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Comparison of Reinforcement Alone and in Combination with Redirection for Treating Automatically-Reinforced Motor Stereotypy

A Thesis Presented

by

Gesell Gavidia

The Department of Counseling and Applied Educational Psychology

In partial fulfillment of the requirements

for the degree of

Master of Science

in the field of

Applied Behavior Analysis

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Bouvé College of Health Sciences Graduate School

Thesis Title: Comparison of Reinforcement Alone and in Combination with Redirection for Treating Automatically-Reinforced Motor Stereotypy

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Comparison of Reinforcement Alone and in Combination with Redirection for Treating Automatically-Reinforced Motor Stereotypy

by

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ABSTRACT

Response interruption and redirection (RIRD) alone and in combination with reinforcement-based interventions have been effective in reducing automatically-reinforced stereotypy. However, it is unclear whether differential reinforcement of an alternative behavior (DRA) alone would be effective in decreasing stereotypy. In addition, it is unclear whether the combination of DRA and redirection may affect appropriate alternative responding. The purpose of this study was to evaluate the relative effectiveness of DRA alone and in combination with RIRD as treatment for stereotypy while measuring collateral effects on accuracy and rate of completion of appropriate alternative behavior. Three individuals, with an autism spectrum disorder, who exhibited motor stereotypy maintained by automatic reinforcement, participated. The effects of DRA alone and DRA with RIRD were evaluated using a combination of reversal and multielement designs. During DRA, a high preference edible was delivered contingent on an appropriate academic response, and no programmed consequences were provided for motor stereotypy. During DRA with RIRD, a redirection procedure was added, which involved interruption and presentation of instructions to engage in motor compliances contingent on stereotypy. Results suggest that direct reductive procedures, such as RIRD, may be necessary for reducing automatically-reinforced stereotypy. However, RIRD did not negatively impact academic performance.

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Stereotypy has been defined as a high frequency, repetitive, and topographically invariant behavior that serves no apparent purpose (Lewis & Baumeister 1982). Motor stereotypies are behaviors that are usually performed the same way every time and are resistant to change (Foster, 1998). Some topographies of stereotypy include hand mouthing (Goh et al., 1995), motor stereotypy (e.g., object spinning, hand flapping, body rocking, tapping, hand wringing; Rapp, Vollmer, St. Peter, Dozier, & Cotnoir 2004), and repetitive nonfunctional vocals (Ahearn, Gardenier, Chung, & Dube, 2003).

Research has shown that stereotypy is often observed among individuals diagnosed with autism. Bodfish, Symons, Parker, and Lewis (2000) compared levels of stereotypy between two groups, a group of individuals diagnosed with autism and a group of individuals diagnosed with mental retardation who did not have a diagnosis of autism. Results showed elevated levels of stereotypy in the group of individuals diagnosed with autism relative to individuals without autism, but of the same age, gender, and level of intellectual functioning.

In addition to the prevalence of stereotypy in autism, it is important to look at the social effects of stereotypy and the effects of stereotypy on educational programming. Jones, Wint, and Ellis (1990) evaluated the social effects of stereotypic behavior. Four groups of 14- to 15-year old high school students participated in this study. They filled out questionnaires after watching four different videos. Two of the groups watched videos depicting typical behavior, while the other two groups observed videos depicting stereotypic behavior. One group saw the model engaging in typical behavior when she was given the label, “university student,” and another group saw the model engaging in the same behavior, but the tape was labeled, “mentally handicapped”. The questionnaire

was used to obtain the participants' ratings of the person they saw in the video. Results showed that low ratings on the questionnaire were associated with individuals exhibiting stereotypy, regardless of whether it is was exhibited by a university student or a person labeled mentally handicapped. These findings indicate that stereotypy may be associated with social stigma.

Stereotypy may interfere with educational programming. For example, Dunlap, Dyer, and Koegel (1983) evaluated the effects short versus long durations between work trials on work performance of children diagnosed with autism. Higher levels of stereotypy were observed during longer inter-trial durations, whereas lower levels of stereotypy were associated with shorter inter-trial durations. In addition, lower levels of stereotypy were observed with shorter inter-trial durations. Therefore, these findings showed an inverse relationship between stereotypy and correct responding. Lower levels of correct responses, suggesting that decreases in stereotypy may be associated with increases in appropriate task behavior.

Because stereotypy had been found to be associated with a negative social stigma, and has also been found to interfere with educational programming, it is important to find an effective treatment to reduce the occurrences of stereotypy found in individuals with autism and other related developmental disabilities. The first step in identifying an effective intervention is to determine the function of an individual's stereotypy by conducting a functional analysis. A functional analysis involves the manipulation of antecedent and consequent environmental variables and repeated measurement to determine the environmental variables maintaining problem behavior (Iwata, Dorsey, Slifer, Bauman, & Richman 1994). Research involving a functional analysis of stereotypy

has shown that it is often maintained by automatic reinforcement (Ahearn, Clark, MacDonald, & Chung (2007); Piazza, Roane, Keeney, Boney, & Abt, 2002). However, some studies have shown that stereotypy may be sensitive to escape (Kennedy, Meyer, Knowles, & Shukla, 2000) or attention as a reinforcer (Goh et al., 1995). Although some studies have shown stereotypy to be maintained by social contingencies, the majority of studies have indicated that stereotypy is maintained by automatic reinforcement.

Problem behavior maintained by automatic reinforcement can be difficult to treat because the specific reinforcer maintaining the response is unknown and cannot be socially mediated. Automatic reinforcers are continuously available because the behavior and the reinforcer are inseparable (Piazza, Adelinis, Hanley, Goh, & Delia 2000). Therefore, clinicians are limited in the treatments they can develop for problem behavior maintained by automatic reinforcement.

Two different categories of treatment have been evaluated for automatically-reinforced problem behavior. These include indirect treatment and direct treatment. Indirect treatments are considered indirect because they involve the arrangement of consequences independent of the target behavior of interest. One type of indirect treatment is noncontingent reinforcement (NCR). NCR has been shown to be effective in reducing automatically-reinforced behavior. An early study on NCR was conducted by Favell, McGimsey & Schell (1982), who provided continuous access to leisure items that were hypothesized to match the sensory stimulation from SIB, such as hand mouthing. When presented with the continuous access to leisure items, self injury decreased. When appropriate toy play was differentially reinforced, SIB decreased further. Although this study was informative in demonstrating that NCR can be effective in treating self-injury,

a functional analysis was not conducted. Therefore, potential maintenance of SIB by social reinforcers was not ruled out.

Piazza et al. (2000) also evaluated NCR for treating automatically-reinforced problem behavior. The authors conducted functional analyses to rule out maintenance by social reinforcers, and they conducted systematic preference assessments to identify highly preferred items for use during NCR. During the NCR treatment evaluation, the authors compared two types of NCR, one using highly-preferred matched items and one using highly-preferred unmatched items. The results showed that NCR using matched items was more effective than NCR using unmatched items. These findings suggest that when using NCR as an intervention for automatically-reinforced behavior, it may be helpful to identify preferred items that are hypothesized to match the response product produced by stereotypy.

Another type of indirect treatment is differential reinforcement of alternative behavior, or DRA. In this procedure, reinforcers are delivered contingent on the occurrence of an alternative response, while withholding reinforcement for the problem behavior. In a study by Wacker et al. (1990), they evaluated a DRA procedure alone and in combination with DRO for reducing a participant's body rocking. DRA involved presenting a preferred activity contingent on pressing a microswitch. Results showed that DRA alone was effective in decreasing body rocking and in increasing an appropriate communicative response. This is one of the few studies that showed positive treatment effects using differential reinforcement alone. Most studies have evaluated found that DRA alone is ineffective, requiring the addition of a more direct form of intervention.

Although, it is considered more favorable to use reinforcement procedures to treat problem behavior, it may be difficult to treat automatically-reinforced behavior with reinforcement procedures alone. For example, Lindberg, Iwata and Kahng (1999) attempted to increase item engagement and reduce automatically-reinforced self-injurious behavior (SIB) by presenting continuous access to leisure items while implementing prompting with DRA for item engagement. Results showed that prompting with DRA was ineffective in increasing appropriate item engagement and decreasing SIB. Therefore, response blocking and protective equipment were required to obtain low levels of SIB. Vollmer, Marcus and Leblanc (1994) evaluated environmental enrichment for treating three participants' automatically-reinforced SIB and stereotypy. Results showed that environmental enrichment was effective in reducing problem behavior for 1 participant, environmental enrichment with DRA was effective for the second participant, and neither procedure was effective for the third participant. Therefore, a blocking procedure was required for reducing the third participant's problem behavior.

Because automatically-reinforced behavior may be resistant to reinforcement-based interventions, direct interventions, involving the delivery of consequences contingent on the problem behavior of interest, may be required. Examples of direct interventions that have been evaluated for treating automatically-reinforced problem behavior include response blocking, overcorrection, and response interruption with redirection.

A number of studies have shown that response blocking, which involves either physically preventing or interrupting the target response, decreases automatically-reinforced stereotypy. Reid, Parsons, Phillips, and Green (1993) evaluated response

blocking for reducing hand mouthing in two participants. In this study, the therapist blocked each occurrence of hand mouthing by placing his or her hand approximately 2 cm in front of the participant's mouth to block, preventing the participant's hand from entering their mouth. This procedure effectively decreased hand mouthing for both participants. According to the authors, it was hypothesized that sensory extinction was the mechanism responsible for treatment effects. Lerman and Iwata (1996) evaluated response blocking for treating a participant's automatically-reinforced hand mouthing. In this study, response blocking involved physically preventing the target response. That is, the therapist held their hand in front of the participant's mouth to prevent an occurrence of hand mouthing. In addition, they successively thinned the blocking schedule to determine whether blocking functioned as extinction or punishment. Because participants' hand mouthing continued to decrease and remained low across schedule thinning, punishment seemed to be the mechanism responsible for the effects of blocking. If blocking functioned as extinction, higher levels of hand mouthing should have occurred as the schedule of blocking was thinned. Smith, Russo, and Le (1999) used a similar blocking and schedule-thinning procedure to that used by Lerman and Iwata to treat a participant's automatically-reinforced eye poking. Although response blocking was found effective in suppressing the participant's eye poking, the outcome differed from that observed by Lerman and Iwata in that eye poking increased rather than decreased as the blocking schedule was successively thinned. Therefore, higher responding during thinner schedules was most likely due to intermittent reinforcement, suggesting that blocking served as a form of extinction for this participant.

Another form of response blocking involves interrupting rather than preventing problem behavior. Sprague, Holland, and Thomas (1997) evaluated this type of response blocking by comparing DRA alone with DRA plus response interruption for automatically-reinforced problem behavior. First, they identified a reinforcer for use during DRA by conducting a series of sessions that were similar to the play condition from the functional analysis. During these sessions, different forms of stimulation, including vibratory stimulation (a toy massager), auditory stimulation (music) and food, were compared to see which form of stimulation was associated with high levels of engagement and low levels of stereotypy. Results showed that vibratory stimulation was most effective for one participant and auditory stimulation was most effective for the other participant. During DRA, these items were provided for 10 s contingent on task attempts. During DRA plus interruption, the same contingency as DRA alone was in effect; in addition, the therapist gently placed the participant's hands down and delivered a vocal reprimand (e.g., "No, don't do that"). DRA alone was not effective in reducing participants' stereotypy; the response interruption procedure was necessary for successful treatment effects. DRA with redirection was associated with slight increases in on-task behavior for one of the participants. Although this procedure was noteworthy in that it was one of the first to evaluate the independent effects of DRA, there were a number of methodological limitations associated with this study that prevented clear interpretation of the data provided. First, SIB and stereotypy were combined as the target behavior, making it unclear whether similar effects would have been obtained if only stereotypy was included. Second, the materials used in the play condition of the FA were also included in the attention condition of the FA. Therefore, it is possible that a false negative

outcome for attention-maintained behavior occurred during the FA. Third, during the treatment assessment, the therapist delivered escape contingent on the target behavior during baseline and DRA alone conditions, but not during response interruption condition. Therefore, the interruption procedure introduced multiple independent variable manipulations (i.e., the break was no longer delivered and the hands down procedure was introduced), making it unclear whether removal of the break or presentation of hands down was responsible for the effects obtained). Forth, because they used leisure items rather than edibles as a reinforcer during DRA, it is unclear whether preferred edibles identified from a systematic preference assessment may have resulted in increases in task behavior and decreases in problem behavior. Given these methodological concerns, future research on DRA alone for treating automatically-reinforced problem behavior is warranted.

Another direct intervention that has been shown effective in reducing automatically-reinforced problem behavior is overcorrection. Overcorrection involves either improving the environmental effects of problem behavior or requiring the participant to repetitively practice correct forms of an appropriate behavior. In restitutional overcorrection, the therapist requires the participant to greatly improve the environment from how it was before problem behavior occurred (e.g. vocally or physically instructing the participant to brush his/her teeth contingent on hand mouthing (Foxx and Azrin 1973)). In positive practice overcorrection, the therapist requires the participant to repetitively practice appropriate behavior (e.g. vocally or physically instructing the participant to move hands in specific directions contingent on motor stereotypy (Cole, Montgomery, Wilson, and Milan 2000)). In both of these types of

overcorrection, physical guidance is often used to ensure compliance with the overcorrection procedure.

Harris and Wolchik (1979) evaluated overcorrection and compared its effects with a DRO procedure and with a time-out procedure for reducing four participants' stereotypy. During the overcorrection procedure, the therapist stated "No hand play" and guided the participant's hands above his head into an exaggerated clap for 10 s, contingent on the target response. During the DRO procedure, the therapist delivered verbal praise and food contingent on correct responses to academic tasks. During the time-out procedure, the therapist stated "No hand play" and turned his/her head away from the child for 10 s contingent on the occurrence of stereotypic behavior. The results showed that overcorrection was the most effective treatment in reducing stereotypy across all participants.

Foxx and Azrin (1973) evaluated overcorrection and compared it with DRO, physical punishment, and NCR for treating automatically-reinforced stereotypy, including hand mouthing, hand clapping, and head weaving. During the overcorrection procedure for hand mouthing, the teacher stated "no" in a firm voice and physically prompted the child to brush her teeth and gums with a toothbrush that was partially immersed in a container of oral antiseptic. During the 2 min overcorrection procedure, the therapist periodically instructed the child to expectorate the solution into a sterile cup. During the overcorrection procedure for head weaving, the therapist held the participant's head still and instructed her to move her head up, down, or straight. During the DRO procedure, the therapist delivered edibles and praise contingent on each 10 s interval without stereotypy. During the punishment procedure (used for hand mouthing only), the

therapist slapped the participant on the leg contingent on an occurrence of mouthing. During the distasteful-solution condition (for mouthing behavior only), at the start of the session, the therapist painted the participant's hand with a distasteful solution. During the NCR condition, the therapist delivered an edible paired with social praise on a variable-interval 1-min schedule. The results of this study showed that overcorrection was the most effective treatment in decreasing automatically-reinforced stereotypic behavior. Hall, Maynes, and Reiss (2009) used an overcorrection procedure to increase eye contact when the therapist prompted to do so. During the overcorrection procedure, the therapist delivered two-step prompting (vocal followed by physical) for the child to move their head up, down or straight ahead, and maintain the position for 15 s. Overcorrection resulted in increased compliance when participants were prompted to make eye contact, and eye contact maintained after the overcorrection contingency was no longer in effect. Cole et al. (2000) compared three durations (30 s, 2 min, 8 min) of overcorrection to treat participants' motor stereotypy. During overcorrection, the therapist stated "No! Hands down!" and vocally or physically prompted the participant to exhibit three motor directives, including "Hands up," "Hands out," and "Hands down". Results of this study showed that overcorrection was effective in reducing participants' motor stereotypy, regardless of the duration of the intervention.

Ahearn et al. (2007) evaluated response interruption and redirection for treating participants' vocal stereotypy. During treatment, the therapist interrupted occurrences of vocal stereotypy by immediately interrupting and redirecting the participant by asking the participant questions (e.g., "What is your name?"). The teacher continued to provide prompts for appropriate language until the student complied with three consecutive

correct responses in the absence of vocal stereotypy, at which time the teacher delivered social praise for using appropriate language. Results showed that the response interruption and redirection procedure significantly decreased vocal stereotypy in all four participants in the study. This study was noteworthy because it showed that contingent presentation of only vocal prompts was sufficient for reducing participants' stereotypy.

Although direct interventions have been found effective treatment for reducing automatically-reinforced problem behavior, there are some potential negative side effects associated with use of these procedures. For example, one possible adverse effect is an increase in collateral problem behavior. A study by Hagopian and Adelinis (2001) showed that blocking alone reduced pica, but was associated with increases aggression. Blocking plus redirection effectively reduced pica with near zero instances of aggression.

Lerman, Kelley, Vorndran, and Van Camp (2003) also evaluated the collateral effects of response blocking as a treatment for stereotypy. During Phase 1, environmental enrichment (EE) was compared with environmental enrichment plus blocking (EE+RB). In the EE condition, highly preferred leisure items were continuously available, and the therapist did not interact with the participant. In the EE+RB condition, leisure items were continuously available as in EE alone; however, the therapist guided the participant's hands away from her head and face contingent on head and tooth tapping. Response blocking produced a substantial decrease in head and tooth tapping, but was associated with a collateral decrease in item interaction and a collateral increase in hand wringing. In the next analysis (Phase 2), EE was compared to EE plus conditional response blocking (EE + CON RB). During the EE + CON RB condition the therapist blocked tapping only when it occurred in the absence of item interaction. Low levels of tapping

were observed when it was blocked in the absence of item interaction. Tapping occurred at unacceptably high levels when it occurred simultaneously with item interaction and it was not blocked. Also, hand wringing occurred at high levels when tapping was blocked contingent on the absence of item interaction. When prompts were combined with response blocking in the next two phases, tapping was much lower compared to the other conditions. Item engagement was at a similar level as in the EE condition, but higher than EE plus prompted item interaction (EE + PI). Also during this condition, Hand wringing was higher at higher levels than in the EE condition, but lower than EE + PI.

Research has shown that it can be difficult to find the most appropriate and effective treatment in reducing automatically maintained behavior. Both reinforcement based procedures and direct treatment, have advantages and disadvantages, but neither has been shown to the most effective based treatment to treat such a difficult and complicated behavior as stereotypy.

The purpose of this study is to compare effects of DRA with and without redirection or redirection + blocking for reducing motor stereotypy and increasing appropriate behavior. In addition, the effects of this intervention on the frequency and accuracy of the academic task will be evaluated.

METHOD

Participants and Setting

Three individuals, who attended a residential school for children with developmental disabilities, participated. All participants exhibited motor stereotypy that interfered with educational programming and all had been diagnosed as having an Autism Spectrum Disorder. Hannah was a 14-year-old female who exhibited several

topographies of motor stereotypy including hand flapping, hair flipping, object tapping, clapping, jumping up and down, and rocking back and forth. Nathan was a 13-year-old boy who exhibited motor stereotypy in the form of hand wringing. Daniel was a 14- year-old boy, who exhibited motor stereotypy in the forms of hand flapping and rocking back and forth.

Hannah's sessions were conducted in her classroom. A desk, chair, video camera, and materials necessary to conduct sessions were present. The primary observer was always present, while a second observer videotaped sessions. Nathan and Daniel's sessions were conducted in a room that was 1.5 m by 3 m, which was equipped with a videocamera, microphone, and materials needed to conduct functional analysis and treatment sessions.

Response Measurement and Interobserver Agreement

For Hannah, motor stereotypy was defined as any instance of hand flapping, hair flipping (whipping head forward such that it resulted in hair flying in front of her face), object tapping (any object in the room or on one's own body), clapping, jumping up and down, and rocking back and forth. For Nathan, motor stereotypy included hand wringing, defined as grasping and applying pressure or rubbing of fingers from one hand with fingers from the other hand For Daniel, motor stereotypy was defined as flapping hands with or without objects and moving his body in a back and forth motion. Stereotypy was measured using duration recording and was summarized as percentage duration. *Appropriate behavior* that the participant had in his or her repertoire and that was part of educational programming was also measured. For Hannah and Daniel, appropriate behavior was defined as placing a bead on a string, and grasping and pulling the string so

that it was completely through the hole in the middle of the bead. Nathan's appropriate behavior was sorting coins into four different containers. Each coin sorted was counted as one response. Both beading and sorting were measured as frequency and summarized as responses per min. Interobserver agreement was collected on 35.3% of functional analysis sessions for Hannah. The mean agreement for the functional analysis was 91.3% (range, 78.5% to 100%). Interobserver agreement was collected on 33.3% of functional analysis sessions for Nathan. The mean agreement was 99.6% (range, 99.2 to 100%). Interobserver agreement was collected on 33.3% functional analysis sessions for Daniel. The mean agreement was 98.9% (range, 96.5 to 100%). of treatment sessions, Interobserver agreement was collected on 33.3% of treatment sessions for Hannah. The mean agreement for treatment sessions was 95.6% (range, 82.3 to 100%) for motor stereotypy and 99.8% (range, 95% to 100%) for beading.

PRE-ASSESSMENT

Functional Analysis

A functional analysis was conducted based on procedures described by Iwata et al. (1982/1994). Conditions included alone/no interaction, attention, play, and demand. During the alone (Daniel and Nathan) condition, the therapist and all materials were not in the room. The participant was closely monitored through a two-way mirror. A no interaction condition was conducted instead of the alone condition only for Hannah. During this condition, the therapist was present in the room, and no programmed consequences were delivered. During the attention condition, the therapist read a magazine and delivered attention. Contingent on occurrences of motor stereotypy, the

therapist provided brief attention (a verbal reprimand paired with physical contact). All other behaviors were ignored. During the demand condition, three-to-five task demands were rotated in a quasi-random order. Demands were continuously presented in a three-step prompting hierarch (vocal, model, and physical). Contingent on an occurrence of motor stereotypy, the therapist stated “Ok, you don’t have to” and removed the demand for 15 s. All other behaviors were ignored. During the play condition, preferred leisure items were continuously available, and the therapist delivered brief attention in the form of neutral statements (e.g., “Nice job playing.”) every 15 s. All sessions were 10 min.

Preference Assessment

A paired stimulus (based on that described by Fisher et al., 1992) or a multiple-stimulus (based on that described by DeLeon and Iwata, 1996) was conducted to identify a preferred item for use during the differential reinforcement treatment component. In the multiple-stimulus method, seven edibles were presented simultaneously and the participant was instructed to choose an item. After an item was selected, the participant was given access to that item for 10 s, or until consumed. The remaining items were represented until all items were consumed or chosen. This procedure was repeated with the items rotated in different placements. The items were then ranked based on the order in which they were chosen. During the paired-stimulus preference assessment (name participants who received this assessment here), two items were presented simultaneously. Each item was presented twice with every other item, rotating the side it was presented. Data were summarized as percentage selection by dividing the number of times each item was selected by the number of times it was presented. The item associated with the highest percentage selection was identified as participants’ high

preference edible for use during the differential reinforcement treatment component. The item/items chosen the most frequently in either preference assessment was used as the reinforcer for that participant. Results from the preference assessment showed that Oreos were high preference for Hannah (M = 92%), gummy candy was high preference for Daniel (M = 92%). For Nathan, the top three edibles from the paired stimulus preference assessment were used as reinforcers. These included cookies, marshmallows, and raisins (M = 87.5%, 62.5%, and 50% respectively).

Motor Directive Assessment

The purpose of this assessment was to identify simple motor directives the participant could easily perform and readily complied with for use as a punisher during the interruption and redirection procedure. The therapist presented several directives three times each. Directives that were performed independently in two out of three trials were chosen for the redirection procedure. Some examples of these are: Touch red, touch your shoulder, and touch your belly.

TREATMENT

Experimental Design

For Hannah, experimental control was demonstrated by using a combination of a reversal and alternating treatments design. For Nathan and Daniel, experimental control was demonstrated using a reversal design. All baseline and differential reinforcement alone sessions were 5 min. During the redirection component, sessions were 5 min of non-interruption time or X min of total session time. Treatment sessions that included the redirection component often extended beyond 5 min; however, only 5 min of nonintervention time was included when summarizing the data. (i.e., session time only

included time when the redirection procedure was not being implemented). Because the maximum duration of redirection sessions was 20 min, some sessions were less than 5 min of nonintervention time (Hannah: 5 min - 7min 12 s, Nathan: 5 min 16 s - 9 min 42 s, Daniel: 5 min 58 s – 20 min).

For all three participants, to signal the contingencies in effect during the DRA alone condition, the edible reinforcer was continuously in view of the participant. After no responding was observed in the appropriate task during the first DRA alone condition for Nathan, an additional preference assessment was conducted. The top three were chosen for the sessions that followed. For Nathan only, three edibles were in view during the DRA alone condition. For Hannah only, to signal the contingencies in effect, prior to the start of each session, the therapist presented a picture of the high-preference edible and stated “During this condition you will be earning X.” This was only implemented after no differentiation in responding occurred when both treatments were rapidly alternated.For all three participants, to signal the contingencies in effect during the DRA plus redirection condition, the edible reinforcers and a board with squares of different colors, which was associated with the redirection motor task, was continuously in view of the participant. For Hannah only, to signal the contingencies in effect during the DRA plus redirection condition, prior to the start of each session, the therapist presented a picture of the highly preferred edible, a picture of a redirection motor task, and the vocal instruction “During this session you will be earning X, and sometimes you will be touching colors.” This was only implemented after no differentiation in responding occurred when both treatments were rapidly alternated. To signal the contingencies in place during the DRA plus redirection and blocking condition (Daniel only), the edible

and the color board were present, in addition to a hat worn by the therapist to help prevent any injury that may occur with possible problem behavior (e.g., head directed aggressions).

No materials baseline (Nathan only)

During the no-materials baseline for Nathan, appropriate task materials were not present, and no programmed consequences for motor stereotypy were delivered. This condition was included due to engagement of stereotypy with materials, possibly competing with the targeted motor stereotypy.

Baseline

Baseline conditions were similar to the no interaction condition from the functional analysis. The therapist was present in the room and task materials (list materials that were present for each participant here) were continuously available. No programmed consequences were provided motor stereotypy or for appropriate behavior. Prompts to engage in the appropriate task were not delivered prior to baseline sessions.

DRA Condition

During the DRA condition, the therapist delivered the high-preference edible on a fixed-ratio (FR)-1 schedule for appropriate behavior. No consequences were presented contingent on motor stereotypy. All other behaviors were also ignored.

DRA + Redirection Condition

During the DRA plus redirection condition (DRA + RIRD), the therapist delivered the high-preference edible on a FR-1 schedule for appropriate responses. Contingent on occurrences of motor stereotypy, the therapist immediately redirected the response by vocally prompting the participant to complete motor directives (e.g., “Touch your head”,

“Touch your belly”, “Touch green”). Between five and ten different directives were rotated randomly for each participant. If the participant did not comply with the verbal directive within 5 s, the verbal directive was repeated and paired with a model of the directive. If the participant did not comply after an additional 5 s, the therapist delivered a different directive. The redirection procedure continued until the participant emitted 3 consecutive motor directives in the absence of stereotypy. During the redirection procedure, the session timer was stopped. Upon completion of the last motor directive during the redirection procedure, the therapist provided brief praise and restarted the session timer. DRA plus RIRD sessions lasted until the session timer reached 5 min or until total session time was X. All other responses were ignored.

DRA + Redirection with Blocking Condition (Daniel only)

During the DRA plus redirection with blocking condition, the therapist delivered the reinforcer on an FR-1 schedule for appropriate responses. Contingent on occurrences of motor stereotypy, the therapist immediately blocked the stereotypy by guiding the participant’s hands down for approximately 2 s and simultaneously redirected the response by vocally prompting the participant to complete motor directives as described for previous condition. The therapist also blocked occurrences of motor stereotypy emitted during the redirection procedure.

RESULTS

Functional Analysis

Figure 1 shows results from the functional analysis for all three participants. For Hannah (top panel), responding occurred at moderate and variable levels across all conditions, with no differentiation in any of the test conditions. During an extended no

interaction condition, Hannah's motor stereotypy persisted at a high and stable level, suggesting maintenance by automatic reinforcement For Nathan (middle panel), motor stereotypy occurred at differentially higher levels during the alone test condition relative to the other conditions. During the extended alone phase, motor stereotypy maintained, suggesting maintenance by automatic reinforcement. For Daniel, responding occurred at moderate and variable levels across conditions, with no differentiation in any test condition. During the extended alone phase, motor stereotypy maintained at moderate and variable levels, suggesting maintenance by automatic reinforcement.

Treatment Assessment

Figure 2 shows the results for Hannah's treatment assessment. The top panel depicts motor stereotypy and the bottom panel depicts appropriate task behavior. During the first baseline condition, stereotypy was at a high variable level with an increasing trend and appropriate behavior did not occur. When the first DRA alone condition was implemented, stereotypy immediately decreased and appropriate behavior immediately increased. However, stereotypy did not decrease to clinically acceptable levels. During the second baseline phase, stereotypy increased to a higher, variable level and appropriate behavior did not occur. During the DRA + RIRD condition, Hannah's motor stereotypy decreased to a low and stable levels, with near zero levels of stereotypy toward the end of the condition, and her appropriate behavior immediately increased to around four responses per minute. After a return to baseline, stereotypy eventually increased to a higher stable level and appropriate behavior immediately decreased to zero RPM. During the multielement phase, when DRA alone was rapidly alternated with DRA + RIRD, Hannah's motor stereotypy immediately decreased to near zero levels and appropriate

behavior increased to high levels during both treatment conditions, with no differentiation between DRA alone and DRA + RIRD conditions. During a forth return to baseline, Hannah's motor stereotypy increased to high variable levels, and appropriate behavior decreased to zero. During the final DRA alone condition, Hannah's motor stereotypy decreased to zero levels and appropriate behavior increased to levels seen in the prior treatment conditions.

In Figure 3 depicts results from Nathan's treatment assessment. The top panel shows Nathan's motor stereotypy, and the bottom panel shows his appropriate behavior. During the no-materials baseline, Nathan's motor stereotypy occurred at high and variable levels. Because materials were not present in this condition, appropriate task behavior is not depicted during this condition. During the subsequent baseline condition, task materials were included and stereotypy slightly decreased yet continued to occur at moderate and stable levels. Nathan's exhibited appropriate behavior only in the first session of this condition. During the subsequent DRA alone condition, Nathan's motor stereotypy continued to occur at similar levels to that observed during baseline for the first 8 sessions. During the final 3 sessions of this condition, there was an increasing trend. Nathan did not exhibit appropriate behavior at any point in this condition. During this phase, the therapist began to prompt the appropriate response three times, prior to the start of each session, on an FR-1 schedule. This procedure was conducted for all sessions that followed. Also, during this phase, in order to ensure that the highest preferred edibles were used, a paired preference assessment was conducted and the top three chosen edibles were used and rotated for correct appropriate responses in all sessions that followed. During the DRA+RIRD condition, stereotypy decreased to low levels.

However, appropriate task behavior did not occur. During the final DRA alone phase, motor stereotypy initially remained at low levels, and gradually showed an increasing trend. Levels did not replicate to levels of the previous DRA alone condition.

Figure 4 depicts treatment results for Daniel. The top panel shows Daniel's motor stereotypy and the bottom panel shows Daniel's appropriate behavior. During baseline, Daniel exhibited high and variable levels of stereotypy, with an increasing trend, and he exhibited appropriate behavior at low levels with a decreasing trend. During the DRA alone condition, Daniel showed higher levels of stereotypy than during the initial baseline condition, and he exhibited moderate and variable levels of appropriate behavior. During the DRA + RIRD condition, Daniel exhibited decreased levels of motor stereotypy from the DRA alone condition, but a similar level to that of his initial baseline, with an increasing trend. He exhibited appropriate behavior at a low and variable, level. During the DRA + RIRD with blocking condition, Daniel showed low levels of motor stereotypy and high levels of appropriate behavior During the return to the DRA + RIRD condition, Daniel showed increased levels of stereotypy and low levels of appropriate behavior, similar to the previous DRA + RIRD condition and initial baseline. During the second DRA + RIRD with blocking condition, Daniel exhibited decreased levels of stereotypy and increased levels of appropriate task behavior, replicating the previous DRA + RIRD with blocking condition.

Figure 5 depicts Daniel's motor stereotypy during the response interruption procedure of his treatment assessment. During the first DRA+RIRD, Daniel exhibit high and variable levels of motor. During the initial DRA + RIRD with blocking condition, Daniel immediately exhibited lower levels for motor stereotypy. During the second

DRA+RIRD condition, Daniel again exhibited high and variable levels of motor stereotypy. During the reversal to DRA + RIRD with blocking condition, Daniel showed low levels of motor stereotypy.

DISCUSSION

Results from this study indicate that in some cases, DRA can be effective in reducing automatically-reinforced stereotypy, yet in other cases it may be necessary to include a more intrusive procedure, such as response interruption and redirection, or response blocking. For Hannah, DRA and DRA+RIRD were found to be effective in reducing her stereotypy and increasing the appropriate task response. Although the initial exposure to DRA alone did not result in levels that were as low as those observed when the redirection component was added, subsequent exposures to DRA alone resulted in similarly low levels to those observed during DRA + RD. During the second exposure to DRA + RD, this condition was alternated with DRA alone using a multielement design. Therefore, it is possible that low levels observed during the second DRA alone condition were due to carry over effects due to a lack of discrimination between the two conditions. In an attempt to minimize this potential confound, more salient discriminative stimuli were added prior to the start of the fifth session. For the DRA condition, a picture of Oreos was present on the table and the therapist stated, “In this session you can earn Oreos”. For the DRA+RIRD condition, a picture of Oreos and a picture of a hand touching a color were present on the table. The therapist stated, “In this session you can earn Oreos and sometimes you have to touch colors”. However, inclusion of these additional cues did not affect responding (i.e., stereotypy remained low in both treatment conditions). When DRA alone was implemented a third time and not rapidly alternated

with DRA +RIRD, Hannah's stereotypy remained at near zero levels. Because lower levels of the DRA alone condition were only observed when it was alternated with DRA + RIRD or following previous exposure with DRA + RIRD, it is unclear whether these low levels were the result of sequence effects (i.e., history effects). However, the initial exposure to DRA alone was associated with substantial decreases in stereotypy, suggesting that this treatment component may be a viable choice because it is less time intensive and staff intrusive than DRA+RIRD.

Results for Nathan showed that the response interruption and redirection procedure was necessary for reducing his hand wringing. DRA alone was not effective in reducing Nathan's hand wringing. In addition, a surprising finding was that the appropriate behavior never occurred during DRA alone or during DRA + RIRD conditions. To ensure that low levels of the appropriate response were not due to lack of exposure with the contingency in effect during this phase, we initiated a prompting procedure prior to each DRA session starting with the fifth session. During prompting, the appropriate response was manually guided 3 times on an FR1 schedule. This prompting procedure remained in effect for every session in the remainder of his treatment analysis. In addition, we reimplemented his preference assessment prior to the eighth session of the DRA alone condition to ensure that the edibles delivered were preferred. We also rotated his top three preferred edibles to prevent satiation effects. One potential explanation for why DRA alone was ineffective for Nathan is because he exhibited stereotypy with the task materials (i.e., plastic coins). Therefore, it is possible that the automatic reinforcer associated with his object stereotypy was more potent than the arbitrary reinforcer (i.e., a preferred edible) delivered during DRA. We did not record

Nathan's stereotypy with materials because it could not be reliably observed from the videotape footage. We initially conducted a no materials baseline to determine whether object stereotypy (associated with the task materials) competed with his hand wringing. Although the materials baseline was associated with a decrease in hand wringing, the level of hand wringing was still high enough during the materials baseline to warrant treatment. It is hypothesized that the stereotypy with the coins competed with the correct response, therefore, coin stereotypy occurred, rather that coin sorting. The responses interruption with redirection component of the DRA+RIRD condition effectively reduced hand wringing to near zero levels of responding. In the reversal to DRA alone condition, hand wringing remained low, possibly due to punishment, or carryover effects from the previous DRA+RIRD treatment.

For Daniel, neither DRA alone or in combination with response interruption and redirection effectively decreased hand flapping and body rocking. A brief hands down procedure was necessary to effectively decrease stereotypy. RIRD+Block condition was not only more effective in decreasing motor stereotypy, but sessions were shorter in duration when compared to DRA+RIRD. Because session time was paused during redirection time, several sessions during the DRA+RIRD condition lasted greater than 10 min or met the 20-min time cap. By contrast, all of RIRD+Block were less than 10 min in duration. Higher levels of stereotypy were seen during the response interruption procedure in the DRA+RIRD condition, than during the RIRD+Block condition. Higher and more stable rates of responding of beading were also seen in the RIRD+Block condition when compared to the other treatment conditions. Therefore, the inclusion of the blocking component was necessary for reducing Daniel's motor stereotypy. A

limitation of this study was that the task materials identified for Nathan were associated with object stereotypy. Future research target object stereotypy by assessing materials that are not associated with object stereotypy or by targeting object stereotypy in addition to the non-object directed forms of stereotypy. A Future research could also evaluate the effects of schedule thinning both during DRA alone (if effective) and during redirection. Because these procedures are associated with continued monitoring by a therapist, it would be helpful to determine whether reduced treatment integrity comprised intervention effects. Future research could also evaluate whether certain types of reinforcers may be more or less effective during differential reinforcement procedures. For example, leisure items may be more effective than edibles as a reinforcer for some participants.

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Figure 1. This figure represents the functional analysis data for all three participants.

Figure 2. This figure represents stereotypy data (top) and beading data (bottom) for Hannah.

Figure 3. This figure represents stereotypy data (top) and beading data (bottom) for Nathan.

Figure 4. This figure represents stereotypy data (top) and beading data (bottom) for Daniel.

Figure 5. This figure represents stereotypy data during the response interruption procedure for Daniel.

Figure 1

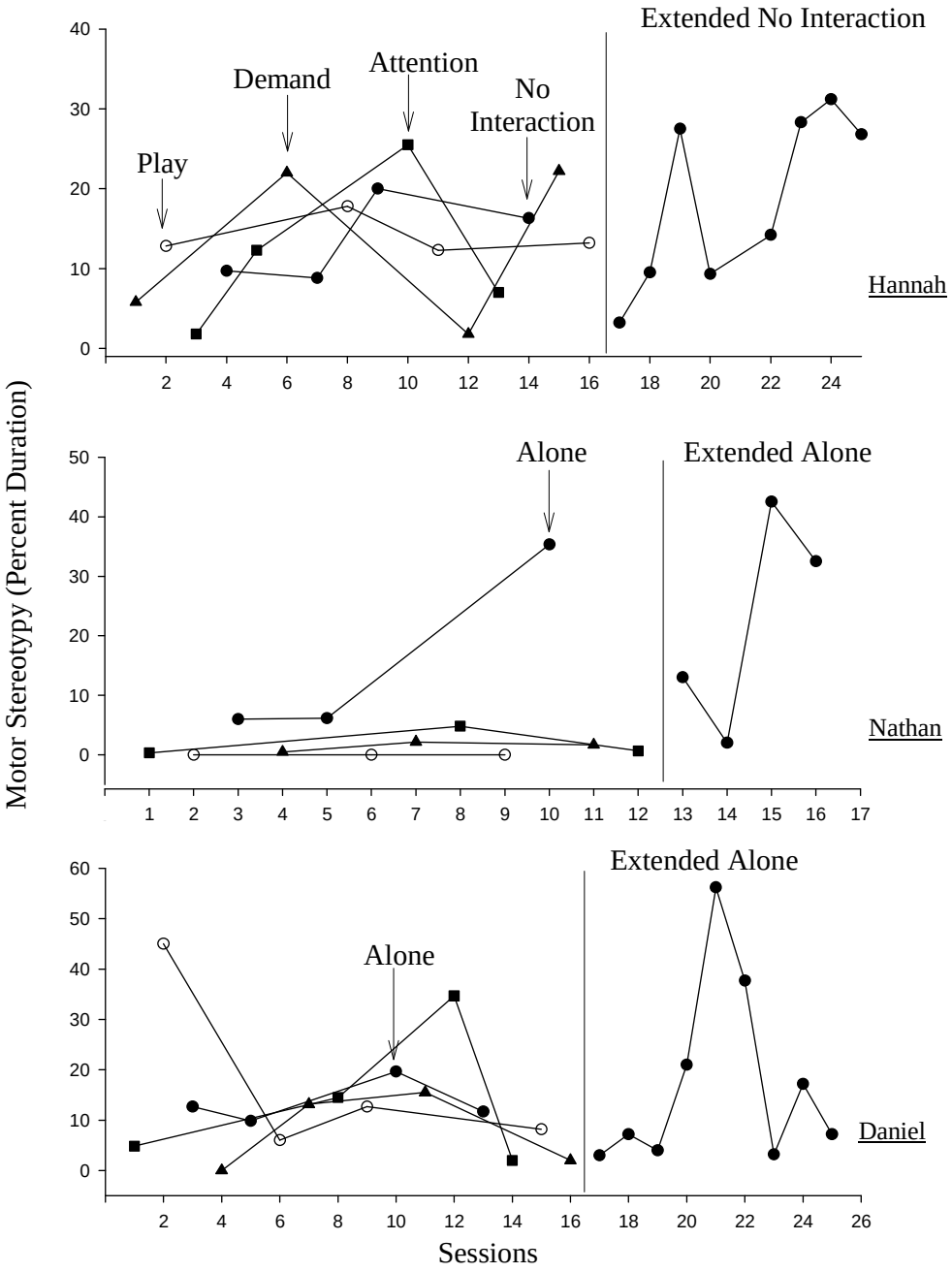

Extended No Interaction
Demand
Attention
No Interaction
Play
Hannah
Motor Stereotypy (Percent Duration)
Alone
Extended Alone
Nathan
Extended Alone
Alone
Daniel
Sessions

Figure 2

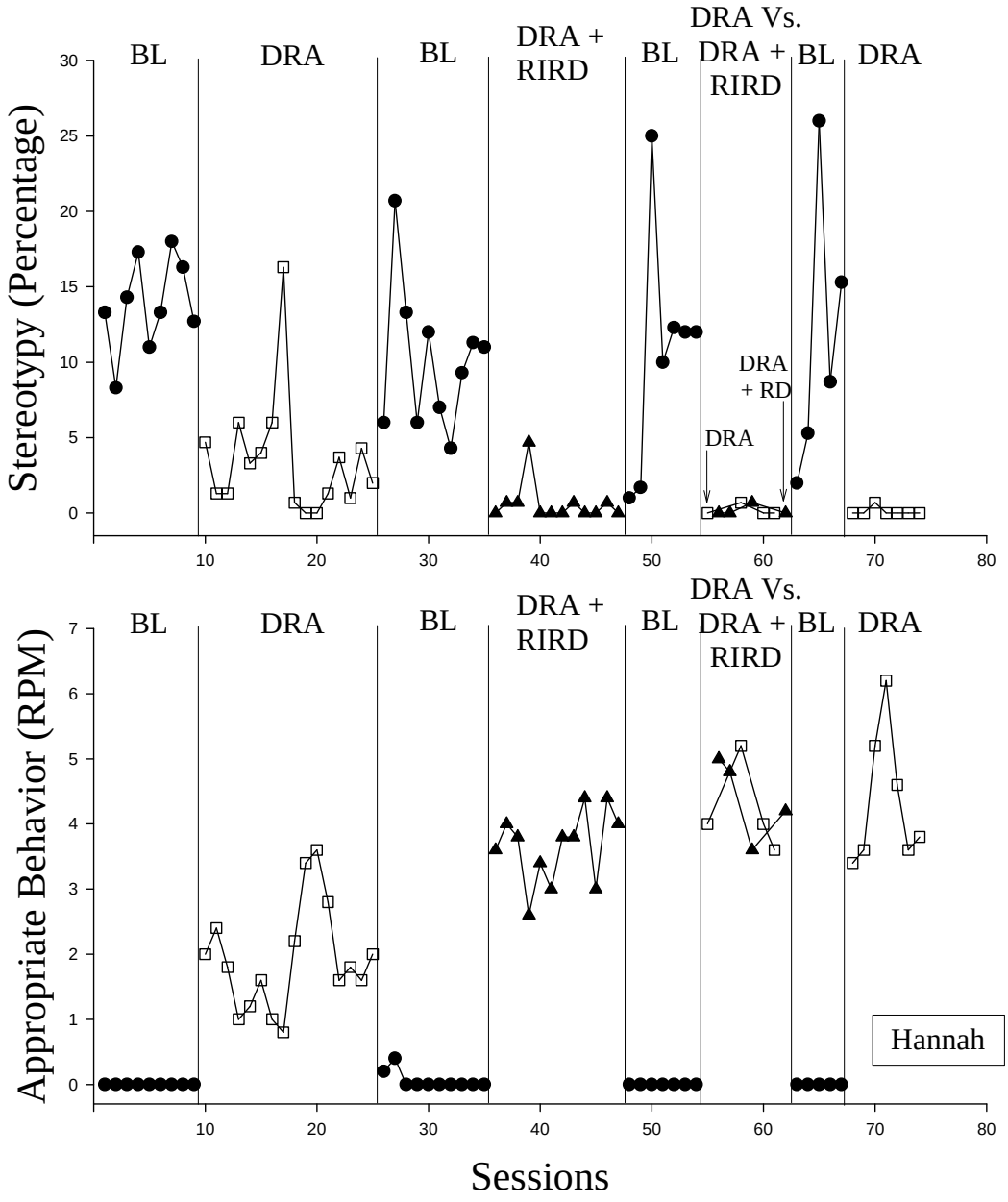

BL
DRA
BL
DRA + RIRD
BL
DRA Vs. DRA + RIRD
BL
DRA
Stereotypy (Percentage)
DRA + RD
DRA
Appropriate Behavior (RPM)
Hannah
Sessions

Figure 3

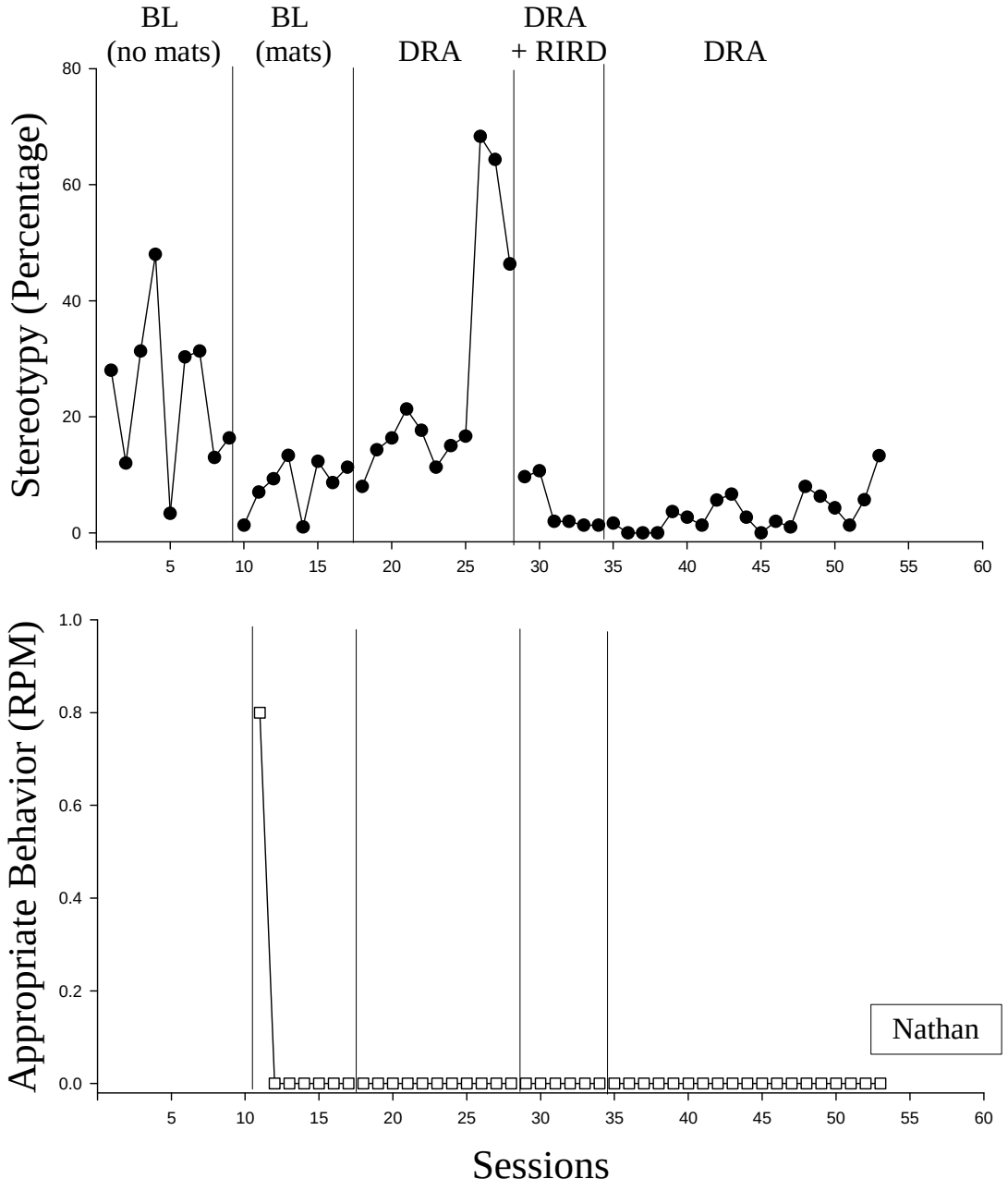

BL
(no mats)
BL
(mats)
DRA
DRA
+ RIRD
DRA
Stereotypy (Percentage)
80
60
40
20
0
5
10
15
20
25
30
35
40
45
50
55
60
Appropriate Behavior (RPM)
1.0
0.8
0.6
0.4
0.2
0.0
Nathan
Sessions

Figure 4

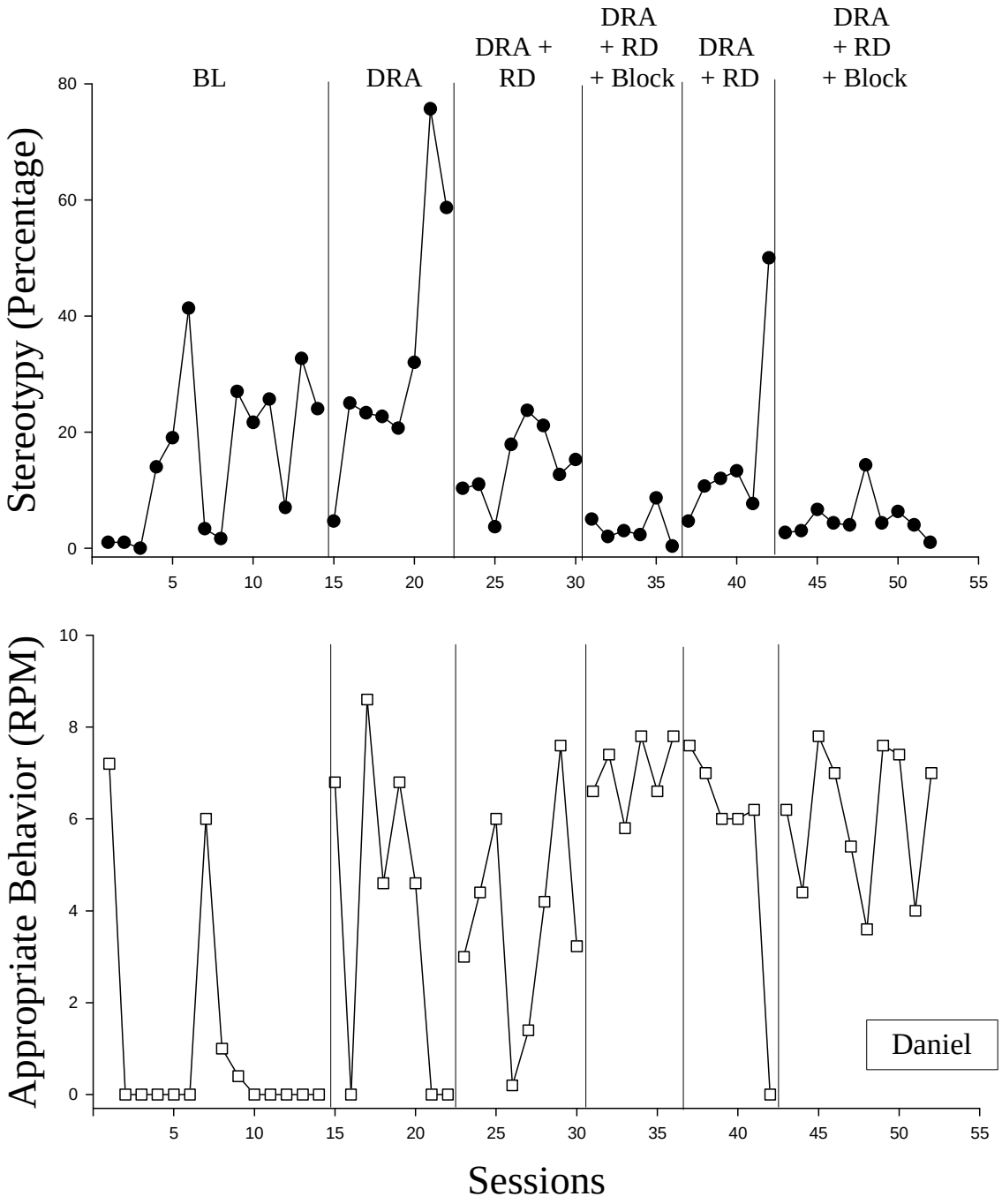
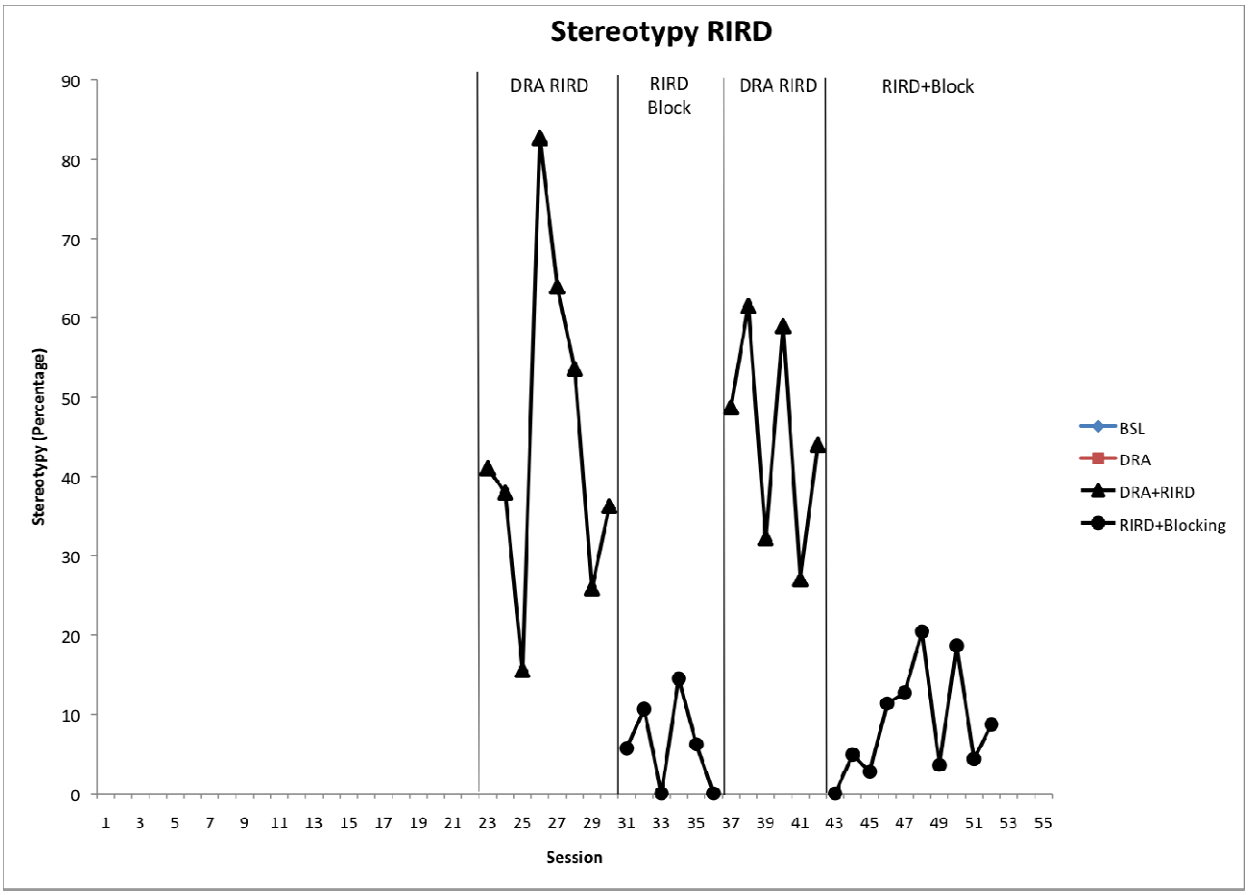

BL
DRA
DRA + RD
DRA + RD + Block
DRA + RD
DRA + RD + Block
Stereotypy (Percentage)
Appropriate Behavior (RPM)
Daniel
Sessions

Figure 5


Stereotypy RIRD
DRA RIRD
RIRD Block
DRA RIRD
RIRD+Block
Stereotypy (Percentage)
Session
BSL
DRA
DRA+RIRD
RIRD+Blocking