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Using the Three-Component Multiple-Schedule to Examine the Effects of Treatments on Stereotypy

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Abstract

We compared the effects of differential reinforcement of other behaviour (DRO) and noncontingent access to sound-producing toys on the vocal stereotypy of a child with autism. A three-component multiple-schedule was combined with brief reversals to evaluate the effects of each treatment on immediate and subsequent engagement in vocal stereotypy. The results showed that DRO did not decrease vocal stereotypy, but that noncontingent access to sound-producing toys reduced both immediate and subsequent engagement in the behaviour. The results are discussed in terms of the utility of the three-component multiple-schedule to assess treatments for automatically reinforced behaviour.

In recent years, there has been a considerable increase in the amount of research conducted on the assessment and treatment of acontextual vocalizations maintained by nonsocial consequences (e.g., Ahearn, Clark, MacDonald, & Chung, 2007; Athens, Vollmer, Sloman, & St. Peter Pipkin, 2008; Falcomata, Roane, Hovanetz, Kettering, & Keeney, 2004; Lanovaz, Fletcher, & Rapp, 2009). Because these vocalizations are also generally repetitive and invariant, the term "vocal stereotypy" is used to label these acontextual behaviours. Vocal stereotypy is said to be automatically reinforced because engaging in the behaviour produces its own reinforcing consequence (Vollmer, 1994). That is, some sensory product of vocal stereotypy (e.g., auditory stimulation) maintains the occurrence of the behaviour.

The effects of treatment on subsequent engagement (i.e., when the treatment is withdrawn) are often a serious concern for individuals working with children who display vocal stereotypy because most intervention procedures are difficult to implement across entire days. As such, clinicians must select treatments that reduce levels of vocal stereotypy below baseline levels even when they are withdrawn. Such treatments are said to function as abolishing operations (AOs) because both the reinforcing-value and the occurrence of the behaviour are decreased (Laraway, Snycerski, Michael, & Poling, 2003). Although several treatments are effective at decreasing immediate levels of vocal stereotypy (e.g., Ahearn et al., 2007; Falcomata et al., 2004), the only intervention that has been shown to decrease subsequent engagement is noncontingent matched stimulation (NMS), which consists of providing noncontingent (i.e., independent of the behaviour) access to stimuli that match the putative sensory product of stereotypy (e.g., Lanovaz et al., 2009; Rapp, 2007). With the exception

of punishment procedures which have been shown to increase subsequent engagement (see Rapp, 2006, 2007), the effects of other treatments (e.g., differential reinforcement of other behaviour [DRO]) on subsequent engagement in stereotypy remain unknown. Thus, the purpose of this study was to use the three-component multiple-schedule to examine the effects of providing the same auditory stimuli in a DRO procedure and noncontingently on immediate and subsequent engagement in vocal stereotypy.

Method

Participant and Setting

Chloe (pseudonym) was a 6-year-old girl who had a diagnosis of autism. She used two-word utterances to make requests and followed simple two-step instructions. All sessions were conducted at the child's home in a room with a bed, a mirror, and a chest of drawers. Informed consent was sought from the child's parents and the study was approved by a Research Ethics Board.

Data Collection, Response Definitions, and Reliability

Data were collected on the duration of vocal stereotypy. Vocal stereotypy was defined as acontextual audible sounds produced with an opened or closed mouth. All sessions were videotaped and subsequently scored by a trained graduate student using a laptop computer. A second observer scored at least 30% of sessions for each phase. Interobserver agreement (IOA) was calculated using the block-by-block method by measuring agreement in each 10-s interval and then computing a mean for the session (Mudford, Taylor, & Martin, 2009). The mean IOA was 91% (range, 86% to 95%).

Experimental Design and Procedures

Prior to the experiment, a functional analysis (Iwata, Dorsey, Slifer, Richman, & Bauman, 1994) was conducted to confirm that the behaviour was maintained by automatic reinforcement and a paired-choice stimulus preference assessment (Fisher et al., 1992) was also conducted to identify the most preferred toys that produced music or sounds (data available from first author). The effects of two treatments on Chloe's vocal stereotypy were evaluated using a combination of a three-component multiple-schedule and brief reversals. Each sequence was comprised of three 10-min components. The baseline sequences were three consecutive free-operant (FO) components during which Chloe was placed in a room with no preferred stimuli and no social consequences were provided. The first and third components of the intervention sequences were also FO components, but the second component varied. During the second component of the DRO sequence, a xylophone and a musical keyboard (i.e., most preferred auditory toys) were provided for 5 s contingent on the absence of vocal stereotypy for 10 s (i.e., 80% of the mean inter-response time [IRT] observed in the no-interaction conditions of the functional analysis). During the second component of the noncontingent matched stimulation (NMS) sequence, we provided noncontingent (i.e., continuous) access to the same auditory toys. Initially, the DRO and baseline sequences were alternated in a brief reversal design. Next, the NMS sequence was alternated with the baseline sequence.

Results and Discussion

Figure 1 displays the percentage of time Chloe engaged in vocal stereotypy during the first, second, and third components, and the difference between the third and first components across the baseline, DRO, and NMS sequences. Levels of vocal stereotypy during the first component (first panel) remained undifferentiated across the two comparisons, suggesting that prior to the introduction of treatment, vocal stereotypy was similar across sequences. During the second component (second panel), levels of stereotypy were undifferentiated for the baseline and DRO sequences. In contrast, noncontingent access to the same toys produced lower levels of vocal stereotypy than baseline. The third panel shows that levels of vocal stereotypy were generally undifferentiated during the third component. Because we expected relatively small behaviour changes during the third component and extraneous variables may have obscured relevant patterns, we also analyzed within-sequence patterns of stereotypy (Lanovaz et al., 2009).

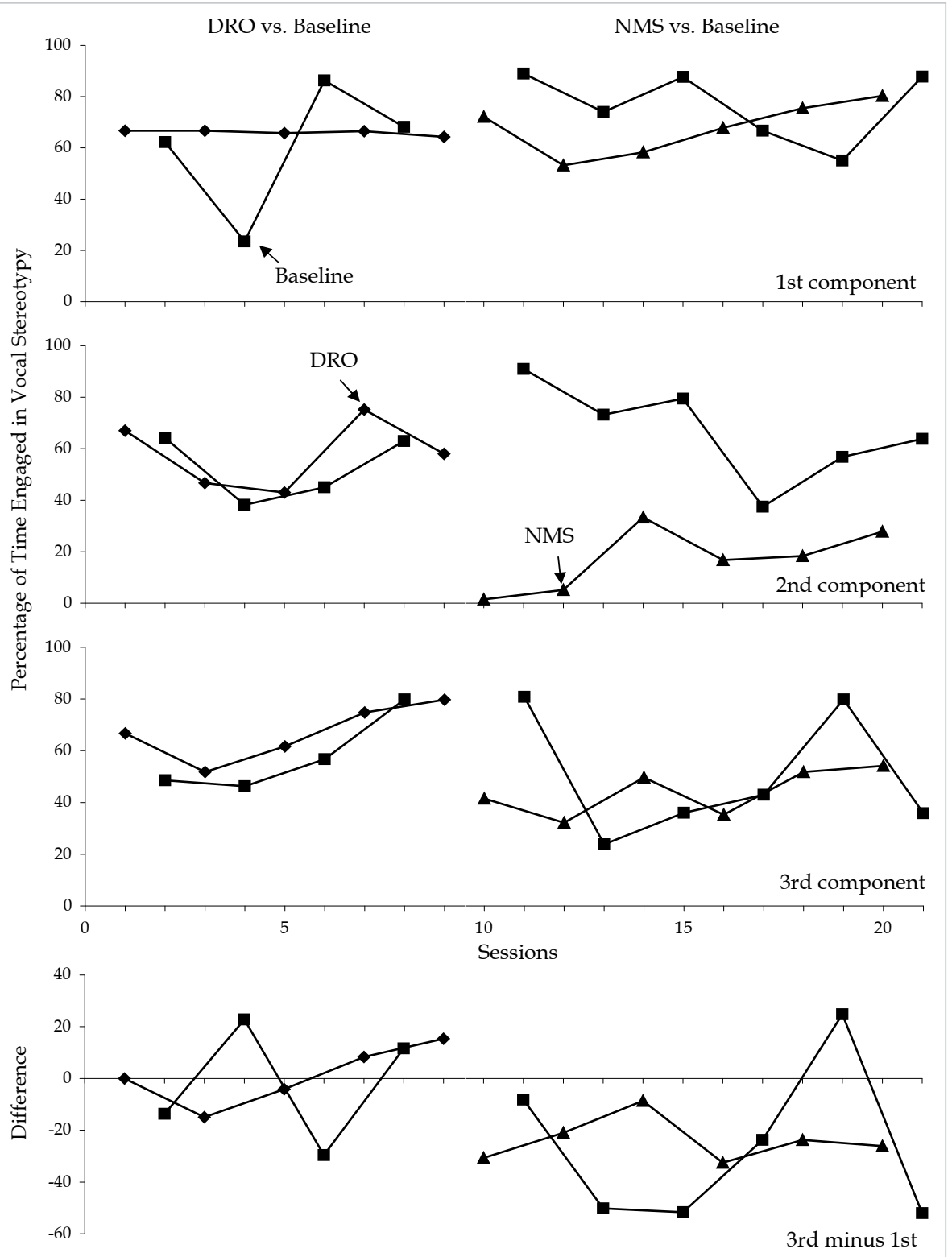

Figure 1. Percentage of time Chloe engaged in vocal stereotypy during the first, second, and third components, and the difference between the third and first components across baseline, DRO, and NMS sequences.

The bottom panel of Figure 1 shows the percentage of time Chloe engaged in vocal stereotypy in the third component minus the percentage observed in the first component for each individual sequence. The graph facilitates the analysis of data by highlighting whether the difference was negative or positive. The emphasis is not on the differentiation between the two paths, but on whether each sequence is above or below the horizontal axis. A difference below zero (i.e., negative) indicates that the treatment decreased subsequent vocal stereotypy (i.e., functioned as an AO) whereas a difference above zero (i.e., positive) indicates that the treatment did not decrease subsequent engagement. During the DRO vs. baseline comparison, there were no systematic patterns. However, the NMS vs. baseline comparison shows that both prior access to vocal stereotypy and noncontingent access to auditory toys decreased subsequent engagement in vocal stereotypy (i.e., in the third component).

Altogether, the results show at least three interesting patterns. First, the DRO procedure did not decrease vocal stereotypy. A study conducted by Rozenblat, Brown, Brown, Reeve, and Reeve (2009) showed that DRO schedules must be very dense (i.e., 25th percentile of the IRT) in order to effectively decrease vocalizations. Thus, the current schedule (i.e., 80% of the IRT) may have been too lean to reduce the behaviour. However, given the complexity of implementing DRO schedules and concerns for satiation, it would be unadvisable to use intervals shorter than 10 s in applied settings. Second, the noncontingent presentation of the auditory toys decreased immediate and subsequent engagement in vocal stereotypy. Because the stimuli decreased the occurrence of stereotypy in the third component below levels observed in the first component for each NMS sequence, we can conclude that the stimuli functioned as AOs for subsequent engagement. As such, the results suggest that the auditory toys were functionally matched stimuli for vocal stereotypy (see Lanovaz et al., 2009; Rapp, 2007). Finally, prior access to stereotypy produced lower levels of stereotypy in the third component than in the first component of the baseline sequence during the NMS vs. baseline comparison, but not during the initial comparison (i.e., DRO vs. baseline). The low number of baseline sequences (i.e., 4) conducted in the initial comparison may explain the absence of a clear effect. Alternatively, carryover effects from the NMS sequences or repeated exposure to FO conditions may also have produced the patterns observed in the NMS vs. baseline comparison only.

The data from the present study are limited in at least two ways. First, the DRO and NMS sequences were never directly compared; thus, we cannot draw definitive conclusions regarding the relative effectiveness of one treatment compared to the other. Second, DRO was ineffective at reducing immediate levels of stereotypy. As such, the subsequent effects of DRO when treatment is effective at reducing immediate levels of stereotypy cannot be determined. The main implication of the results is that the three-component multiple-schedule can be used to identify treatments that will decrease both immediate and subsequent engagement in stereotypy. The study extends the research conducted by Rapp (2007) by applying the methodology to a different treatment (i.e., DRO). Furthermore, the methodology may serve as a systematic assessment tool to evaluate the effectiveness of treatments for automatically reinforced behaviour. For example, one treatment may be initially assessed and if immediate and subsequent engagement in the behaviour are not reduced (as for DRO in this study), a second treatment can be evaluated immediately using the same methodology. Future research should attempt to replicate the study by using the methodology with DRO schedules that reduce immediate engagement and with other intervention procedures for stereotypy. Finally, the effects of decreasing subsequent engagement in automatically reinforced behaviour on the occurrence of other behaviour (e.g., playing, attending to instructions) should also be examined because treatments that both decrease nonfunctional behaviours and increase socially acceptable behaviours would be most valuable to facilitate the inclusion of children with developmental disabilities.

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