


A REVIEW OF ANTECEDENT AND CONSEQUENCE BASED INTERVENTIONS USED  
TO REDUCE VOCAL STEREOTYPY IN CHILDREN WITH AUTISM

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Abstract

A REVIEW OF ANTECEDENT AND CONSEQUENCE BASED INTERVENTIONS USED  
TO REDUCE VOCAL STEREOTYPY IN CHILDREN WITH AUTISM

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Vocal stereotypy is a common problem behavior associated individuals with autism that can interfere with learning and the acquisition of new social skills. To assist the behavior analyst in developing interventions to reduce vocal stereotypy, a review of the research on vocal stereotypy is presented. Specific focus on the research related to the antecedent and consequence-based interventions that can be effective in reducing vocal stereotypy are discussed.

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## Chapter One: Introduction

Since autism was first described in the 1940s, the presence of stereotypical behaviors has been a central behavior feature of the disorder (Kanner, 1943). Stereotypy is typically characterized by repetitive movements or vocalizations that do not appear to serve an adaptive function (Berkson & Davenport, 1962). Researchers generally assume that repetitive vocalizations maintained by nonsocial reinforcement produce some type of internal reinforcing stimulation (Lovaas, Newsom, & Hickman, 1987). Several studies have shown that vocal stereotypy can be maintained by automatic reinforcement (Ahearn, Clark, MacDonald, & Chung, 2007; Falcomata, Roane, Hovanetz Kettering, & Kenney, 2004; Taylor, Hoch, & Weissman, 2005). Although several recent studies on automatically reinforced behavior have included novel assessments or interventions (Ahearn et al., 2007; Rapp, 2007; Roantree & Kennedy, 2006), research on automatically reinforced behavior lags behind research on socially reinforced behavior.

The occurrence of stereotypy has been associated with impaired learning (Lovaas, Koegel, Simmons, & Long, 1973) and social development (e.g., Koegel, Firestone, Kramme, & Dunlap, 1974; Macdonald, Green, Mansfield, Geckeler, Gardenier, Anderson, Holcome, & Sanchez, 2007). Due to vocal stereotypy significantly interfering with learning (Lovaas et al., 1973) and social development (Koegel, et al. 1974; Macdonald et al, 2007), interventions focusing on reducing vocal stereotypy in these areas are important.

Effective antecedent based interventions for reducing vocal stereotypy include non-contingent auditory reinforcement (Saylor, Sidener, Reeve, Fetherston, & Progar, 2012; Lanovaz, Rapp, & Ferguson, 2012; Lanovaz, Sladeczek, & Rapp, 2011), matched stimulation (Love, Miguel, Fernand, & LaBrie, 2012), social stories (Laprimé, & Dittrich, 2014), and verbal

operant training (Colon, Ahearn, Clark, & Masalsky, 2012). Studies have also evaluated the effects of medication on reducing verbal stereotypy (Miguel, Clark, Tereshko, & Ahearn, 2009).

Effective consequence based interventions for reducing vocal stereotypy in individuals with autism include differential reinforcement (Taylor et al., 2005; Rozenblat, Brown, Brown, Reeve, & Reeve, 2009), response interruption and redirection (RIRD) (Ahearn et al., 2007; Aherns, Lerman, Kodak, Worsdell, & Keegan, 2011; Schumacher & Rapp, 2011), response cost (Falcomata, Roane, Hovanetz, Kettering, & Kenney, 2004) and verbal reprimanding (Cook, Rapp, Gomes, Frazer, & Lindblad, 2014).

Macdonald et al. (2007) conducted a study to compare stereotypic behavior in children with autism and their same aged peers that were typically developing. The results of this study found that two year old children with autism had only somewhat higher levels of stereotypic behaviors than their same aged typically developing peers. While three and four year old children with autism had substantially higher levels of stereotypic behavior when compared to same aged typically developing peers. The researchers in this study suggest that the results of this study confirm that early intervention prior to the age of two is key due to individuals with autism spending increasing amounts of time engaging in stereotypic behaviors that interfere with learning after this age.

### **Statement of the Problem**

The following questions are addressed in this paper. What is vocal stereotypy and why is it important to reduce this behavior in children with autism? What are the effective interventions for reducing vocal stereotypy in children with autism?

### **Definition of Terms**

**Stereotypy:** Stereotypy is typically characterized by repetitive movements or vocalizations that do not appear to serve an adaptive function (Berkson & Davenport, 1962).

Differential Reinforcement: Reinforcing one response class and withholding reinforcement for another response class (Cooper, Heron, & Heward, 2007, p. 470)

Response Interruption and Redirection: A variation of response blocking that interrupts a response by delivering demands contingent on the occurrence of stereotypy and redirected to a more appropriate response (Ahearn et al., 2007)

Antecedent-based intervention: Events are manipulated independent of the occurrence of the target behavior (Lanovaz & Sladeczek, 2012)

Consequence-based intervention: Events are manipulated contingent on the occurrence or nonoccurrence of the target behavior (Lanovaz & Sladeczek, 2012)

### **Delimitations of Research**

This research was conducted through Internet searches of available research articles, texts, and other documents in the University of Wisconsin-Platteville, Elton S. Karrmann Library. Search terms included: stereotypy, vocal stereotypy, response interruption and redirection, autism, differential reinforcement, and medication used to treat autism. Research was primarily pulled from the following peer-reviewed journals: Journal of Applied Behavior Analysis and Behavior Modification. Other journals were also consulted; please see the reference section for a complete list of peer-reviewed journals consulted for this paper. The textbook Applied Behavior Analysis (Cooper et al., 2007) was also consulted.

### **Method of Approach**

A review of the history and functions of vocal stereotypy and effective antecedent and consequence-based interventions are discussed. A review of the relevant literature and information presented in textbooks relating to vocal stereotypy was conducted. The implications of research and a discussion regarding the findings are summarized and recommendations are made.

## Chapter Two: Review of Related Literature

### The Function Stereotypy

Before any discussion begins regarding effective interventions to reduce vocal stereotypy, it is important to understand the functions that maintain the behavior. Operant interpretations of stereotypy are most commonly derived from functional analysis methodologies (e.g. Iwata, Dorsey, Slifer, Bauman, & Richman, 1994). Lovas et al. (1987) defined automatic reinforcement as behavior that produces its own sources of reinforcement, independent of social mediation. Automatic reinforcement is thought to be the most common function of stereotypy (not only vocal) as several studies have indicated (e.g., Piazza, Adelinis, Hanley, Goh, & Delia, 2000; Vollmer, Marcus, & LeBlanc, 1994). These studies demonstrated that stereotypy persists in an alone condition of a functional analysis and is therefore automatically reinforced due to the lack of social consequences.

Automatic negative reinforcement, social positive reinforcement, and social negative reinforcement have been associated with stereotypy as well; however, limited studies to date have unequivocally demonstrated the maintenance of stereotypy by these functions (Rapp & Vollmer, 2005). For example, Tang, Kennedy, Koppekin, & Caruso (2002) found that an individual's stereotypic ear covering was most probable when noise was present. They concluded that ear covering produced automatic negative reinforcement in the form of attenuation of or escape from ambient noise. In an example of social positive reinforcement Kennedy, Meyer, Knowles, and Shukla (2002) found via functional analysis that stereotypic behavior of two individual diagnosed with autism was maintained by multiple sources of reinforcement including social positive reinforcement. In an example of social negative reinforcement, Durand and Carr (1987) found that stereotypic behaviors displayed by four

individuals increased as task difficulty increased. Stereotypy also increased when a ten second break from the task was imposed contingent on stereotypy. Overall, most of the available literature strongly supports an automatic positive reinforcement (behavior that occurs in the absence of social consequences) account of stereotypy (Rapp & Vollmer, 2005)

### **Antecedent Based Interventions**

#### **Noncontingent Reinforcement**

Antecedent based interventions for the treatment of vocal stereotypy typically involve the altering of the environment before the individual displays the problem behavior; and, this alteration sets the occasion for the individual to engage in a different non-problematic behavior (Rapp & Vollmer, 2005). Noncontingent auditory stimulation in the form of music, white noise, and recordings of individual's own vocal stereotypy were found to reduce vocal stereotypy in individuals with autism (Saylor et al., 2012). Saylor et al. provided headphones to individuals in the study during unstructured times of each participant's day. The study used an alternating treatment design to evaluate the effect of music, white noise, and recordings of each individual's own vocal stereotypy on their vocal stereotypy. While all independent variables reduced vocal stereotypy in all participants, music was found to cause the most dramatic reduction in vocal stereotypy in all participants.

Other studies found similar results with the use of music to reduce vocal stereotypy (Lanovaz et al., 2012; & Lanovaz et al., 2011). Lanovaz et al. (2011) found that music could decrease immediate engagement in vocal stereotypy; however, the effects on subsequent engagement in the behavior (after withdrawal of the independent variable, music) were marginal, suggesting that music was effective while playing; however, the lasting effects were minimal. Lanovaz et al. (2012) found that high preference music as identified by a modified choice

preference assessment produced lower levels of vocal stereotypy than did low preference music in 3 out of 4 participants. The results indicated the potential importance of assessing preference prior to using noncontingent music to reduce vocal stereotypy. One limitation was presented in both of the Lanovaz et al. (2011 & 2012) articles. Using music to reduce vocal stereotypy may interfere with engagement in other behaviors (i.e. listening to directions from a teacher). During unstructured time using music to reduce vocal stereotypy may be when it is most effective; however, the researchers suggest further research to examine whether music interferes with tasks that do not require listening. One advantage was also presented in both studies. Music does not require constant attention from a trainer or teacher as in RIRD or differential reinforcement consequence based procedures.

### **Verbal Operant Training**

Colon et al. (2012) found that verbal operant training can reduce vocal stereotypy in children with autism. The researchers conducted mand (requesting) and tact (labeling) training with three participants diagnosed with autism. While the verbal operant training produced lower levels of vocal stereotypy; more significantly, it also produced higher levels of appropriate vocalizations. The researchers implemented a RIRD phase of the intervention to further lower vocal stereotypy in two of the participants to a more acceptable level. RIRD is a consequence-based intervention that will be discussed further in following sections. The one participant that they did not implement RIRD with received more significant mand training. While this participant's levels of vocal stereotypy decreased considerably, the two participants that received RIRD had more significant decreases.

### **Social Stories**

Laprine & Dittrich (2014) used a treatment package consisting of a social story, discrimination training, and differential reinforcement with response cost to reduce vocal stereotypy in a child with autism. While the treatment package was effective, it is difficult to discern from the data which part of the treatment package had the most effect; or, if the treatment package as a whole was effective in reducing vocal stereotypy. The use of the social story would be considered an antecedent intervention; however, the use of differential reinforcement would constitute a consequence-based intervention.

### **Matched and Unmatched Stimulation**

Piazza et al. (2000) studied environmental enrichment. The researchers identified and then provided specific sources of stimulation that were intended to compete with stimulation derived from automatically reinforced behavior. The researchers evaluated the repetitive behavior of three individuals during several antecedent conditions where stimuli that were matched (toys with noise, etc.) or unmatched (toys without noise, i.g. puzzle) to the sensory products of the participants behavior were presented. Even though some unmatched toys were more preferred, toys that were matched produced the greatest reduction in repetitive behavior.

Love et al. (2012) used an alternating treatment design to assess the effects of matched stimulation (MS), RIRD, and MS with RIRD combined. Toys that made noise were presented to each participant in the matched stimulation phase. For one participant MS was effective in reducing vocal stereotypy across all phases. For the other participant MS with RIRD was the most effective in reducing vocal stereotypy. For both participants, increased appropriate vocalizations were associated with phases with an RIRD component.

### **Noncontingent Exercise**

Several studies have examined the effects of noncontingent exercise on vocal stereotypy (Levinson & Reid, 1993; Prupas and Reid, 2011). Levinson and Reid (1993) found that vigorous exercise such as 15 minutes of jogging decreased subsequent engagement in vocal stereotypy for 1 of 3 participants with autism. However, baseline levels of vocal stereotypy returned after 1.5 hours. Non-vigorous exercise had no effect on vocal stereotypy.

### **Medication**

Other studies have examined the use of medication to reduce vocal stereotypy. For example Miguel et al. (2009) evaluated the effects of a Selective Serotonin Reuptake Inhibitor (SSRI) called Sertraline on vocal stereotypy. The study used an alternating treatments design to assess the use of Sertraline, Sertraline and RIRD, and RIRD alone on vocal stereotypy. The researchers found that RIRD was the most effective at reducing vocal stereotypy and that Sertraline had no effect on vocal stereotypy.

### **Consequence Based Interventions**

During consequence-based interventions, events are manipulated contingent on the occurrence or nonoccurrence of the target behavior. Two consequence-based interventions that have the most empirical support to reduce vocal stereotypy are Differential Reinforcement and RIRD (Lanovaz & Sladeczek, 2012). Other consequence-based interventions are also discussed.

### **RIRD**

Ahearn et al. (2007) was the first to demonstrate the use of RIRD to decrease vocal stereotypy. This study used an ABAB reversal design to demonstrate experimental control of the independent and dependent variables in four participants with autism. During the intervention phases of the experiment, the researchers implemented RIRD. RIRD took the form of asking a

series of questions (“What’s your name?,” “Where do you live?,” or “What color is your shirt?,” etc.) or requiring a vocal imitation response (“Say ball,” “Say red,” or “Say dog,” etc.). The researchers also provided positive verbal reinforcement for appropriate verbal requests and statements. The results of this study found that RIRD was effective in significantly reducing vocal stereotypy in all four participants. In addition to this 3 of the 4 participants had higher levels of appropriate vocalizations as well.

Several other studies have evaluated the effects of RIRD on vocal stereotypy (e.g. Schumacher & Rapp, 2011; Ahrens et al., 2011; Cassella, Sidener, Sidener, & Progar, 2011; Martinez & Betz, 2013; Colon et al., 2012; & Love et al., 2012). Schumacher and Rapp (2011) assessed whether RIRD decreased immediate engagement in vocal stereotypy in two participants and whether the participant’s vocal stereotypy increased above no-intervention levels after RIRD was removed. The researchers hypothesized that the used of RIRD could cause a deprivation of the stimulation vocal stereotypy provides; thus, when RIRD is withdrawn the individuals vocals stereotypy could substantially increase. The results of the study found that there was an immediate decrease for all participants when RIRD was implemented and there was no subsequent increase in vocal stereotypy when RIRD was withdrawn.

In a systematic replication of Ahearn et al. (2007), Cassella et al. (2011) found that RIRD was effective in substantially reducing vocal stereotypy in two boys with autism; however, no increase in appropriate vocalizations was observed in either of the two participants. A possible explanation of this could be that the researches used unmatched demands (motor responses) as their RIRD demands. This study also noted that vocal stereotypy did not remain low without RIRD in place.

Ahrens et al. (2011) examined the topography of responses used in an RIRD intervention, either motor or vocal. The participants in this study were four individuals that had been diagnosis with autism. In the intervention phases of this experiment, the researchers required both vocal responses (“Say mom,” or “Where do you live?,” etc.) and motor actions (“stand up,” “clap,” etc.) contingent on the occurrence of vocal stereotypy. The findings of this study found that both vocal and motor responses were effective in reducing vocal stereotypy in an RIRD procedure. A notable feature of this study was that both motor and vocal demands were associated with increases in appropriate vocalizations, suggesting that vocal redirection was not necessary to produce higher levels of appropriate vocalizations.

### **Differential Reinforcement**

Dickman, Bright, Montgomery, and Miguel (2012) evaluated the effects of a Differential Reinforcement of Incompatible Behavior (DRI) intervention combined with RIRD on vocal stereotypy and appropriate vocal behavior in one child with autism using an ABABCBA reversal design (A=baseline, B=RIRD, C=RIRD and DRI). The results of the study found that RIRD was effective in reducing vocal stereotypy and increased appropriate vocalizations; however, appropriate vocalizations doubled with the introduction of RIRD and DRI together. In the RIRD + DRI condition the participant earned a star for every appropriate vocalization. Each star could be exchanged for a piece of candy.

Taylor et al. (2005) compared the effects of noncontingent reinforcement and Differential Reinforcement of Other Behavior (DRO) in a child with autism using matched stimulation. The researchers found that providing access to a toy that produced matched stimulation for 30 seconds contingent on the absence of vocal stereotypy for 1 minute was more effective at

decreasing vocal stereotypy than the noncontingent (independent of vocal stereotypy) delivery of the same toy every 1 minute.

Rozenblat et al. (2009) evaluated the schedule of reinforcement in DRO interventions. The researchers in this study noted that the duration of the intervals during which vocal stereotypy must be absent for the child to receive a preferred item may need to be very short (e.g. two or three seconds) for the DRO procedure to effectively reduce vocal stereotypy in some children with autism, which may be very challenging in applied settings. Thus while DRO was effective in reducing vocal stereotypy other procedures such as matched stimulation or RIRD may be more convenient and effective to implement.

#### **Other Consequence Based Interventions**

Cook et al. (2014) used verbal reprimands to decrease the occurrence of both targeted and untargeted stereotypy. For the five participants, the researchers targeted one aspect of the individual's stereotypy (vocal or motor) and provided a verbal reprimand in the form that matched the stereotypy ("Hands down," for hand flapping, "No talking," for vocal stereotypy). The results of this study found that verbal reprimands decreased targeted stereotypy in all five participants, decreased untargeted stereotypy in 2 of 5 participants, and increased the untargeted stereotypy in 1 of 5 participants.

Falcomata et al. (2004) used a response cost procedure to reduce vocal stereotypy in one individual diagnosed with autism. The experiment used an alternating treatments design to assess the effects of noncontingent reinforcement and noncontingent reinforcement with response cost on the vocal stereotypy of the participant. The results of the study found that noncontingent reinforcement with response cost was more effective than noncontingent reinforcement alone at reducing vocal stereotypy. The results suggest that in some individuals

the loss of high-preference stimuli may complete with engagement in automatically reinforced vocal stereotypy.

### **Summary**

This paper sought to gather existing research on vocal stereotypy in children with autism and present a review of the existing literature on this topic. The functions of vocal stereotypy were discussed and a review of antecedent and consequence-based interventions that have been found by the research to be effective have been discussed. While it is clear that many different interventions—both antecedent and consequence based—have been shown to be effective, some interventions have been demonstrated to be favorable. My examination of this literature and recommendations for future research are presented in the conclusion chapter of this paper.

### **Chapter Three: Conclusions and Recommendations**

Through my review of the available literature on vocal stereotypy, this paper discussed what vocal stereotypy is, why it is important to treat, and the functions that maintain the behavior in children with autism. Antecedent-based interventions such as matched and unmatched stimulation, noncontingent reinforcement, medication, verbal operant training, and environmental enrichment have all been found—with the exception of medication in the cited study—to reduce vocal stereotypy in children with autism. While many of these antecedent-based interventions were effective, it was interesting that the most effective interventions were consequence based. Several of the antecedent interventions added a consequence phase to reduce vocal stereotypy to acceptable levels (e.g. Colon et al., 2012). Also, many of the studies using antecedent-based interventions were conducted in unstructured settings during unstructured times. For example Saylor et al. (2012) used headphones to play recordings of the child's own vocal stereotypy, white noise, and music during unstructured times of the day (no demands placed on the child). A partial limitation of this study exists in which headphones could significantly interfere with learning and skill acquisition as the headphones compete with hearing the teacher or instructor place demands on the child. While it is important to reduce vocal stereotypy during unstructured times of the day, according to Lovaas et al. (1973), vocal stereotypy can significantly interfere with learning and social development. Therefore, it seems as though interventions designed to reduce vocal stereotypy in learning settings when demands are being placed on the child may be more important to the literature base. Other studies involving matched and unmatched stimulation and environmental enrichment were conducted during play or unstructured times of the child's day as well (Piazza et al., 2000). The practice of taking medication to reduce vocal stereotypy is intriguing as it has the potential to be less

intrusive to the person with autism; however, according to Miguel et al. (2009) medication does not seem to have an effect on vocal stereotypy. This study was limited by only one medication being tested for its effect on vocal stereotypy. Other medication may hold more promise. More research should be done in this area to fully determine whether existing medication has an effect on vocal stereotypy in children with autism. While having these antecedent-based interventions are important to understanding vocal stereotypy as a whole, the most promising and most researched behavior interventions for vocal stereotypy seem to be consequence based.

The consequence-based intervention that appears from the literature review to be the most effective in reducing vocal stereotypy in children with autism is RIRD. This procedure has the added benefit that in most studies, the participants increased their frequency of appropriate vocalizations while reducing their levels of vocal stereotypy. RIRD when applied to vocal stereotypy was first described by Ahearn et al. (2007), so the use of this procedure is relatively new. Several systematic replications and extensions of Ahrens work have been completed in the short time it has been in existence (e.g., Cassella et al., 2011; Schumacher & Rapp, 2011) confirming the validity of its use with children with autism to reduce vocal stereotypy. Much of the available research on RIRD was conducted in the presence of toys. For example, Cassella et al. (2011) conducted their experiment while the participants engaged in toy play. The researchers in this experiment posited that the interruption of toy play could also function as negative punishment due to the interruption of play. In Ahearn et al. (2007) the teacher was present in a room with the participant without any material that was not needed for the experiment. Further research is needed to assess RIRD in a demand or instructional setting such as that found in typical and special education settings.

DRO and DRI have also been shown to decrease vocal stereotypy (e.g., Taylor et al., 2005). While these procedures have been shown to be effective in reducing vocal stereotypy, they have the distinction from RIRD in that they do not increase appropriate vocalizations as they do not redirect the participant to appropriate language. Such redirection could be incorporated into DRO or DRI procedures in future research. This notable feature should be addressed as increasing appropriate vocalizations is a desirable effect of reducing vocal stereotypy. Also because DRO requires the undivided attention of the trainer, does not teach an alternative behavior, and may be difficult to apply consistently under dense schedules, this intervention may be challenging to implement in applied settings (Rozenblat et al., 2009).

Verbal reprimanding was shown effective in one study (Falcomata et al. 2004); however, more research should be conducted in this area to confirm the effects of verbal reprimands on vocal stereotypy. Verbal reprimanding could be an effective intervention for parents to implement; as, it requires little training and may come natural to parents.

Other punishment-based procedures such as overcorrection or contingent effort have much research in areas of reducing other problematic behaviors; however, they do not appear to have research conducted in the areas of reducing vocal stereotypy. Future research could explore these options for reducing vocal stereotypy.

Several of the studies used treatment packages (two or more interventions implemented in conjunction with each other) to reduce vocal stereotypy (e.g., Laprime et al., 2014). While implementing several interventions at the same time might be effective in an applied setting, it can be difficult to discern what intervention had the most significant effects on vocal stereotypy. Using a different treatment design where one intervention is implemented and then others are

added one at a time might provide more information on what are the most effective interventions for the reduction of vocal stereotypy.

When determining what intervention is most appropriate for a child, it is important to use the least intrusive intervention necessary to reduce the child's vocal stereotypy. The Behavior Analyst Certification Board's Guidelines for Responsible Conduct for Behavior Analysts has several recommendations regarding treatment of clients. For example ethical guideline 2.10a states that, "The behavior analyst always has the responsibility to recommend the most effective treatment procedures (Behavior Analyst Certification Board, 2013)." In addition, ethical guideline 4.05 states that, "the behavior analyst recommends reinforcement rather than punishment whenever possible (Behavior Analyst Certification Board, 2013)." While the use of a punishment-based procedure may be the most effective to reduce vocal stereotypy according to the research, it would be most ethical to attempt to reduce a child's vocal stereotypy with an intervention that uses reinforcement first, prior to using punishment. An exception to this would be where a punishment procedure is needed to quickly reduce a behavior due to the significance of the behavior needing to be reduced (e.g., aggression, self-injurious behavior, etc.). While it is important to reduce vocal stereotypy in children with autism, it is not a behavior that will cause harm to the client or others; therefore, it would be most ethical to consider reinforcement-based procedures first.

The practitioner should consider what are the most feasible and practical interventions that are the most likely to be effective given the available resources. Who will be implementing the intervention, the cost of the intervention, and the environment the intervention is implemented in are all factors that need to be considered prior to implementation.

Overall, this paper reviewed effective antecedent and consequence based interventions for treating vocal stereotypy in children with autism. It is clear from the literature review that many interventions work to treat vocal stereotypy; however, some are more preferred than others for reasons described above. Future research should continue to systematically replicate existing research and explore other options for treating vocal stereotypy in children with autism. While much of the research shows promise, the field of applied behavior analysis is in its infancy and with more research in this and other areas, the field will continue to grow and continue to be the treatment of choice for children with autism.

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