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The effects of response interruption redirection and differential reinforcement of other behavior on motor stereotypy

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Running head: RIRD vs. DRO

**The Effects of Response Interruption Redirection and Differential Reinforcement of Other
Behavior on Motor Stereotypy**

A Thesis Presented

by

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The Department of Counseling and Applied Educational Psychology

In partial fulfillment of the requirements

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Abstract

Motor stereotypy can be a challenging behavior to decrease, particularly when the behavior is maintained by the sensory consequences the response itself produces. Response interruption and redirection (RIRD) has proven to be an effective treatment in reducing the rate of stereotypy for individuals diagnosed with an autism spectrum disorder. Though it is an effective treatment, the RIRD procedure requires intensive resources to implement. Additionally, low treatment integrity could have detrimental effects on the efficacy of the treatment. Differential reinforcement of other behavior (DRO) is another effective treatment that has been shown to reduce the rate of stereotypy. DRO is not as staff intensive; however, it is not always an effective treatment when used alone. The current study compared the effects RIRD and DRO on motor stereotypy in an ABAB design with both treatments being implemented in the B phase. Three students diagnosed with an autism spectrum disorder participated. Our findings demonstrated that the treatment of motor stereotypy is idiosyncratic to the individual. For two participants, the RIRD procedure was more consistently effective than DRO. For the other participant the DRO was at least equally effective as RIRD.

The Effects of Response Interruption Redirection and Differential Reinforcement of Other Behavior on Motor Stereotypy

Stereotypic behavior occurs with approximately 40% of individuals diagnosed with severe developmental disabilities (Schroeder, 1991). It is behavior that naturally occurs with typically developing individuals; however, it persists at unusual levels throughout adulthood for many individuals in the developmentally disabled population (Troster, 1994). Stereotypy has been observed to occur between 7-47% of the time with institutionalized individuals and 13% of the time with the developmentally disabled population that are integrated into the community (Repp, Barton, & Gottlieb, 1983). Stereotypy is one of the most prevalent behavioral deficits related to the autism spectrum disorders, and is one of its diagnostic criteria (Lewis & Bodfish, 1998). Individuals with autism have higher rates of stereotypic behavior than individuals with other developmental disabilities (Bodfish, Symons, Parker, & Lewis, 2000).

Koegel, Firestone, Kramme, and Dunlap (1974) defined stereotypy as high idiosyncratic, self-stimulatory vocal and motor responses that appear to provide the individual with sensory input but have no obvious social consequence. There are hundreds of response topographies of stereotypy, including body rocking, clapping, hand flapping, manipulation of objects, mouthing, and repetitive or non-contextual vocalizations (LaGrow & Repp, 1984). The persistence of stereotypy can interfere with skill acquisition (Dunlap, Dyer, & Koegel, 1983; Rapp & Vollmer, 2005), and can be socially stigmatizing (Jones, Wint, & Ellis, 1990). Lovaas, Litrownik, and Mann (1971) reported that individuals engaging in stereotypy had longer response latencies to auditory stimuli than individuals that did not engage in the behavior. Stereotypy has been demonstrated to interfere with other tasks such as simple discrimination learning (Koegel & Covert, 1972) and toy play (Koegel et al.).

Functional analysis methodologies (e.g., Iwata, Dorsey Slifer, Bauman, & Richman, 1982/1994) are used to identify the maintaining variables of the behavior. The purpose of functional analyses is to find one or more functions of the target behavior in order to develop a functionally appropriate intervention. Common functions of problem behavior include: social attention, access to materials or settings, escape or avoidance from demands or settings, and sensory stimulation. Formal assessments expose the individuals to several different conditions that are similar to various naturally occurring conditions that set the occasion for the various possible functions (McEntee & Saunders, 1997). It is widely concluded that stereotypy serves no function, but is speculated that it is maintained by the automatically reinforced sensory consequences it produces (Ahearn, Clark, MacDonald, & Chung, 2007; Lovaas, Newsom, & Hickman, 1987; Rapp & Vollmer, 2005; Rincover, 1978), which makes it difficult to treat (Rapp & Vollmer, 2005). Previous studies have provided evidence that stereotypic behavior may be maintained by social consequences. Mace, Browder, and Lin (1987) examined escape or avoidance of demand situations as a potential function of stereotypy. Kennedy, Meyer, Knowles, and Shukla (1987) suggested stereotypy could be sensitive to other social consequences. However, it has been more commonly indicated that stereotypy is a function of the automatically reinforced sensory consequences it produces or controlled by multiple sources of reinforcement (Ahearn et al.; Rapp & Vollmer).

One effective approach to treating automatically reinforced behavior is to isolate the specific source of stimulation that maintains the behavior. Vollmer (1994) suggested that enriching the environment with preferred items, which were empirically identified, successfully decreased stereotypy. Other studies have shown using matched stimuli (i.e., items that generate stimulation similar to the apparent stimulation produced by stereotypy) can effectively compete

with automatically reinforced behavior (Piazza, Adelinis, Hanley, Goh, & Delia, 2000). Furthermore, it has been shown that when matched stimuli have been available, individuals preferred it to engaging in stereotypy. In contrast, Ahearn, Clark, DeBar, and Florentino (2005) conducted a duration-based preference assessment that concluded that, in some situations, unmatched stimuli (i.e., stimuli that do not generate the same sensory-stimulation produced by stereotypy) can also decrease stereotypy.

Other approaches used to decrease stereotypy demonstrated using stereotypy as a reinforcer for alternative behavior (Hanley, Iwata, Thompson, & Lindberg, 2000). The purpose of Hanley and colleagues' (2000) study was to identify the functional components of stereotypy as reinforcement for play behavior. After determining that stereotypy was maintained by automatic reinforcement, the researchers based their treatment on the Premack principle (i.e., behavior having a higher probability of occurrence may be used as reinforcers to strengthen behaviors having a lower probability of occurrence). For one of the three participants, stereotypy may have functioned as a reinforcer for the occurrence of play.

Response-cost has also been used to decrease vocal stereotypy, by removing a preferred item for 5 s contingent on instances of vocal stereotypy (Falcomata et al., 2004). Response-cost was a successful treatment for automatically reinforced problem behavior.

The most commonly used treatment for decreasing aberrant behavior in people with developmental disabilities is differential reinforcement (Marcus & Vollmer, 1996). Differential reinforcement is a procedure that only reinforces those responses within a particular response class, which meet a specific criterion along some dimension(s) (i.e., frequency, topography, duration, latency, or magnitude) and places all other response in that class on extinction. There are several types of differential reinforcement procedures (i.e., differential reinforcement of

alternative behavior (DRA), differential reinforcement of diminishing rates (DRD), differential reinforcement of high rates (DRH), differential reinforcement of incompatible behavior (DRI), differential reinforcement of low rates (DRL), and differential reinforcement of other behavior (DRO)). The four most researched are DRA, DRI, DRL, and DRO (Cooper, Heron, & Heward, 2007). Azrin, Kaplan, and Foxx (1973) effectively implemented DRI to reduce stereotypy by reinforcing toy play. Wacker et al. (1990) used functional communication training (FCT), which is a form of DRA, to teach one of their participants a response to access a recreational activity. The authors granted access to either an exercise bike or a rocking chair, which produced the same sensory consequence as the target behavior, body rocking, and body rocking was put on extinction. Singh, Dawson, & Manning (1981) used DRL to reduce stereotypy of three participants by increasing the interresponse time (IRT), the time between stereotypic responding.

The most widely used differential reinforcement procedure is DRO. DRO, as first described by Reynolds (1961), is a procedure in which reinforcement is contingent on the absence of the target response during or at specific times. The term implies that DRO is a reinforcement procedure, in which any behavior other than the target response is reinforced (Thompson & Iwata, 2007). However, the procedure may function as negative punishment in which the omission of the reinforcer contingent upon the occurrence of the target response decreases the future frequency of the target response. DRO procedures generally have been found to be more effective than extinction procedures (Topping, Pickering, & Kackson, 1972). Interval DRO (i.e., the target behavior does not occur throughout the entire interval) has been found to be more effective than momentary DRO (i.e., the target behavior does not occur at a specific moment of time) for suppressing problem behavior (Repp, Barton, & Brulle, 1983); however, it has been demonstrated that momentary DRO is more useful for maintaining reduced

levels of problem behavior originally produced by interval DRO (Barton, Brulle, & Repp, 1986). DRO procedures do not always need to be used with a functional reinforcer or even a preferred arbitrary reinforcer to serve as an effective treatment (Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993). Also, recent research has suggested that resetting DRO procedures, which is when the DRO interval resets after the target response occurs, are more common than non-resetting DRO procedures (e.g., Himle, Woods, & Bunaciu, 2008; Roane, Falcomata, & Fisher, 2007).

DRO has been shown to work effectively alone or in combination with other procedures (Repp et al., 1983). Wacker et al. (1990) used DRO alone to decrease automatically maintained body rocking for one participant by using access to a rocking chair or an exercise bike as the reinforcer. Likewise, Vollmer, Iwata, Zarcone, Smith, and Mazaleski (1993) used a DRO procedure to reduce the rate of attention maintained SIB for 3 participants diagnosed with mental retardation. In addition, Taylor, Hoch, and Weissman (2005) compared Fixed Time Reinforcement and a DRO procedure to reduce vocal stereotypy for a child diagnosed with autism. The DRO procedure was more effective in reducing stereotypy. In contrast with the previously mentioned studies, the purpose of Repp and Deitz (1974) study was to determine whether DRO was more effective when used in combination with other treatment techniques than when used alone. They concluded that DRO was successful when combined with timeout, mild verbal punishment, and response-cost. DRO has also been successful when combined with momentary restraint (Barton, Repp, & Brulle, 1985), DRI and restitution (De Zubicaray & Clair, 1998), contingent demands (Rolider & Van Houten, 1984), and as a supplement to interventions that have produced insufficient results (McCord, Iwata, Galensky, Ellington, & Thomson, 2001). Fellner, Laroche, and Sulzer-Azaroff (1985) combined a DRO and DRI procedure with an

interruption component and successfully reduced motor stereotypy when the DRO plus DRI procedure was ineffective alone.

When DRO is used in isolation and compared with other techniques it has on some occasions proven to be less effective than the alternative procedure. In contrast with the previously mentioned study by Topping et al. (1972), Thompson, Iwata, Hanley, Dozier, and Samaha (2003) found that when comparing extinction, NCR, and DRO, extinction alone had more immediate and dramatic effects on the problem behavior (e.g., skin picking, off-task behavior) than DRO or NCR. Conyers et al. (2004) showed that response-cost was more effective than DRO in decreasing disruptive behavior in a preschool classroom. In another study, Harris and Wolchik (1979) compared overcorrection, time-out and DRO to determine which was the most effective in decreasing self-stimulation. Overcorrection led to the most immediate and dramatic decline in self-stimulation for all four participants, time-out had variable effects, and DRO had no effect for two of the participants and a minimal effect for the other two participants. Conversely, Goetz, Holmberg, and LeBlanc (1975) demonstrated that DRO produced decreased problem behavior more quickly and more dramatically than NCR. Similarly, Himle et al. (2008) found that DRO was the more effective treatment for four typically developing children diagnosed with Tourette syndrome who exhibited tics at a rate of at least 1 per minute. For each participant DRO was more effective decreasing rates of ticking than NCR in comparison to baseline.

Sensory extinction is an effective treatment for stereotypy (Rincover, 1978). Sensory extinction has been defined as disrupting the contingency between the stereotyped response and the sensory product (Rincover, 1978) or directly disrupting the behavior (Dorsey, Iwata, Reid, & Davis, 1982). Rapp and colleagues demonstrated that sensory extinction decreased hair

manipulation when implemented in the form of having a young boy wear gloves. Response blocking procedures have been referred to as sensory extinction, but extinction may not be the behavioral mechanism by which these procedures change responding (Ahearn et al., 2007; Lerman & Iwata, 1996). Some researchers have differentiated between extinction and response blocking, arguing that response blocking prevents the response cycle from being completed, and therefore prevents the occurrence of the maintaining environmental event; whereas with sensory extinction, the response still occurs but no longer produces the maintaining environmental event (Lalli, Livezey, & Kates, 1996).

Response blocking has been a successful treatment for automatically maintained aberrant behavior, such as self-injurious behavior (Fisher, Grace & Murphy, 1996; Lerman & Iwata, 1996; Smith, Russo, & Le, 1999). Reid, Parsons, Phillips, and Green (1993) successfully demonstrated the reduction of hand mouthing by blocking the participants' hand from entering their mouth. Similarly, Lalli et al. (1996) conducted a series of analyses to identify the maintaining variable for eye poking following an undifferentiated functional analysis. After testing several interventions the authors found that response blocking was the most effective.

Various studies have been conducted to establish whether response blocking functions as an extinction procedure or a punishment procedure. It is often unclear what the behavioral mechanism of response blocking is, and it may be idiosyncratic to the individual. Lerman and Iwata (1996) found response blocking to function as punishment when used to treat hand mouthing for 1 participant. They accomplished this by rapidly varying the proportion of responses blocked from 100% of responses to 25% of responses. They concluded response blocking functioned as punishment because blocking only a portion of the responses decreased responding as effectively as blocking 100% of responding. Additionally, blocking all responses

did not produce an extinction effect as responding returned when blocking was terminated. Alternatively, when Smith and colleagues (1999) replicated the Lerman and Iwata study to decrease eye poking for 1 participant, they found response blocking to function as extinction. This was due to the gradual decrease of the target behavior rather than the rapid effect punishment generally produces. Also, when only a portion of responses was blocked the treatment was ineffective and eye poking was slightly elevated relative to baseline. The results across these two studies suggest that response blocking might reduce one participant's behavior via punishment and extinguish another participant's behavior via extinction.

The above studies demonstrated that response blocking could be used as the sole means of producing lower levels of problem behavior (Worsdell, 2000). Response blocking has been used in combination with other methods of treatment (e.g., redirection, matched stimuli, differential reinforcement), and deemed effective. Fisher, Lindauer, Alterson, and Thompson (1998) effectively reduced destructive behavior of ripping and breaking objects by blocking destruction and redirecting the participant's hands towards matched toys. Similarly, Ahearn and colleagues (2007) used a response interruption and redirection (RIRD) procedure to decrease vocal stereotypy by interrupting the vocal response and redirecting the behavior towards appropriate vocalizations.

Adverse side effects can potentially arise when solely using response blocking. Studies have demonstrated that an increase in aggressive behavior occurred when the target behavior was blocked (Hagopian & Adelinis, 2001). To avoid side effects, Hagopian and Adelinis (2001) used response blocking with redirection to decrease pica. They found that aggression had been induced by extinction or punishment in the form of response blocking. However, when they redirected the participant to eat freely available preferred foods, aggression decreased. Another

side effect of response blocking is increased levels of stereotypy during the post-response blocking intervention. This is presumably due to imposed deprivation for the stimulation generated by stereotypy (Rapp, 2006). New topographies of stereotypy have also been reported to emerge in the same response class as the target response when using response blocking (Fellner et al., 1984). Lastly, self-restraint has emerged from the use of response blocking. Self-restraint is a class of behavior that is incompatible with an individual's SIB and may include the entanglement of the hands or limbs in clothing, materials, or other body parts, that can produce arrested muscle development, muscle atrophy, and decreased circulation (Powers, Roane, & Kelley, 2007). Powers et al. (2007) successfully used response blocking and continuous access to preferred toys to decrease face punching and self-restraint. Continuous access to toys likely acted as a competing source of stimulation for SIB, however, toy play was not specifically evaluated. In contrast, researchers have demonstrated that response blocking has positive side effects such as increased appropriate play (Tarbox, Tarbox, Ghezzi, & Wallace, 2007) and increased appropriate speech (Ahearn et al., 2007).

As previously stated DRO and response blocking are both effective treatments to reduce problem behavior. Response blocking is more staff intensive to implement than DRO, and treatment efficacy may suffer when low treatment integrity occurs (Ahearn et al., 2007; Lalli et al. 1996; Smith Russo, & Le, 1999). Conversely, DRO procedures can be easily implemented but have previously been shown to be an ineffective treatment to reduce stereotypy (Harris et al., 1979). Limited research has been done to compare the two treatments. The purpose of the current study was to compare the effectiveness of RIRD and DRO to reduce motor stereotypy.

Method

Participants and Setting

The participants were 2 boys and 1 girl diagnosed with an autism spectrum disorder. Each participant was referred by their case manager or program specialist for displaying high rates of motor stereotypy that occurred at unacceptable levels across the day and interfered with their educational programming. All participants attended a day program for children with autism where they received educational and clinical services.

Eden was a 10-year-old girl who had been diagnosed with autism. Eden had very limited communication skills. She communicated vocally by making requests (for items and activities, termination of activities, and help), imitating actions, labeling items, rejecting items, and greeting others. Her speech was generally inaudible and unintelligible. Her primary method of communication was using a speech-generating device. Bill was an 8-year-old boy who had been diagnosed with pervasive developmental disorder (not otherwise specified). Bill's primary mode of communication was vocal. He used 2-4 word phrases for the purpose of requesting desired items and activities, labeling, gaining attention, protesting, greeting, and answering questions. Jake was a 7-year-old boy who had been diagnosed with autism. Jake had no speech and did not imitate sounds. He had limited skills using a picture exchange communication system (PECS) and manual signs. The majority of his communication attempts were to request desired edibles.

All functional analyses and treatment sessions were conducted in a research room (1.5 m by 3 m) equipped with a wide-angle video camera, microphone, video recording equipment, a table and two chairs. Pre-assessments were conducted in participants' work area in their classroom. Condition-specific stimuli were present during the functional analysis sessions. Materials for treatment sessions included moderately preferred toys and highly preferred edibles

identified from the preference assessment results. Because Eden's stereotypy included manipulating present objects, we baited her functional analysis and treatment sessions with a pencil and token board. Sessions were conducted 2-5 times per week.

Functional Analysis

Response Measurement and Interobserver Agreement

Motor Stereotypy was defined as any instance of non-functional or non-contextual repetitive movements (e.g., hand flapping, hand rubbing, clapping, hair twirling, and manipulation of objects). Non-examples included responding to gross motor imitations, pointing to correct stimuli, playing with toys, and turning pages of a book. All sessions were 5 min in duration. Data on motor stereotypy were collected using 10-s momentary time sampling. Observation lasted for 2 s and began as each interval elapsed (e.g., seconds 10 and 11, 20 and 21, 30 and 31, etc.). Occurrence or non-occurrence of motor stereotypy was recorded during that 2 s of observation. Momentary time sampling was used because it provides an accurate estimate of frequency and duration for stereotypic behavior as opposed to other time sampling methods (Gardenier, MacDonald, & Green, 2004). Interobserver agreement was calculated by dividing the number of intervals with agreement by the total number of intervals with agreement plus disagreement and multiplying by 100%. Agreement was scored for a minimum of 33% of each condition for each participant. The mean total agreement for motor stereotypy was 7.8% (range, 80% to 100%) for Eden, 98.7% (range, 93.3% to 100%) for Bill, and 99.34% (range, 96.7% to 100%) for Jake.

Assessment Design, Conditions, and Results

A functional analysis of motor stereotypy was conducted based on those reported by Roscoe, Carreau, MacDonald, and Pence (2008). All sessions were 5 min in duration and

followed the order: alone, alone, attention, alone, alone, demand. An ignore condition was used for Eden instead of an alone condition.

During the alone condition, the participant was alone in the research room and all materials were removed; all behavior was ignored. The ignore condition for Eden was identical to the alone condition except the therapist was present. During the attention condition, the therapist provided the participant with a moderately preferred leisure item at the start of the session and stated, "Here are some toys to play with, I need to do some work." Contingent on motor stereotypy, the therapist stated "stop that (name)," and ignored all other behavior. During the demand condition, the therapist issued demands that were associated with less than 80% compliance every 15 s. If the participant did not respond within 5 s or emitted an incorrect response, the therapist modeled the correct response until the participant complied. The therapist delivered verbal praise (e.g., "nice work," "good job") for correct responses. Contingent on motor stereotypy, the therapist stated "OK, you don't have to" and removed the task materials; all other behavior was ignored.

The results of Eden's functional analysis are depicted in Figure 1. High levels of motor stereotypy were observed during the ignore and demand conditions, with low levels occurring during the attention condition. In the attention condition, the participant was observed to manipulate the moderately preferred leisure item (i.e., the pin-wheel). It is possible that the low level of stereotypy during this condition may be attributed to this activity. Bill and Jake's functional analysis results are depicted in Figure 2 and 3 respectively. For Bill, motor stereotypy was variable throughout the functional analysis but occurred at the highest level during the alone condition. For Jake, motor stereotypy occurred at the highest level during the alone condition. Stereotypy was presumed to be maintained by automatic reinforcement for each of the

participants.

Treatment

Response Measurement and Interobserver Agreement

During treatment, observers recorded motor stereotypy using continuous duration recording. The definition of motor stereotypy was the same as that noted above. To summarize the percentage of stereotypy, the duration (s) of stereotypy was divided by the total session duration (300 s) and multiplied by 100. Interobserver agreement data were collected by having two independent observers record a minimum of 33% (range, 34.1% to 35.3%) of sessions for each condition for each participant. The mean agreement for motor stereotypy was 92.3% (range, 91.3% to 100%) for Eden, 95.3% (range, 91.4% to 97.6%) for Bill, and 91.9% (range, 89.1% to 98.4%) for Jake.

Procedure

In the current study, the effects of an intervention (either RIRD or DRO) were evaluated using an ABAB design. During the treatment phase, an alternating treatments design was used to compare the relative effects of RIRD and DRO. The therapist presented salient stimulus cues (different books for the participant to engage with and different colored shirts for the therapist to wear) to enhance discrimination across the two interventions. Data were not collected on the effectiveness of these stimuli.

Baseline. Baseline sessions were 5 min in duration. The therapist sat at a table with the participant. At the start of the session the therapist prompted the participant to read a book. The therapist delivered no consequences during this condition

RIRD. RIRD Sessions resembled baseline in that the participant and therapist sat at a table, and the therapist instructed the participant to read a book. However, contingent on

occurrences of motor stereotypy, the therapist immediately interrupted and redirected stereotypy by stating the child's name and initiating instructions in the form of one-step motor compliances. Examples of types of motor compliances presented were "Touch your nose," "Clap your hands," "Touch the table." These were interspersed with gross motor imitation instructions (e.g., Therapist stated "Do this" while modeling touching nose, clapping hands, touching table, etc.) for Bill and Eden. Only gross motor imitation was used for Jake because he did not have reliable receptive communication skills. The therapist continued to present motor compliances to the participant until he or she complied with three consecutive compliances in the absence of motor stereotypy.

To ensure equal durations of baseline (non-intervention) time across conditions, observers collected data for 5 min when RIRD was not occurring. To this end, the therapist used two timers and started them both at the start of the session. The therapist paused one timer (Timer A) when RIRD was in effect and did not pause the other timer (Timer B). As soon as the therapist initiated RIRD, he or she paused Timer A. After the participant successfully complied with three consecutive motor responses in the absence of motor stereotypy, the therapist restarted Timer A. The session continued until 5 min had elapsed on Timer A. For scoring purposes, the time in which RIRD was being implemented was subtracted from the total session time, so that observers only scored motor stereotypy during the 5 min of non-intervention time.

DRO. First, a high preference edible was identified from a paired stimulus preference assessment (as described by Fisher, Piazza, Bowman, Hagopian, Owens, & Slevin, 1992) for use during these sessions. Next, a DRO interval size was determined based upon levels of motor stereotypy during the baseline condition and was different for each participant. To determine each participants' DRO interval the baseline data, the mean interresponse time (Cooper et al.,

2007), and the inverse of the mean baseline (Barton et al., 1985) were examined. For Jake, a 2-s DRO interval was used. For Bill, a 15-s DRO interval was used. For Eden, a 5-s DRO interval was used.

DRO sessions resembled baseline in that the participant and therapist sat at a table in the research room, and the therapist prompted the participant to read a book. At the start of the session, the therapist started a timer. Contingent on motor stereotypy, the therapist ignored the behavior and reset a timer. However, if the criterion time interval elapsed without an occurrence of stereotypy, the therapist delivered an edible paired with verbal praise (“good job having nice hands”). To equate DRO and RIRD session durations, DRO session durations were yoked to the preceding RIRD session, that is, seconds in which RIRD time was removed during the preceding RIRD session was also removed during the subsequent DRO session.

DRO schedule thinning (Eden only). Because DRO was effective for Eden, we evaluated the effects of gradually increasing the DRO interval. The first two sessions were conducted at the participant’s initial DRO interval (5 s). After two consecutive sessions with intervals of stereotypy below 5%, the DRO interval was increased by 50%. At session 71, the increase in the DRO interval changed from 50% to 25%, due to increased levels of motor stereotypy. The terminal goal was to increase the DRO interval to 300s.

Results

For Eden, baseline levels of motor stereotypy were moderate to high with some variability (Figure 4). When the RIRD vs. DRO phase was introduced, motor stereotypy immediately decreased in both conditions to low levels. There was slightly more variability and slightly higher levels of motor stereotypy in the RIRD condition. During the return to baseline, motor stereotypy increased but did not replicate the level observed during the initial baseline.

After the reintroduction of the RIRD vs. DRO phase, levels of motor stereotypy immediately decreased to near zero levels in both conditions. The levels of motor stereotypy were slightly lower in the DRO condition. When returning baseline again, levels of motor stereotypy immediately increased. During the DRO schedule thinning phase, levels of stereotypy immediately decreased and remained low. Between sessions 60 to 68, motor stereotypy was variable. For the remaining sessions motor stereotypy approached and remained at near zero level.

For Bill, baseline levels of motor stereotypy were moderate with some variability (Figure 5). When the RIRD vs. DRO phase was introduced, motor stereotypy immediately decreased in the RIRD condition. Levels of motor stereotypy then slightly increased, followed by a decreasing trend from moderate to low levels. There were high to moderate levels of stereotypy with a decreasing trend in the DRO condition to slightly below baseline levels. During the return to baseline, motor stereotypy returned to moderate levels. After the reintroduction of the RIRD vs. DRO phase, motor stereotypy decreased across both conditions with lower levels in the RIRD condition.

For Jake, levels of motor stereotypy were high during the initial baseline (Figure 6). When the RIRD vs. DRO phase was introduced, motor stereotypy immediately decreased during both treatments. During the RIRD condition, motor stereotypy immediately decreased to low levels. During the DRO condition, motor stereotypy decreased to moderate levels. During the return to baseline, motor stereotypy occurred at low to high levels with a deteriorating trend. After the reintroduction of the RIRD vs. DRO phase, levels of stereotypy immediately decreased. During the RIRD condition, motor stereotypy immediately returned to low levels and remained stable. During the DRO condition, the level of motor stereotypy was variable and unstable. It

immediately decreased to moderate levels, and then spiked to high levels, followed by a decrease to low levels below the level obtained during RIRD.

Discussion

The functional analyses conducted prior to the study indicated that participants' motor stereotypy was maintained by automatic reinforcement. These results replicate the findings of previous research that stereotypy serves no social function, but is speculated that it is maintained by the automatically reinforced sensory consequences it produces (Ahearn et al., 2007; Lovaas et al., 1987; Rapp & Vollmer, 2005; Rincover, 1978). Although these findings suggested that the target behavior was not socially mediated, it does not rule out that stereotypy that persists in the absence of social consequences is not sensitive to social contingencies (Ahearn et al.; Vollmer, 1994).

The comparison of RIRD and DRO demonstrated that the effective treatment of motor stereotypy is idiosyncratic to the individual. A treatment that is effective in decreasing one participant's target behavior may not have the same effects on another participant. Both treatments demonstrated a decrease in motor stereotypy for all three participants, however, the decrease in DRO was slower to emerge than RIRD, less stable, and did not decrease to clinically significant levels for Bill. For Bill, RIRD was generally a more effective treatment. For Jake, RIRD appeared to be more effective for the first comparison phase and the first half of the second comparison phase; DRO was unstable. However, when motor stereotypy gained stability during the DRO condition, it eventually was as effective as RIRD. For Eden, both DRO and RIRD produced a clinically significant treatment effect, however, unlike the previous two participants; DRO was slightly more effective than RIRD. These results demonstrated that a more invasive and staff intensive treatment may be necessary to reduce stereotypy.

One explanation for why RIRD may have been more effective than DRO is that the contingency associated with the target response and the RIRD procedure may have been more salient than the contingency between the target response and the DRO procedure. In the RIRD procedure, contingent on the target response, the therapist initiates and continues to implement RIRD until the target response no longer occurs and the participant complies with three compliances. In the DRO procedure, contingent on the target response, the therapist does not deliver a consequence. Instead, the therapist delivers a reinforcer contingent on the absence of the target behavior. Therefore, it may take the participant longer to contact the DRO contingency. This possibly is suggested by the decreasing trend associated during the DRO condition for Bill and Jake.

The current study replicates previous studies that found response blocking to decrease behavior, by interrupting or blocking the occurrence of the target behavior (e.g., Ahearn et al., 2007; Fisher et al., 1996; Lerman et al., 1996; Reid et al., 1993; Smith et al., 1999). Further, it replicates the findings that response blocking could be used as the sole means of producing lower levels of problem behavior (Worsdell, 2000). Unlike previous studies in which the target behavior was redirected to an alternative more appropriate behavior (e.g., Ahearn et al.; Fisher et al., 1998), the current study involved redirecting the target behavior to an incompatible chain of behavior.

DRO is one of the most commonly used treatments for decreasing problem behavior in individuals with developmental disabilities (Cooper et al., 2007; Marcus et al., 1996). The current findings provided evidence that treatment assessments should be made prior to implementing a DRO procedure. For 2 of the 3 participants, the DRO procedure was not as effective. This supports previous data that has shown that DRO is not effective when used alone

(Conyers et al., 2004; Harris et al., 1979; Thompson et al., 2003). Conversely, Eden's results supported prior research findings that DRO procedures work effectively alone (Taylor et al., 2005; Vollmer et al., 1993; Wacker et al., 1990). Furthermore, this supports the notion that effective treatment of stereotypy can be idiosyncratic.

There are some potential explanations for why DRO had delayed effects for Jake and was not effective for Bill. First, it is possible that the amount of edibles obtained prior to sessions may have resulted in general food satiation or satiation of the specific edible used within the sessions (Egel 1981), leading to reduced motivation to access edibles. Sessions ran between 18 min and 5 min and all DRO intervals were relatively dense. Using different edibles or multiple edibles may have been more effective. Second, the preferred edible may not have served as a potent enough reinforcer, or may not have competed with the reinforcement produced by the target behavior. Because the sensory consequence for automatically reinforced behavior cannot be withheld, it is important to identify preferred arbitrary stimuli that can effectively compete with the reinforcer maintaining the target response.

DRO may be a useful treatment in settings that have low staff-to-student ratios. To enhance the utility of DRO, the reinforcer schedule should be thinned and the DRO interval increased. For Eden, the DRO interval was thinned from 5 s to 300 s, a much more practical interval size for use in clinical settings. When the DRO interval is thinned to a clinically suitable interval, DRO may be easier to implement and manage. By contrast, RIRD may be more staff intensive if it cannot be successfully faded. Because RIRD may require consistent implementation of the interruption procedure, it may not be practical in some settings. One way to enhance the efficacy of DRO when it does not have a clinically significant effect is to add an RIRD component. If the DRO plus RIRD is effective, then the RIRD procedure can be faded.

The effectiveness of DRO can also be enhanced by combining it with other treatments that introduce and increase an appropriate alternative response. Previous researchers have demonstrated a DRA/DRO combination (Wacker et al., 1990) and a DRO /DRI combination (De Zubicaray et al., 1998; Fellner et al., 1984) to be effective in increasing appropriate play.

There are a couple of limitations of the study that deserve comment. First, decreases observed during DRO for Bill and Jake (Figure 4 & 5) may be under the source of an unprogrammed stimulus, such as the presence of the therapist. Second, because we evaluated RIRD vs. DRO using an alternating treatments design, it is possible that the order of the conditions and the rapid alternation of the treatments may have caused multiple treatment interference. Future research should use a different research design such as an ABAC (i.e., baseline, RIRD, baseline, DRO) withdrawal design to control for a multiple treatments effect, or reverse the order of the conditions (i.e., DRO, RIRD). Another direction is to compare the more effective treatment to a treatment package containing both treatments.

References

- Ahearn, W. H., Clark, K. M., DeBar, R., & Florentino, C. (2005). On the role of preference in response competition. *Journal of Applied Behavior Analysis, 38*, 247–250.
- Ahearn, W. H., Clark, K. M., MacDonald, R. P. F., & Chung, B. I. (2007). Assessing and treating stereotypy in children with autism. *Journal of Applied Behavior Analysis, 40*, 263-275.
- Azrin, N. H., Kaplan, S. J., & Foxx, R. M. (1973). Autistic reversal: Eliminating stereotypic self-stimulation of retarded individuals. *American Journal of Mental Deficiency, 78*, 241-248.
- Barton, L. E., Brulle, A. R., & Repp, A. C. (1986). Maintenance of therapeutic change by momentary DRO. *Journal of Applied Behavior Analysis, 19*, 277-282.
- Barton, L. E., Repp, A. C., & Brulle, A. R. (1985). Reduction of stereotypic behaviours using differential reinforcement procedures and momentary restraint. *Journal of Mental Deficiencies Research, 29*, 71-79.
- Bodfish, J. W., Symons, F. J., Parker, D. E., & Lewis, M. H. (2000). Varieties of repetitive behavior in autism: comparisons to mental retardation. *Journal of Autism and Developmental Disorders, 30*, 237-243.
- Conyers, C., Miltenberger, R., Maki, A., Jurgens, M., Sailer, A., Haugen, M., & Kopp, B. (2004). A comparison of response cost and differential reinforcement of other behavior to reduce disruptive behavior in a preschool classroom. *Journal of Applied Behavior Analysis, 37*, 411-415.
- Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied Behavior Analysis* (2nd ed.) New Jersey: Pearson Education Inc.
- interresponse times: interval DRL. *Behavior Therapy, 9*, 37-46.

- De Zubicaray, G., & Clair, A. (1998). An evaluation of differential reinforcement of other behavior, differential reinforcement of incompatible behaviors, and restitution for management of aggressive behaviors. *Behavioral Interventions, 13*, 157-168.
- Dorsey, M. F., Iwata, B. A., Reid, D. H., & Davis, P.A. (1982). Protective equipment: continuous application in the treatment of self-injurious behavior. *Journal of Applied Behavior Analysis, 15*, 217-230.
- Dunlap, G., Dyer, K., & Koegel, R. L. (1983). Autistic self-stimulation and intertribal duration. *American Journal of Mental Deficiency, 88*, 194-202.
- Egel, A. L. (1981). Reinforcer variation: Implications for motivating developmentally disabled children. *Journal of Applied Behavior Analysis, 14*, 345-350.
- Falcomata, T. S., Roane, H. S., Hovanetz, A. N., & Kettering, T. L. (2004). An evaluation of response cost in the treatment of inappropriate vocalizations maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 37*, 83-87.
- Fellner, D. J., Laroche, & Sulzer-Azaroff, B. (1984). The effects of adding interruption to differential reinforcement on targeted and novel self-stimulatory behaviors. *Journal of Behavior Therapy and Experimental Psychiatry, 15*, 315-321.
- Fisher, W. W., Grace, N. C., & Murphy, C. (1996). Further analysis of the relationship between self-injury and self-restraint. *Journal of Applied Behavior Analysis, 29*, 711-717.
- Fisher, W. W., Lindaur, S. E., Alterson, C. J., & Thompson, R. H. (1998). Assessment and treatment of destructive behavior maintained by stereotypic object manipulation. *Journal of Applied Behavior Analysis, 31*, 513-527.
- Fisher, W., Piazza C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A

- Comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis*, 25, 492-498.
- Goetz, E. M., Holmberg, M. C., & LeBlanc, J. M. (1975). Differential reinforcement of other behavior and noncontingent reinforcement as control procedures during the modification of a preschooler's compliance. *Journal of Applied Behavior Analysis*, 8, 77-82.
- Hagopian, L. P., & Adelinis, J. D. (2001). Response blocking with and without redirection for the treatment of pica. *Journal of Applied Behavior Analysis*, 34, 527-530.
- Hanley, G. P., Iwata, B. A., Thompson, R. H., & Lindberg, J. S. (2000). A component analysis of "stereotypy" for alternative behavior. *Journal of Applied Behavior Analysis*, 33, 285-296.
- Harris, S. L., & Wolchik, S. A. (1979). Suppression of self-stimulation: three alternative strategies. *Journal of Applied Behavior Analysis*, 12, 185-198.
- Himle, M. B., Woods, D. W., & Bunaciu, L. (2008). Evaluating the role of contingency in differentially reinforced tic suppression. *Journal of Applied Behavior Analysis*, 41, 285-289.
- Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis*, 27, 197-209. (Reprinted from *Analysis and Intervention in Developmental Disabilities*, 2, 3-20, 1982)
- Jones, R. S. P., Wint D., & Ellis, N. C. (1990). The social effects of stereotyped behavior. *Journal of Mental Deficiency Research*, 34, 261-268.
- Kennedy, C. H., Meyer, K. A., Knowles, T., & Shukla, S. (2000). Analyzing the multiple functions of stereotypical behavior for students with autism: implications for assessment and treatment. *Journal of Applied Behavior Analysis*, 33, 559-571.

- Koegel, R. L., & Covert, A. (1972). The relationship of self-stimulation to learning in autistic children. *Journal of Applied Behavior Analysis, 5*, 381-387.
- Koegel, R. L., Firestone, P. B., Kramme, K. W., & Dunlap, G. (1974). Increasing spontaneous play by suppressing self-stimulation in autistic children. *Journal of Applied Behavior Analysis, 7*, 521-528.
- LaGrow, S. J. & Repp, A. C. (1984). Stereotypic responding: a review of intervention research. *American Journal of Mental Deficiency, 88*, 595-609.
- Lalli, J. S., Livezey, K., & Kates, K. (1996). Functional analysis and treatment of eye poking with response blocking. *Journal of Applied Behavior Analysis, 29*, 129-132.
- Lewis, M. H., & Bodfish, J. W. (1998). Repetitive behavior disorders in autism. *Mental Retardation and Developmental Disabilities Research Reviews, 4*, 80-89.
- Lerman, D. C., & Iwata, B. A. (1996). A methodology for distinguishing between extinction and punishment effects associated with response blocking. *Journal of Applied Behavior Analysis, 29*, 231-234.
- Lovaas, I. O., Litrownik, A., & Mann, R. (1971). Response latencies to auditory stimuli in autistic children engaged in self-stimulatory behavior. *Behaviour Research and Therapy, 9*, 39-49.
- Lovaas, I., Newsom, C., & Hickman, C. (1987). Self-stimulatory behavior and perceptual reinforcement. *Journal of Applied Behavioral Analysis, 20*, 44-68.
- Mace, F. C., Browder, D. M., & Lin, Y. (1987). Analysis of demand conditions associated with stereotypy. *Journal of Applied Behavior Analysis, 18*, 25-31.

- Marcus, B. A., & Vollmer, T. R. (1996). Combining noncontingent reinforcement and differential reinforcement schedules as treatment for aberrant behavior. *Journal of Applied Behavior Analysis, 29*, 43-51.
- Mazaleski, J. L., Iwata, B. A., Vollmer, T. R., Zarcone, J. R., & Smith, R. G. (1993). Analysis of the Reinforcement and extinction components of DRO contingencies with self-injury. *Journal of Applied Behavior Analysis, 26*, 143-156.
- McCord, B. E., Iwata, B. A., Galenski, Y. L., Ellingson, S. A., & Thomson, R. J. (2001). Functional analysis and treatment of problem behavior evoked by noise. *Journal of Applied Behavior Analysis, 24*, 447-462.
- McEntee, J. E., & Saunders, R. R. (1997). A response-restriction analysis of stereotypy in adolescents with mental retardation: Implications of applied behavior analysis. *Journal of Applied Behavior Analysis, 30*, 485-506.
- Piazza, C. C., Adelinis, J. D., Hanley, G. P., Goh, H., & Delia, M. D. (2000). An evaluation of the effects of matched stimuli on behaviors maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 33*, 13-27.
- Powers, K. V., Roane, H. S. & Kelley, M. E. (2007). Treatment of self-restraint associated with the application of protective equipment. *Journal of Applied Behavior Analysis, 40*, 577-581.
- Rapp, J. T. (2006). Toward an empirical method for identifying matched stimulation for automatically reinforced behavior: a preliminary investigation. *Journal of Applied Behavior Analysis, 39*, 137-140.
- Rapp, J. T., Dozier, C. L., Carr, J. E., Patel, M. R., & Enloe, K. A. (2000). Functional analysis of hair manipulation; replication and extension. *Behavioral Interventions, 15*, 121-133.

- Rapp, J. T., & Vollmer, T. R. (2005). Stereotypy I: A review of behavioral assessment and treatment. *Research in Developmental Disabilities, 26*, 527-547.
- Rapp, J. T., Vollmer, T. R., St. Peter, C., Dozier, C. L., & Cotnoir, N. M. (2004). Analysis of response allocation in individuals with multiple forms of stereotyped behavior. *Journal of Applied Behavior Analysis, 37*, 481-501.
- Reid, D.H., Parsons, M. B., Phillips, J. F., & Green, C. W. (1993). Reduction of self-injurious hand mouthing using response blocking. *Journal of Applied Behavior Analysis, 26*, 139-140.
- Repp, A. C., Barton, L. E., & Brulle, A. R. (1983). A comparison of two procedures for programming the differential reinforcement of other behavior. *Journal of Applied Behavior Analysis, 16*, 435-445.
- Repp, A.C., Barton, L. E., & Gottlieb, J. (1983). Naturalistic studies of institutionalized profoundly or severely mentally retarded persons: the relationship of density and behavior. *American Journal of Mental Deficiency, 87*, 441-447.
- Repp, A. C., & Deitz, S. M. (1974) Reducing aggressive and self-injurious behavior of institutionalized retarded children through reinforcement of other behaviors, *Journal of Applied Behavioral Analysis, 7*, 313-325.
- Reynolds, G. S. (1961). Behavioral contrast. *Journal of the Experimental Analysis of Behavior, 4*, 57-71.
- Rincover, A. (1978) Sensory extinction: A procedure for eliminating self-stimulatory behavior In developmentally disabled children. *Journal of Applied Behavior Analysis, 6*, 299-310.
- Rincover, A., & Devany, J. (1982). The application of sensory extinction procedures to self injury. *Analysis and Interventions in Developmental Disabilities, 2*, 67-81.

- Roan, H. S., Falcomata, T. S., & Fisher, W. W. (2007). Applying the behavioral economics principle of unit price to DRO schedule thinning. *Journal of Applied Behavior Analysis, 40*, 529-534.
- Rolinder, A., & Van Houten, R., (1984). Training parents to use extinction to eliminate nighttime crying by gradually increasing the criteria for ignoring crying. *Education and Treatment of Children, 7*, 119-124.
- Roscoe, E. M., Carreau, A., MacDonald, J., & Pence, S. T., (2008). Further evaluation of leisure items in the attention condition of functional analyses. *Journal of Applied Behavior Analysis, 41*, 351-364.
- Schroeder, S. R. (1991). Self-injury and stereotypies. In J. L. Matson & J. A. Mulick (Eds.), *Handbook of mental retardation*. New York: Pergamon Press.
- Singh, N. N., Dawson, M. J., & Manning, P. (1981). Effects of spaced responding DRI on the stereotyped behavior of profoundly retarded persons. *Journal of Applied Behavior Analysis, 14*, 521-526.
- Smith, R. G., Russo, L., & Le, D. D. (1999). Distinguishing between extinction and punishment effects on response blocking; a replication. *Journal of Applied Behavior Analysis, 32*, 367-370.
- Taylor, B. A., Hoch, H., & Weissman, M. (2005). The analysis and treatment of vocal stereotypy in a child with autism. *Behavioral Interventions, 20*, 239-253.
- Thompson, R. H., & Iwata, B. A. (2005). A review of reinforcement control procedures. *Journal of Applied Behavior Analysis, 38*, 257-278.

- Thompson, R. H., Iwata, B. A., Hanley, G. P., Dozier, C. L., & Samaha, A. L. (2003). The effects of extinction, noncontingent reinforcement, and differential reinforcement of other behaviors as control procedures. *Journal of Applied Behavior Analysis, 36*, 221-238.
- Tarbox, R. S. F., Tarbox, J., Ghezzi, P. M., & Wallace, M. D. (2007). The effects of blocking mouthing of leisure items on their effectiveness as reinforcers. *Journal of Applied Behavior Analysis, 40*, 761-765.
- Troster, H. (1994). Prevalence and Functions of stereotyped behaviors in nonhandicapped children in residential care. *Journal of Abnormal Child Psychology, 22*, 79-95.
- Topping, J. S., Pickering, J. W., & Jackson, J. A. (1972). Comparison of omission and extinction following FR reinforcement training. *The Psychological Record, 22*, 221-224.
- Vollmer, T. R. (1994). The concept of automatic reinforcement: implications for behavioral research in developmental disabilities. *Research in Developmental Disabilities, 15*, 187-207.
- Vollmer, T.R., Iwata, B.A., Zarcone, J.R., Smith, R.G., & Mazaleski, J.L. (1993). The role of attention in the treatment of attention-maintained self-injurious behavior: Noncontingent reinforcement and differential reinforcement of other behavior. *Journal of Applied Behavior Analysis, 26*, 9-21.
- Wacker, D. P., Steege, M.W., Northrup, J., Sasso, G., Berg, W., Reimers, T., Cooper, L., Cigrand, K., & Donn, L. (1990). A component analysis of functional communication training across three topographies of severe behavior problems. *Journal of Applied Behavior Analysis, 23*, 417-429.
- Worsdell, A. S., (2000). Response blocking as treatment for severe behavior disorders. *Self Injury Abstracts and Reviews, 9*, 3.

Figure Caption

Figure 1. Functional Analysis of motor stereotypy for Eden.

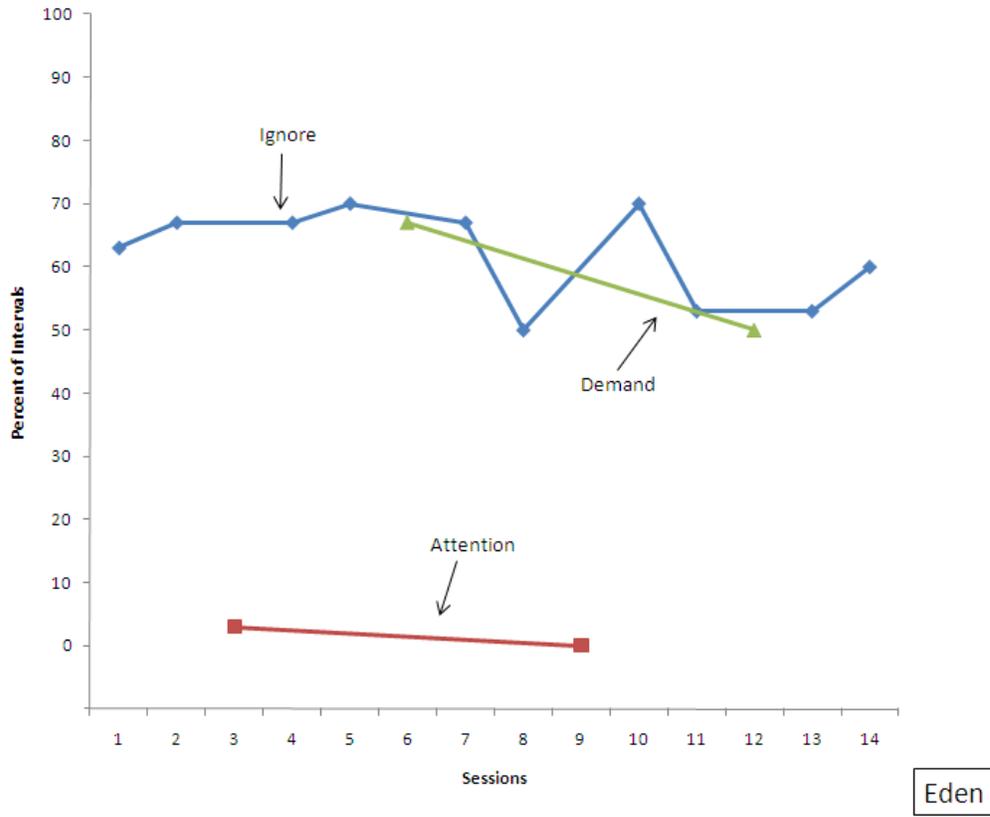
Figure 2. Functional Analysis of motor stereotypy for Bill.

Figure 3. Functional Analysis of motor stereotypy for Jake.

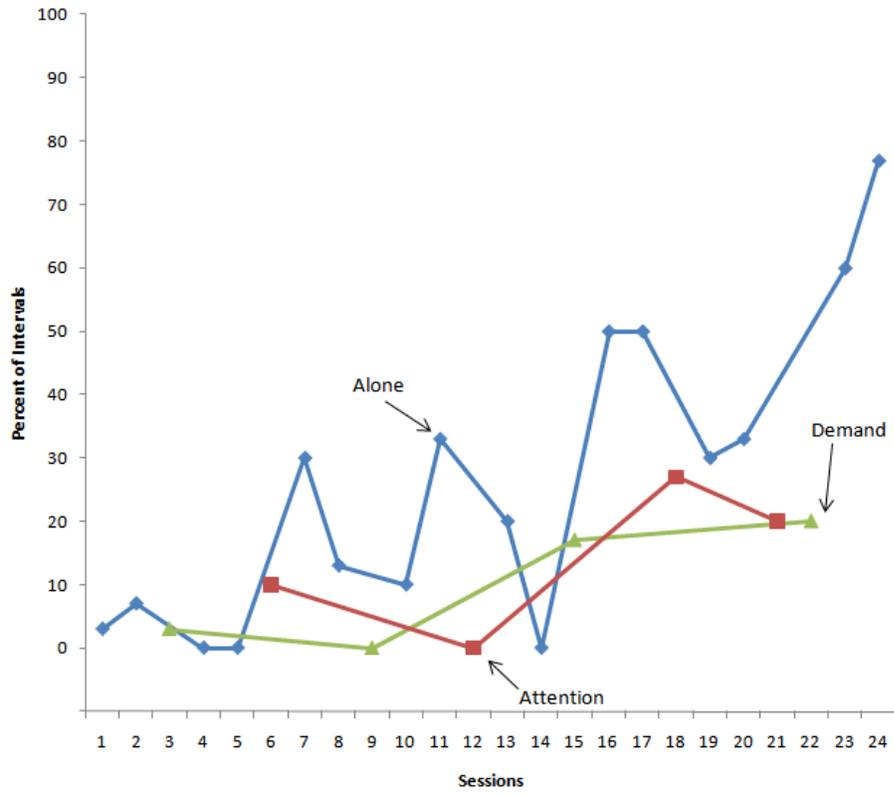
Figure 4. Comparison of RIRD and DRO for Eden.

Figure 5. Comparison of RIRD and DRO for Bill.

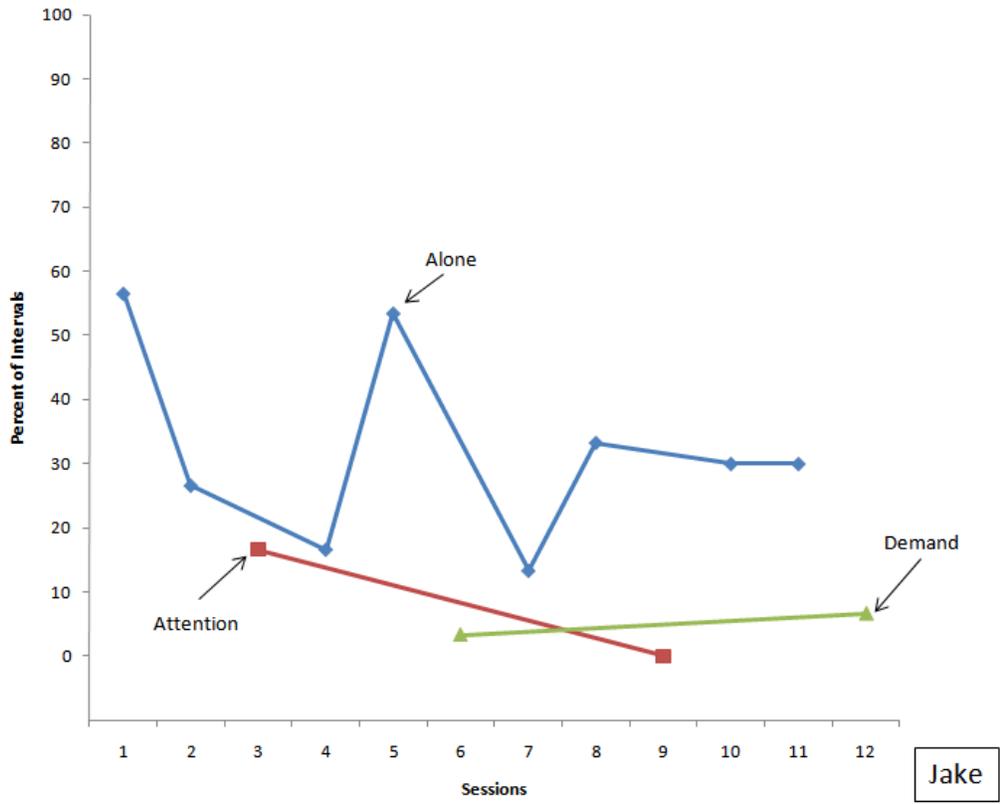
Figure 6. Comparison of RIRD and DRO for Jake.

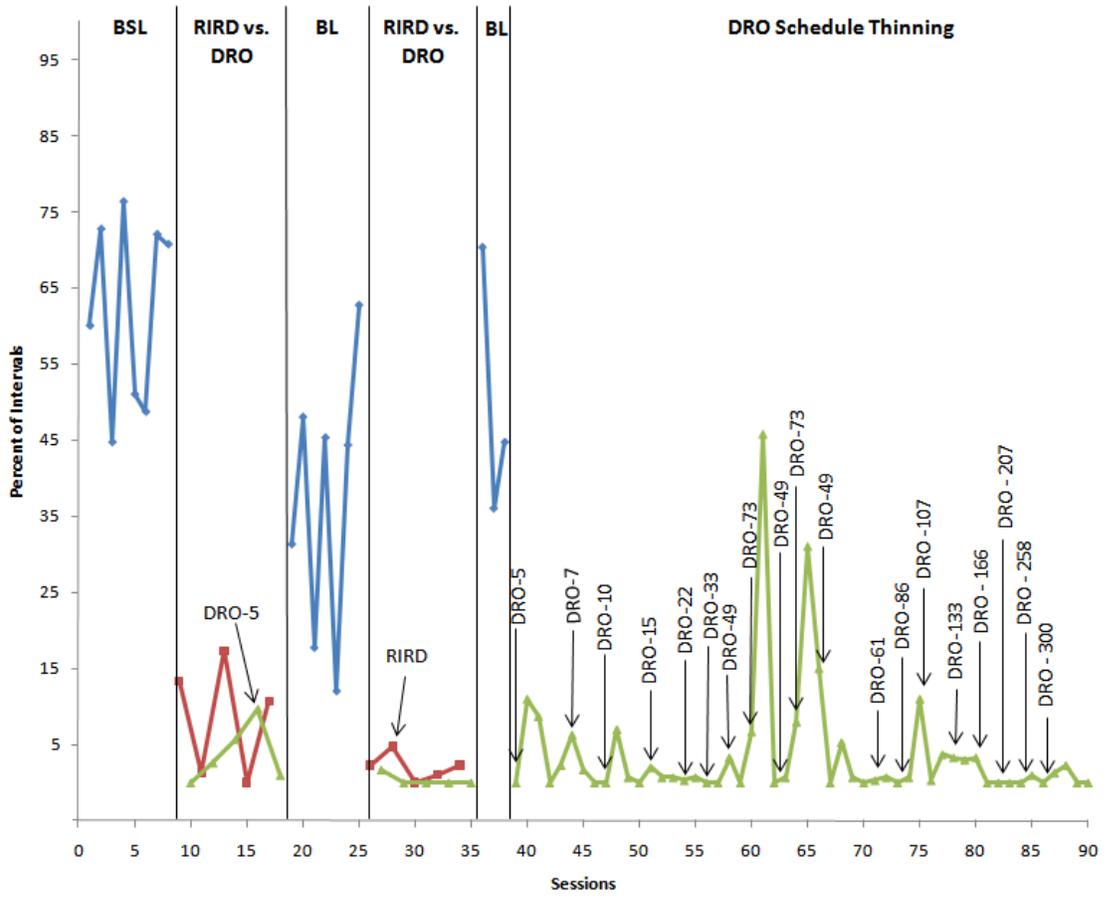


Eden



Bill





Eden

