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EFFECTS OF THREE TYPES OF NONCONTINGENT AUDITORY STIMULATION ON VOCAL STEREOTYPY IN CHILDREN WITH AUTISM

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We evaluated the effects of 3 types of noncontingent auditory stimulation (music, white noise, recordings of vocal stereotypy) on 2 children with autism who engaged in high rates of vocal stereotypy. For both participants, the music condition was the most effective in decreasing vocal stereotypy to near-zero levels, resulted in the highest parent social validity ratings, and was selected as most preferred in treatment preference evaluations.

Key words: stereotypy, music, white noise, noncontingent auditory stimulation, autism

Because stereotypy may occur at high rates during unstructured time (McEntee & Saunders, 1997), interventions that reduce stereotypy during free time are an important part of effective programming for children with autism. Effective interventions for vocal stereotypy in individuals with developmental disabilities include differential reinforcement (e.g., Taylor, Hoch, & Weissman, 2005), response interruption and redirection (e.g., Ahearn, Clark, MacDonald, & Chung, 2007), and noncontingent auditory stimulation.

Aiken and Salzberg (1984) found that the continuous presentation of 95-dB white noise through earphones substantially reduced stereotypic singing, snorting, and slurring by two children with autism. Despite these promising results, no other studies have evaluated noncontingent white noise as a treatment for vocal stereotypy. More recently, studies have evaluated the effects of noncontingent auditory stimulation from music, videos, and toys on vocal stereotypy, with mixed results obtained across studies. For example, Gunter, Fox, McEvoy, and Shores (1993) found noncontingent music to be effective when implemented alone, whereas Falcomata, Roane, Hovanetz, and Kettering (2004) found that noncontingent music resulted in clinically acceptable reductions in vocal stereotypy only when response cost was added. Other studies have compared stimuli that were matched and unmatched to the hypothesized sensory stimulation produced by vocal stereotypy (i.e., auditory stimulation), with results suggesting that either matching (e.g., Rapp, 2007) or stimulus preference (e.g., Ahearn, Clark, DeBar, & Florentino, 2005) may be the most important variable to consider in the development of interventions for vocal stereotypy.

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The purpose of the present study was to evaluate the relative effects of three types of noncontingent auditory stimulation on vocal stereotypy. We evaluated white noise and music, two stimuli that have been shown to be effective in reducing vocal stereotypy. In addition, we presented a recording of the participant's own stereotypy, a stimulus necessarily matched to the auditory response products of vocal stereotypy (i.e., a potential maintaining variable). Although this type of stimulus has been examined as a method of confirming the auditory stimulation function of stereotypy (e.g., Patel, Carr, Kim, Robles, & Eastridge, 2000), no previous research has evaluated audiotaped stereotypy as a treatment for vocal stereotypy in children with autism.

METHOD

Participants

Participants were two children who had been diagnosed with autism by an independent specialist: Vikki (6 years 7 months old) and Kyle (5 years 6 months old). Both participants were selected based on caregiver reports that they engaged in high rates of vocal stereotypy that significantly interfered with their educational and social activities. Vikki engaged in social initiations using many clearly understandable words, and her vocal stereotypy consisted of singing, humming, and noncontextual phrases (e.g., repeating lines from movies). Kyle rarely emitted sounds other than vocal stereotypy, which consisted of grunting and high pitched screams and squeals. Caregivers of both participants reported that vocal stereotypy frequently occurred when the child was alone, and descriptive data showed that vocal stereotypy was not associated with any specific antecedent condition.

Response Measurement

We conducted 10-min sessions twice per day, 4 to 10 times per week, in a quiet area of each child's home. Using 30-s momentary time sampling, observers collected data on *vocal stereotypy* (any noncontextual vocalization, excluding coughing). A second independent observer collected data on vocal stereotypy during at least 43% of sessions across all conditions for each participant, and interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Mean interobserver agreement across participants was 99.7% (range, 95% to 100%). The experimenter checked the sound played through the headphones prior to every session; the type and volume of sound were accurate for both participants for all sessions.

Design and Materials

We used a reversal design with an embedded alternating treatments design to evaluate the effects of the interventions. During all sessions, the participant wore headphones and had access to moderately preferred, nonauditory toys (identified via stimulus preference assessments). Sounds were played on a Jensen digital audio player (Kyle) or Nextar digital MP3 player (Vikki). Participants could not manipulate these players during sessions. At the beginning of each session, we used a sound-level meter to measure the volume of the sounds and ensure that the decibel level was safe and appropriate during each session (62 to 75 dB; Portnuff & Fligor, 2006).

Procedure

Prior to baseline sessions, an assessment revealed that both participants tolerated the headphones without prompts for at least 20 min. The experimenter sat behind the participant during all sessions and provided assistance to remain in the play area and keep headphones on if needed (Kyle only). Programmed consequences were never delivered contingent on vocal stereotypy during the assessment sessions.

During baseline, headphones were worn but auditory stimulation was not provided. During the alternating treatments evaluation, three different types of sessions were conducted in quasirandom order: white noise, music, and a "self" condition, in which the participant listened to a recording of his or her own vocal stereotypy. *White noise* is defined as "a sound that contains every frequency within the range of human hearing, generally from 20 Hz to 20 kHz, in equal amounts" ("White Noise," 2001). Music was a repeated recording of four to five age-appropriate songs nominated by parents as being preferred. For the self condition, a recording of the participant's vocal stereotypy was played. Using a voice recorder, the participant's voice was recorded while he or she was engaging in vocal stereotypy. The voice recorder recorded sounds only when vocal stereotypy was present. The recorded sounds then were downloaded onto a computer and transferred onto an MP3 player.

Following the treatment evaluation, treatment extension sessions were conducted in settings selected by parents as being those in which vocal stereotypy was typically high, stigmatizing, and difficult to manage. These sessions were conducted in the living room, grocery store, and pharmacy for Kyle and living room, outside on a walk, and playground for Vikki.

Social Validity

First, we administered the Treatment Evaluation Inventory–Short Form (TEI-SF; Kelly, Heffer, Gresham, & Elliott, 1989) to caregivers for the music and self interventions. The TEI-SF measures caregiver acceptability of a treatment using a Likert-type scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Second, participant treatment preference was assessed based on procedures described by Hanley, Piazza, Fisher, and Maglieri (2005). Three different-colored (but otherwise identical) headphones were correlated with each of the three interventions. Initially, trials were conducted to expose the participants to the treatments correlated with each of three different sets of headphones. Each participant was prompted to select one of the headphones from an array. Once a set of headphones was selected, the other headphones were removed, and the participant was exposed to the intervention correlated with those headphones for 2 min. The array was rearranged prior to each trial. These trials were conducted until Vicki selected a set of headphones independently within 5 s of the presentation of the array. Because Kyle consistently selected based on position, a modified procedure was implemented for him. After being prompted to point to a pair of headphones, Kyle was exposed to sound from that set of headphones for 2 min. This was done with each pair of headphones, five times in quasirandom order. If he attempted to remove the headphones or pushed them away as they were being placed on his head, they were removed and the next trial was conducted.

Next, a treatment preference evaluation was conducted with both participants. For Vikki, a multiple-stimulus preference assessment was conducted in which she was asked to select a set of headphones and was provided access to the corresponding music for 2 min. Data were summarized as percentage of trials each set of headphones was selected. For Kyle, each set of headphones was presented individually for up to 2 min (the trial ended if he pushed away or removed the headphones), five times in a quasirandom order. Data were summarized as the percentage of trial duration each set of headphones was worn.

RESULTS AND DISCUSSION

Results are depicted in Figure 1. Similar patterns of responding were obtained for both participants across conditions, including high levels of vocal stereotypy during baseline, substantial decreases to near-zero levels in the music and self conditions, and only a transitory decrease in the white noise condition. Music was selected for use in the treatment extension due to the low levels of vocal stereotypy

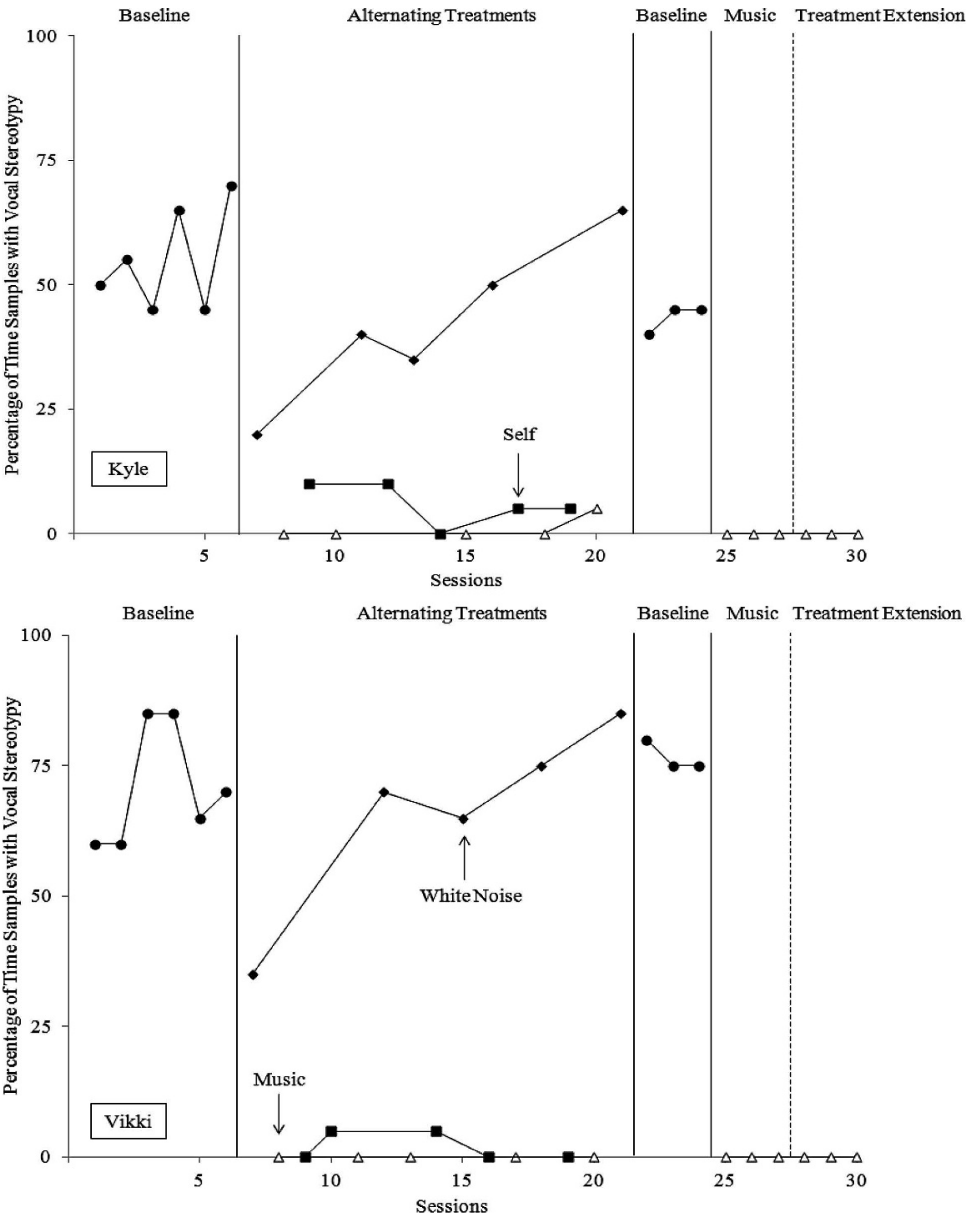

Figure 1. Percentage of 30-s time samples with vocal stereotypy for Kyle and Vikki.

produced and the higher results obtained on the TEI-SF (music M = 4.4, 4.5; self M = 2.9, 3.9). During the final two phases, music resulted in zero levels of vocal stereotypy. During the treatment preference evaluation, both Vikki and Kyle indicated preference for music (60%, 100%) over self (40%, 90%) and white noise (0%, 39%).

The findings on the effectiveness of music replicate previous research using music as an intervention to decrease vocal stereotypy in individuals with autism (e.g., Gunter et al., 1993). These effects were demonstrated with two children with autism with different language skills and topographies of vocal stereotypy, and across various home and community settings. To our knowledge, the current study was the first evaluation of noncontingent audiotaped stereotypy as a treatment for vocal stereotypy for children with autism. Although social validity ratings for this intervention were not as high as for the music intervention, noncontingent audiotaped stereotypy may be more acceptable to caregivers when other interventions are ineffective, or if it is presented with a plan for fading. Although not evaluated in the current study, it is possible that the music and audiotaped stereotypy decreased stereotypy by producing auditory stimulation that competed with or substituted for the reinforcer produced by vocal stereotypy. It is also possible that the auditory consequences of vocal stereotypy no longer were accessed during these conditions and reductions were produced via sensory extinction.

Noncontingent white noise was ineffective in reducing vocal stereotypy. This failure to replicate the findings of Aiken and Salzberg (1984) may have occurred because the white noise in the current study was a different type of sound or played at a different sound level (i.e., 62 to 75 dB) than the white noise used by Aiken and Salzberg (i.e., 95 dB). It is possible that when white noise was available, instances of vocal stereotypy still produced auditory stimulation that was more reinforcing than the auditory stimulation provided by the white noise, and therefore vocal stereotypy did not decrease. Although higher sound levels of white noise may be effective, current safety recommendations (e.g., Portnuff & Fligor, 2006) should be considered when using interventions with auditory components delivered via headphones.

Results of the current study should be interpreted in light of at least two limitations. First, although interviews and direct observation suggested an automatic reinforcement function for vocal stereotypy, a functional analysis was not conducted. However, the high levels of vocal stereotypy obtained during baseline in the absence of social consequences for stereotypy provide additional support for an automatic reinforcement function. Second, although the music and audiotaped stereotypy both were hypothesized to be highly preferred and to match the sensory consequences of vocal stereotypy, conclusions about these variables cannot be drawn because we did not directly assess preference for auditory stimuli, and the specific automatic reinforcers for vocal stereotypy are unknown.

Future research on noncontingent auditory stimulation as a treatment for vocal stereotypy might evaluate methods for maintaining treatment effects over long periods of time. Additional research also is needed on methods for increasing the utility of such interventions in public situations in which it may not be acceptable or practical to wear headphones all day (e.g., school).

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