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ESTABLISHING STIMULUS CONTROL OF VOCAL STEREOTYPY DISPLAYED BY YOUNG CHILDREN WITH AUTISM

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We examined the vocal stereotypy of three boys who were diagnosed with an Autism Spectrum Disorder (ASD). Results of functional analyses indicated that each participant's vocal stereotypy was maintained by non-social consequences. For two participants, verbal reprimands were provided contingent on vocal stereotypy in the presence of a red card (RC). For the third participant, after verbal reprimands alone did not decrease vocal stereotypy, toys were withdrawn contingent on vocal stereotypy in the presence of the RC. For all three participants, vocal stereotypy was permitted without programmed consequences the presence of a green card (GC). The results showed that vocal stereotypy decreased in the presence of the RC for all three participants; however, vocal stereotypy came under inhibitory control of the RC for only one of the three participants. The potential utility of using punishment to develop stimulus control of automatically reinforced problem behavior in academic settings is briefly discussed. Copyright © 2009 John Wiley & Sons, Ltd.

A recent review of the behavioral literature concluded that most forms of stereotypy are maintained by automatic positive reinforcement (Rapp & Vollmer, 2005). That is, the results of most studies suggest that repetitive behavior displayed by individuals with various developmental disabilities was reinforced by the stimulation that was directly generated by the behavior (Lovaas, Newsom, & Hickman, 1987). Stereotyped behavior involving repetitive body movement or vocalizing is one of the defining characteristics of Autism Spectrum Disorders (ASDs: American Psychiatric Association, 2000). Based on the structural and functional definition of stereotypy provided by Rapp and Vollmer, repetitive vocalizing, echolalia, and 'acontextual' speech are forms of stereotypy because each involves topographically invariant and repetitious behavior that can be shown to persist in the absence of social consequences

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via functional analysis methodology (e.g., Iwata, Dorsey, Slifer, Bauman, & Richman, 1994/1982). An automatically or non-socially reinforced behavior is identified when said behavior persists at high levels (a) in an alone or a no-interaction condition (i.e., in the absence of social consequences) or (b) across multiple experimental conditions.

Several recent studies have shown that various antecedent and consequent interventions decrease vocal stereotypy in children with ASD (e.g., Ahearn, Clark, MacDonald, & Chung, 2007; Falcomata, Roane, Hovanetz, Kettering, & Keeney, 2004; Rapp, 2007; Taylor, Hoch, & Weismann, 2005). For example, Rapp found that non-contingent access to auditory stimulation decreased vocal stereotypy for two individuals. Conversely, Taylor et al. found that access to toys that generated auditory stimulation decreased an individual's vocal stereotypy only when such stimulation was provided contingent on the omission of vocal stereotypy. Whether competing stimulation is provided non-contingently or contingently, such interventions may be of limited utility in academic settings insofar as engagement with alternative stimulation may interfere with the child's or his or her classmates' engagement with academic activities. In this sense, engagement with alternative items may produce the same problems as engagement in vocal stereotypy. Therefore, research on additional interventions is needed to treat vocal stereotypy in educational settings.

In a recent review of the literature on punishment, Lerman and Vorndran (2002) concluded that the '. . .current knowledge about basic processes is insufficient for translation to application' (p. 456). In light of the field's incomplete understanding of punishment, Lerman and Vorndran indicated that punishment may be necessary to reduce some problem behavior to clinically acceptable levels. In part, the authors suggested that behavior analysts should further evaluate factors that promote generalization of behavior suppression that is produced with punishment. Given the field's insufficient understanding of punishment procedures, and the likelihood that verbal reprimands are employed by parents to treat problem behavior (e.g., Sloman et al., 2005), further research on the effectiveness of verbal reprimands for decreasing socially and non-socially reinforced problem behavior is warranted.

Some recent studies have used mild punishment to treat automatically reinforced vocalizing that was displayed by individuals with ASD. For example, Ahearn et al. (2007) used response interruption and redirection (RI + RD), during which participants were provided vocal demands (e.g., social questions) contingent on engagement in vocal stereotypy, to decrease vocal stereotypy that was displayed by four children. Although praise was delivered for appropriate vocalizing, RI + RD may be conceptualized as a positive punishment procedure. Similarly, after determining that non-contingent auditory stimulation decreased, but did not eliminate, an individual's automatically reinforced vocalizing, Falcomata et al. (2004) found that negative punishment in the form of contingent removal of auditory stimulation

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decreased vocalizing to near-zero levels. Although the Ahearn et al. and Falcomata et al. studies both demonstrated that automatically reinforced vocalizing decreased following treatment with punishment procedures, neither study evaluated the extent to which response suppression could be brought under stimulus control of an external stimulus.

If vocal stereotypy decreases with punishment, the suppressive effects may be enhanced if responding can be brought under stimulus control. Specifically, after repeated presentation of the punisher in the presence of an external stimulus, vocal stereotypy may be inhibited in the presence of that stimulus (see Rilling, 1977). Although vocal stereotypy is typically deemed inappropriate during periods of educational programming and socialization, studies have shown that contingent access to stereotypy can be used as a reinforcing event (e.g., Charlop, Kurtz, & Casey, 1990; Hanley, Iwata, Thompson, & Lindberg, 2000). Thus, eliminating a child's vocal stereotypy in one context and subsequently permitting the child to engage in vocal stereotypy in a different context may be of benefit to the child's educational programming. As a first step in this process, a salient stimulus could be presented during periods when vocal stereotypy will be punished and a different stimulus could be presented during periods when vocal stereotypy will not be punished. Thereafter, the former and latter stimuli may become discriminative for when vocal stereotypy is and is not acceptable.

Doughty, Doughty, O'Donnell, Saunders, and Williams (2007) recently reviewed the literature on stimulus control of punishment. Specifically, Doughty, Doughty et al. analyzed 56 basic and 11 applied studies to determine whether responding in each study was suppressed by a stimulus that was discriminative for punishment (S^{Dp}) or by the delivery of the first punishing stimulus (S^{P}) within a session. Doughty, Doughty et al. concluded that none of the applied studies conclusively demonstrated S^{Dp} control of the target behavior (but see McKenzie, Smith, Simmons, & Soderlund, 2008). The authors noted that the two most common limitations of applied studies were the absence of (a) a component where responding was analyzed in the presence of the antecedent stimulus (i.e., a putative S^{Dp}) without a punishment contingency and (b) a condition wherein the punishing stimulus was delivered on a fixed-time basis to evaluate whether decreases in the target behavior were a function of conditioned emotional responses (CERs).

As the guidelines employed by Doughty, Doughty, et al. (2007) were developed to control for the possibility that positive punishers (e.g., shock) elicited responses that were incompatible with the target response, the authors questioned the necessity of evaluating CERs with conditioned punishers. From a clinical standpoint, it is unlikely that response-independent delivery of aversive stimulation, unconditioned or conditioned, would be deemed ethical. Thus, it may be reasonable for an applied study involving mild or conditioned punishers to demonstrate S^{Dp} control without

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evaluating the effects of CERs. The issue of assessing CERs notwithstanding, it is clear from the Lerman and Vordran (2002) and Doughty, Doughty, et al. review articles that further research on the use of punishment and inhibitory stimulus control for treating automatically reinforced behavior is warranted.

The purpose of the current investigation was to extend the literature on the use of punishment and stimulus control of punishment by evaluating (a) the effects of verbal reprimands on vocal stereotypy, (b) whether an antecedent stimulus that was correlated with either positive or negative punishment developed inhibitory stimulus control of vocal stereotypy, and (c) whether vocal stereotypy increased in the presence of a stimulus that was correlated with no social consequences for engaging in vocal stereotypy.

STUDY 1: ANALYSIS OF OPERANT VARIABLES MAINTAINING VOCAL STEREOTYPY

Method

Participants and Settings

Three children diagnosed with ASD participated in this study. Al and Art were 8 year-old twin brothers who attended an 'autism classroom' within a public school district. Al and Art spoke in four- to five-word sentences and exhibited many academic skills (e.g., each could spell and read three letter words and complete two-digit addition and subtraction problems). They were referred by the school district for treatment of vocal stereotypy, which consisted primarily of phrases from movies. According to their teacher, this behavior distracted other children in the classroom and made it difficult to keep Al and Art on task. Brandon was a 5 year-old male who attended a University-sponsored autism center for 30 h/week and a normally developing pre-school for 3 h/week. He spoke in three- to four-word sentences and displayed many academic skills (e.g., he could spell and read three- to four-letter words and complete two- and three-digit addition and subtraction problems) and engaged in some non-vocal reciprocal play (i.e., exchanging toys with peers). Brandon's parents requested intervention because they believed that Brandon's vocal stereotypy was socially inappropriate. According to Brandon's teacher, the children in his pre-school labeled Brandon as being 'different' because of the high level of his vocal stereotypy. Brandon's vocal stereotypy consisted primarily of repetitive words or phrases that were provided in movies, computer games, or by his tutors.

All sessions for Al and Art were conducted in an isolated section of their classroom, which contained various toys and academic materials. The other children were removed from this section of the classroom when sessions were being conducted. The

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therapist, the participant, and a video camera were present during all sessions. Al and Art were assessed and treated separately. All sessions for Brandon were conducted in a room at the autism center. The room was furnished with a table and several chairs.

Data Collection, Dependent Variables, and Interobserver Agreement

The dependent variable for all three participants was the percentage of time engaged in vocal stereotypy. Vocal stereotypy was operationally defined as a vocal response that was (a) not appropriate to the context (e.g., reciting phrase from movies while in school) or (b) indistinguishable (i.e., could not be identified as a word or phrase) or repetitive (more than three repetitions of a word or phrase within 10 s). If the participants engaged in appropriate verbal behavior, the therapist reinforced those responses. For example, if a participant said 'tie my shoes', the therapist would then tie the participant's shoelaces. These types of responses rarely occurred. All sessions were 5 min in duration and were conducted two to three times per day (i.e., 3 to 5 sessions were conducted in a given day).

All sessions were videotaped and later coded using a real-time recording method (Miltenberger, Rapp, & Long, 1999). The target behavior was recorded if the individual engaged in the target behavior during a given second. Data from each 5 min session were then converted into the percentage of time the participant engaged in vocal stereotypy. A second observer independently scored 25% of the sessions. Interobserver agreement (IOA) was calculated on a second-by-second basis for the occurrence of vocal stereotypy by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. The mean IOA scores for Al, Art, and Brandon were 94% (range, 93–100%), 96% (range, 91–100%), and 96% (range, 94–100%), respectively.

Design and Procedure

A functional analysis, as described by Iwata et al. (1994/1982), was conducted to analyze the variables that may have contributed to the maintenance of each participant's vocal stereotypy. A multielement design was employed for all three participants. A description of each condition is provided below. A Demand condition was not conducted with Al and Art because they rarely experienced demands in their classroom.

In the No-interaction condition, the participant was placed in a room with a therapist but was not provided access to toys or attention. The purpose of this condition was to determine if vocal stereotypy persisted in the absence of social contingencies.

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During the Attention condition, brief attention in the form of a mild verbal reprimand was provided contingent on vocal stereotypy. For Al and Art, the reprimand 'no movie talk' was used because their parents and teacher often used this phrase as a consequence for vocal stereotypy. For Brandon, the reprimand 'quiet time' was delivered contingent on vocal stereotypy. The purpose of this condition was to determine if vocal stereotypy was maintained by social positive reinforcement in the form of verbal reprimands.

In the Demand condition (Brandon only), the therapist provided a verbal prompt to complete a given task (reading words and sentences). If Brandon did not respond within 5 s, the instruction was repeated and the therapist modeled the correct response. Praise was delivered contingent on correct responding. If Brandon engaged in vocal stereotypy during the task presentation, the therapist removed the task for 30 s. The purpose of this condition was to determine if vocal stereotypy was maintained by social negative reinforcement in the form of escape from educational tasks.

Last, in the Control condition, the participant was provided contingent access to preferred stimuli and attention from a therapist throughout the session. The purpose of this condition was to evaluate levels of vocal stereotypy in an enriched environment without demands.

Results and Discussion

The results of the functional analysis for each participant are shown in Figure 1. Al (upper panel) engaged in high levels of vocal stereotypy in the No-interaction condition ($M = 47.3\%$) and near-zero levels of vocal stereotypy in the Attention ($M = 4\%$) and Control ($M = 2\%$) conditions. Art (center panel) engaged in relatively high levels of vocal stereotypy in the No-interaction ($M = 27.1\%$) condition, but displayed lower levels of vocal stereotypy in the Attention ($M = 12.5\%$) and Control ($M = 11.3\%$) conditions. Brandon (lower panel) engaged in the highest levels of vocal stereotypy in the No-interaction ($M = 30.8\%$) condition, lower levels of vocal stereotypy in the Attention ($M = 18.3\%$) condition, and near-zero levels of vocal stereotypy in the Control ($M = 3.7\%$) and Demand ($M = 3\%$) conditions.

The high levels of vocal stereotypy in the No-interaction condition suggest that Al's vocal stereotypy was maintained by non-social reinforcement. For Art, vocal stereotypy was higher in the No-interaction condition in comparison to the Attention and Control conditions, which were relatively undifferentiated. These data suggest that Art's vocal stereotypy was also maintained by non-social reinforcement. Brandon also exhibited the highest levels of vocal stereotypy in the No-interaction condition when compared to the other conditions, suggesting that his behavior was also maintained by non-social reinforcement. For each participant, within-session patterns

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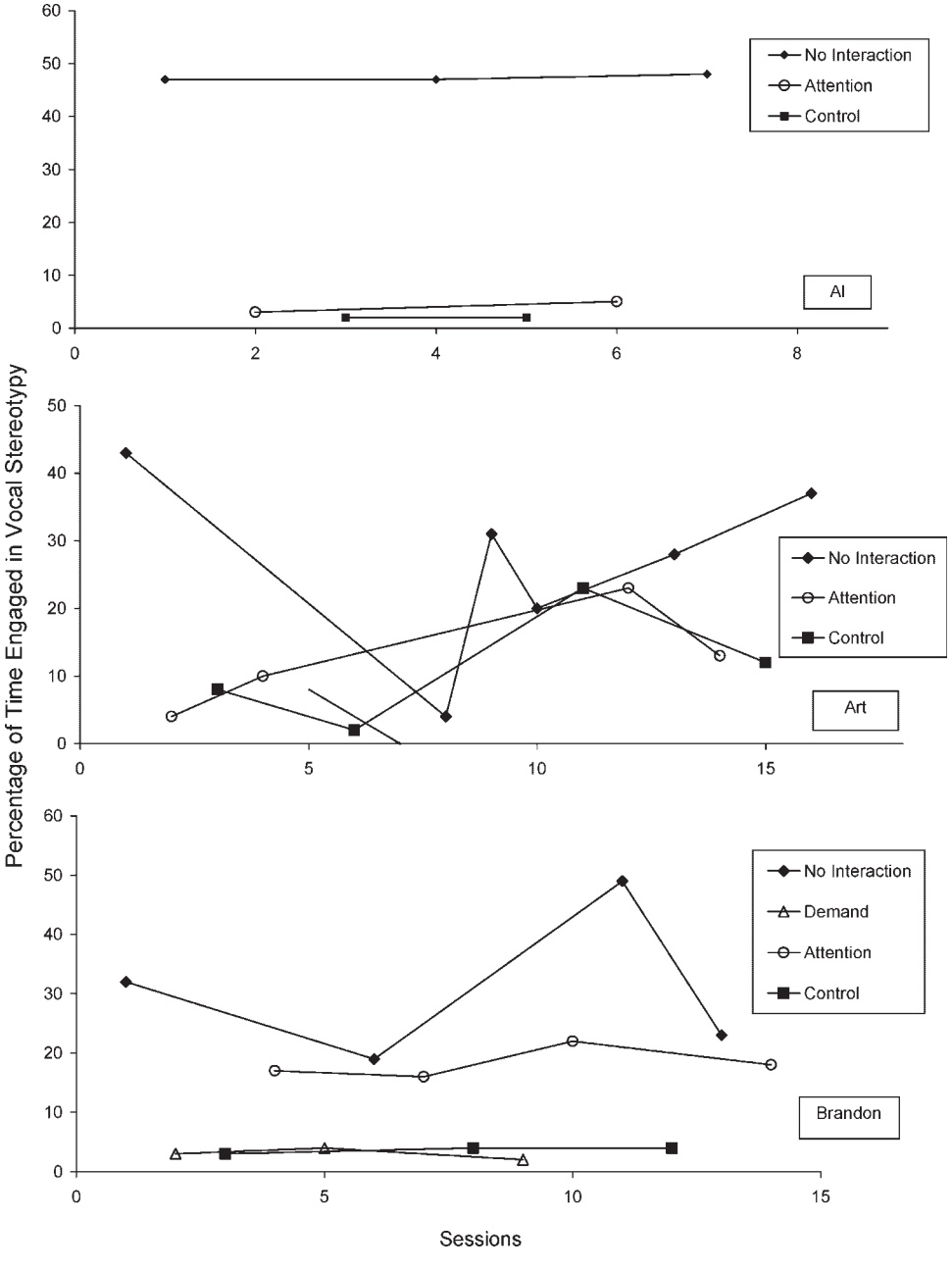

Figure 1. Percentage of time that Al (upper panel), Art (center panel), and Brandon (lower panel) engaged in vocal stereotypy across functional analysis conditions.

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of responding during the Attention condition indicated that the interresponse times for bouts of vocal stereotypy increased when verbal reprimands were provided. Likewise, levels of vocal stereotypy were lower in the Attention condition than in No-interaction condition. Together, these patterns suggested that contingent verbal reprimands may be an effective intervention for decreasing each participant's vocal stereotypy.

STUDY 2: STIMULUS CONTROL WITH POSITIVE PUNISHMENT

In a recent study, Doughty, Anderson, Doughty, Williams, and Saunders (2007) used a multiple schedule design to evaluate whether stimulus control of punishment could be acquired by an external stimulus for three individuals who displayed various forms of stereotypy. During the no punishment component, two participants wore wrist bands and a third participant was positioned toward a blue wall. During the punishment component, the wrist bands were removed from the first two participants, the third participant was positioned toward a red wall, and a 'hands down' procedure was implemented contingent on each participant's engagement in stereotypy. As responding was eventually suppressed in the punishment component for each of the participants, Doughty, Anderson et al. concluded that each participant's stereotypy was under S^{Dp} control rather than S^{P} control (i.e., control of the first application of punishment). Similarly, McKenzie et al. (2008) showed that an individual's automatically-reinforced eye poking was under S^{Dp} control in multiple settings when she wore wrist bands that were correlated with contingent verbal reprimands.

Although S^{Dp} control of vocal stereotypy may be preferable to S^{P} control because less effort and supervision are needed to maintain zero or near-zero levels of behavior, control of automatically reinforced behavior with either process may still yield clinically relevant behavior changes. The purpose of this study was to extend the findings of Doughty, Anderson et al. (2007) and McKenzie et al. (2008) by determining if vocal stereotypy displayed by two individuals with ASD could be brought under S^{Dp} control of a visual stimulus.

Method

Participant and Setting

Al and Art participated in this study. All sessions were conducted in their respective classroom using the 'no-interaction' context as described in Study 1.

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Data Collection and Dependent Variables

Data were collected in the same manner as described in Study 1. The definition of vocal stereotypy was also the same as in Study 1. A second observer independently scored 25% of the sessions for Al and Art; the mean IOA scores were 97% (range, 89–100%) and 99% (range, 95–100%), respectively.

Design and Procedures

A combination of a non-concurrent multiple baseline across participants with a multielement and a reversal design was employed to evaluate the effects of verbal reprimands on vocal stereotypy for Art and Al. In the baseline phase, vocal stereotypy was evaluated in the presence of a red card (RC) and a green card (GC). Following the baseline phase, a treatment phase was conducted wherein verbal reprimands were provided contingent on vocal stereotypy in the RC condition and no consequences were provided in the GC condition. For Al, the contingencies were removed during the second baseline phase and re-implemented for the final treatment phase. Art's vocal stereotypy was also evaluated during three 'no-card' (NC) probes in the treatment phase. Sessions without stimulus cards were conducted with Art in an attempt to simulate an environment wherein social consequences for vocal stereotypy were not clearly signaled. On each day, conditions were conducted in a semi-random order.

Baseline. During the RC condition, each session began when the therapist held the RC where is could be seen by the participant and said 'red time, no movie talk'. In the GC condition, the therapist held the GC where it could be seen and said 'green time'. During both conditions, no social consequences were provided for vocal stereotypy or other behavior.

Treatment. During the RC condition, each session began when the therapist held the RC where it could be seen by the participant and stated 'red time, no movie'. The card remained visible for the duration of each session. Likewise, contingent the participant's engagement in vocal stereotypy, the therapist held up the RC where it could be seen by the participant (in the event the participant turned away from the therapist) and said 'red time, no movie talk'. The purpose of the RC condition was to evaluate vocal stereotypy in the presence of the RC when verbal reprimands were delivered on a continuous schedule. The GC condition was conducted in the same manner as in the baseline phase. The purpose of this condition was to assess the level of vocal stereotypy in the presence of a stimulus that had no history of being paired with verbal reprimands. No-card probes were also conducted where a card was *not* presented to Art at the beginning of the session and no social consequences were provided for vocal stereotypy. The purpose of this condition was to evaluate vocal stereotypy in a context more similar to Art's natural

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environment (i.e., one void of cards) and to determine if his vocal stereotypy increased in the GC condition relative to the NC condition.

Results and Discussion

Figure 2 shows the results of the treatment evaluation for Art (upper panel) and Al (lower panel). In the baseline phase, Art's vocal stereotypy was high and undifferentiated across the RC ($M = 53.5\%$) and GC ($M = 51\%$) conditions. In the treatment phase, vocal stereotypy decreased sharply during the RC condition ($M = 4.3\%$), but was high and variable during the GC ($M = 19.4\%$) condition and in the NC probes ($M = 19.3\%$).

The results of treatment evaluation for Al are also depicted in Figure 2 (lower panel). In the baseline phase, levels of Al's vocal stereotypy in the RC ($M = 21.5\%$) and GC conditions ($M = 27.7\%$) were relatively undifferentiated. During the treatment phase, vocal stereotypy decreased in the RC condition ($M = 5.1\%$) and increased in the GC condition ($M = 47\%$). In the subsequent baseline phase, vocal stereotypy increased and became undifferentiated in the RC ($M = 35.4\%$) condition and became variable in the GC condition ($M = 43.4\%$). Following the re-introduction of the treatment phase, vocal stereotypy decreased again in the RC condition ($M = 4.7\%$), but continued at baseline levels in the GC condition ($M = 23.2\%$).

The results for Al and Art suggest that verbal reprimands punished vocal stereotypy during the RC condition. As vocal stereotypy was never suppressed in three consecutive RC sessions for either participant, vocal stereotypy did not appear to be under S^{Dp} control. Instead, the delivery of the first reprimand or the combination of the delivery of the first reprimand in the presence of the RC may have signaled that verbal reprimands were forthcoming contingent on vocal stereotypy. Thus, the vocal stereotypy of both participants appeared to be under S^{P} control.

For Al, a substantial increase in vocal stereotypy was observed in the last two sessions of the GC condition in the first treatment phase. This pattern suggests that the GC may have signaled the absence of punishment. This finding is consistent with the increase in stereotypy observed by Rollings and Baumeister (1981) when a light that was associated with the absence of punishment was illuminated. Alternatively, it is possible that the high levels of in vocal stereotypy that were observed during the last two sessions of the GC condition may be a result of deprivation (for the product of vocal stereotypy) that was imposed when reprimands were delivered for vocal stereotypy in the RC condition (see Rapp, 2007). A handful of studies, which did not employ specific antecedent stimuli, have found that automatically reinforced behavior often increases following periods of response restriction or reduction (e.g., Himle, Woods, Concelea, Bauer, & Rice, 2007; Rapp, Vollmer, Dozier, St. Peter, & Cotnoir, 2004; Rapp, 2006, 2007). Therefore, it is not clear whether the GC developed

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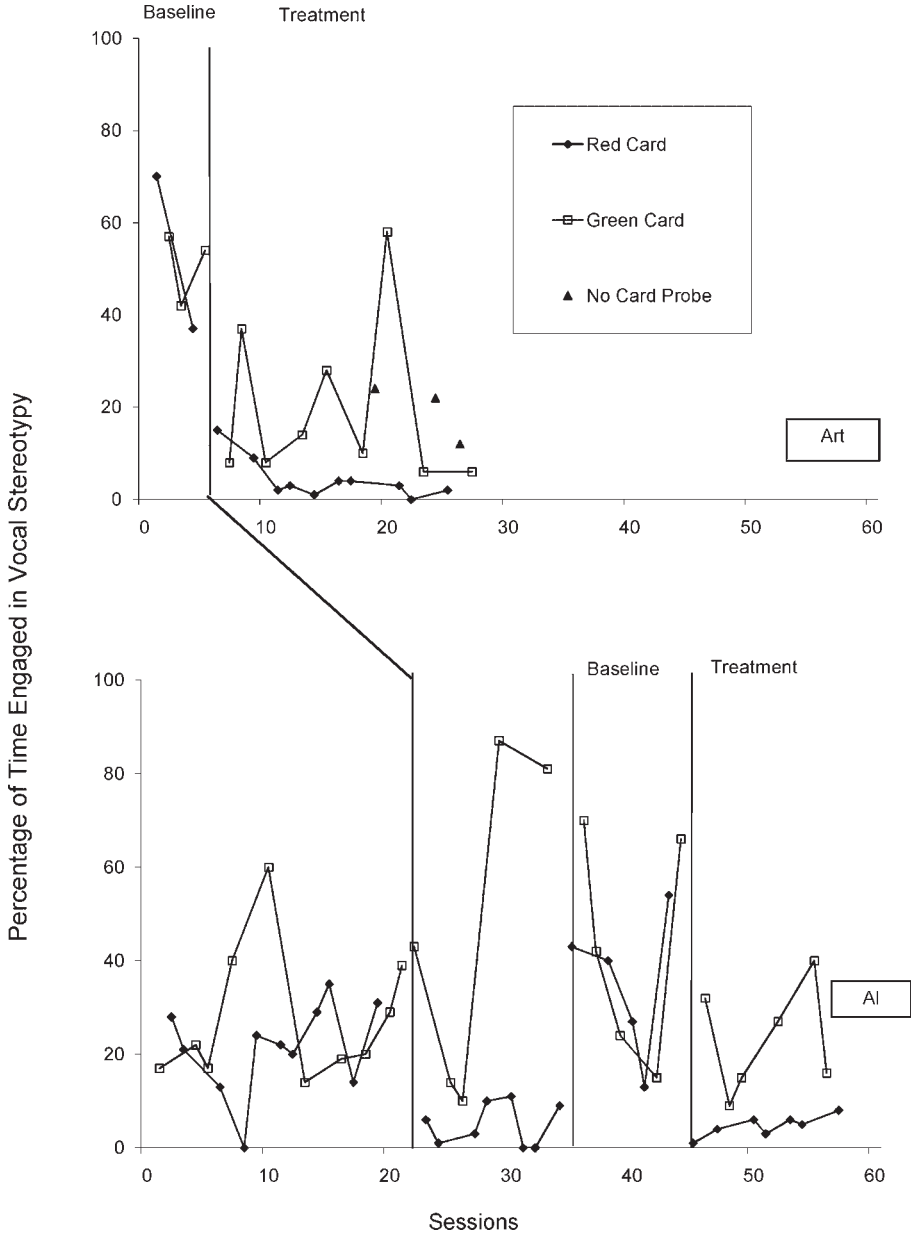

Figure 2. Percentage of time that Art (upper panel) and Al (lower panel) engaged in vocal stereotypy across baseline and treatment phases during the red card, green card, and no card conditions (Art only).

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evocative properties for Al's vocal stereotypy as a result of the consequences that were delivered in the presence of the RC. Nonetheless, the results for Art showed that the levels of his vocal stereotypy were high and undifferentiated in the GC and NC conditions, which suggests that the GC did not acquire evocative properties for his vocal stereotypy.

Although verbal reprimands reduced both participants' vocal stereotypy, the methodology used in this study did not allow for a complete analysis of stimulus control. In fact, permitting vocal stereotypy in the presence of the RC during the reversal phase likely weakened the association between the RC and verbal reprimands. Additionally, vocal stereotypy was not assessed in the absence of a stimulus card for Al or in the presence of the RC without the punishment contingency for either participant. As a whole, the fact that neither Al's nor Art's vocal stereotypy was suppressed for three consecutive sessions suggests that responding was controlled, at least in part, by the delivery of the first punisher.

STUDY 3: STIMULUS CONTROL WITH NEGATIVE PUNISHMENT

Falcomata et al. (2004) found that negative punishment in the form of brief removal of preferred auditory stimulation decreased automatically reinforced vocalizing. Although not explicitly stated in the Falcomata et al. study, the results suggest that inappropriate vocalizing was not under S^{Dp} control because no specific stimulus was presented when punishment was provided. Thus, the participant's vocalizing was likely under S^{P} control. The purpose of this study was to determine if S^{Dp} control of Brandon's vocal stereotypy could be acquired with a negative punishment procedure after verbal reprimands were found to be ineffective for decreasing his vocal stereotypy. In addition, we conducted generalization probes in Brandon's classroom to further evaluate the extent to which suppression of vocal stereotypy could be obtained with the RC in the absence of punishment.

Method

Participant and Setting

Brandon participated in this study. All sessions were conducted in an 2.5 m × 4 m room in the 'no-interaction' context. Generalization probes were conducted in a classroom (4 m × 4 m) where Brandon received educational training.

Data Collection and Dependent Variables

Data were collected in the same manner as in study 1. The definition of vocal stereotypy was also the same as described in study 1. A second observer scored 25%

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of the sessions. The mean IOA score for Brandon's vocal stereotypy was 95% (range, 94–100%).

Design and Procedures

The effects of verbal reprimands and, subsequently, contingent removal of preferred stimulation on Brandon's vocal stereotypy were evaluated using a combined multi-element and ABCDD'B' design. Conditions were conducted in a semi-random order within each phase. To assess for the possible generalization of treatment effects to Brandon's natural environment, generalization probes were conducted with each condition in the first baseline phase and the last treatment phase.

Baseline. In this phase, vocal stereotypy was assessed in three conditions. The GC and NC conditions were conducted as described in study 2. In the RC condition, the therapist held a RC where it could be seen by Brandon and said 'red card, quiet time' at the beginning of each session. No social consequences were provided for vocal stereotypy in any of the three conditions. Baseline probes were collected in Brandon's treatment room in the presence of his tutor and a therapist. Each probe session (RC, GC, and NC) was conducted in a manner that was identical to the respective condition.

Treatment 1 (T1). In this phase, the GC and NC conditions were identical to the baseline phase and remained the same throughout the subsequent treatment phases. In the RC condition, the therapist began each session by holding up the RC where it could be seen by Brandon and stating 'red card, quiet time'. Thereafter, the therapist repeated this statement contingent on each instance of vocal stereotypy.

Treatment 2 (T2). This phase was implemented after the 'quiet time' reprimand failed to produce clinically significant reductions in vocal stereotypy. In this phase, the RC condition was identical to the RC condition in the T1 phase except that a potentially more aversive verbal reprimand (in the form of the statement 'red card, no talking') was delivered contingent on vocal stereotypy.

Treatment 3 (T3). When the RC condition in the T2 phase did not produce further reductions in vocal stereotypy, the 'quiet time' reprimand was re-instituted with a response cost contingency for vocal stereotypy. In this phase, Brandon was provided access to a preferred toy during the RC condition. Prior to each session, a single-trial multiple-stimulus preference assessment was conducted with 6 toys (see Carr, Nicolson, & Higbee, 2000). Accordingly, the first stimulus that was touched or vocally requested was used during the respective session. At the beginning of each

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session, the therapist held up the RC and said 'red card, quiet time'. Subsequently, the reprimand was repeated and the preferred toy was removed for 10 s contingent on each instance of vocal stereotypy. If Brandon engaged in vocal stereotypy during the 10-s interval, the toy was withheld for an additional 10 s for each occurrence. During this phase, a no-card-toys (NC-T) probe was also conducted. This condition was the same as the NC condition, except that Brandon had access to 6 toys throughout the session. The purpose of this condition was to evaluate whether the mere availability of alternative stimulation (i.e., reinforcer competition) decreased Brandon's vocal stereotypy.

Treatment 3′ (T3′). As the ultimate goal of the intervention was to bring responding under the control of the RC, the toys were faded from the RC condition. In this phase, toys were placed in a box (the toys were visible to Brandon), but Brandon was not allowed to interact with the toys during the session. Contingent on instances of vocal stereotypy, the therapist delivered the verbal reprimand 'red card, quiet time'. At the end of each session, Brandon was allowed to interact with the toys for approximately 60 s. During this phase, the NC-T probes were identical to those used in the T3 phase. This phase evaluated whether the verbal reprimand punished vocal stereotypy after a history of pairing with contingent removal of toys (see Vorndran & Lerman, 2006).

Treatment 1′ (T1′). All conditions in this phase were conducted in the same manner as described in the Treatment 1 phase. The RC condition differed only to the extent that the RC was recently paired with contingent removal of toys in the T3 phase. Sessions with the GC, RC, and NC generalization probes were conducted as in the baseline phase.

Results and Discussion

Figure 3 shows the levels of Brandon's vocal stereotypy across all phases with the RC, GC, and No Card conditions (upper panel) and across all phases with the RC condition and all probes sessions (lower panel). Figure 3 shows that in the initial baseline phase, Brandon's vocal stereotypy was high and variable during the RC ($M = 29.9\%$), GC ($M = 26.9\%$), and NC ($M = 16.6\%$) conditions (upper panel) and during the RC ($M = 34.3$), GC ($M = 27.3\%$), and NC ($M = 25.3\%$) generalization probes (lower panel). During the T1 phase, differentiation between conditions emerged after approximately five sessions were conducted with each condition. As in the baseline phase, variable levels of vocal stereotypy persisted in the GC ($M = 28.9\%$) and NC conditions ($M = 28.7\%$); however, vocal stereotypy decreased but was not suppressed in the RC condition ($M = 13.9\%$). During the T2 phase,

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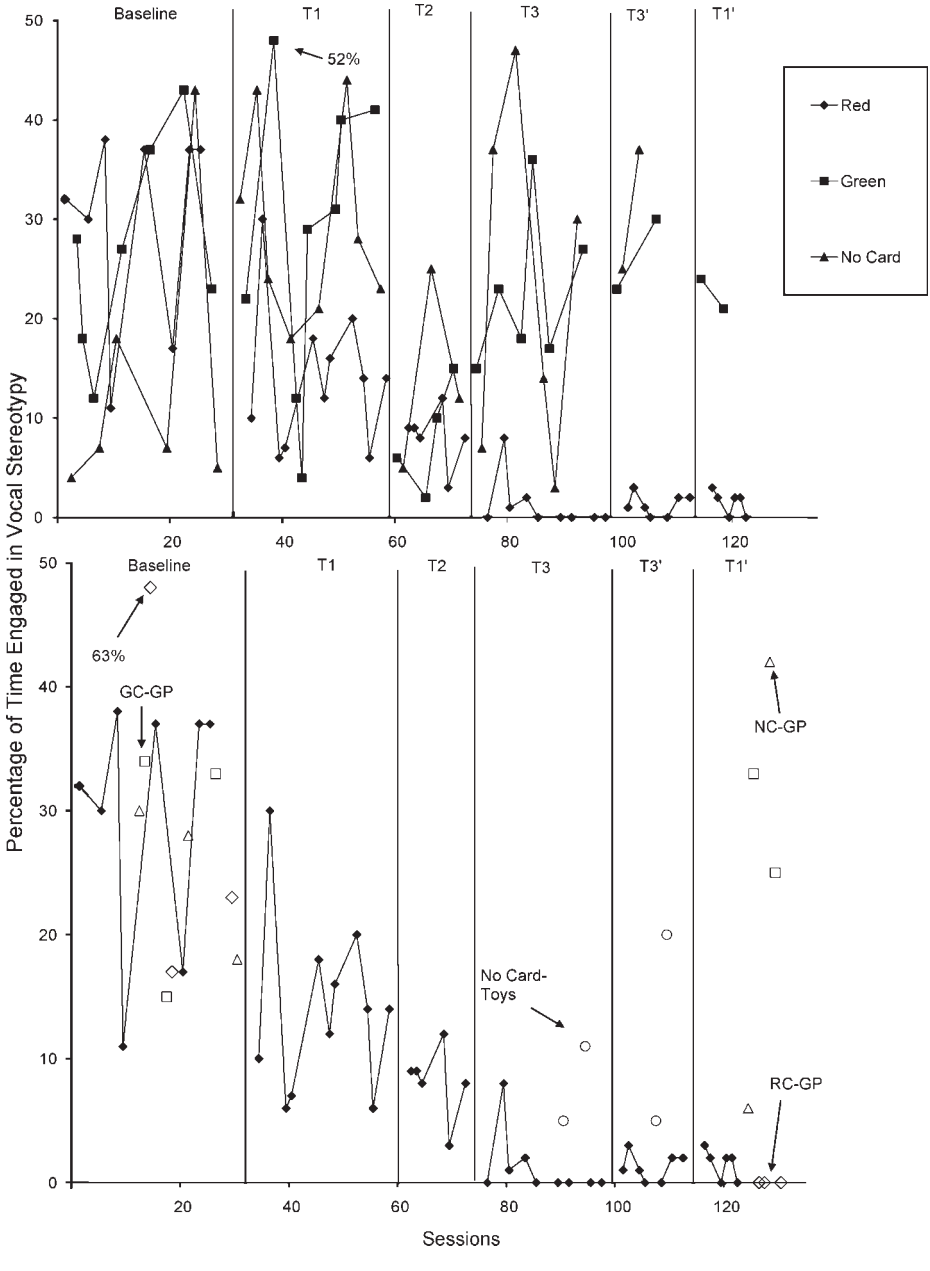

Figure 3. Percentage of time that Brandon engaged in vocal stereotypy across all phases with the red card, green card, and no card conditions (upper panel) and across all phases with the red card condition, the no card-toys probes, and the red-card generalization probe (RC-GP), green-card generalization probe (GC-GP) and no-card generalization probe (NC-GP) sessions (lower panel).

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Brandon's vocal stereotypy decreased across the RC ($M = 8.2\%$), GC ($M = 8.3\%$), and NC ($M = 14\%$) conditions and became undifferentiated across the three conditions.

Following the implementation of the T3 phase, vocal stereotypy decreased and was ultimately suppressed in the RC condition ($M = 1.2\%$); however, vocal stereotypy continued at high levels in the GC ($M = 22.7\%$) and NC ($M = 23\%$) conditions and at low levels in the in the NC-T probe sessions ($M = 8\%$). In the T3′ phase, vocal stereotypy persisted at high levels in the GC ($M = 26.5\%$) and NC ($M = 31\%$) conditions and at lower levels in the NC-T probe sessions ($M = 12.5\%$), but remained at near-zero levels during the RC condition ($M = 1.3\%$). In the T1′ phase, Brandon's vocal stereotypy persisted in the GC ($M = 22.5\%$) and NC ($M = 39\%$) conditions, but remained at near-zero levels in the RC condition ($M = 1.2\%$). Likewise, Brandon's vocal stereotypy remained at high levels during the GC ($M = 29\%$) and NC ($M = 24\%$) generalization probes, but was suppressed during the RC generalization probes.

As a whole, Figure 3 shows that vocal stereotypy decreased across phases in the RC condition and persisted in the GC condition. Specifically, the figure shows that Brandon's vocal stereotypy was suppressed for five consecutive sessions in the RC condition during the T3 phase. In addition, Figure 3 (lower panel) shows that levels of vocal stereotypy were high and undifferentiated across conditions in the baseline and T1′ phases, except in the RC condition of the latter phase wherein vocal stereotypy was suppressed for three consecutive sessions. Furthermore, the figure shows that Brandon's vocal stereotypy decreased but was not suppressed in the NC-T probe sessions during the T3 and T3′ phases.

Initially, treatment data for Brandon indicated that neither form of verbal reprimand (T1 and T2 phases) was an effective punisher of his vocal stereotypy. Ultimately, Brandon's vocal stereotypy was suppressed in RC condition of the T3 phase after preferred items were removed contingent on vocal stereotypy. The fact that Brandon engaged in vocal stereotypy during the NC-T probe sessions suggests that the suppression of vocal stereotypy in the RC condition cannot be attributed to reinforcer competition. As Brandon essentially abstained from vocal stereotypy in order to retain access to toys, it is likely that the product of manipulating toys was more preferred than the product of vocal stereotypy (at least in this context). Interestingly, the verbal reprimand from the T1 phase became a more effective punisher of vocal stereotypy after it was paired with contingent toy removal. Overall, the results in the T3 and T1′ phases suggest that Brandon's vocal stereotypy was under S^{Dp} control of the RC. By contrast, the results in the T3′ phase suggest that Brandon's vocal stereotypy was under S^{P} control of verbal reprimands. The results of this study replicate and extend those from the Doughty, Doughty et al. (2007) and McKenzie et al. (2008) studies by showing that negatively punished automatically-reinforced behavior came under S^{Dp} control.

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GENERAL DISCUSSION

The results of study 1 showed that each participant's vocal stereotypy persisted in the absence of social consequence. The results of study 1 are consistent with prior studies, which showed that repetitive vocalizations exhibited by children with ASD were automatically reinforced (Ahearn et al., 2007; Falcomata et al., 2004; Rapp, 2007; Taylor et al., 2005). The results of study 2 showed that verbal reprimands were effective in decreasing vocal stereotypy for Al and Art. Although S^{Dp} control of vocal stereotypy was not achieved with either participant, the results of the treatment evaluations for Al and Art are consistent with those from a study by Richman, Lindauer, Crosland, McKerchar, and Morse (2001), which showed that the punishing effects of verbal reprimands on automatically reinforced behavior were predicted by lower levels of problem behavior in the Attention condition relative to the No-interaction condition of a functional analysis.

The results of study 3 showed that verbal reprimands did not suppress Brandon's vocal stereotypy until verbal reprimands were paired with contingent toy removal (i.e., negative punishment). Based on the criteria established by Doughty, Doughty et al. (2007), only Brandon's vocal stereotypy came under S^{Dp} control of the RC. To this end, it is possible that the suppression of vocal stereotypy was enhanced by the toys in the T3 phase. Nevertheless, the toys were not available during the T1′ phase. Thus, Brandon's vocal stereotypy was suppressed in the presence of the RC, without an ongoing punishment contingency or access to toys, during three generalization-probe sessions. It is not clear why suppression of vocal stereotypy occurred in the RC generalization probes in T1′ phase after low levels of vocal stereotypy were observed in two of the three preceding sessions in the RC condition. It is possible that the high levels of vocal stereotypy in the GC generalization probes sessions produced an abolishing operation (i.e., satiation for vocal stereotypy) that altered the value of the product of vocal stereotypy in the subsequent RC probe sessions and facilitated the inhibitory effects of the RC.

The results for Al and Art suggest that the RC, alone, did not inhibit vocal stereotypy (i.e., each participant engaged in low levels of vocal stereotypy in nearly every session). As suggested by Doughty, Doughty, et al. (2007), it is possible that the first instance of punishment exerted stimulus control over subsequent responding within the RC condition. This possibility could have been further evaluated if reprimands had been delivered in the absence of the RC. If comparable levels of responding were observed in the absence of the RC, it would suggest that the delivery of punishment controlled responding. From a clinical standpoint, S^{Dp} control is probably more desirable than S^{P} control for parents and educators because problem behavior is essentially absent and additional consequences are obviated. Nevertheless, S^{P} control involving the combination of an external stimulus and

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the first delivered punisher may decrease the number of consequences that a teacher or trainer needs to provide in order to maintain low levels of problem behavior during training segments. Thus, both S^{Dp} control and S^{P} control of automatically reinforced behavior may be useful in educational settings.

The results of this study contribute to the literature on punishment and stimulus control in at least four ways. First, this is one of only a few applied studies to demonstrate that automatically reinforced problem behavior can come under S^{Dp} control. Specifically, the results for Brandon extend the findings from the Doughty, Anderson et al. (2007) and McKenzie et al. (2008) studies by showing that S^{Dp} control can be produced with a negative punishment procedure. Second, the results for Brandon replicate those from the Falcomata et al. (2004) study by showing that response contingent removal of preferred stimulation produced greater reductions in automatically reinforced behavior than non-contingent access to preferred stimulation. Third, the results for Brandon are also consistent with the results from the Vorndran and Lerman (2006) study insofar as a less intrusive procedure (verbal reprimands) was shown to function as more effective punisher after systemic pairings with an effective, but more intrusive punisher (contingent toy removal). Finally, the results add to the literature by showing that mild punishers decreased problem behavior when reinforcement was concurrently available for problem behavior.

Although vocal stereotypy decreased for each of the three participants using punishment, some potential limitations to this study should be noted. First, complete behavior suppression of vocal stereotypy was not produced for either Al or Art during the RC condition. It is possible that further suppression or S^{Dp} control of vocal stereotypy may have been achieved if these two participants had received more extensive histories with verbal reprimands in the presence of the RC; however, constraints of time and space (in their classroom) prevented the development of such histories. Second, the level of Art's vocal stereotypy was typically lower in the GC condition of the treatment phase than in the GC condition of the baseline phase. As reprimands were never provided in the greed card condition of either phase, this pattern suggests that the trainer, an uncontrolled environmental stimulus, or both may have influenced Art's vocal stereotypy in the GC condition of the treatment phase. Nevertheless, the levels of Art's and Brandon's vocal stereotypy were relatively unchanged across baseline and treatment phases in the GC condition.

Another potential limitation of this investigation stems from the number of phases that were conducted with Brandon before his vocal stereotypy was suppressed. Specifically, there was a potential confound of sequence effects in that various interventions were implemented in progressive phases. This limitation could have been addressed by using a reversal design; however, functional control of the intervention on vocal stereotypy was clearly demonstrated with the multielement portion of the experimental design and, moreover, S^{Dp} control of vocal stereotypy was achieved.

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A third potential limitation is that we did not utilize latency measures (i.e., from the start of a punishment session to the delivery of the first punisher) that were described by Doughty, Anderson et al. (2007) to determine whether vocal stereotypy was under S^{Dp} control or S^{P} control. For the purposes of this study, we would argue that the complete suppression of vocal stereotypy for three or more consecutive sessions is a strong indicator of S^{Dp} control by the RC whereas the reduction, but not suppression, of vocal stereotypy is an indicator of S^{P} control or control by a combination of the punisher and the RC.

The results of this study provide several avenues for further investigation. For example, future research should evaluate changes in untargeted responses in the presence of a S^{Dp}. Ahearn et al. (2007) found that appropriate vocalizing increased for three of the four participants when the RI + RD procedure was implemented; however, this increase may be attributable to the concurrent availability of praise for appropriate vocalizing. Thus, future research on the treatment of vocal stereotypy should evaluate whether appropriate behavior increases in the presence of inhibitory stimuli. Second, as implied by Lerman and Vorndran (2002), when S^{Dp} control of automatically reinforced behavior is demonstrated, researchers should also evaluate the long-term suppressive effects of the inhibitory stimulus. Third, as it appeared that contingent verbal reprimands (after being paired with toy removal) may have served to orient Brandon toward the RC, it may be useful to evaluate methods for enhancing the salience of the stimulus that is correlated with punishment. Finally, researchers should determine if the use of a condition (e.g., the GC condition) that signals the absence of punishment enhances the development of S^{Dp} control.

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