Effects of "Noncontingent Reinforcement Plus Differential Reinforcement of Alternative Behavior" and "Response Interruption and Redirection" on a Child's Vocal Stereotypy Maintained by Automatic Reinforcement

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Purpose: In this study, the authors investigated the effective treatment of repetitive and noncontextual vocal behaviors of a 5-year-old child (John) with an autism spectrum disorder. **Background:** Autism is a life-long disability characterized by deficits in social interactions, communication, and behavior. Children with autism often display stereotypic movements that are characterized by their repetitive and nonfunctional nature. Although it is believed that stereotypic behaviors might be automatically reinforced by the sensory consequences produced by engaging in the response, some evidence also shows that stereotypy can be related to social or demand consequences. Meanwhile, stereotypic behaviors can interfere with auditory processing, discrimination learning, and appropriate social behaviors. The focus of a treatment for frequent engagement in stereotypic movements by children with autism has been examined because this type of behavior may hamper children's development. Non-contextual vocalization is one stereotypic behavior that children with autism often display. However, there has been relatively limited research focused on the treatment of vocal stereotypy for children with autism. Specifically, it is difficult to treat if vocal stereotypy is self-reinforcing (i.e., automatic reinforcement). An approach to treating vocal stereotypy maintained by automatic reinforcement is response interruption and redirection (RIRD). To block vocal stereotype, RIRD treatment may involve teachers initiating vocal demands with whichthe child readily complies Previous research revealed the positive effects of RIRD on reducing the level of

vocal stereotype. Another approach to developing treatment for automatic reinforcement has focused on noncontingent access to preferred items (NCR). According to operational definition of NCR, it is hypothesized that if the child chooses to spend more time with the alterative stimuli, rather than engage in the aberrant response (e.g., vocal stereotype), these stimuli can effectively compete with the aberrant response. But, both approaches (RIRD and NCR) have their own limitations. The treatment of RIRD is labor-intensive while NCR alone was not effective as a treatment. **Method:** Functional analyses (FA) were implemented to identify the function of John's stereotypical behavior. Using the methods described by Iwata and his colleagues (1982/1994), vocal stereotype was assessed in four specific conditions (i.e., attention, demand, alone, control/play) to determine which specific consequences (e.g., attention, escape, or sensory) were maintaining the behaviors. According to previous preference assessment, a cookie served as strong reinforcement for John, and could be used to promote the use of appropriate language. In addition, differential reinforcement of alternative behavior (DRA) was included to eliminate the limitation of NCR as well as strengthen appropriate communication (e.g., request). Following FA, two treatment packages, "RIRD" and "NCR plus DRA," were implemented in an ABCACBC design to determine whether either RIRD or NCR plus DRA could reduce John's vocal stereotypy. **Findings:** The results of FA suggested that vocal stereotypy was maintained by automatic reinforcement. The findings suggested that NCR plus DRA can significantly reduce the behavior of noncommunicative vocalization maintained by automatic reinforcement. The findings also revealed that NCR plus DRA produced levels of appropriate vocal behaviors more thanthose observed in both baseline and RIRD phases. **Conclusions/Implications:** This study suggests that highly preferred stimuli may compete with engagement in automatically reinforced challenging behaviors. Implications of this study are also discussed in this paper.

Keywords: autism spectrum disorder, vocal stereotypy, automatic reinforcement, response intervention and interruption, noncontingent reinforcement

Children with autism often display stereo-typical behaviors that are repetitive and nonfunc-tional. A wide range of topographies of vocal stereotypy have been discussed in published arti-cles, including echolalia (Ahearn, Clark, DeBar, & Florentino, 2005), non-contextual phrases or words (Falcomata, Roane, Hovanetz, Kettering, & Keeney, 2004), repetition of unintelligible sounds (Taylor, Hoch, & Weissman, 2005), or some com-bination. In particular, the frequent engagement in vocal stereotypy in children with autism has been a concern to teachers and families because it in-terferes with appropriate social behavior (Athens, Vollmer, & Sloman, & St. Peter Pipkin, 2008). However, the focus of treatment and assessment of vocal stereotypy has not received much atten-tion in the field of behavioral literature (Ahearn, Clark, MacDonald, & Chung, 2007).

In light of this information, it is important to determine how a behavior's antecedents and con-sequences are manipulated in order to alter the behavior (i.e., reduce stereotypic behaviors and increase appropriate behavior). Analog functional analysis allows researchers to assess the relation-ship between inappropriate behaviors and a vari-ety of environmental stimuli or events, thereby allowing one to determine how the behaviors might be altered. Iwata and his colleagues (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) identified four functions of self-injurious behavior using analogue functional analyses: social nega-tive reinforcement (i.e., escape from demands), social-positive reinforcement (i.e., access to atten-tion or tangibles), automatic reinforcement (i.e., sensory), and multiple controlling variables. These same functions have been identified with challenging behaviors, including vocal stereotypy.

Automatically reinforced, vocal stereotypy is frequently observed in children with autism (Ath-

ens et al., 2008). When this sort of automatic rein-forcement is responsible for maintaining a chal-lenging behavior, treatment strategies are difficult, because the specific maintaining variable of the behavior is unknown or unable to be directly ma-nipulated (Thompson, Fisher, Piazza, & Kuhn, 1998).With the advancement in functional analy-sis technology in the early 1900s, researchers suggest the treatment procedure must address the response-reinforcer relationship of the stereotypic behavior to be optimally effective. When the re-sults of functional analysis were undifferentiated, Goh and his colleagues (Goh et al., 1995) sug-gested that the behavior may be resistant to inter-vention and a multifaceted intervention approach might be necessary. Iwata and his colleagues (Iwata et al., 1982/1994) further suggested that a possible treatment for automatically-maintained behavior would be to replace the behavior with one that provides similar sensory input (i.e., a matched stimulus). On the other hand, Goh et al. (1995) suggested that when an automatically-maintained behavior is differentiated, social rein-forcement and play may act as competing rein-forcers. Moreoever, challenging behavior does not occur when given attention, task demands, or play activities in functional analysis conditions.

Response interruption (RI) is the strategy shown to be effective in treating automatically-reinforced stereotypic behavior (Hagopian & Ade-linis, 2001). RI consists of physically or verbally preventing the individual from engaging in the stereotypic behavior, thereby blocking the rein-forcing sensation maintaining the behavior.   For example, Ahearn et al. (2007) found that response interruption and redirection (RIRD) effectively decreased the vocal stereotypy of 4 children with autism spectrum disorder (ASD). At the same time, researchers have argued that RI is consid-

ered a highly labor-intensive procedure, because the individual being treated needs continuous monitoring for the experimenter to successfully block or interrupt each attempt at the target behavior (Tarbox, Wallace, & Tarbox, 2002).

Recent research on the treatment of vocal stereotypy maintained by automatic reinforcement has also focused on the use of noncontingent reinforcement (NCR) schedules (e.g., Falcomata et al., 2004). Carr and his colleagues (Carr, Coriaty, Wilder, Gaunt, Dozier, & Britton, 2000) reviewed three main theories behind the processes that make NCR a reductive effect on stereotypic behaviors. First, as a result of satiation and environment enrichment, the reinforcer's establishing operation is eliminated. Second, by disrupting the response-reinforcer relationship, the stereotypic behavior is reduced via extinction. Finally, the reinforcement of other responses increases responses that compete with the stereotypic behavior. There are several advantages associated with NCR intervention. One of these is that NCR is not like other treatment strategies (e.g., DRO, response interruption); the individual needs to be under constant supervision to block responses on a continuous schedule, or to divert reinforcement for total absence of behavior (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993).

On the other hand, three main disadvantages of using NCR treatment are often cited: (a) appropriate behavior is not specifically reinforced; (b) alternate forms of challenging behavior may be inadvertently reinforced; and (c) the procedure may lose effectiveness due to long-term satiation (Marcus & Vollmer, 1996; Vollmer et al., 1993). Marcus and Vollmer (1996) addressed the first disadvantage by implementing a functional communication training intervention simultaneously with the implementation of NCR in the treatment of tangibly-maintained disruptive behavior. Specifically, participants were taught how to functionally request desired items, while also receiving those desired items on a fixed-time schedule. Results showed a decrease in challenging behavior with a simultaneous increase in adaptive communication.

The current study not only examined the effects of RIRD, but also further investigated the effects of NCR in the treatment of automatically-reinforced vocal stereotypy in a 5 year-old child with autism. As a result of the participant's (John) low rates of the stereotypy during the demand condition in the functional analysis, the preferred reinforcer (i.e., cookie) was delivered noncontingently (i.e., NCR component) during structured work time on a fixed time schedule (i.e., every one minute). To address the disadvantages of NCR, the current study implements NCR procedures that would reinforce appropriate behaviors. In other words, a reinforcer was delivered contingently on each occurrence of an alternative reinforcer (i.e., differential reinforcement of alternative behavior). With regard to the loss of effectiveness of NCR interventions over time due to satiation, this study rotated sets of possible tasks within the NCR schedule. In total, this study contained seven phases. This study also assumed that NCR plus differential reinforcement of alternative behavior (DRA) may be a more effective treatment than interrupting vocal responses.

Method

Participant

John (pseudonym) was a five-year-old boy who had been diagnosed with autism, attending preschool program for children with autism. John lives with his parents and younger sister. He was

able to communicate vocally to request specific items (e.g., cookie, movie, and his favorite toys), but he initiated communicative attempts inconsistently. According to the results of preference assessment and reinforcer survey, cookie is the most frequent verbal request item. Instead of using vocal mode, he may use gestures (move adult's hands) to indicate his desires. John's unintelligible speech was frequently observed. Moreover, John's target behavior was "vocal stereotypy" defined as singing (not appropriate in the context), a mixture of repeated words, word approximations, and noises.

He has been referred by his parents as exhibiting vocal stereotypy that occurred at unacceptable levels at home. His school special education teacher also reported to John's parents that his vocal stereotypy interfered with his participation in educational activities (e.g., group circle time). Due to high frequency of vocal stereotype, John's parents reported their (both parents and school teacher) concern to John's in-home behavior therapist. Before conducting this package of intervention plan, the therapist's role was the consultant, and offered parents and special education teacher the effective strategy (i.e., RIRD) demonstrated in current literature. However, vocal stereotypy was still consistently demonstrated in high rate during daily life.

Setting

This study was implemented by the current study's first author, John's in-home behavioral therapist. Because behavior therapist primarily provided services at his home setting, she was limited access to John's school setting. After consulting to John's parents, parents' bedroom was selected for assessment and intervention. The room contained a mirror, bed, table, drawers,

chairs, a variety of toys, a basketball stand, and an easel. To ensure that the plan was as simple and contextually-appropriate as possible, the researchers reviewed the family ecological information to better fit their daily routine. To reduce the interruption of other family members' daily schedules, John's mom reported that the bedroom is the only available place for us to use.

Response Definitions and Measurement

Vocal stereotypy was defined "as any instance of noncontextual or nonfunctional speech and included singing, babbling, repetitive grunts, squeals, and phrases unrelated to the present situation" (Ahearn et al., 2007). This behavior was measured in the functional analysis and all baseline and intervention phases. Appropriate vocalizations were defined as any contextual, appropriate vocalization not directed by the therapist and included requests for attention, breaks, or tangible activities. An occurrence of appropriate vocalization was always immediately followed by the therapist's response. However, if the appropriate vocalization occurred twice before the therapist responded, it was not scored as an appropriate vocalization. If the vocalization was repeated following the therapist's response, it was scored as another appropriate vocalization. Appropriate vocal behavior was measured in the all baseline and intervention phases. More data collection discussion described as follows:

Dependent variables.

Two dependent variables (DVs) were collected. DV1 was the percentage of 10-second partial intervals during which John engaged in vocal stereotypy within each experimental session. Experimental sessions (i.e., RIRD and the combination of NCR and DRA) lasted 10 minutes, and

the session consisted of sixty, 10-second intervals.

DV2 was the percentage of 10-second partial intervals during which John engaged in appropriate vocalizations. Examples of appropriate vocalizations include requests for social interactions (e.g., John said "ball", which means he wanted the therapist to play ball with him), edible items (e.g., cookie), and nonedible items (e.g., keyboard). Although the researcher collected data on DV2, there was no treatment component specifically implemented to directly teach appropriate vocalizations with specific requests.

Independent variables.

Types of treatment were the independent variables (IVs) for this study. The current study investigates the effect of two treatments on the frequency of DVs. Specifically:

IV1 = Response interruption and redirection (RIRD), defined as vocal stereotypy behavior interrupted immediately by the therapist, and redirected to other appropriate vocalizations.

IV2 = NCR plus DRA, defined as fixed-time access to the tangible stimuli matched to vocal stereotypic behavior during structured work time (i.e., demand condition). In terms of NCR component, preferred reinforcement was provided non-contingently on a fixed-time (FT) schedule. In other words, the therapist continuously provided John a variety of tasks and a small piece of cookie (less than one centimeter) every minute. In terms of DRA component, John could also obtain edible items contingent on a mand (i.e., a vocalized request).

Data Collection and Interobserver Agreement

To assess inter-rater agreement data on the occurrence or nonoccurrence of the target behavior in baseline and experimental sessions, sessions were videotaped and scored. Two observers, the first author and another person (i.e., professional who was certified behavior analyst and had over 10 years working with children with autism), independently scored data on the target behavior from the videotapes for 25% of total sessions (including both baseline and experimental phases). The first author, who was the primary coder, taught a second observer the operational definitions of the target behaviors and gave examples for each. Data from the two observers were compared for agreement and disagreements. An agreement was scored if the two observers recorded the same behavior(s) for each interval. A discrepancy between the two observers was counted as a disagreement. Interobserver agreement on the dependent measures was calculated on an interval-by-interval basis using the formula below. The average total interobserver agreement was 95% (range 85.3-100%), indicating that agreement occurred during approximately 95% of data intervals. The overall percent of sessions coded and individual reliability scores are presented for each participant in Table 1.

$$\text{Interobserver agreement} = \left(\frac{\text{Agreements}}{(\text{Agreements} + \text{Disagreements})} \right) \times 100$$

Table 1.   Interobserver Agreement of Each Phase

Phase	Baseline	RIRD	NCR plus DRA
IOA	93.5 (range from 85.3-96.5%)	96 (range from92.5%-100%)	95.5 (range from 91.7-98.5%)

Treatment Fidelity

Treatment fidelity is important for the purposes of external validity of the data and to provide a means of replicating the procedures. The current study ensured treatment fidelity by providing clear operational definitions of the target behaviors under treatment, outlining the treatment parameters and procedures, videotaping sessions, and having all treatments conducted by the first author.

Evaluation of treatment fidelity was conducted by randomly selecting 25% of the intervention sessions and having an observer score the sessions using a fidelity checklist (see Appendix A-1 and A-2) to evaluate intervention conditions. The sample question on the checklist was if the therapist interrupted and redirected John's inappropriate vocal behaviors. Before assessing treatment fidelity, the observer was trained using videos of the interventions and was told what to look for and how to use the checklist. Following this instruction, the observer watched a video and completed the checklist. After making sure the observer understood the definitions of each procedure, each checklist was scored by giving two points to each correctly answered question and multiplying the total score by 100%. The overall treatment fidelity for 25% of the intervention sessions was 95% (range from 83-100%).

Social Validity

The social validity data was from John's parents, nanny, and his special education teacher. They were asked to evaluate the intervention goals, procedures, and outcomes using a seven-item instrument with a 5-point Likert-type scale. All four people completed two evaluations during the intervention phase. Before implementing this package of intervention, both parents and special education teachers conducted RIRD intervention alone at both home and school settings. This study hypothesize NCR plus DRA would be effective than RIRD. Therefore, social validity would focus on the impact of NCR plus DRA on John's vocal stereotype.   The first evaluation was completed after the first NCR plus DRA phase, and the second evaluation was completed at the third NCR plus DRA phase (see Appendix B).

Research Design

Before implementing a package of treatment interventions, conducting an analogue functional analysis is important because it would determine if John's vocal stereotypy was maintained by automatic reinforcement (i.e., not maintain by social reinforcement). Even though functional analysis served no indication regarding how the results of this analysis related to the selection of intervention, Hanley, Iwata, Thompson, and Lindberg (2000, p. 298) further stated that results of the functional analysis indicated maintenance by automatic reinforcement "served as the basis for the intervention".

This study employed a single-subject design. The multiple treatment reversal design was chosen, and treatment conditions were presented in an ABCACBC format. A phases represented base-

line conditions; B phases represented RIRD condition; C phases represented NRC plus DRA condition. All sessions were conducted in John's parents' bedroom. Additionally, all phases except C were conducted during free-play activities.

Procedures

Functional analysis.

The functional analysis was based on the procedures described by Iwata and his colleagues (Iwata et al., 1982/1984) to identify the specific condition(s) (i.e., attention, demand, alone, control/play) that maintained John's inappropriate vocalization. Five conditions (attention, demand, control/play, access to tangibles, and alone/ignore) were used. During the attention condition, the researcher allowed John to walk around the room filled with various play objects, and brief social reprimands ("John, stop singing"/ "Be quiet") were delivered contingent on vocal stereotypy. If the percent of vocal stereotypy was high in this condition and low in all others, it would be hypothesized that vocal stereotypy was maintained by access to attention.　In the demand condition, the researcher required John to sit at a table. He was given different tasks by the researcher who was sitting across the table. Demands were skills targeted for instruction in John's home training lesson plan (e.g., touch pen). The researcher used prompting to maintain task engagement, and delivered minimal verbal reinforcement for correct responding. Fifteen-second instructional breaks upon engagement in the target behavior were provided by the researcher. If the percent of vocal stereotypy was high in this condition and low in all others, it would be hypothesized that vocal stereotypy was maintained by escape from tasks.

In the tangible condition, play items were available for John to access, and the researcher gave John 15 seconds of free access to a highly-preferred tangible item (e.g., clock). After the 15 seconds, the researcher removed the tangible item and denied him access to it for the reminder of the session. The researcher returned the tangible item for 15 seconds following each instance in which the researcher observed the target behavior. In the control/play condition, the researcher gave John free access to a highly-preferred reinforcer and the researcher's attention on a dense schedule. No demands were presented. There were no scheduled consequences for engagement in the target behavior. If the percent of vocal stereotypy is high in this condition and low in all others (differentiated), or high across all conditions (undifferentiated), it would be hypothesized that vocal stereotypy was maintained by automatic reinforcement.

This study hypothesized that vocal stereotypy was maintained by automatic reinforcement. Following up the functional analysis, alone session was conducted to further evaluate whether the target behavior (i.e., vocal stereotypy) occurred in the absence of programmed contingencies (Vollmer, Marcus, Ringdahl, & Roane, as cited in Falcomata, Roane, Hovanetz, Kettering, & Keeney, 2004). Though it was not possible to follow the procedures of alone condition described by Iwata and his colleagues (Iwata et al., 1982/1984) the researcher still included alone condition to test if the behavior was maintained by automatic reinforcement. The researcher modified the alone condition in the analysis because she was not able to remove the materials included in the room. Furthermore, the researcher asked John to stay in a corner of the room and did not allow him to access any materials in the room. The researcher did not ignore John (e.g., did not give eye contact), and tried to block John from leaving the corner. Functional analysis sessions

lasted 5 minutes each and were repeated three times for consistency. The researcher used ten-second partial interval data on engagement in target behaviors and calculated and graphed percents per session.

Baseline (phase A).

Baseline data were collected on both DV1 (vocal stereotypy) and DV2 (appropriate vocalization). During baseline, John and the therapist stayed in the room's corner with two drawers and no other materials (i.e., no edible items or activities were present). There were no scheduled or social consequences for engaging in the vocal stereotypic behaviors during baseline sessions. If John independently vocalized, the therapist delivered praise for using appropriate language and delivered the request if possible or if it is available. For example, if John said "cookie" that was not available, the therapist responded to him by saying "Good job for asking for a cookie, maybe we can have some soon." To establish a stable rate of responding before treatment is introduced, baseline sessions lasted 5 minutes each and were repeated for 3 sessions.

Response interruption and redirection (phase B).

RIRD followed this baseline. Data collection procedures were identical to those used in the initial baseline. When John demonstrated appropriate language, the therapist delivered praise which resemble as baseline. During this phase, the therapist immediately interrupted each episode of vocal stereotypic behavior. After immediately interrupting, the therapist directed John to appropriate vocalizations. More specifically, the therapist stated the child's name in a natural tone of voice while initiating eye contact and issued the prompts that required a vocal response.

The prompts were in the form of labeling question (e.g., "what's this?") and vocal imitation (e.g., "say monkey"). The vocal demands were skills that had been performed correctly (i.e., at least 90% correct per opportunity) and fluently (i.e., correct across different settings and adults) during regular educational instruction. Furthermore, a session clock that started at the beginning of the session was stopped each time the therapist implemented RIRD, and was restarted after the therapist-delivered social praise following the three consecutive instances of compliance. The session continued until the session clock indicated that 10 minutes had passed in which John was not in treatment. When treatment sessions were scored, seconds during which the procedure was being implemented were subtracted from the total session time, so that each session consisted of 10 minutes in which behavior was free to occur.

NCR plus DRA (phase C).

During this phase (i.e., demand condition), John was noncontingently given a variety of tasks and a small piece of cookie. Noncontingent edible reinforcement was provided for in a predetermined FT schedule (every one minute). In other words, different tasks and a small piece of cookie were delivered every minute during structured work time (i.e., demand condition). After offering a small piece of edible item, the therapist continuously placed demands on John. Offering a small piece of cookie would not interrupt John's continuous access to tasks. When delivering demands, the therapist mixed demands from all the skill areas, including motor imitation, receptive identification of objects or pictures (e.g., give me "spoon"), visual performance (e.g., putting puzzle together), and receptive commands (e.g., what's this, John said "eye"). Interspersed easy and hard demands were used. Moreover, the therapist used the ratio of 20% hard (acquisition) and 80% easy (maintenance) when presenting demands at the

table. Easy responses are things which John can typically do without prompts. Fluency was also taken into account. The therapist kept inter-trial intervals less than one second (fast paced instruction). This is the time between John's response and the therapist's next demand. The therapist also kept the latency of John's responses to less than two seconds. If John did not answer within 2 seconds, the therapist used whatever prompt level was necessary to get the response and then immediately fade the prompt. By providing a noncontingent reinforcer, there was no programmed consequence when John engaged in vocal stereotypic behaviors.

With regard to the DRA component, the therapist taught and reinforced John to use appropriate language while requesting. John could obtain edible items contingent on a mand. For example, the therapist used verbal prompting question: "what do you want?" John said "cookie." The therapist immediately offered him cookie. The purpose of including DRA component is to reinforce and increase the appropriate verbal behavior (e.g., request and labeling), and ignore the inappropriate verbal stereotypy. During demand condition, at least two different edible items were provided (John could not reach the items, but those items were placed in a visible distance). While initiating appropriate verbal behavior, the therapist still continuously placed demands on John without interrupting the pre-determined NCR schedule.

Prior to NCR plus DRA condition, John has been taught to say edible items (i.e., cookie, chip, banana, muffin, fries, and cereal) via imitation and reinforcement procedures. To avoid satiation, the therapist made sure John was not offered any snacks before conducting each NCR plus DRA. This NCR plus DRA treatment session lasted 10 minutes. All vocal stereotypy and appropriate vocalizations that occurred during NCR plus DRA sessions were recorded.

Results

Functional Analysis

Figure 1 shows the frequency of John's vocal stereotypy behaviors during functional analysis sessions. Data suggest that vocal stereotypic behaviors were being maintained through automatic reinforcement. Rates of vocal stereotypy were low in the demand conditions, indicating that stereotypy behaviors did not serve as a means of escape. Undifferentiated patterns of responding across multiple social conditions can either indicate a behavior being controlled by multiple functions, or a behavior being controlled by automatic reinforcement (Iwata et al., 1994). In the present analysis, the researcher concluded that target behaviors for John were automatically reinforced.

John obtained a mean rate of vocal stereotypy of 78% in the attention condition, and a mean of 20% in the demand condition. He achieved a mean of 81% in tangible condition and a mean of 68% in control condition. In the ignore/alone condition, he obtained a mean of 57% (See figure 1).

Treatment Results

Figure 2 shows the results of the RIRD and NCR plus DRA interventions. In the baseline condition, John engaged in inappropriate vocalizations an average of 82.5% intervals (range 75-92%); while he engaged in appropriate vocalization an average of 4% intervals (range 3-5%). When the RIRD was implemented, the percent of vocal stereotypy were below baseline levels and showed a decreasing trend. On average, he en-
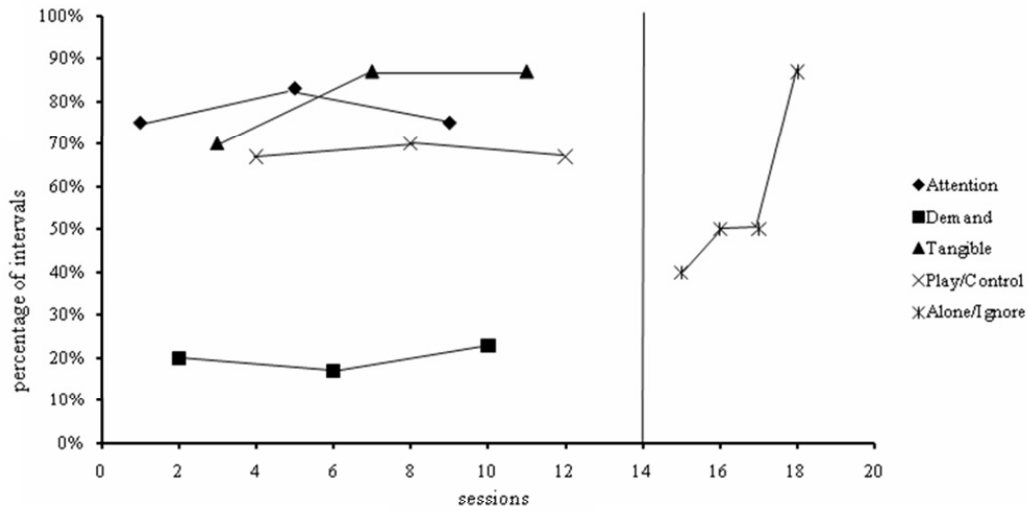
Figure1.   Functional analysis data.

gaged in inappropriate vocalizations during 64.5% of the intervals (range 50%-80%). In this treatment session, the percent of his appropriate vocalization showed an increase, with an average of 27% (range 20-33%). When the NCR plus DRA was introduced, the appropriate vocalizations immediately increased to an average of 58.3% of intervals (range 55-60%). During this session, John's vocal stereotypic behaviors also immediately decreased to an average of 21.3% of intervals (range 15-25%).

When baseline was re-implemented, John's inappropriate vocalizations increased to an average of 74% (range 67-75%) while his appropriate vocalizations decreased to an average of 9.3% (range 8-12%). When the intervention of NCR plus DRA was re-introduced, his vocal stereotypic behavior again immediately decreased to an average of 14.3% (range of 10-20%), and his appropriate behavior increased to an average of 60% (range of 55-67%). The intervention of RIRD was then implemented, and inappropriate vocalizations increased to an average of 56% (range 50-63%). His appropriate vocalizations dropped to an

average of 26.3% (range 25%-28%). The NCR plus DRA was then re-implemented, and he returned to his previous NCR plus DRA levels (M = 10.8% for inappropriate vocalizations, 63.8% for appropriate vocalizations).

The purpose of multiple treatment reversal design is to "compare the effects of two or more experimental conditions to baseline and/or one another. " (Cooper, Heron, Heward, 2007, p. 181). According the results of this study, vocal stereotypy reduced in the condition of NCR plus DRA when comparing in the baseline and RIRD condition, respectively. Additionally, John demonstrated higher rate of appropriate behavior in NCR plus DRA condition than the other two conditions.

Social Validity Ratings

Across all evaluations (1 = *disagree*, 5 = *agree*) by four persons (mom, dad, nanny, and special education teacher), the average social validity rating was 4.5 (range from 4.2 to 4.8). Overall, they consistently believed that the target goals, procedures, and outcomes were acceptable.
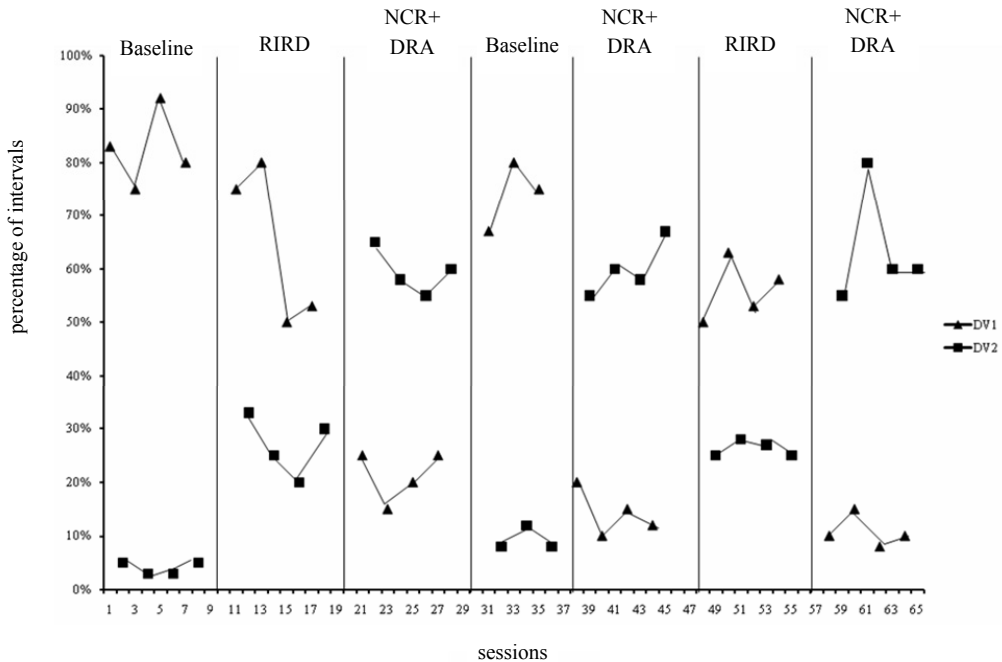
Figure 2. Percentage of session with vocal stereotypy;
DV1 = Inappropriate vocalizations; DV2 = Appropriate vocalizations.

Discussion and Implication

In the first phase of this study, functional analyses were used to examine the inappropriate vocalizations of one child with autism. Results suggested that the behavior was maintained by automatic reinforcement. Moreover, the results represented undifferentiated patterns (i.e., inappropriate vocalizations occurred across all conditions, except demand).

With regard to the behavioral principle underlying the effectiveness of RIRD, the current study did not support the findings presented by Ahearn et al. (2007). In the current study, RIRD produced rates of slight reduction in stereotypical behaviors, but did not produce significant behavior change. When implementing RIRD, it is also interesting to know that there was a slight difference between baseline and RIRD treatment in the

contingencies for appropriate vocalizations. Even though appropriate vocalizations were not at a significant level, the slight change may emerge as a positive side effect of RIRD (Ahearn et al., 2007). However, it is necessary to further investigate whether specific instruction/redirection (e.g., mand training) may produce the effect of appropriate behaviors. Overall, the finding suggests that behavior reduction for vocal stereotypy maintained by automatic reinforcement may not be effective when using an RI strategy.

In the current study, NCR plus DRA was implemented during the demand condition (i.e., structured work time). Before implementing this study, John was taught to wait before requests to receive preferred stimuli were reinforced. Furthermore, John's percentage of vocal stereotypy was significantly reduced during intervals in which he did not have access to preferred items.

Fixed-interval schedules were compatible with both NCR and DRA, because reinforcer delivery is noncontingent with respect to inappropriate vocalizations but contingent to alternative behavior (e.g., requesting for the preferred items). The finding that NCR plus DRA decreased vocal stereotypy is similar to the findings presented by Marcus and Vollmer (1996). When stimuli delivered noncontingently were properly matched to the stereotypic behaviors (e.g., inappropriate vocalizations), Carr and his colleagues (Carr et al., 2002) indicated that such behaviors for reduction seemed more preferred by individuals. In other words, the effectiveness of NCR plus DRA suggested that gaining highly preferred stimuli may compete with engagement in automatically reinforced challenging behaviors.

Ahearn et al. (2007) also discussed producing appropriate behavior that was momentarily incompatible with vocal stereotypy. Specifically, the authors argued that academic demands were not associated with problem behaviors. In the current study, the therapist presented a variety of tasks (including both vocal and nonvocal demands), and John reduced inappropriate behaviors which had the advantage of producing appropriate vocalizations (i.e., requesting preferred item) in the demand conditions (i.e., doing structured work). Regardless of rates of stereotypic behavior, the finding suggests that the child with autism may need a structured learning environment to produce appropriate vocalizations.

Limitations

Several limitations are presented. First, as with all single subject designs, findings are based on participants' characteristics. The finding cannot be generalized to all children with autism who had vocal stereotypy. Although this restricted sample is a possible limitation to the generalizability of the findings, the rigor of single-subject designs, including the reversal design used in the current study, establishes a functional relationship between the independent and dependent variables (Cooper et al., 2007). Additionally, quality indicators within single-subject research, including detailed descriptions of participants and setting, precise definition of dependent and independent variables, established a pattern of responding during baseline, and consideration of the importance of social validity, proposed by Honer et al. (Honer, Carr, Hall, Mcgee, Odom, & Wolery, 2005). This study met above quality indicators, which would provide future research replicates the design of current study to determine the generalization of different subjects.

A second limitation of the study was the limited number of data points within each phase. It is possible that treatment effects would have been obtained, where they were not obtained, if the treatment phases were conducted for a greater number of sessions. Thirdly, this study's external validity is limited because of including only one child and one setting. Honer et al. (2005) also stated that "experimental effects are replicated across participants, settings, or materials to establish external validity" (p. 174). Fourthly, an empirical case study cannot control all threats to internal validity, such as history, maturation, and sequence effects. Although precise operational definitions of target behaviors and training help increase the degree of treatment fidelity, it did not reach 100%. All possible threats (e.g., sequence effects) to the interval validity of treatment procedures may impede the results of validity. This study employed a multiple treatment reversal design to compare two treatments, which may be vulnerable to confounding by sequence effects.

Interpretation of this study's results should be cautious.

Finally, there was a question as to the effectiveness of using reinforcers for the RIRD condition. Even though RIRD conducted during free play conditions, those items may not be as preferred as the vocal stereotypy. It remains possible that the RIRD would have shown greater effectiveness if the activities were more closely matched to the automatic reinforcement produced by the stereotypic behavior of the individual.

Implications

The current findings suggest some areas of implications for practitioners and researchers who are involved in behavior interventions. First, future study should strengthen the internal and external validity while replicating procedures of the current study. One important implication would be to see the effectiveness of the NCR plus DRA under the condition of structured work with preferred stimuli designed to increase appropriate behaviors in children with autism in classroom settings. To promote long-term meaningful change and reduce the limitation of external validity, NCR plus DRA should be implemented across different settings (e.g., classroom) and people (e.g., school teachers). Specifically, this study only focused on one setting. Even though special education teacher acknowledges the influence of NCR plus DRA on reducing vocal stereotypy, ongoing maintenance and generalization data at the classroom should be collected to verify the effectiveness of NCR plus DRA across settings. External validity would also be enhanced if the efficacy of NCR plus DRA was demonstrated at different settings.

Another investigation would be to run a study similar to the current research, but implementing the treatment contingencies on a full-day basis within a natural setting (e.g., school, community) instead of within short, isolated treatment sessions. Because this study only implemented at certain time per day, the results were unable to reveal whether the parents or school teachers would encounter any difficulties (e.g., setting up the structured environment) Specifically, NCR plus DRA was under the condition of structured work time. The findings of current study were unable to determine the possibility of treatment contingencies on a full-day basis. This would show the longer-term effectiveness of interventions and may highlight practical difficulties in implementing these interventions across an entire school day using trained teachers.

Finally, a variety of appropriate vocalizations, mands, and tacts emerged for the participant. Although current study recorded data of using appropriate language, future study should continue examine the quality as well as quantity of using appropriate language under different treatments. For example, this study did not highlight whether John's appropriate language frequently appeared under the therapist's vocal demand or under self-initiation. NCR plus DRA condition focused more on providing the participant the opportunities to use appropriate language, while the participant may be observed to self-initiate appropriate language under RIRD condition. Though NCR plus DRA condition produced more appropriate language than RIRD condition, it is essential to further examine the quality of appropriate language (e.g., whether appropriate language is self-initiated).

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Appendix A-1　Treatment Fidelity

Checklist for RIRD intervention

Please watch the following video and circle the corresponding answer:

Procedural Steps	Yes	No
Was vocal stereotype blocked at any point during the session?		
Were any social consequences (e.g., saying nice job) provided contingent upon the participant demonstrated appropriate language?		
When demonstrating inappropriate vocal behaviors, did the therapist immediately redirect the participant by providing prompts for appropriate language?		
While offering vocal demands, did the therapist consider if the participant was likely to respond correctly? In other words, could the participant be able to respond the questions at most of time?		
Did the therapist continue to provide vocal demands for appropriate language until the student complied with three consecutive correct responses in the absence of vocal stereotypy?		
Did the clock immediately re-start the clock after the therapist delivered social praise following the three consecutive instances of compliance?		

Appendix A-2　Treatment Fidelity

Checklist for NCR plus DRA intervention

Please watch the following video and circle the corresponding answer:

Procedural Steps	Yes	No
Did the therapist continuously provide a variety of tasks within ten minute session?		
Did the therapist used fast-past instruction and allow the participant to be able to respond majority of tasks?		
Was the participant continuously given a small piece of cookie (less than one cm) every one minute?		
Did the therapist provide no consequences for occurrences of the vocal stereotypy within 10 minutes?		
Was a small piece of edible item provided contingent upon participant appropriately request? (Did the therapist respond to the participant's appropriate language?)		
Was the participant not be able to reach edible items, but could the participant see it?		

Appendix B　Social Validity Evaluation

The purpose of this questionnaire is to obtain information that will aid in understanding the effectiveness of NCR plus DRA for reducing the child's vocal stereotypy.　Please circle the number that best describes your agreement or disagreement with each statement (1=disagree, 5= agree). You also have space to write comments or suggestions for change or improvement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.The plan recognizes and builds on my child's (or my student's) needs and preference	1	2	3	4	5
2.The plan is based on an understanding of the reasons for the problem behavior (i.e., automatic reinforcement).	1	2	3	4	5
3.The plan really addresses my highest priority goals for my child and family (for my student).	1	2	3	4	5
4.The goals of the plan are consistent with my family's goals, values, and beliefs (or are consistent with my educational goals).	1	2	3	4	5
5.The strategies and procedures used are difficult to carryout in the home (or at school).	1	2	3	4	5
6.The strategies and procedures used are effective in improving my child's (or my student's) behavior.	1	2	3	4	5
7.The outcome of this treatment is beneficial for my child (or my student).	1	2	3	4	5

Comments:

探討「非立即性增強」以及「打斷行為反應和重新引導」兩種策略對自閉症幼童的語言固著行為之成效

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　　自閉症是終身殘疾，其特徵包含在社會互動、溝通及行為方面的缺陷，自閉症兒童並時常展現重複和非功能性的固著行為（stereotypic behaviors）。固著行為可能藉由本身感官所產生的反應，而導致自動增強（automatic reinforcement）。同時，固著行為會干擾聽覺處理、無法區別學習，以及有困難展現適切的社會行為。因為固著行為會影響孩童發展，目前針對自閉症幼童此行為有其相關研究策略。然而，目前相對少的研究文獻針對自閉症兒童的語言固著行為（vocal stereotypy）進行探討。先前研究提出「打斷行為並重新引導」（response interruption and redirection）策略可以降低語言固著行為。另一策略是藉由非立即性增強（noncontingent reinforcement），孩子將其注意力放在可替代的刺激上而異常反應（例如：語言固著行為），這樣替代性刺激可以有效的取代異常反應。然而這兩種策略都有其限制。本研究的目的在探討行為策略的介入，是否可以有效改善一位五歲自閉症幼童的語言固著行為。採用功能分析檢視幼童的語言固著行為的由來。結果顯示「自動增強」為語言固著行為產生的原因。除了非立即性增強外，應用區別性增強替代行為（differential reinforcement of alternative behavior）策略去提升適切語言溝通的機會。根據行為功能分析的結果，實驗設計為 ABCACBA，使用兩種行為策略（打斷行為並重新引導以及非立即性增強以及替代行為增強）並分成階段進行介入，以比較兩種策略的成效。研究結果顯示，使用「非立即性增強以及替代行為增強」策略不僅顯著降低不適切的語言固著行為，並顯著提高適切語言行為的使用。

關鍵詞：自閉症、固著語言行為、自動增強、打斷反應並重導方向、非立即性增強