Response Interruption and Redirection (RIRD) as a Behavioral Intervention for Vocal Stereotypy: A Systematic Review

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Abstract: Response interruption and redirection (RIRD) is an intervention that involves presenting demands or other types of distracters to interrupt an interfering behavior and redirect it to a more appropriate response. It targets the decrease of repetitive, stereotypic, and self-injurious behaviors. Research indicates that stereotypy is commonly maintained by automatic reinforcement (Rapp & Vollmer, 2005). Ahearn, Clark, MacDonald, and Chung (2007) were the first to evaluate the use of RIRD as a behavioral intervention for vocal stereotypy. Due to the success of RIRD as being the one behavioral intervention that not only decreases vocal stereotypy but may increases engagement in appropriate vocalizations the authors chose to examine additional studies that have used RIRD to address vocal stereotypy in children with autism in order to see if the replication and expansion of RIRD has continued to produce support for this intervention. Ten single-subject design studies were identified between 2000 and 2016. With such a limited number of studies, all showing positive results, future research should focus on replicating and expanding RIRD as a behavioral intervention to address vocal stereotypy in children with autism.

Individuals diagnosed with autism spectrum disorder (ASD) often engage in stereotypic behavior which is defined as a repetitious behavior that does not serve a clear function for the individual engaging in it (Boyd, McDonough, & Bodfish, 2012). The current diagnostic criteria for ASD classify stereotypic behaviors exhibited in autism into three categories, including stereotyped or repetitive speech, stereotyped or repetitive motor movements, and stereotyped or repetitive use of objects (American Psychiatric Association, 2013). One of the subcategories that falls under stereotyped or repetitive speech is repetitive vocalizations which includes repetitive guttural sounds, intonational noise-making, and repetitive humming (American Psychiatric Association, 2013). Vocal stereotypy is a repetitive behavior that involves utterances that are considered to be contextually inappropriate (Falcomata, Roane, Hovanetz, & Kettering, 2004), purposeless sounds (Cook, Rapp, Gomes, Frazer, & Lindblad, 2014), persistent vocalizations (Anderson & Le, 2011), unintelligible speech (Rapp, Patel, Ghezzi, O’Flaherty, & Titterington, 2009), and/or words and phrases that are non-conversational (O’Connor, Prieto, Hoffmann, DeQuinzio, & Taylor, 2011).

Stereotypy may interfere with the acquisition of functional or academic skills and can be disruptive to home and school environments (MacDonald et al., 2007; Wunderlich & Vollmer, 2015). MacDonald et al. (2007) and colleagues compared stereotypic behavior in children with autism and typically developing children all between the ages of 2 and 4 years. While typically developing children tend to produce contextually appropriate vocalizations, their peers with autism were apt to emit repetitive and non-contextual vocalizations. Results indicated that children with autism displayed substantially higher levels of stereotypic behavior than their same age peers. Hence, decreasing the levels of vocal stereotypy in individuals with autism was identified as a goal of high priority (MacDonald et al., 2007).
Research has shown that most stereotypic behaviors serve an automatic function (Rapp & Vollmer, 2005). According to Rapp and Vollmer, there are at least five sources of evidence to support the notion that stereotypy is maintained by automatic positive reinforcement including studies that show stereotypy persists in the absence of social consequences, environmental enrichment is correlated with reductions in stereotype, and restricting access to or providing prior access to stereotypy results in subsequent increases or decreases in stereotypy (p. 530). Thus, the automatic consequence of vocal stereotypy warrants thoughtful planning, because it cannot be interrupted through physical blocking (Ahrens, Lerman, Kodak, Worsdell, & Keegan, 2011). Reducing the occurrences of vocal stereotypy, which interferes with instructional time and social opportunities, may lead to significant positive outcomes for children with autism (Taylor, Hoch, & Weissman, 2005).

Over the years, many interventions have been used in an attempt to decrease vocal stereotypy through different approaches such as self-management (Mancina, Tankersley, Kamps, Kravits, & Parrett, 2000), auditory stimulation (Lanovaz, Rapp, & Ferguson, 2013), overcorrection (Anderson & Le, 2011), appropriate alternative verbal behavior (Colon, Ahearn, Clark, & Malaska, 2012), and verbal reprimands (Cook et al., 2014). Some of these interventions have shown effectiveness in decreasing vocal stereotypy, yet a lot of them still lack the sufficient replication of research to be considered evidence-based treatments (Mulligan, Healy, Lydon, Moran, & Foody, 2014).

In a review conducted by Rapp and Vollmer (2005), they examined behavioral interventions that were used to treat stereotypy into two categories, antecedent manipulations and consequent manipulations. For purposes of their review, the authors “adopted the descriptors of movement invariance and movement repetition to categorize behavior of humans, which generally persists in the absence of social consequences, as stereotyped or stereotypic” (p. 529). Interventions categorized under antecedent manipulations included the use of multi-sensory stimulation, engagement in physical exercise, and matched stimulation. Sensory extinction, displacement of reinforcement, differential reinforcement, punishment and inhibitory stimulus control were all procedures classified under consequent manipulations. A short-term reduction in stereotypic behavior was reported in both categories. Previously, LaGrow and Repp (1984) had reported that antecedent based interventions were less effective for reducing stereotypy than consequent based interventions, but DeLeon and Iwata (1996) suggested that the expanded technology of stimulus preference assessment may have contributed to the effectiveness of antecedent based interventions.

Expanding on the work of Rapp and Vollmer (2005), Lanovaz and Sladeczek (2012) published a review that specifically focused on reducing vocal stereotypy in individuals with ASD using behavioral interventions with an emphasis on the applicability of the procedures in the natural environment. The term vocal stereotypy was defined as “any repetitive sounds or words produced by an individual’s vocal apparatus that are maintained by nonsocial reinforcement” (p. 36). The behavioral interventions were divided into antecedent- and consequence-based strategies. Antecedent-based treatments included non-contingent reinforcement, matched and unmatched stimulation, physical exercise, and visual cues. Consequence-based treatments included differential reinforcement for other behavior (DRO), response interruption/redirection (RIRD), verbal reprimands, contingent demands, and response cost. Findings revealed that many behavioral treatments, such as non-contingent reinforcement and response cost, have been successful at decreasing vocal stereotypy. However, RIRD has been the only behavioral treatment that could decrease the occurrences of vocal stereotypy as well as increase the occurrences of appropriate vocalizations. The study recommended using RIRD when developing an intervention for decreasing vocal stereotypy, but it was noted that the frequent prompting that is required might limit its applicability in some environments (Miguel, Clark, Tereshko, & Ahearn, 2009).

RIRD is an intervention that involves presenting demands or other types of distracters to interrupt an interfering behavior and redirect it to a more appropriate response. It targets the decrease of repetitive, stereotypic,
and self-injurious behaviors. Ahearn, Clark, MacDonald, and Chung (2007) were the first to evaluate the use of RIRD as a behavioral intervention for vocal stereotypy, and their study will be discussed later in the review. RIRD is most effective at reducing behaviors that are maintained by automatic reinforcement (Wong et al., 2014).

Due to the success of RIRD as being the one behavioral intervention that not only decreases vocal stereotypy but increases engagement in appropriate vocalizations (e.g., Ahearn et al., 2007), the authors chose to examine additional studies that have used RIRD to address vocal stereotypy in children with autism in order to see if the replication and expansion of RIRD has continued to produce support for this intervention. To date, two reviews were identified that examined vocal stereotypy and behavioral interventions (Lanovaz & Sladeczek, 2012; Rapp & Vollmer, 2005), but no reviews were identified that examined the literature using RIRD or a combination of interventions including RIRD to address vocal stereotypy.

**Method**

**Literature Search Procedures**

The following search procedures were used to retrieve relevant studies for the review. First, a computer-assisted search of three major databases was conducted including Academic Search Complete, PsycINFO, and Education Research Complete from 2000 to 2016. The following descriptors were used: autism, autism spectrum disorder (ASD), Asperger Syndrome, vocal stereotypy, response interruption, and redirection. Second, a hand search of relevant articles was conducted. Third, a hand search of reference lists and tables of content of relevant journals was completed.

**Criteria for Inclusion**

The five main criteria for inclusion in the literature review included: (a) articles published between 2000 and 2016 in English; (b) studies that focused on using RIRD as treatment for vocal stereotypy; (c) studies that focused on using RIRD as treatment for vocal stereotypy and motor stereotypy (data was disaggregated for vocal stereotypy); (d) individuals included in the study were classified as having autism; and (e) only intervention studies were included (used either a group experimental, a quasi-experimental design, or a single-subject design).

Although additional studies were identified, they were excluded if: (a) the focus was on motor stereotypy (e.g., Lang et al., 2010; Pastrana, Rapp, & Frewing, 2013); (b) the focus was on the influence of measurement and data analysis procedures on RIRD outcomes (e.g., Carroll, & Kodak, 2014; Wunderlich & Vollmer, 2015); or (c) if the treatment for vocal stereotypy did not include RIRD (e.g., Athens, Vollmer, Sloman, & Pipkin, 2008; Taylor et al., 2005).

**Coding Instrument**

A coding system was developed to identify and summarize the procedures and the effectiveness of RIRD in each study. The coding system included variables in the following areas: (a) introduction (e.g., study ID, author, year, study design); (b) sample characteristics (e.g., demographic information about the participants); (c) intervention characteristics (e.g., setting, intervener, dependent variables, intervention); and (d) study outcomes (e.g., findings reported by the researcher).

Ten studies, including one with two experiments were identified during the period from 2007 to 2015 in the following journals: Behavioral Interventions, Journal of Applied Behavior Analysis, and Behavior Modification. A total of 24 participants with autism were included in these studies with a mean age of 6.9 years and ranging from 3 to 12 years of age). All 11 studies included in the review employed a single-subject design. Table 1 provides a synthesis of the studies.

**RIRD as an Intervention**

In 2007, Ahearn et al. was the first study identified to examine the effects of RIRD on vocal stereotypy in children with ASD. The participants were a 3-year-old boy, an 11-year-old boy, and 4-year-old twin girls diagnosed with ASD. Results of the functional analysis conducted suggested that the participants’ vocal stereotypy was maintained by automatic rein-
<table>
<thead>
<tr>
<th>Citation</th>
<th>Participants</th>
<th>Design</th>
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<th>Results</th>
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<tr>
<td>Ahearn, Clark, MacDonald, &amp; Chung, B. (2007)</td>
<td>N = 4 Autism Ages = 3, 7 &amp; 11</td>
<td>ABAB Design</td>
<td>Vocal RIRD</td>
<td>Substantial decrease in VS; increase in AV; effective in the natural environment</td>
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<td>Ahrens, Lerman, Kodak, Worsdell, &amp; Keegan (2011)</td>
<td>N = 2 Autism Ages = 4 &amp; 6</td>
<td>Combined reversal and multielemental design</td>
<td>Vocal RIRD, motor RIRD</td>
<td>Decrease in VS; increase in AV; termination of demands contingent on responses is not required for treatment effectiveness</td>
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<td>Ahrens, Lerman, Kodak, Worsdell, &amp; Keegan (2011)</td>
<td>N = 2 Autism Ages = 4 &amp; 5</td>
<td>Combined reversal and multielemental design</td>
<td>Vocal RIRD, motor RIRD</td>
<td>Decrease in VS; increase in AV; termination of demands contingent on responses is not required for treatment effectiveness; motor RIRD slightly more effective than vocal RIRD at decreasing</td>
</tr>
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<td>Colon, Ahearn, Clark, &amp; Masalsky (2012)</td>
<td>N = 3 Autism Ages = 8 &amp; 10</td>
<td>Multielement design</td>
<td>Verbal operant training, vocal RIRD</td>
<td>Verbal operant training alone increased AV, but did not produce significant decrease in VS; RIRD produced socially significant decrease in VS</td>
</tr>
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<td>Dickman, Bright, Montgomery, &amp; Miguel (2012)</td>
<td>N = 1 Autism Age = 5</td>
<td>ABABCB reversal design</td>
<td>Vocal RIRD, Differential Reinforcement for incompatible behavior (DRI)</td>
<td>RIRD alone resulted in slightly lower rate of VS and an increase in AV; RIRD+DRI resulted in a significant decrease in VS and an increase in AV</td>
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<td>Duffy-Cassella, Sineder, Sidener, &amp; Progar (2011)</td>
<td>N = 2 Autism Ages = 4 &amp; 7</td>
<td>ABAB reversal design</td>
<td>Motor RIRD</td>
<td>Substantial decrease in VS</td>
</tr>
<tr>
<td>Liu-Gitz &amp; Banda (2010)</td>
<td>N = 1 Autism Age = 10</td>
<td>ABAB reversal design</td>
<td>Vocal RIRD</td>
<td>Decrease in VS</td>
</tr>
<tr>
<td>Love, Miguel, Fernand, &amp; LaBrie (2012)</td>
<td>N = 2 Autism Ages = 8 &amp; 9</td>
<td>Multitreatment reversal design</td>
<td>Vocal RIRD, Matched Stimulation (MS)</td>
<td>Increase in AV; decrease VS, RIRD+MS produced lower VS for one participant</td>
</tr>
<tr>
<td>Miguel, Clark, Tereshko, &amp; Ahearn (2009)</td>
<td>N = 1 Autism, communication delay Age = 4</td>
<td>ABABCB reversal design</td>
<td>Vocal RIRD, Sertraline</td>
<td>RIRD decreases VS and increases AV; Sertraline does not lower the frequency of VS</td>
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<td>Schumacher &amp; Rapp (2011)</td>
<td>N = 2 Autism Ages = 5 &amp; 8</td>
<td>Multielement design</td>
<td>Vocal RIRD</td>
<td>Immediate decrease in VS; withdrawal of RIRD did not produce subsequent increase in VS</td>
</tr>
<tr>
<td>Shawler &amp; Miguel (2015)</td>
<td>N = 5 Autism Age = 5, 6, 7 &amp; 12</td>
<td>Multielement design</td>
<td>Vocal RIRD, motor RIRD</td>
<td>Both methods decrease VS and increase AV</td>
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*Note: VS = vocal stereotypy; AV = appropriate vocalizations.*
forcement. Using an ABAB design, RIRD sessions were conducted in a room with only a table and chairs. During the treatment session, the teacher provided a vocal demand for the child contingent on the occurrence of vocal stereotypy. The demands provided for each child were skills that he/she mastered which included answering a social question (e.g. “What’s your name?”), or performing vocal imitation (e.g. “say ball”). The teacher stopped providing vocal demands after the child performed three consecutive correct responses of appropriate language, which were followed by praise. The teacher delivered reinforcement whenever a participant used appropriate vocalizations in the form of praise or requested item. The results suggested that vocal stereotypy may be able to be decreased through RIRD and that an increase in appropriate vocalizations may be an added benefit of the treatment.

In 2010, Liu-Gitz and Banda replicated the RIRD strategy developed by Ahearn and colleagues (2007) with a 10-year-old student with autism who displayed vocal stereotypic behavior in a special education classroom. A functional analysis revealed that the problem behavior was possibly maintained by automatic reinforcement. Thus, an ABAB reversal design was used to determine the effectiveness of implementing RIRD to decrease vocal stereotypy. The classroom teacher implemented the intervention sessions during the classroom activities. Contingent on the occurrence of vocal stereotypy, the classroom teacher called the student’s name and delivered vocal demands. Responses to demands were immediately followed by praise. The delivery of demands was discontinued after two or three responses. The results showed that the procedure reduced the vocal stereotypy of the student and increased appropriate vocalizations. In addition, the teacher indicated that the student was less resistant to academic tasks.

In order to further evaluate the effects of RIRD, Ahrens et al. (2011) assessed the effectiveness of using motor and vocal demands in RIRD to decrease vocal stereotypy and attempted to determine the behavioral principle responsible for the decreasing effect of RIRD. Two experiments using a combined reversal and multi-element design were conducted. Functional analyses conducted prior to the study suggested that the behavior was maintained by automatic reinforcement. The children participating in the first experiment were a 6-year-old and a 4-year-old boy with ASD. One of the participants’ session was conducted in his bedroom while the other sessions were conducted in a treatment room with table, chairs, and preferred items.

For vocal RIRD, the therapist provided a vocal demand whenever the child emitted vocal stereotypy and waited 5 seconds for the child to respond. The therapist continued to present demands until three consecutive demands were delivered without the child engaging in vocal stereotypy. Correct responses were followed by praise; however, responses from the child were not necessary for ending the delivery of demands.

Next, the therapist used RIRD with motor demands. Motor demands were instructions that required motor responses such as “stand up” and “clap hands”. The therapist presented a motor demand and waited 5 seconds for the child to respond. If he did not perform the response within 5 seconds from the delivery of the prompt, the therapist physically guided him to perform it. Correct responses, whether prompted or not, were followed by praise. The delivery of demands stopped after the child performed three consecutive correct responses without emitting vocal stereotypy. During treatment sessions, appropriate vocalizations were followed with the requested item or the therapist’s attention. The treatment sessions were divided equally between vocal RIRD and motor RIRD. Both conditions of RIRD increased appropriate vocalizations and decreased vocal stereotypy. The increase in appropriate vocalizations in both conditions indicated that motor demands could be as effective as vocal demands at achieving this result. Also, the decrease in the level of stereotypy indicated that not responding to RIRD demands did not influence the effectiveness of the treatment. Moreover, the authors concluded that RIRD worked as a punishment procedure for the participants since both conditions demonstrated similar effectiveness at reducing vocal stereotypy.

The participants in the second experiment included two boys, ages 4 and 5 years of age with ASD. Their sessions were conducted in a room at a day-treatment center. In this exper-
iment, vocal and motor stereotypies were targeted using the same procedure implemented in the first experiment. The only difference was that the time between each prompt was two to three seconds instead of five. Results concerning vocal stereotypy revealed that both RIRD conditions were effective in decreasing vocal stereotypy and increasing appropriate vocalizations which further suggests that RIRD functions as a punishment procedure. Motor RIRD produced a slightly lower level of vocal stereotypy than vocal RIRD. The higher effectiveness of motor RIRD may be due to the fact that motor demands are stronger punishers than vocal ones.

In 2011, Duffy-Cassella, Sidener, Sidener, and Progar focused on systematically replicating and extending Ahearn et al.’s 2007 study by examining the effects of using RIRD directions that required motor responses to decrease the vocal stereotypy of two boys with autism, age 4 years 11 months and 7 years 2 months, respectively. Functional assessments used prior to the study suggested an automatic reinforcement function. Using an ABAB reversal design, the sessions were conducted with an experimenter and took place in the participants’ schools. The method involved calling the child’s name, establishing eye contact, and presenting directions for motor responses following the occurrence of vocal stereotypy. If the child did not perform the response within 5 seconds from the delivery of the direction or performed it incorrectly, the experimenter provided a model for the desired response. If the response did not occur within 5 seconds from the delivery of the model, the child was physically guided to perform it. Each correct response was followed by behavior-specific praise. RIRD trials were discontinued after the child performed three consecutive correct responses, whether prompted or not, without engaging in vocal stereotypy. Demanding motor response in RIRD to decrease vocal stereotypy proved to be effective for both participants. However, there was no increase in appropriate vocalizations as found in the Ahearn et al. 2007 study.

After previous research, as reported above, revealed some positive results in decreasing vocal stereotypy using RIRD in students with autism, Schumacher and Rapp (2011) evaluated whether or not there were lasting effects once the RIRD treatment was extinguished. Thus, Schumacher and Rapp examined the effectiveness of RIRD in decreasing vocal stereotypy and whether the level of vocal stereotypy increases after withdrawing the treatment. The participants in the study included a 5-year-old girl and an 8-year-old boy with ASD. Using a multi-element design, their treatment sessions were implemented in a home-based therapy room. During the RIRD treatment, the therapist presented vocal demands, selected randomly from a prearranged set of options whenever the child engaged in vocal stereotypy. The therapist continued to present vocal demands, such as “What is your name?” or “How old are you?”, until the child performed three consecutive correct responses without engagement in vocal stereotypy. During the no-interaction sequence the therapist was present in the room but did not interact with the participant. Results revealed that RIRD was effective at reducing engagement in vocal stereotypy and its withdrawal did not lead to a subsequential increase in its level of occurrence.

In the most recent and final study identified using RIRD as the only behavioral intervention, Shawler and Miguel (2015) used a multiple treatment reversal design to compare the effects of both motor and vocal RIRD procedures on vocal stereotypy as well as their associated effects on appropriate vocalizations. An abbreviated functional analysis was conducted to verify whether stereotypy was present in the absence of social contingencies. Five children with ASD between the ages of 5 and 12 years of age participated in the study. For vocal RIRD, the participants were given access to preferred items. Whenever the child emitted vocal stereotypy, the experimenter removed the item and called the child’s name to gain his/her attention and initiate eye contact. Three consecutive correct responses to vocal demands, without engagement in vocal stereotypy, were required to terminate RIRD trials. Instances of appropriate language were followed by praise. Other than presenting motor demands instead of vocal ones, motor RIRD involved the same procedure as vocal RIRD. These demands included either gross motor imitations or following directions, such as ‘Touch your nose’ and ‘Clap your hands.’ Results showed that both motor and vocal RIRD were effective.
at decreasing vocal stereotypy and increasing appropriate vocalizations for all the participants except for one. Results also indicated that motor RIRD could also lead to an increase in appropriate vocalizations.

**RIRD with Combined Treatments**

Because of the number of children with autism on medication and the success of RIRD, it is not surprising that Miguel et al. (2009) were interested in examining the effects of RIRD combined with medication. Specifically, Miguel et al. explored the effects of RIRD with and without sertraline, an antidepressant, on automatically maintained vocal stereotypy of a 4-year-old child with ASD. The functional analysis conducted suggested that the participant’s stereotypy was maintained by automatic reinforcement. Using an ABABC reversal design, the treatment sessions were conducted with an experimenter in a room in the participant’s school where preferred items were present. A was sertraline only, B was RIRD plus sertraline, and C was RIRD only. During the sessions where sertraline was presented with RIRD, the child took 10 mg of sertraline daily. Moreover, whenever the child engaged in vocal stereotypy, the item that the child was engaged in was removed and vocal imitation demands were presented until he performed three correct responses without vocal stereotypy. The experimenter delivered praise after correct vocal imitations, while correct mands were followed by praise and the requested items. Sessions where only RIRD was implemented were similar except that the medication doses were faded out. The results revealed that sertraline was not effective in reducing vocal stereotypy while RIRD was successful at decreasing vocal stereotypy and increasing appropriate language. It also showed that vocal stereotypy did not return to its previous level when sertraline was removed.

There has also been research suggesting that skill acquisition; specifically verbal operant training (Skinner, 1957) may increase appropriate verbal behavior while decreasing inappropriate verbal behavior (Morrow & Foxx, 1986). Thus, Colon et al. (2012) sought out to explore whether verbal operant training could produce the same results without using RIRD. A non-concurrent multiple baseline design across participants was used to analyze the effects of verbal operant training, while a reversal design was used for implementing RIRD. Results of a functional analysis supported the hypothesis that vocal stereotypy was supported by automatic reinforcement. The experiment was conducted with two 10-year-old boys and one eight-year-old girl with ASD in a therapy room. The sessions initially consisted of verbal operant training of teaching tacts and mands to all three participants. Although vocal stereotypy continued to occur throughout the training, two of the students continued to emit high levels of vocal stereotypy, so RIRD was implemented. During the RIRD component, every occurrence of vocal stereotypy was followed by prompts for emitting tacts. The experimenter continued to deliver prompts until the child emitted three consecutive correct tacts without engagement in vocal stereotypy. Instances of appropriate vocalizations were followed by praise.

Results showed that verbal operant training increased the participant’s appropriate vocalizations but was not as effective in producing a socially significant decrease in vocal stereotypy for two of the participants. Following their verbal operant training, the two participants received RIRD procedures, which was effective at producing a socially significant decrease in their vocal stereotypy.

In 2012, Love, Miguel, Fernand, and LaBrie hypothesized that since vocal stereotypy may occur quite frequently, it may be possible to decrease the motivating operation for engaging in stereotypy through the presentation of a MS, and therefore, be more effective than just RIRD alone. Love et al. (2012) used a multi-treatment reversal design to examine the effects of RIRD alone, Matched stimulation (MS) alone, and MS combined with RIRD on vocal stereotypy. Two children diagnosed with ASD participated in the study. The sessions of the 8-year-old participant were conducted in his bedroom while the sessions of the 9-year-old participant were conducted in a treatment room. Throughout the RIRD and MS sessions, the experimenter provided an access to one of two preferred items that produced auditory stimulation. If the child produced vocal stereotypy, the experimenter removed the item, called the child’s name, and presented vocal demands. After responding to
three consecutive demands without producing vocal stereotypy, praise was delivered and the item was returned. RIRD alone sessions were implemented in the same manner, except that the two preferred items used did not produce auditory stimulation. One of the participants’ results showed a similar level of decrease in vocal stereotypy across conditions while the other participant showed a lower level of vocal stereotypy during the RIRD plus MS condition. For both participants, the frequency of appropriate vocalizations increased when RIRD was part of the condition.

Further, a study conducted by Dickman, Bright, Montgomery, and Miguel (2012) tested the relation between vocal stereotypy and appropriate vocalization by implementing RIRD and differential reinforcement of incompatible behavior (DRI). The completion of a functional analysis suggested that the vocal stereotypy was maintained by automatic reinforcement. Using an ABABCBC reversal design, the implementation included A consisting of baseline, B consisting of RIRD, and C consisting of RIRD plus DRI. The sessions were implemented with a 5-year-old child with autism in his bedroom. During the RIRD alone condition, the child was seated at a table and engaging in an activity. Contingent on the occurrence of vocal stereotypy, the experimenter blocked access to the activity, called the child’s name until eye contact was established, and issued demands that required vocal responses. Demands were discontinued after three consecutive responses were obtained without engagement in vocal stereotypy. Praise was delivered following the occurrence of appropriate vocalizations and correct responses to demands.

The RIRD plus DRI condition involved the same procedure implemented in RIRD alone with the addition of using token economy for appropriate vocalizations. Before the beginning of the session, the child was informed that he would receive a star for every time he uses “nice words” and that each star could be exchanged for candy after the session was over. The use of RIRD alone increased appropriate vocalization, but did not result in substantial reduction in vocal stereotypy while RIRD and DRI combined resulted in significant decrease in vocal stereotypy and a higher frequency of appropriate vocalization.

Results and Discussion

The purpose of this literature review was to examine the research that has explored the effectiveness of using RIRD as a treatment for vocal stereotypy in children with autism. Unlike motor stereotypy, physical blocking is not an option for vocal stereotypy. Ahearn and colleagues (2007) first described the RIRD procedures and while six of the studies included in the review focused on using RIRD as the intervention, four of the studies combined the RIRD procedures with other interventions, such as medication (Miguel et al., 2009), verbal operant training (Colon et al., 2012), matched simulation (MS); (Love et al., 2012), and differential reinforcement of incompatible behaviors (DRI); (Dickman et al., 2012).

RIRD – Results of Vocal, Motor, and Combined

Three of the six studies (Ahearn et al., 2007; Lui-Gitz & Banda, 2010; Schumacher & Rapp, 2011) implemented vocal RIRD procedures. In 2007, Ahearn et al. reported a decrease in vocal stereotypy and an increase in appropriate vocalizations. Extending on this research, Lui-Gitz and Banda (2010) reported a decrease in vocal stereotypy while the teacher indicated that the participant’s appropriate vocalizations had improved. Schumacher and Rapp (2011) reported success with decreasing vocal stereotypy, but no increase in appropriate vocalizations. They also noted that withdrawal of the RIRD procedures did not lead to an increase in its level of occurrence.

Additionally, one of the six studies (Duffy-Cassella et al., 2011) implemented motor RIRD procedures while two of the six studies (Ahrens et al., 2011; Shawler & Miguel, 2015) implemented motor and vocal RIRD procedures. Duffy-Cassella et al. (2011) found that demanding a motor response in RIRD to decrease vocal stereotypy was effective, but contrary to the Ahearn et al. (2007) study, there was not an increase in appropriate vocalizations.

Ahrens et al. (2011) conducted two experiments comparing vocal RIRD and motor RIRD. Results showed a decrease in vocal stereotypy and a slight increase in appropriate vocalizations. Thus, the increase in appropriate vocalizations in both conditions indicated
that motor demands could be as effective as vocal demands at achieving this result. Ahrens et al. (2011) noted that the vocal and motor RIRD acted as a punisher. Shawler and Miguel (2015) reported the same results revealing that both vocal and motor RIRD were equally effective in reducing vocal stereotypy and increasing appropriate vocalizations and supported Ahrens et al. (2011) findings that RIRD is a punishment procedure.

In five of the six studies, the teacher/therapist also used social praise when participants produced appropriate vocalizations, while Schumacher and Rapp (2011) did not report that social praise was part of the RIRD procedures.

**RIRD and Other Interventions**

There were four studies, which implemented RIRD procedures in comparison with other interventions. These included medication (Miguel et al., 2009) verbal operant training Colon et al., (2012), MS (Love et al., 2012), and DRI (Dickman et al., 2012). While the medication was not effective in reducing vocal stereotypy (Miguel et al., 2009), the verbal operant training increased the participant’s appropriate vocalizations but was not as effective in producing a socially significant decrease in vocal stereotypy (Colon et al., 2012). When using MS as an intervention, findings revealed that using RIRD as part of the condition increased the frequency of appropriate vocalizations (Love et al., 2012). When comparing the use of RIRD and DRI, the use of RIRD alone increased appropriate vocalization, but did not result in substantial reduction in vocal stereotypy while RIRD and DRI combined resulted in a significant decrease in vocal stereotypy and a higher frequency of appropriate vocalization (Dickman et al., 2012).

With only ten studies identified between 2000 and 2016, it is clear that the research is very limited. This may seem surprising as the results of all ten studies suggests that RIRD may be successful in decreasing vocal stereotypy while showing an increase for more appropriate vocalizations. As Ahrens et al. (2011) noted that the research on treatments for vocal stereotypy is limited and even more so for the effectiveness of RIRD.

Overall, the findings from these 10 studies revealed RIRD is a promising intervention that can be used to decrease vocal stereotypical behavior for children with autism and increase more appropriate vocalizations. RIRD is considered a relatively nonintrusive intervention that can be easy to implement and may be considered as a possible option when reinforcement-based interventions alone are ineffective in reducing vocal stereotypy. Not only is further research needed, but questions about its effectiveness in educational settings, as well as, the possible lasting effects of RIRD on reducing vocal stereotypy and increasing appropriate vocalizations for children with autism need to be explored.

**References**

* denotes articles included in the review.


Received: 2 February 2017
Initial Acceptance: 24 March 2017
Final Acceptance: 15 June 2017