We conducted a series of reversals to compare the effects of four different treatments on vocal stereotypy emitted by a 7-year-old boy with autism. The results showed that (1) the level of vocal stereotypy decreased during exposure to matched stimulation but returned to high levels immediately upon its removal; (2) stereotypy did not significantly decrease during differential reinforcement of other behavior; and (3) contingent withdrawal of movies and music (i.e., response cost) was only moderately effective. However, positive practice overcorrection decreased vocal stereotypy by clinically significant levels. Further, when differential reinforcement of engagement in a Lego® building task was implemented, the level of engagement was significantly higher when positive practice overcorrection was in place than when overcorrection was withdrawn. Copyright © 2011 John Wiley & Sons, Ltd.

Stereotypic behavior is a behavioral excess commonly displayed by children with autism spectrum disorders (APA, 2000). Abatement of stereotypy has been a topic of inquiry in the applied behavior analytic literature for over 40 years, and several different procedures (e.g., matched stimulation, response cost, and differential reinforcement of alternative behavior [DRA]) have been shown to effectively reduce its frequency (Rapp & Vollmer, 2005). Recent studies have demonstrated a clinically significant abative effect of matched stimulation on subsequent rates of vocal stereotypy (Rapp, 2007). This procedure consists of the noncontingent presentation of stimulation with relevant properties matching the putative stimulation produced by the participant’s stereotypic behavior. For instance, if vocal stereotypy, such as repeated phrases from children’s stories, is thought to be maintained by the auditory stimulation it produces, the participant may be presented with matched auditory stimulation in the form of access to audio-recordings of children’s stories.

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Despite the apparent effectiveness of such treatments, the abative effect of matched stimulation during post-exposure conditions has usually been demonstrated only over brief time periods, and there is indication that controlled, non-conjuge perceptual stimulation may not produce an adequate abatement of automatically maintained behavior. That is, when produced perceptual stimulation does not correspond to ongoing stereotypic behavior, such stimulation often does not serve as an effective substitute for the stimulation produced by stereotypy (Falcomata, Roane, Hovanetz, Kettering, & Keeney, 2004; Rapp, Dozier, Carr, Patel, & Enloe, 2004; Taylor, Hoch, & Weissman, 2005). In cases in which matched stimulation does not produce clinically significant or lasting effects, positive practice overcorrection may be considered as an alternative. Earlier research (Foxx & Azrin, 1973; Harris & Wolchik, 1979) has shown positive practice overcorrection to be effective in reducing levels of stereotypy. Moreover, Harris and Wolchik reported that overcorrection was more effective than differential reinforcement, whereas Foxx and Azrin reported that it had a greater abative effect than either response-independent reinforcer delivery or punishment by slapping the child’s thigh. Since the 1970s, few researchers have examined the effects of overcorrection on stereotypy. One notable exception is the repetitive redirection components of response interruption and redirection procedures (RIRD; Ahearn, Clark, MacDonald, & Chung, 2007), which may be conceptualized as brief positive practice.

The current study extends the work of Foxx and Azrin (1973) by (1) evaluating the relative effectiveness of matched stimulation, differential reinforcement procedures, response cost, and overcorrection on stereotypy reduction; (2) extending the use of overcorrection from stereotypic movement to vocal stereotypy; and (3) evaluating levels of engagement in the Lego® building task with and without positive practice overcorrection.

METHOD

Participant, Setting, and Session Structure

A 7-year-old boy with a diagnosis of autism and a limited verbal repertoire participated in the study. Bob historically engaged in high frequencies of vocal stereotypy across all observed settings. Prior to the beginning of the study, Bob’s tutors conducted a curriculum placement assessment and began discrete trials teaching but had been unsuccessful in teaching new skills because of his nearly constant vocal stereotypy (i.e., Bob rarely responded to instructions while engaging in stereotypy).

The study was conducted in a room (2.8 m x 3.7 m), equipped with a one-way mirror, situated in a center for children with autism. Bob attended the center 6 h per day, 4 days per week. Sessions were 10 min in length for all conditions except the pairwise functional analysis, in which session duration was 20 min, and the ABA’ (pre-exposure,
exposure, and post-exposure) matched stimulation phase, in which sessions were 30 min long. We selected a 30-min session length during the ABA’ matched stimulation phase because it was presumed to present a higher likelihood that Bob would be satiated or habituated with regard to the presented stimulation, thereby decreasing motivation for auditory stimulation when it was withdrawn. Sessions were conducted throughout the entirety of Bob’s days of attendance, with the exception of 1 h for recess and lunch. Moreover, each intervention was in place for at least one full day. A total of 324 post-functional analysis sessions were conducted over a period of 6.5 weeks. On average, sessions totaled 270 min per day, comprising either 30-min or 10-min sessions, depending on the condition in effect.

Measurement and Interobserver Agreement

Vocal stereotypy was defined as the non-contextual emission of laughter and repetitive sounds and words, excluding all vocalizations during crying or tantrums. Bob’s stereotypy generally took the form of repeated phonemes with interspersed phrases from his preferred television programs. Engagement in the Lego® design task was defined as interacting with or visually scanning the task materials (Lego® blocks) without emission of vocal stereotypy.

Observers collected vocal stereotypy data using a partial-interval procedure. During all functional analysis sessions and the first 58 treatment sessions, a 1-min partial-interval recording method was used. That is, 1-min partial-interval recording was used during a portion of the very first intervention phase (see Figure 1) but not during other intervention phases. The 1-min interval was deemed too insensitive to detect changes in behavior, and a 10-s partial-interval recording method was used for the remainder of the study (i.e., sessions 59 through 324). Observers collected engagement data using a momentary time sampling method whereby the observer scored engagement for the first 2 s of every 10-s interval.

A second trained observer simultaneously but independently collected data on both dependent measures (i.e., stereotypy and engagement) during 49.2% of sessions. Interobserver agreement was calculated by dividing the number of agreements (intervals scored in an identical manner by both observers) during each session by the number of agreements plus disagreements and multiplying that value by 100 to arrive at a single value representing agreement for both vocal stereotypy and engagement. Mean interobserver agreement was 97.38% (range, 93.33–100%).

Experimental Design and Procedures

The effects of multiple intervention procedures on the level of Bob’s vocal stereotypy were compared using a series of reversals. No-interaction sessions were initially
compared with two forms of putatively matched stimulation in ABCACB order, then as pre-exposure and post-exposure in an ABA’ format (Simmons, Smith, & Kliethermes, 2003) to the single form of matched stimulation that had engendered lower levels (i.e., a recording of his own voice). The ABA’ format was chosen because it would allow for examination of the abative effect of matched stimulation not only during presentation but also following its removal when teaching would occur. The effects of music response cost, differential reinforcement of other behavior (DRO), and digital versatile disc (DVD) response cost were evaluated before the overcorrection procedure was added to DVD response cost. Finally, a DRA procedure, applied to a Lego® design replication task, was examined alone and when combined with overcorrection to evaluate relative levels of vocal stereotypy and task engagement. In all conditions, when music (MP3 player) or DVDs (portable DVD player) were presented, sound was delivered exclusively via headphones. Because it was highly unlikely that Bob was sensitive to rule governance (i.e., he had a limited verbal repertoire both as a listener and as a speaker), descriptions of the operating contingencies and instructions were not

Figure 1. Percent of intervals in which vocal stereotypy was scored during no-interaction, exposure to rock music, and exposure to a recording of his own vocal stereotypy, presented in ABCACB order. Note that 1-min partial-interval measurement was used in sessions 1–58, before switching to 10-s partial interval for the remainder of the study.
communicated to him at the start of each condition, except asking him, ‘which one do you want?’ during the DRO condition and ‘build this’ during the two conditions involving building Legos® (i.e., Overcorrection + DRA-Legos® and DRA-Legos®).

**Functional Analysis**

A pairwise functional analysis (Iwata, Duncan, Zarcone, Lerman & Shore, 1994a) consisting of alternating alone and no-interaction sessions was initially conducted to determine the function of Bob’s vocal stereotypy. During the alone condition, Bob was alone in the room, with no toys or materials, and vocal stereotypy did not result in programmed consequences. The procedures during the no-interaction condition were identical to those of the alone condition except that a therapist was in the room with Bob. The therapist did not interact with or look at Bob throughout the session. The level of vocal stereotypy was high and undifferentiated in both conditions, suggesting that it was automatically maintained (data available from first author upon request). Additional conditions were not included in the functional analysis because the level of stereotypy reached 100% of intervals during the final eight 20-min sessions. Because different functional analysis conditions (e.g., escape, attention, tangible) could not engender higher than 100% levels of stereotypy and would not have suggested the absence of an automatic function (Iwata et al., 1994b), such conditions were not implemented.

**No-interaction, Pre-exposure, and Post-exposure (88 Sessions)**

The experimenter was present in the room but looked at the floor throughout the session and did not interact with Bob. Vocal stereotypy did not result in programmed consequences. The room contained only a table and two chairs (i.e., no toys or activities were available). Contingencies in place during pre-exposure (12 sessions; see Figure 2), post-exposure (12 sessions; see Figure 2), no interaction (47 sessions during the ABCACB phase; see Figure 1), and no-interaction probe sessions (2 sessions; see Figure 4) were identical.

**Matched Stimulation (74 Sessions)**

Headphones connected to an MP3 player were placed over Bob’s ears, and sound files were played at maximum volume from the onset of each session, independent of Bob’s behavior. Moreover, vocal stereotypy did not result in programmed consequences. Both authors listened to music through this player set to maximum volume and judged that it was at a comfortable level and within the range of volumes most adults would select when listening to music. The presented sound was either music (rock and kids’ music) or a 5-min sample of Bob’s vocal stereotypy recorded with a TASCAM® DR-1 digital recorder (TEAC Corporation, Montebello, CA, USA). See Figures 1 and 2 for the
conditions in which sound files or each type were played. The sound files selected were those that the authors subjectively judged to be of relatively consistent volume throughout and with no breaks or pauses.

**Response Cost (36 Sessions)**

Bob was provided either kids’ music or a preferred DVD at the onset of each session. Preference was indicated by an informal, one-trial variant of the multiple-stimulus preference assessment method (a full description of the assessment method can be found under the differential reinforcement of other behavior section). Vocal stereotypy resulted in termination of the music or movie, which was re-presented contingent on 5 s without emission of vocal stereotypy.

**Differential Reinforcement of Other Behavior (91 Sessions)**

One minute of a DVD was played, and a preferred edible was delivered contingent on a specified period (5 s, 10 s, or 5 min) without stereotypy. Because watching a movie and eating were not incompatible with vocal stereotypy (i.e., Bob could still engage in vocal
stereotypy while watching a movie and eating and often did so), reinforcer consumption duration was not subtracted from session length. Preference for both movies and edibles (Skittles® or Cheetos®) was determined by placing either the available DVDs in their cases or edibles on the table in front of Bob before each session and asking ‘which one do you want?’ The first option Bob picked up or vocally manded for was used during that session. These particular DRO intervals were chosen to examine the difference in level of vocal stereotypy between two relatively modest intervals (5 s or 10 s) and 5 min, which was deemed to be a clinically significant target that would allow Bob to complete an acceptable amount of academic tasks.

**Overcorrection (20 Sessions)**

The experimenter physically guided Bob to make a ‘shush’ sign with his hand (i.e., by extending his index finger) and quickly raised it to his lips 100 times contingent on each occurrence of vocal stereotypy. Overcorrection implementation was not incompatible with the emission of vocal stereotypy. If Bob engaged in stereotypy during overcorrection, the number of repetitions was not increased or reset (i.e., there was no programmed consequence for such responding). When the duration of overcorrection was recorded by the experimenter, each implementation took between 30 and 40 s. The duration of implementation of overcorrection was not subtracted from session duration because Bob was still able to engage in vocal stereotypy during the implementation of overcorrection.

**Overcorrection + DRA-Legos® (21 Sessions)**

The experimenter placed an 8 × 10 cm picture of a four-piece Lego® design and the four corresponding Legos® on the table and delivered the instruction ‘build this.’ A set of 34 unique designs was presented in rotation. Overcorrection proceeded as in the previous overcorrection condition, and 1 min of preferred DVD plus a preferred edible were delivered if the design was completed in the absence of stereotypy. The purpose of this phase was to increase social validity by demonstrating that the probability of compliance with academic instructions would occur at an acceptable level when stereotypy was decreased.

**DRA-Legos® (12 Sessions)**

The aim of this phase was to examine the extent to which a clinically significant outcome could be accomplished without the use of punishment, increasing the probability that the intervention would be used following Bob’s eventual transfer to public school. The procedures were similar to those of the preceding condition but
without overcorrection. Lego® designs were presented as in the prior session. The experimenter simultaneously delivered 1 min of access to a preferred DVD and a preferred edible (such as Skittles® or Cheetos®) if the design was completed in the absence of stereotypy. For the initial five sessions in this phase, the experimenter dismantled the design and re-presented the task if stereotypy occurred. For the remaining sessions in this phase, the experimenter presented a new picture with corresponding Legos®. This procedural change was implemented after we observed that hand-to-hand contact during dismantling may have functioned similar to overcorrection.

RESULTS

Figure 1 displays the percentage of intervals in which vocal stereotypy occurred during the three session types during the ABCACB matched stimulation phase. Presentation of the voice recording had a greater abative effect than rock music, but as indicated by the level of stereotypy during no-interaction sessions, this effect was not durable, and stereotypy resumed immediately when the voice recording was removed (confirmed by analyzing the level of vocal stereotypy during the first minute of no-interaction sessions following exposure to matched stimulation). Figure 2 displays the level of vocal stereotypy during the ABA’ matched stimulation phase. Exposure to kids’ music had a greater abative effect than exposure to the voice recording, but the same lack of durability was encountered during the previous phase. Because it would be impractical to present music continuously and doing so would hinder teaching, matched stimulation was not a feasible treatment procedure.

As can be seen in Figure 3, response cost-(kids’) music did not produce an adequate decrease in stereotypy. With the exception of the last two sessions, stereotypy averaged at approximately 50% of the intervals during the response cost-kids’ music condition. Similarly, DRO did not produce an adequate decrease in stereotypy. The mean level of vocal stereotypy was 47.5% during the DRO 10-s phase, and mean level of stereotypy during the DRO 5-min probes was 80.5%, ranging from 68.3% to 98.3%.

Figure 4 shows that response cost-DVD produced levels of stereotypy at or below 5% of intervals during 9 of 22 sessions; however, the level of stereotypy was at or above 20% of intervals during six sessions. The introduction of overcorrection (Figure 4, second phase) resulted in zero or near-zero levels of vocal stereotypy during most sessions of that phase (less than 2% of intervals during 15 of 20 sessions), and greater stability was observed than during the preceding response cost conditions. Anecdotally, it is notable that Bob did not cry, engage in aggression, or forcefully resist the implementation of overcorrection. A no-interaction probe session produced an immediate return to high levels of stereotypy. When the Lego® design task was added, the percentage of intervals with stereotypy remained low, whereas the percentage of time samples with task
engagement was high. DRA-Legos® initially produced high rates of stereotypy and low probability of engagement. This pattern reversed following contact with confounding hand-over-hand dismantling of the design contingent upon stereotypy. When dismantling was discontinued, the rate of stereotypy increased, whereas engagement decreased. A final return to overcorrection resulted in a return to previous low levels of stereotypy and high levels of engagement. Mean engagement in the Lego® replication task was 92.8% of time samples during overcorrection compared with 58.6% during DRA sessions.

**DISCUSSION**

Although the recent literature indicates the effectiveness of treatments such as matched stimulation, DRA, and RIRD for vocal stereotypy, the current study suggests that positive practice overcorrection, which has received little experimental attention in recent years, might be necessary in some cases. The current findings systematically replicate the results of previous studies (Koegel & Covert, 1972; Risley, 1968), which suggest that abatement of stereotypy might be a necessary step toward training...
habilitative and academic behaviors. Thus, in some cases elimination of stereotypy should be a high-priority treatment goal, for which a range of treatment alternatives should be investigated.

The prevailing ethical stance within behavior analysis, as well as the Behavior Analyst Certification Board® (2010) Guidelines for Responsible Conduct (guideline 4.05) dictate that procedures based on positive reinforcement be attempted prior to punishment procedures (Bailey & Burch, 2005). Although we generally agree with such recommendations, it is important that clinicians not take such recommendations to an extreme and consider punishment as a viable treatment option only as a last-ditch effort to ameliorate serious risks to the client’s health. According to the functional definition of punishment laid out by Azrin and Holtz (1966), punishment is identified exclusively by an observed decrease in frequency of a behavior it is made contingent upon, and not painful stimulation or distress on the part of the organism (Hanley, Piazza, Fisher, Maglieri, 2005). As a case in point, in the current experiment the positive practice overcorrection procedure was easily implemented (e.g., Bob rarely resisted the

Figure 4. Percent of 10-s intervals in which vocal stereotypy was scored during DVD response cost, overcorrection, no-interaction probes (NI), overcorrection + DRA-Legos®, DRA-Legos®, and a return to overcorrection + DRA-Legos® sessions. Percent of time samples in which engagement was scored during overcorrection + DRA-Legos® and DRA-Legos® sessions.
implementation of overcorrection), had no apparent negative side effects (i.e., crying and aggression were not observed), and its duration of less than 45 s was on the low end of the range cited in reviews of the overcorrection literature (Miltenberger & Fuqua, 1981; Carey & Bucher, 1983).

These reviews of the overcorrection literature (Miltenberger & Fuqua, 1981; Carey & Bucher, 1983) have called for parametric analysis of overcorrection duration; however, a parametric analysis was not conducted in this case. It seems likely that the results of such an analysis would lack generality unless data were gathered over large numbers of participants and target behaviors, while acknowledging that the punishing potency of a given procedure and reinforcing potency of a given form of stimulation produced by stereotypy will vary considerably from individual to individual. As is the case with all reinforcers and punishers, the magnitude required to produce behavior change will depend on the history of the organism. Asking ‘how many repetitions of overcorrection are required to abate stereotypy?’ would be akin to asking ‘how large of an engine do you need to make a vehicle move?’ That said, the current study is an additional demonstration that punishment need not be of long duration or of high intensity to effectively treat problem behavior. Although habituation is possible when punishment intensity is gradually increased (Azrin, 1960), it may be most effective and ethical to begin by quickly probing brief durations of overcorrection when implementing such procedures to avoid overestimating the necessary duration.

For Bob, response cost-DVD resulted in comparatively lower levels of vocal stereotypy than response cost-kids’ music. It could be the case that watching a DVD is a more preferred activity than listening to music; therefore, termination of watching a movie is a more potent punisher than termination of listening to music. Alternatively, lower levels of vocal stereotypy during response cost-DVD could be related to the recent DRO history (DRO sessions started on session 153 and ended on session 243, for a total of 91 sessions). That is, it might be the case that having experienced the delivery of a preferred activity contingent on the absence of vocal stereotypy for 91 sessions somehow increased the aversiveness of the response cost procedure. Regardless, given that data from both response cost procedures were variable and the effects were not durable, overcorrection was used as an attempt to decrease vocal stereotypy.

One limitation of this study is that baseline data on level of engagement were not collected in the absence of both DRA and overcorrection contingencies. Instead, the effects of positive practice overcorrection on engagement were evaluated using a BAB reversal design, whereby B and A represent engagement during DRA with and without positive practice overcorrection, respectively. Given that engagement was high during the two phases with positive practice overcorrection but was low in its absence, it is reasonable to conclude that the reduction of Bob’s vocal stereotypy played a role in the increase in engagement with the Lego® replication task.
In summary, because matched stimulation, DRO, response cost, and DRA were ineffective and Bob’s limited verbal skills precluded the use of RIRD, positive practice overcorrection was evaluated and proved effective. Future research should examine variables that predict the efficacy and effectiveness of various treatment methods (Van Houten, 1987) so that practitioners may rapidly assess and select effective treatment for vocal stereotypy. For example, the identification of prerequisite components of the child’s verbal repertoire and reliable measures of preference for various forms of stimulation may aid in designing and choosing RIRD or matched stimulation procedures, respectively. Additional efforts should seek to expand our understanding of overcorrection, particularly as applied to treatment of vocal stereotypy, so that we may identify additional effective, empirically validated treatments (Van Houten et al., 1988) for clients who present stereotypy not abated by other procedures.

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