictory to Ollendick and colleagues (1978) who found that topography of demands must match the topography of the behavior in order to most successfully reduce behavior, results suggest that for three of the four participants, there were not significant differences between the topography of the demands to interrupt and redirect stereotypy. In other words, both vocal demands and motor demands were equally effective at reducing vocal stereotypy. Specifically, for Sally, Charlie, and Josh, there were minimal differences in rates of stereotypy when vocal demands in the form of social questions and/or vocal imitation, as well as motor demands in the form of following instructions and/or imitating gross motor actions were presented. Moreover, because the topography of demands was equally effective at reducing stereotypy, these results suggest that the controlling mechanism behind RIRD was punishment (e.g., Lerman & Iwata, 1996) as opposed to extinction (e.g., Smith et al., 1999). If RIRD were an extinction procedure, it would be expected that VRIRD would be the most effective procedure because providing vocal demands contingent upon stereotypy would mask the sensory consequences of engaging in vocal stereotypy. In contrast, MRIRD would be less effective because stereotypy could occur simultaneously with the compliance of motor demands. Therefore, MRIRD would allow the sensory consequences of stereotypy to occur. However, the fact that VRIRD and MRIRD were equally effective at reducing stereotypy, provides support that the behavior mechanism responsible for reduction was punishment.

In contrast, Adam’s data support that VRIRD produced a much quicker suppressive effect than MRIRD. However, it is unclear whether this suppression can be attributed to the procedure alone. It may have been that the order of conditions played a role, suggesting the second condition was more effective because participants had previous exposure to the first treatment. More specifically, it could be that VRIRD was the most effective procedure because he had already been exposed to the MRIRD procedure. Therefore, generalization of treatment effects may have occurred from the initial intervention to the subsequent intervention. This may not be likely since, the second intervention was only found to be more effective for one of the four participants. Thus, more research is required to investigate this finding. Future research should further control for sequence effects by comparing the
two RIRD procedures in a multiple-treatments design (see Colon, Sveinbjorsdottir, Ahearn, Clark, Sinclair, Kinshaw, & Andrejczyk, 2010). Examining the effects using a multiple-treatments design would help to discern whether it was a specific treatment that was effective, or the order in which the treatment was presented.

In addition, other interesting findings include specific differences between the VRIRD and MRIRD conditions. Sally and Charlie emitted a larger frequency of appropriate vocalizations during the MRIRD condition than during the VRIRD condition. However, Sally’s frequency of appropriate vocalizations was directly positively correlated with the number of RIRD implementations. More precisely, the removal of the item during the RIRD sequence, created the MO for Sally to independently mand for the item. Therefore, every time the item was removed, Sally learned to independently mand for the item back. On the other hand, Josh, and Adam’s data depict that there were no differences in the average number of appropriate vocalizations emitted between the VRIRD and MRIRD conditions. Notably, there were found to be differences specifically, in the rate of appropriate vocalizations between different topographies of vocal demands. When social questions were used as the consequences for Josh’s stereotypy, his appropriate vocalizations were emitted at a low rate. Once his demands were changed to vocal imitation, appropriate vocalizations increased two-fold. One explanation may be the order of conditions in which he may have had repeated exposure to learn to independently request for items over time. In addition, Josh’s frequency of appropriate vocalizations was also directly positively correlated with the number of RIRD implementations. More specifically, there were similar increases in the number of appropriate vocalizations for each session in which there was an increase in the number of RIRD implementations. In other words, each time the item was removed, it created a MO in which Josh was more likely to mand for the item, and mands were then reinforced. Conversely, a lower number of RIRD implementations produced a lower frequency of appropriate vocalizations.

Social validity results also yielded significant findings for caretakers and/or teachers who may be interested in implementing these procedures. Overall, two parents reported similar preference between using the VRIRD and MRIRD procedures. Conversely, one parent indicated a preference for
the MRIRD procedure, because it gained compliance better in her child. Moreover, for both procedures, parents agreed that the procedure was at least moderately effective, and a socially appropriate intervention for reducing their child’s stereotypy rates as well as increasing their appropriate vocalizations. In addition, both procedures were found to be very easy to implement for parents, once trained. Lastly, parents did not find either procedure to be intrusive, or produce negative reactions in their children.

Implications

Most significantly, results suggest that even with the use of motor demands to interrupt/reduce stereotypy, the emergence of appropriate vocalizations is possible. In addition, another important finding lends to the practicality of MRIRD as an effective procedure to reduce stereotypy. Because there were not significant differences between the two procedures, motor demands may function as a better option for children who have limited vocal repertoires. For those individuals, it may be equally effective to interrupt and redirect vocal stereotypy with motor demands which may be much more practical and time efficient than attempting to redirect with vocal imitation.

There were found to be great differences in session length between the VRIRD and MRIRD conditions. For three out of four participants, total session length was found to be shorter during sessions in which VRIRD was implemented as oppose to MRIRD sessions. Josh’s data was the only data that found MRIRD sessions to take less time. However, this inconsistency may be attributed to his lack of fluency for responding to social questions during his initial VRIRD condition. The major implication may be that while the topography of the demands does not play a significant role on suppression rates of stereotypy, the VRIRD procedure may reduce stereotypy faster than the MRIRD procedure. Because VRIRD presented responses that competed with engaging in vocal stereotypy, results suggest that it could take less time to gain compliance in participants. More specifically, compliance with vocal demands competed with the sensory consequences produced by vocal stereotypy; thereby, preventing vocal stereotypy from occurring simultaneously. Therefore, when examining practicality of both procedures, in a clinical setting, it may be most advantageous to
implement the procedure that reduces stereotypy in the shortest amount of time. This is especially true, if there are no significant differences in stereotypy rates based on the topography of demands. The next priority would be then to look at the most time efficient procedure for these individuals.

Moreover, results indicate that for three of the four participants, there was a larger frequency of RIRD implementations during the second treatment condition. Specifically, for Sally, Charlie, and Josh, their stereotypy required more implementations of RIRD during the second treatment condition, in order to effectively reduce. These findings could suggest that for these three participants, they may have habituated to the treatment procedure over time. Specifically, exposure to the interruption and redirection demand (regardless of topography) may have lost its effectiveness due to repeated exposure.

Limitations

Despite the important findings in this study, there were some possible limitations that warrant attention. First, all sessions were conducted by the same experimenter, for both baseline and treatment conditions. Josh’s data failed to demonstrate experimental control because there was no differentiation between his second baseline data and both the VRIRD and MRIRD conditions. In addition, his third baseline was only slightly higher than the previous conditions as well. Thus, it could be argued that no discrimination between the baseline and treatment conditions was achieved, which could explain the lack of differentiation in rates of stereotypy during both conditions. In addition, the same experimenter conducted both treatment conditions for Charlie, when VRIRD and MRIRD conditions were rapidly alternated. Although differential stimuli were in place during the MRIRD condition (the experimenter wore a hat and sunglasses) data from both treatment conditions were not differentiated, suggesting the possibility that there was no discrimination between treatment conditions. Future research should investigate the effects of utilizing different experimenters for baseline and treatment conditions, as well as between treatment conditions as well. The use of more salient stimuli could also be included to further enhance discrimination between conditions.

Secondly, specifically to Sally, her appropriate vocalizations had reduced to zero levels by the conclusion of the study. A possible explanation for this reduction is that her vocalizations were
difficult to differentiate between appropriate vocalizations and stereotypy. More specifically, Sally did engage in appropriate vocalizations, but had stereotypy embedded in her appropriate language. For example, she would say, “The duckkkk---sss are swimming in the wattttt-errrr” while playing with a Lucky Ducks ™ game. Therefore, while the experimenter punished her stereotypy, the experimenter may have also inadvertently punished appropriate vocalizations, as well. Thus, repeated punishment of appropriate vocalizations (whether stereotypy was included or not) ultimately lead to suppression of all vocalizations. Future research should investigate the effects of increasing appropriate vocalizations using tact and/or mand training in individuals with disabilities to help increase this distinction.

Another limitation involved the prolonged session lengths that some participants experienced. For example, five of Charlie's sessions lasted a minimum of 30 minutes before the 5-minute treatment time had elapsed. Longer sessions were a direct result of Charlie’s high and continuous rate of stereotypy, which contributed to extensive out of session time. Extensive exposure to treatments may explain why Charlie habituated to the treatment effects. Catania (2007) described habituation as a reduction in responding over repeated presentations of a stimulus. Moreover, Charlie was the only participant who was exposed to each treatment twice, so that over time the treatments may have lost their effectiveness. Charlie’s data depict this loss of effectiveness during the second MRIRD and VRIRD conditions by the increase in stereotypy rates over time. Future research would benefit from limiting each session at or below 30 minutes, so that participants are not exposed to the treatment procedure for long durations of time. Limiting the time would also help to make sessions more consistent overall. In addition, use of a multiple treatments design may also decrease the overall time for the study because both treatment sessions would be rapidly alternated (Colon et al., 2010).

An additional limitation involved the loss of reinforcing efficacy of the toys used during sessions. Because the toys were kept constant throughout the whole study, and were never changed or removed, it may be that repeated exposure to the same toys resulted in a decrease of reinforcing efficacy. For instance, Charlie’s rate of appropriate vocalizations decreased because of the abolishing effects of the original toys. Consequently, novel toys replaced the original toys to help alleviate these
effects. While novel toys did temporarily increase play and appropriate vocalizations during sessions, he reportedly lost interest with the novel toys as well after the first few treatment sessions. Another explanation for the loss of efficacy may be the repeated removal of the toy during the RIRD sequence. Removing the toy contingently with stereotypy may have increased the aversiveness of engaging with the toys. In other words, Charlie may have ceased engaging with the toys to avoid the removal of the toy. Future research could control for the effects of abolishing operations by allowing participants to engage with a wide variety of toys, or by changing toys every session. In addition, implementing RIRD without response cost may be found to be less aversive when engaging with preferred items. Therefore, appropriate play may maintain over time.

In addition, a further limitation of this study involves the contrived nature of the setting. The experimenter did not interact with participants during the session except to praise for appropriate vocalizations and/or appropriate play. Thus, the nature of the session was very contrived and not representative of natural play settings. Furthermore, according to parental report (see social validity results), results did not generalize across settings, and were not found to maintain outside of the laboratory setting. Future research could look at implementing RIRD in more naturalistic settings (see Liu-Gitz & Banda, 2010), to possibly increase generalization of results across settings/people.

Another limitation involved the possible ineffectiveness that the procedure may have for attention maintained or multiply controlled stereotypy. Josh’s functional analysis data depict that his stereotypy may be partly multiply controlled (see Figure 2, top panel). Thus, providing attention when implementing the procedure contingent upon stereotypy may have inadvertently reinforced his stereotypy. This explanation may support the ineffectiveness of RIRD for Josh and Charlie. For example, Charlie began engaging in delayed echolalia in order to produce attention from the experimenter during sessions. Consequently, a second functional analysis was conducted to evaluate an attention function. However, attention was not found to be a controlling variable based on the results of the FA (see Figure 1, bottom panel). In spite of this, future research should investigate the effects of
RIRD for children who exhibit multiply controlled or attention maintained stereotypy. It may be that RIRD is not an appropriate treatment for those individuals.

Lastly, another limitation involved the addition of medication during the middle of the study for Josh. Thus, it is unclear whether any changes in behavior are a direct result of the treatment procedures, or due to side effects of his medication. Future research should help control for this by alerting parents to the significance of withholding medication while their child is participating in a study, or by starting the medication prior to the study and using its removal as a separate variable (see Miguel et al., 2009).

Conclusions

In conclusion, the use of vocal and motor demands was found to be equally effective at reducing vocal stereotypy. Moreover, parental report also indicated that two out of three parents did not have a preference between the vocal and motor procedures. Essentially, as long as one type of demand is in place to interrupt and redirect stereotypy, stereotypy should reduce. Because both VRIRD and MRIRD were found to successfully reduce stereotypy, these data suggest that the behavior mechanism behind the reduction is punishment. Had only VRIRD been effective, would suggest that vocal demands masked the sensory consequences produced by vocal stereotypy, supporting an extinction function. Because data do not support this, provides support for punishment as the controlling mechanism.

Major implications include the use of motor demands as a successful intervention method for individuals with limited vocal repertories. Likewise, there were not found to be differences in appropriate vocal behavior between implementing vocal or motor demands. In other words, providing motor demands resulted in the emergence of appropriate vocalizations. Lastly, one parent reported a preference for motor demands, because she found it as a more efficient way to gain compliance.

In addition, results suggest that providing vocal demands to interrupt and redirect stereotypy may be a quicker method to suppress stereotypy. Because providing vocal demands competes with engaging in vocal stereotypy, vocal demands functioned as an incompatible response. Thus, responding reallocates to a more functional response. However, when motor demands are presented, individuals
may engage in both stereotypy and comply with demands concurrently. Thus, it may be that gaining compliance with motor demands requires much more time. In applied settings, this may not always be the most practical due to the stringent schedules that are in place for many of these individuals. Therefore, providing vocal demands to compete directly with stereotypy may be the most practical.

Future Research

While previous studies have primarily investigated the effects of RIRD on vocal stereotypy, future research should focus its attention on the effects of interrupting and redirecting motor stereotypy. It would be beneficial to assess whether the topography of demands to interrupt and redirect motor stereotypy must match in sensory consequences in order to more effectively reduce motor stereotypy. As mentioned previously, it would also be important to enhance maintenance and generalization of treatment effects outside of the laboratory. This could be investigated by incorporating parent training with the most effective procedure so that generalization of effects could be achieved. Overall, this would increase the social significance of the treatment, because treatment effects may be more likely to occur in novel settings and over time.
APPENDIX A

Questionnaire to be sent to parents prior to the beginning of the study.

Preferred Items Assessment

The purpose of this survey is to obtain information about the toys that you believe would be useful as rewards for your child.

If you have signed the consent form, please answer the following questions regarding your child’s preferences:

1. Some children really enjoy toys like puzzles, books, blocks, figurines, musical toys, playdoh, etc. What are the specific toys your child really likes?
   - ___________________
   - ___________________
   - ___________________
   - ___________________
   - ___________________
   - ___________________
   - ___________________
   - ___________________
   - ___________________

2. Please go back to the list in question number one, and place a number in each box to rank these toys from most favorite (1) to least favorite (10).

3. Are there any toys that you would prefer your child not to play with during our study?

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Appendix C
RIRD Vocal Stereotypy
Continuous Duration Recording

**Operational Definition:**
**Vocal stereotypy:** any instance of non contextual or non functional speech and repetitive sound and/or words, noncontextual singing

Circle one or all of the following at the second it occurs:

**Key:**
- **V:** Vocal stereotypy
- **AV:** Appropriate vocalizations

### Operational Observations

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APPENDIX D

MOTOR LIST 1

1. TOUCH HEAD
2. TOUCH EARS
3. WAVE
4. TOUCH KNEES
5. TOUCH CHIN
6. RAISE HAND
7. TOUCH TUMMY
8. GIVE ME 5
9. TOUCH BACK
10. CLAP HANDS
APPENDIX E

VOCAL LIST 3

1. MOUSE
2. DOG
3. GREEN
4. CUP
5. BOOK
6. FROG
7. FISH
8. PARK
9. DRUM
10. CHAIR
APPENDIX F

Social Validity Scale
Vocal RIRD

After watching the video sessions, please answer all questions honestly and to the best of your ability. This will help to interpret the overall social validity of the study for future reference.

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

| 1. I liked the vocal RIRD procedure.      | 1 2 3 4 5 |
| 2. If trained, I could easily implement the vocal RIRD procedure in my home. | 1 2 3 4 5 |
| 3. I am satisfied with my child’s response to the vocal RIRD procedure. | 1 2 3 4 5 |
| 4. Vocal RIRD reduced my child’s stereotypy during the session. | 1 2 3 4 5 |
| 5. I thought the vocal RIRD procedure was intrusive. | 1 2 3 4 5 |
| 6. Vocal RIRD is a socially appropriate intervention method for my child. | 1 2 3 4 5 |
| 7. I think vocal RIRD improved my child’s rate of appropriate vocalizations during the session. | 1 2 3 4 5 |
| 8. My child will benefit in the long run from the procedures implemented in this study. | 1 2 3 4 5 |
| 9. Vocal RIRD produced negative emotional reactions in my child. | 1 2 3 4 5 |
| 10. I feel vocal RIRD produced little change in my child’s stereotypy rates during session. | 1 2 3 4 5 |

Please provide any additional comments/suggestions about the procedure:
APPENDIX G

Social Validity Scale
Motor RIRD

Please answer all questions honestly and to the best of your ability. This will help to interpret the overall social validity of the study for future reference.

1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

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<th>Question</th>
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<th>2</th>
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<td>1. I liked the motor RIRD procedure.</td>
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<td>2. If trained, I could easily implement the motor RIRD procedure in my home.</td>
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<td>3. I am satisfied with my child’s response to the motor RIRD procedure.</td>
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<td>4. Motor RIRD helped to reduce my child’s stereotypy during the session.</td>
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<td>5. I thought the motor RIRD procedure was intrusive.</td>
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<td>6. Motor RIRD is a socially appropriate intervention method for my child.</td>
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<td>7. I think motor RIRD improved my child’s rate of appropriate vocalizations during the session.</td>
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<td>8. My child will benefit in the long run from the procedures implemented in this study.</td>
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<td>9. Motor RIRD produced negative emotional reactions in my child.</td>
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<td>10. I feel motor RIRD produced little change in my child’s stereotypy rates.</td>
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Please provide any additional comments/suggestions about the procedure:
Please indicate whether each trial did (+) or did not happen (-).

**Trial 1** indicates that the experimenter delivered RIRD contingent upon (within 2 s) of the occurrence of stereotypy.

**Trial 2** indicates that the experimenter waited for at least THREE consecutive responses in the absence of stereotypy

**To calculate:** divide number of occurrences (+'s) out of total number of opportunities

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