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# A comparison of differential reinforcement of other behavior and response interruption and redirection on vocal stereotypy

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# A Comparison of Differential Reinforcement of Other Behavior and Response Interruption and Redirection on Vocal Stereotypy

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# A Comparison Of Differential Reinforcement of Other Behavior and Response Interruption and Redirection on Vocal Stereotypy

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## Abstract

Vocal stereotypy is a common problem behavior among persons with autism spectrum disorder and can prove to be a fairly difficult behavior to treat. One of the main reasons that this behavior is often challenging is that it is usually maintained by the sensory consequences that it produces. Response interruption and redirection and differential reinforcement of other behavior are two treatments which have been shown to be effective in reducing stereotypy. RIRD is often a staff intensive procedure which can be difficult to implement and may not always be done with 100% procedural integrity. While DRO is an easier procedure for staff to implement it is not always as effective when used on its own. This study is a comparison of RIRD and DRO in the treatment of vocal stereotypy using an ABAB design, alternating the treatments during the B phase. Three students with autism spectrum disorder that exhibit high rates of vocal stereotypy were chosen as participants. Stereotypy decreased with both treatments for all three participants. For one participant RIRD was more successful throughout the entire study, while for the other two DRO was at times more effective but not consistently. Results for both DRO and RIRD are effective treatments for decreasing stereotypy in persons with autism spectrum disorder with RIRD as a possibly more reliable treatment.

# A Comparison Of Differential Reinforcement of Other Behavior and Response Interruption and Redirection on Vocal Stereotypy

Vocal stereotypy, defined as any instance of non-contextual or non-functional speech, including singing, babbling, repetitive grunts, squeals and phrases unrelated to the present situation (Ahearn, Clark, MacDonald & Chung, 2007) is among the criteria for autism spectrum disorder. Individuals with autism often display some form of repetitive behavior (Lewis & Bodfish, 1998) that occurs frequently and at very high rates, and has been associated with impaired learning and social development (Kennedy, Meyer, Knowles, & Shukla, 2000). Such behavior is socially stigmatizing (Jones, Wint, & Ellis, 1990). Despite its prominent presence for this population it has received less attention in research then some of the other behaviors that are also on the diagnostic description of this disorder (Lewis & Bodfish, 1998).

Researchers have assessed the consequences that may be maintaining stereotypy (Kennedy et al., 2000). For example, Durand and Carr (1987) and Mace and Belfiore (1990) found that stereotypy was maintained by escaping particular social situations. Kennedy et al. found that the function of stereotypy was multiply maintained by escape and attention and that stereotypy decreased from baseline levels when a functional communication response was taught. Numerous researchers who have conducted functional analyses found that stereotypy persisted in the absence of social mediation (e.g., Piazza, Adelinis, Hanley, Goh, & Delia, 2000; Rapp, Miltenberger, Galensky, Ellingson, & Long, 1999; Vollmer, Marcus, & LeBlanc, 1994) suggesting that it is automatically reinforced by the sensory consequences it produces.

Lovaas, Newsom, Litrownick, and Hickman (1987) found that participants in their study brought in a large variety of different types of high-rate, persistent self-stimulatory behaviors with near-identical forms across children from diverse cultures (Asia, Latin America, Europe). Because these behaviors continued to occur in the absence of social consequences the authors concluded that participants' stereotypy were not maintained by social reinforcement. Because the behavior's maintaining variables have implications for treatment it is important that the function of stereotypy is determined before treatment development. Iwata, Dorsey, Slifter, Bauman, and Richman (1982/1994) illustrated a functional analysis procedure determining the function of self-injurious behavior.

Automatically reinforced behavior is defined as behavior that is maintained by operant mechanisms independent of the social environment (Vaughn & Michael, 1982). Because problem behavior maintained by automatic reinforcement are not dependent on social reinforcement, it can be more difficult behavior to assess and treat (Vollmer, 1994). One of the difficulties facing researchers is that most treatments that have been informed by a functional analysis have been for behavior that is socially mediated. These interventions are highly effective but usually involve withholding the reinforcer that is maintaining the problem behavior (Vollmer). Automatic reinforcement is maintained by a variable that is not within the experimenter's control to withhold.

One idea is that behavior occurs in an environment where the participant is alone because the environment is bare and the consequences of the behavior are producing stimulation. In this theory, an enriched environment may reduce rates of behavior (Lovaas et al.). Another treatment option for automatically maintained problem behavior

is to provide an alternative source of stimulation that produces a similar sensory reinforcement (Vollmer).

Differential reinforcement is one of the most often used treatments for stereotypy and other problem behaviors in persons with developmental disabilities (Marcus & Vollmer, 1996). A basic DRO contingency refers to reinforcement in the absence of a specific behavior after a specified interval of time. A DRO procedure may involve a reinforcer which is the maintaining variable for the problem behavior or it may involve an arbitrary reinforcer. Although DRO has been shown to be more effective if the maintaining reinforcer is used (Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993), arbitrarily selected reinforcers are frequently used. There are two types of DRO; whole interval DRO and momentary DRO (Cooper, Heron, & Heward, 2007). In whole interval DRO the behavior must be absent for the entire interval in order for reinforcement to be delivered. In momentary DRO the behavior need only not occur at the moment that the interval ends. Repp, Barton, and Brulle (1983) found in a comparison of interval DRO and momentary DRO that interval DRO was more effective in reducing problem behavior than momentary DRO. Barton, Brulle, and Repp (1986) found that after behavior was successfully reduced using whole interval DRO, low levels could be maintained using momentary DRO. One possible alteration to the DRO contingency is to use a variable interval instead of a fixed interval. In the variable interval the time of the interval changes throughout a treatment session. Other types of differential reinforcement can include DRA (differential reinforcement of alternative/incompatible behavior) or DRL (differential reinforcement of low rates of behavior). Iwata and Pace (1990) found that DRO was effective in reducing self injurious behaviors without being combined with

other treatments and rates of behavior were reduced as effectively as when those responses were exposed to punishment.

The effectiveness of differential reinforcement may depend on several different variables. Some of these variables are the amount and immediacy of the reinforcement that is being delivered and whether or not the reinforcer is also the maintaining reinforcer or an arbitrary one (Lerman, Kelley, Vorndran, & Van Camp, 2003). Differential reinforcement can also be used in combination with other treatments, and has been found in some cases to be more effective this way. Fellner, Laroche, & Sulzer- Azaroff (1984) found that DRO/DRI was considerably more effective in lowering rates of stereotypy when interruption was added. Barton, Repp, and Brulle (1985) found that when combining DRO and momentary restraint on four individuals with stereotypic behaviors, rates of stereotypy decreased rapidly.

Sensory extinction is another treatment that has been fairly successful in reducing rates of automatically maintained behavior (Rincover, 1978). Sensory extinction consists of disrupting the contingency between the response and the product it produces (Rincover). If perceptual consequences reinforce self-stimulatory behaviors, the behaviors previously maintained by such consequences should decrease in strength when the consequences are removed. That is, the behavior should exhibit extinction (Lovaas, Newsom, Litrownik, & Hickman, 1987). Response blocking is in some cases is considered a type of sensory extinction, although the response is prevented from continuing as opposed to no longer producing the stimulation that it once did (Lalli, Livezey, & Kates, 1996).

Response blocking has been successful in reducing problem behavior which is not socially mediated. Reid, Parsons, Phillips, and Green (1993) found that self injurious hand mouthing was significantly reduced in two individuals with profound disabilities when blocking was introduced. Haerris and Wolchick (1979) found that when comparing DRO, timeout and overcorrection in 4 individuals with developmental disabilities for the treatment of stereotypic behavior, overcorrection had the most dramatic reduction in problem behavior for all four individuals.

A potential side effect of response blocking is that it can induce aggression or responses that are in the same class as the one being blocked (Lerman et al., 2003). Lerman et al. found that when response blocking was used as a treatment there were undesirable side effects that arose in the participant's behavior. Hagopian and Adelinis (2001) conducted a study in which pica was blocked with and without redirection. During the blocking and redirection condition, the participant was redirected to eat popcorn contingent on pica. During the combined condition, pica decreased to lower levels and aggressive behavior was observed. By contrast, higher levels of aggression occurred when only blocking was conducted.

It is also possible that response blocking reduces behavior as a form of punishment. Lerman and Iwata (1996) evaluated response blocking when it was applied intermittently. For instance, in one phase behavior was blocked every fourth response. If blocking was reducing behavior by extinction it would be on a fixed ratio reinforcement schedule and therefore would not decrease in levels. It is also possible that blocking functioned as a punisher and if so, blocking every fourth response would decrease behavior. Lerman and Iwata found that for this particular participant levels of behavior

decreased to near zero levels even when they only blocked a portion of the responses, suggesting that blocking functioned as punishment as opposed to extinction.

Vocal stereotypy presents a problem for clinicians who want to use response blocking because vocalizations cannot be physically blocked. Ahearn et al. (2007) interrupted vocal stereotypy and redirected the participant to emit appropriate vocalizations. Four participants were used in this study and were chosen for their high rates of vocal stereotypy. Each instance of vocal stereotypy was interrupted with a series of vocal demands until the participant complied with three in the absence of stereotypy. Data was taken on percentage of vocal stereotypy and percentage of appropriate vocalizations. An ABAB design was used and results showed that for all four participants stereotypy decreased to near zero levels during treatment and returned to baseline levels when treatment was withdrawn. For three out of the four participants appropriate vocalizations increased from baseline levels as well.

Response interruption and redirection has been shown to be effective in reducing stereotypy in persons with an autism spectrum disorder; however it is an extremely staff and labor intensive procedure. DRO is a less staff intensive procedure to implement than RIRD, however it has not been proven to be as effective in reducing stereotypy. The purpose of this study is to replicate the study conducted by Ahearn et al. (2007), as well as compare the efficacy of differential reinforcement of other with response interruption and redirection in reducing rates of vocal stereotypy in persons with autism spectrum disorder.

## Method

*Participants and setting*

The participants were 2 boys and 1 girl diagnosed with autism, all of whom were reported to exhibit high rates of vocal stereotypy which interfered with their skill acquisition and daily activities.

Ann was a 17- year old girl who attended a residential school for children with autism. She had a small verbal repertoire in which she emitted certain vocal verbal behavior related to food that she was requesting, using the bathroom and a few social questions. Her vocal stereotypy consisted mainly of high pitched sounds and repeating words and phrases.

Rob was a 10- year old boy who attended the same residential school for children with autism as Ann. Rob's vocal verbal repertoire consisted of greetings, social questions and requesting food. His stereotypy consisted of screams, babbling and low pitched sounds.

Mike was a 9- year old boy who attended a day school for children with autism. Mike's communication was vocal verbal and he was able to answer social questions, request items and emit vocal greetings. Mike's stereotypy consisted mostly of words below conversation level that were non contextual, singing and yelling.

All sessions were run in a research room which was 1.5 m x 3m and had only a desk and two chairs in it. The room was equipped with a wide angle video camera and a microphone however that was not visible to the participant. For Rob the desk was taken

out of the room for safety purposes. For the functional analyses the materials necessary for each condition were present. During the treatment assessment a book was present for all sessions. A preferred edible was present during only the DRO sessions.

*Dependent variable and operational definition*

The dependent variable in this study was vocal stereotypy. *Vocal stereotypy* was defined as any instance of the participant engaging in repetitive sounds, words, grunts or humming. Examples of this would be the participant making high pitched squealing sounds or repeating the same word non-contextually.

*Independent variables*

The independent variables in this study were the response interruption and redirection procedure used to interrupt vocal stereotypy and the differential reinforcement of other procedure in which an edible was delivered after a pre-specified duration with no stereotypy.

*Functional analysis*

A functional analysis based on the procedures from Roscoe, Carreau, Pence and MacDonald (2008) was conducted for all participants prior to the study. Each session was 5 min in length and sessions were conducted in the following sequence:, alone, alone, attention, alone, alone, demand. In the alone condition the participant was in a room by themselves. The experimenter did not interact with the participant and delivered no consequences for the occurrence of stereotypy. In the attention condition, the participant was provided with a moderately preferred leisure item and told that the experimenter was busy and needed to do work. The participant was ignored until they engaged in stereotypy in which case attention was immediately provided in the form of a verbal

reprimand, “stop that.” The demand condition consisted of demands being continuously presented. Contingent on stereotypy the therapist said “okay, you don’t have to” and removed demands for 15 s. All other behavior was ignored. For Observers recorded stereotypy using 10 s momentary time sampling, and interobserver agreement was taken for 33% of sessions.

*Results*

Rob’s results were undifferentiated (Figure 1). Ben’s results showed high levels during the alone condition and lower levels during attention and demand (Figure 2). For Ann rates of stereotypy were highest in the alone condition (Figure 3). Results for each participant in the functional analysis suggested that stereotypy was not socially mediated.

*Treatment*

During treatment vocal stereotypy was as defined above, however, it was scored using continuous duration recording. Interobserver agreement was collected by three different independent observers for 33% of each condition. For Ann the mean was 98.6% (range, 92.2% to 100%), for Rob 94.4% (range, 90.9% to 98.9%) for Mike 92.3% (range, 90.1% o 96.6%).

*Procedure*

An ABABAC design was used in this study in order to show the effects of treatment on vocal stereotypy. In order to compare two different treatments, RIRD and DRO, an alternating treatment design was used during the treatment phase of this study. A final phase was conducted for one of the participants in which the treatments were combined.

*Baseline*. During this phase, sessions were 5 min in which the participant was given a leisure item (a book) and no demands. The experimenter did not initiate interaction with the participant and only responded to appropriate requests (e.g. “may I have a cookie” received a response of “nice asking but it’s not available right now”), but did not provide any reinforcement other than minimal attention through verbal responding. No consequences were delivered contingent on vocal stereotypy. Data were collected on vocal stereotypy (continuous duration recording).

*Differential Reinforcement of Other (DRO) behavior*. The DRO condition was similar to baseline; participants had continuous access to a leisure item and no interaction. The DRO interval had been previously calculated by determining the mean inter-response time and the median inter-response time during baseline sessions. The lower time between those two calculations was then used as the DRO. For the mean inter-response time the seconds between each bout of stereotypy were counted and added together and then divided by the number of IRTs. This was done for each baseline session and then the average of those was calculated. For the median inter-response time each IRT was plotted on a scatter plot and the median was found. The average median from the 3 baseline sessions was then calculated. For Ann the DRO was found at five seconds. For Rob the DRO was 3 seconds and for Mike the DRO was 4 seconds. The interval which had been previously calculated was set using a timer and if the participant did not engage in vocal stereotypy during this time period they were given a preferred edible. If the student did engage in vocal stereotypy during this time there were no immediate consequences, but they were not given an edible and the timer was reset. Data collection for vocal stereotypy was taken using continuous duration recording. When

stereotypy was scored for the DRO sessions, any time in which the interruption had been run in the corresponding RIRD session was discounted, meaning that stereotypy which occurred during that time period was not calculated in the data.

*Response interruption and redirection (RIRD).* Sessions were similar to baseline except that stereotypy was followed by response interruption and redirection. Contingent on stereotypy, the experimenter presented a series of vocal compliances (e.g., "What's your name?, Where do you go to school?"). The participants had mastered the responses to these questions prior to participation in this study . After the participant appropriately responded three times consecutively, the experimenter stopped presenting vocal directives. The experimenter used two timers during RIRD, one that ran up for tracking total session time and one which was set at five minutes and ran down. Vocal stereotypy during compliances was not collected in the data, however during those compliances the 5 minute timer was stopped and did not restart until 3 consecutive compliances in the absence of stereotypy were answered so that sessions consisted of five minutes interruption free. The timer which ran up was then used to calculate the session length of the DRO.

*DRO + RIRD.* For one of the participants we evaluated the effects of combining RIRD and DRO. During this phase, three timers were present, one timer was set for 5 minutes and ran down and was stopped during interruption, a second timer was set for the DRO interval and a third timer ran up for the entire session. When stereotypy was below 5% for two sessions in a row the DRO interval was increased by half.

## Results

For Rob, levels of stereotypy were high during baseline and decreased rapidly during both treatments. DRO levels were particularly low at near zero rates. When treatment was withdrawn levels of stereotypy again rose to near baseline levels. In a return to treatment RIRD continued to decrease while DRO levels remained below baseline they rose slightly higher than RIRD and were not as low as they were in the original treatment phase (Figure 4).

For Mike baseline levels were high and decreased during treatment. DRO was met with only relative success; although there was a decrease in stereotypy it was not much lower than baseline. During RIRD levels of stereotypy decreased and were at a continuously decreasing trend. When treatment was withdrawn levels of stereotypy again rose to the original baseline levels. In a return to treatment Mike's stereotypy decreased during RIRD and DRO but again had a more significant decrease in the RIRD (Figure 5).

For Ann, levels of motor stereotypy were high during baseline, and immediately decreased to low rates when RIRD and DRO were implemented. DRO was slightly lower during this phase then RIRD, although both treatments were effective. During the return to baseline levels of stereotypy again rose to almost the original baseline level. In the second alternating treatment phase RIRD was again very low, while the results for DRO were more varied with two of the sessions scoring as high, and higher, than baseline levels. In a second return to baseline increased levels of stereotypy occurred although somewhat lower than in the original baseline and with a slight decreasing trend. A final C phase was then conducted for this participant in whom levels of stereotypy

lowered again from baseline, however the combination phase did not produce results that were any lower than RIRD alone (Figure 6).

For all three participants both treatments decreased stereotypy to below baseline levels. For Ann and Rob the DRO treatment was originally more successful but did not sustain the same effect throughout, while RIRD had a more consistent decrease in behavior. For Mike, RIRD was more effective in decreasing levels of stereotypy throughout the study.

## Discussion

As previously mentioned, automatically maintained behavior poses as a particular problem for behavior analysis because the maintaining variables for a problem behavior that is not socially mediated are not within the control of the experimenter. Stereotypy is a behavior that is typically thought to be maintained by the sensory consequences it produces and therefore is maintained by automatic reinforcement.

The FA procedures, which were run for all three participants in this study, supported previous hypotheses that stereotypy is not socially mediated (Piazza, Adelinis, Hanley, Goh, & Delia, 2000; Rapp, Miltenberger, Galensky, Ellingson, & Long, 1999; Vollmer, Marcus, & LeBlanc, 1994). For two participants stereotypy was higher in the alone condition than in any other condition, and for one participant all three conditions had equally high rates of stereotypy.

DRO and RIRD decreased participants' stereotypy. Although both treatments were somewhat effective, their relative efficacy varied across participants. For all three participants, RIRD resulted in more sustained reductions in stereotypy. Although DRO

occasionally resulted in relatively lower levels than RIRD for two of the participants, these reductions were not maintained.

During the combined treatment phase stereotypy occurred at consistently low levels, but not any lower than the RIRD phase had been. Because DRO resulted in variable outcomes that were not lower than the RIRD treatment, it is unclear whether or not the DRO enhanced the effects of the RIRD.

Because Both DRO and RIRD reduced stereotypy for all participants, it might be more feasible in certain settings to implement the DRO procedure than the RIRD procedure. However, it would be imperative that the DRO schedule be thinned first in order to determine whether the treatment would still be effective if a more practical interval size used. During our treatment assessment, the DRO interval was less than or equal to 5 sec. For Ann, the DRO schedule was thinned during the combined treatment phase and stereotypy remained at lower levels than baseline. However, it is possible that this was the result solely of the RIRD. Therefore, schedule thinning during DRO alone may not have yielded a similar outcome.

For Ann results replicated previous findings that response blocking effectively decreased automatically reinforced problem behavior (Ahearn et al., 2007; Fisher et al., 1996; Lerman & Iwata., 1996; Reid et al., 1993; Smith et al., 1999). In particular these results replicated the findings of Ahearn et al. where RIRD was used as a form of response blocking for vocal stereotypy.

One potential reason why DRO resulted in less stable results than RIRD is that the edible item used during DRO may have lost its reinforcing efficacy due to satiation. Because of the short DRO interval used, satiation may have occurred during a session.

However, this possibility is not likely because The DRO contingency was often not met until part way through the session, at which time the participant had already engaged in high levels of stereotypy. Once the DRO was met for the first time, levels of stereotypy often decreased immediately.

DRO and RIRD resulted in decreases in stereotypy and therefore, could be recommended for use in treatment of automatically reinforced stereotypy. If there are sufficient resources to permit the use of RIRD then this intervention should be used as it resulted in more reliable outcomes. A limitation to this study was that there was possible treatment interference between the RIRD and DRO since the design which was used to compare them was an alternating treatment design. Also, it is possible that both treatments were more effective when used in this design then they would have been in a study in which they were the only treatment. Response interruption and redirection can be extremely staff intensive and often the sessions would go a great deal longer than the 5 minutes, requiring the experimenter to continuously interrupt the participant for minutes at a time when they participant would not comply or would not comply in the absence of stereotypy. The DRO procedure also had limitations in that the density of the reinforcement was so great that it also become somewhat staff intensive as well as provided the participant with the opportunity to be eating at a rapid rate. DRO and RIRD resulted in decreased levels of stereotypy with RIRD being a more reliable treatment than DRO, however also often more staff intensive to implement.

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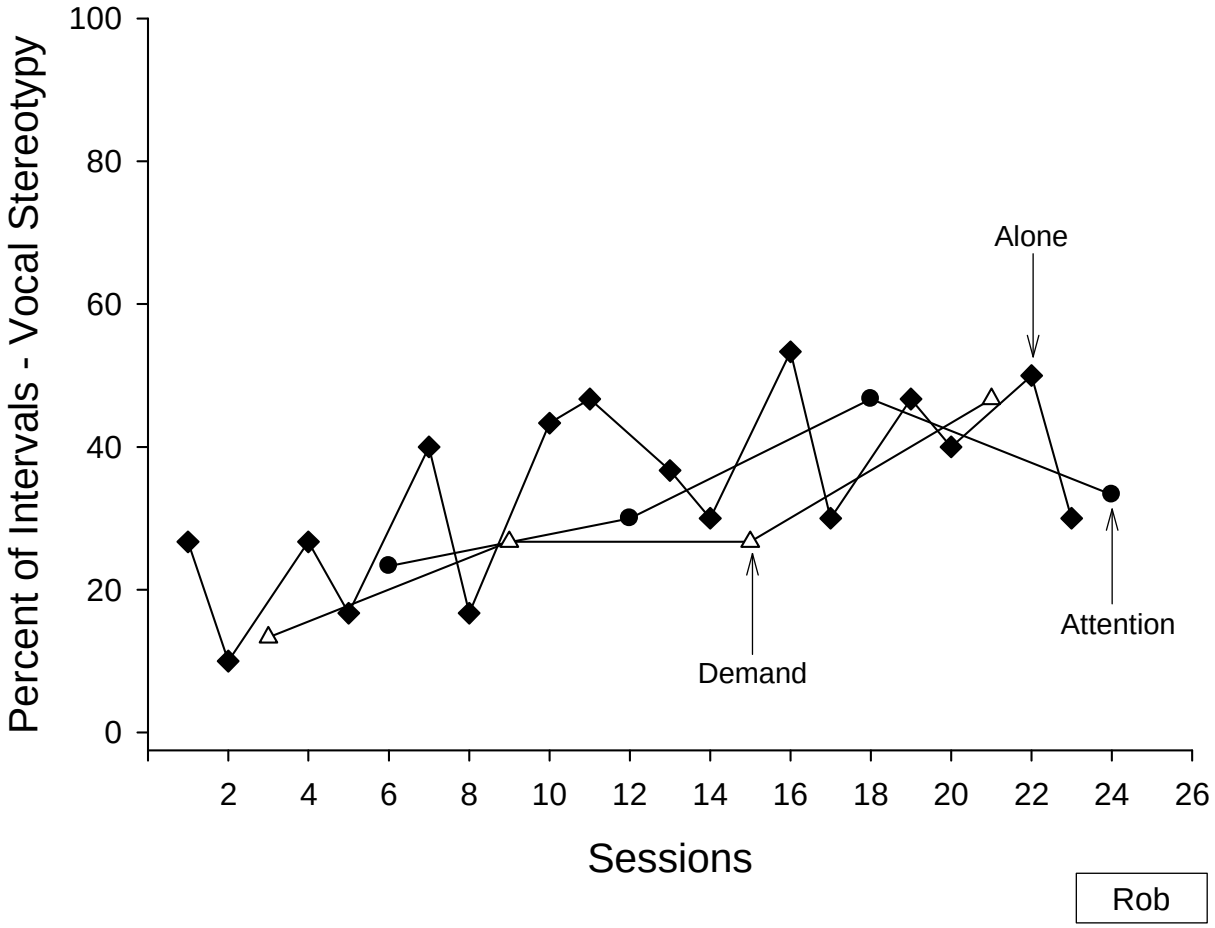
Percent of Intervals - Vocal Stereotypy
100
80
60
40
20
0
2
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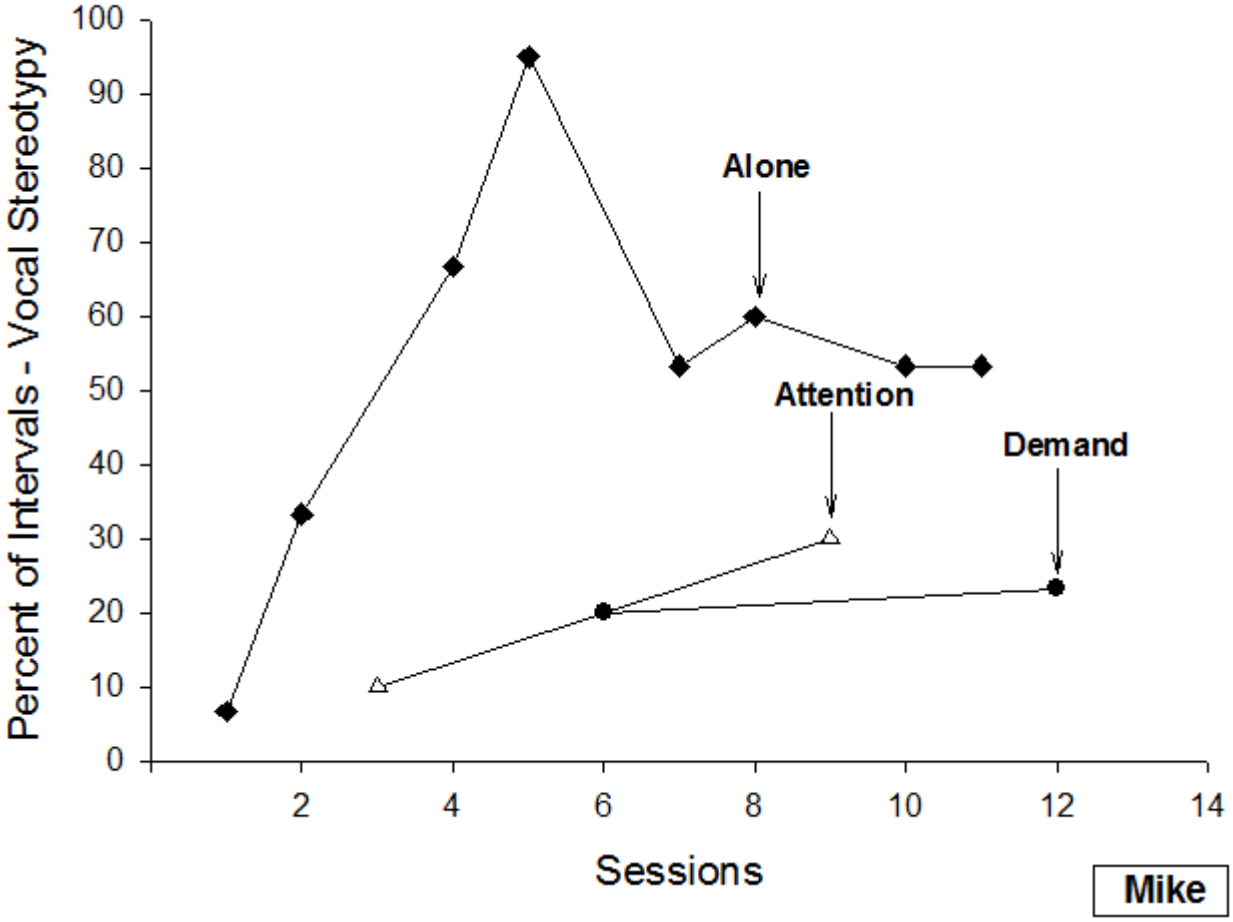
6
8
10
12
14
16
18
20
22
24
26
Sessions
Alone
Demand
Attention
Rob

Figure 1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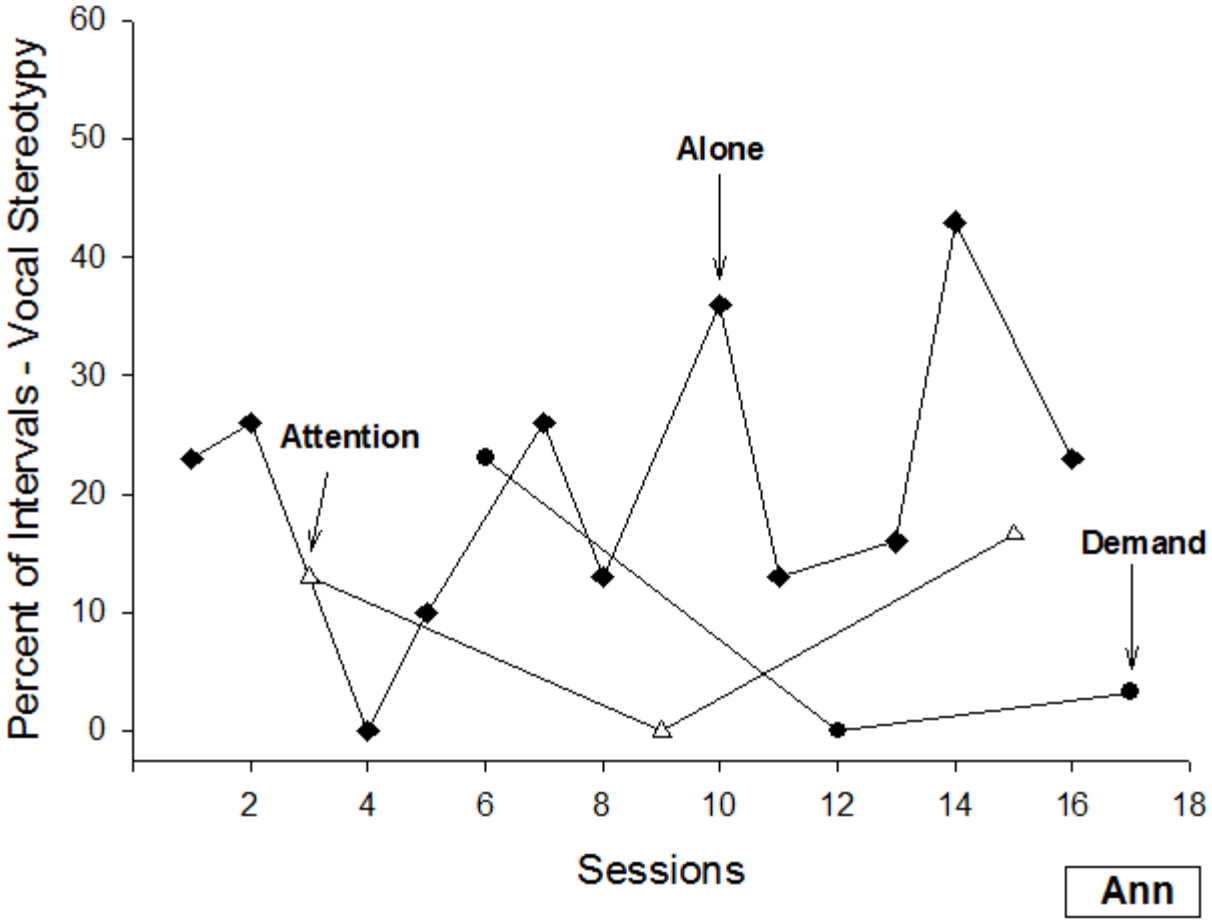
10
12
14
Sessions
Alone
Attention
Demand
Mike

Figure 2


Percent of Intervals - Vocal Stereotypy
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50
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Alone
Attention
Demand
2
4
6
8
10
12
14
16
18
Sessions
Ann

Figure 3

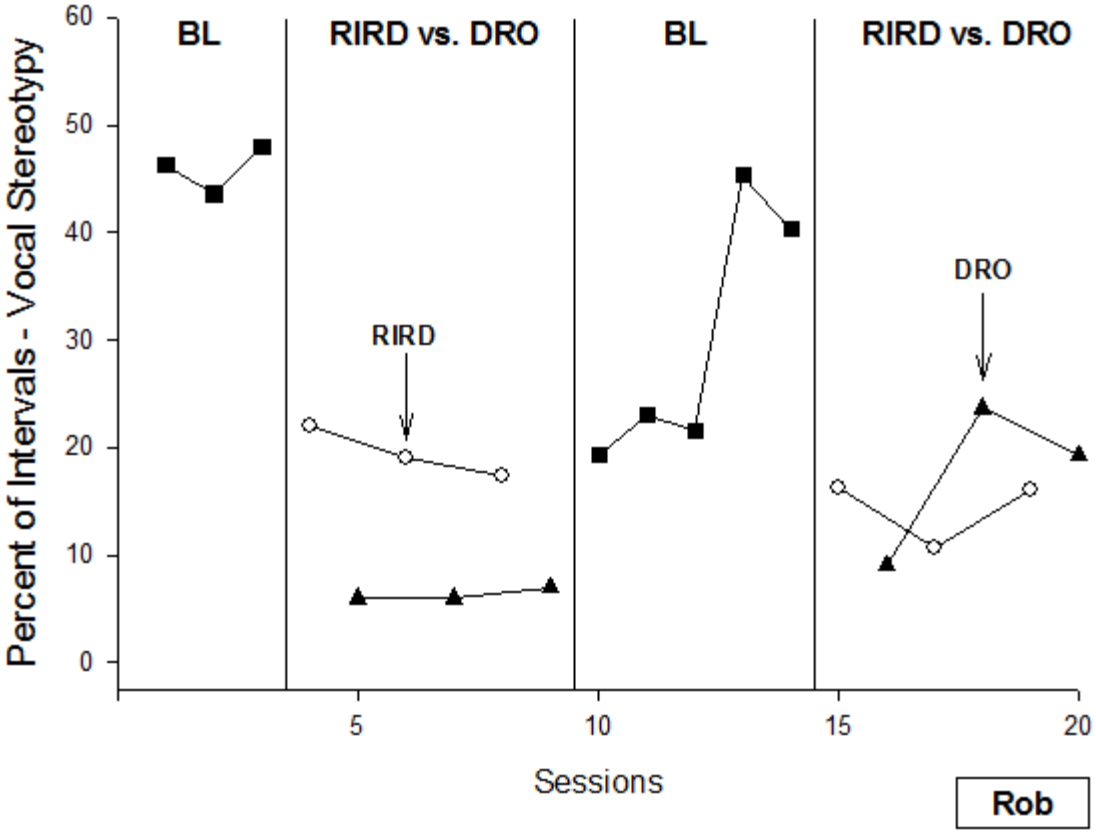
BL
RIRD vs. DRO
BL
RIRD vs. DRO
RIRD
DRO
Percent of Intervals - Vocal Stereotypy
60
50
40
30
20
10
0
5
10
15
20
Sessions
Rob

Figure 4

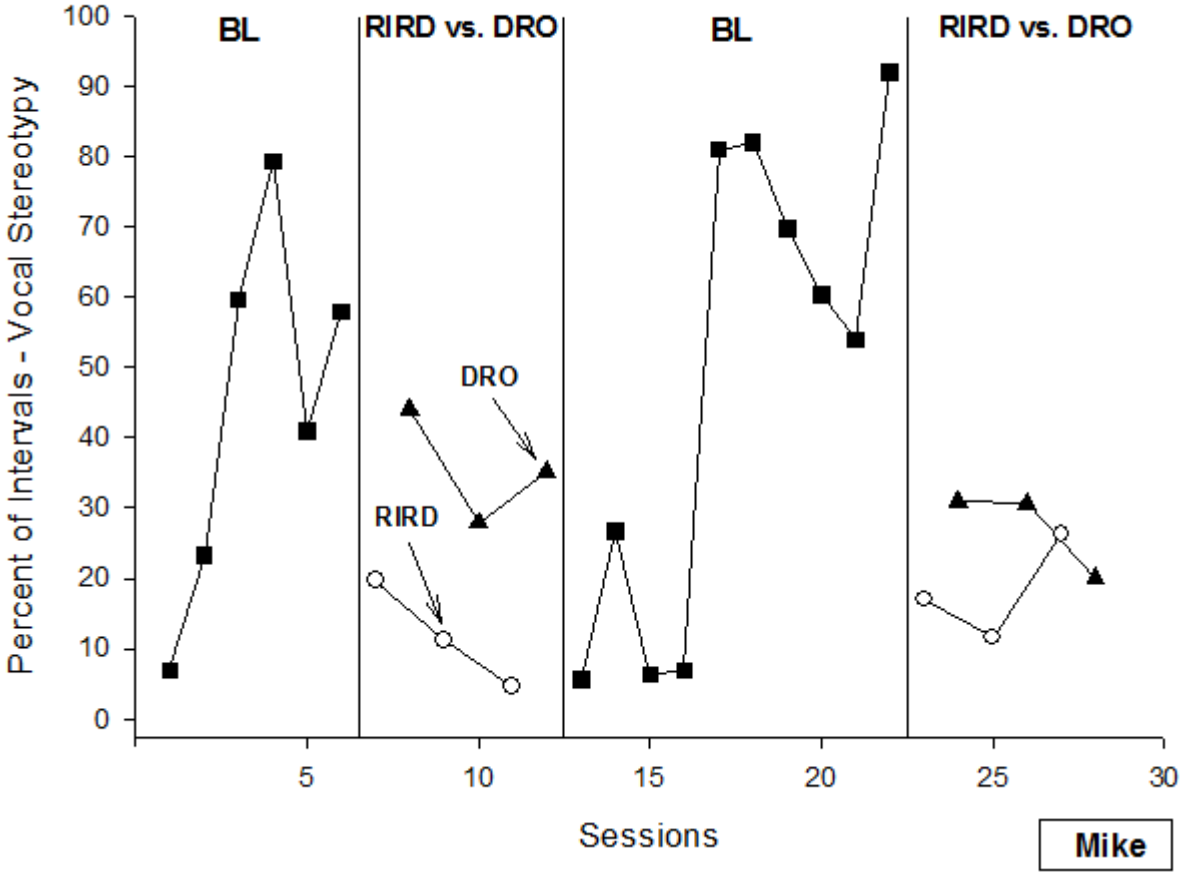
BL
RIRD vs. DRO
BL
RIRD vs. DRO
DRO
RIRD
Percent of Intervals - Vocal Stereotypy
100
90
80
70
60
50
40
30
20
10
0
5
10
15
20
25
30
Sessions
Mike

Figure 5

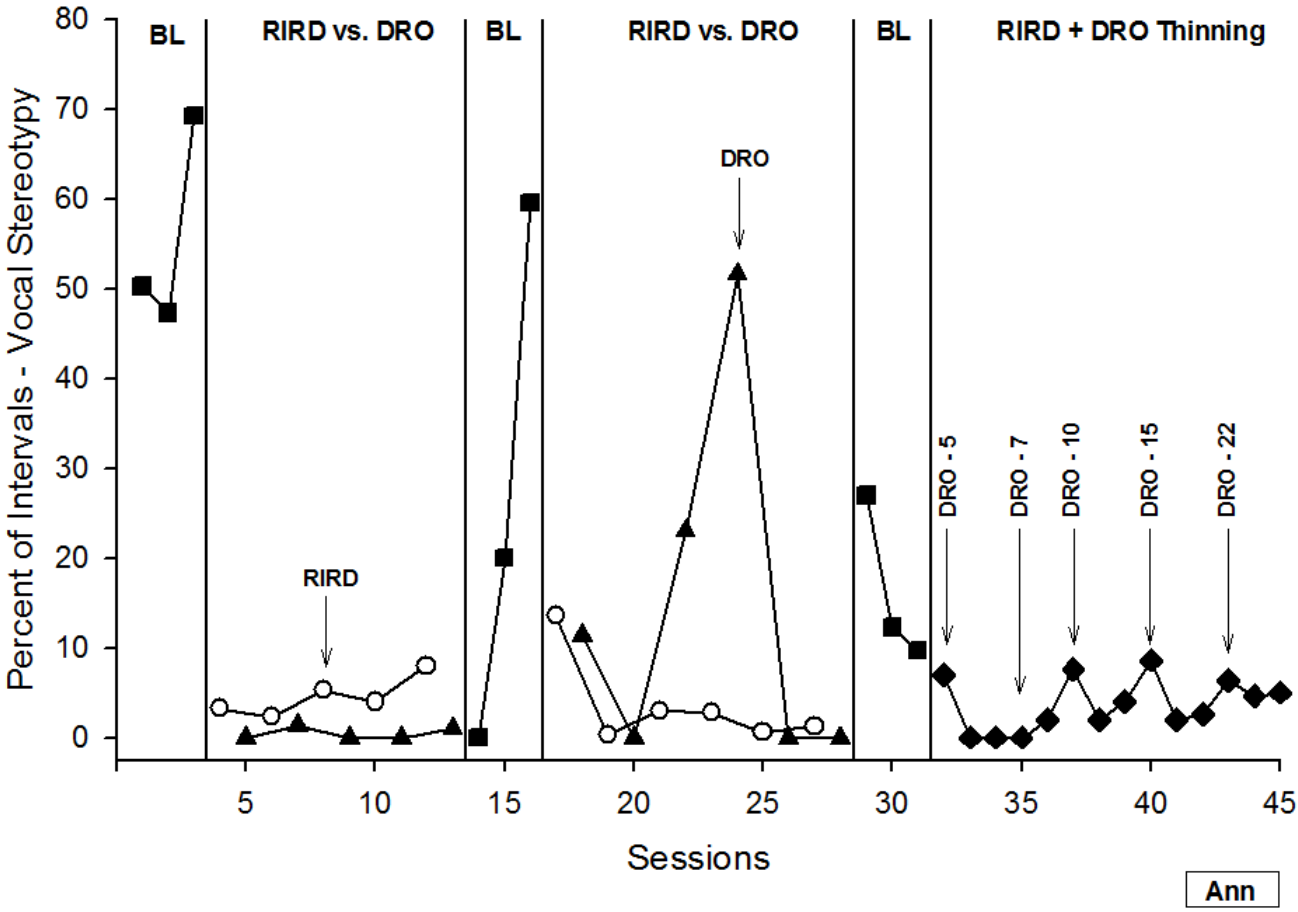
BL
RIRD vs. DRO
BL
RIRD vs. DRO
BL
RIRD + DRO Thinning
RIRD
DRO
DRO - 5
DRO - 7
DRO - 10
DRO - 15
DRO - 22
Percent of Intervals - Vocal Stereotypy
Sessions
Ann

Figure 6