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EFFECTS OF MUSIC ON VOCAL STEREOTYPY IN CHILDREN WITH AUTISM

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We examined the effects of manipulating the intensity (i.e., volume) of music on engagement in vocal stereotypy in 2 children with autism. Noncontingent access to music decreased immediate engagement in vocal stereotypy for each participant, but it produced only marginal effects on subsequent engagement in the behavior (i.e., after withdrawal). Manipulating the intensity of music did not produce differential effects on immediate engagement in vocal stereotypy. The implications of the results and applications for future research are discussed.

Key words: autism, intensity, matched stimulation, music, vocal stereotypy

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Research has shown that noncontingent access to auditory stimulation (e.g., music, sound-producing toys) may decrease immediate engagement in vocal stereotypy in children with autism (e.g., Lanovaz, Fletcher, & Rapp, 2009; Rapp, 2007; Taylor, Hoch, & Weissman, 2005). However, results have been inconsistent regarding the subsequent effects (i.e., after withdrawal) of music. For example, Lanovaz et al. (2009) found that music did not decrease subsequent engagement in vocal stereotypy whereas Rapp (2007) found the converse. The results of previous studies are also limited because only a few intervention sessions containing music were conducted with each participant (i.e., two or three), raising questions about whether the effects of music would have persisted across a larger number of sessions. The purpose of the current study was to extend prior research by examining variables that may have produced the discrepant results. First, the intensity of music was manipulated to evaluate whether altering intensity produced differential effects on immediate and subsequent engagement in vocal stereotypy. Second, we conducted a larger number of music sessions to examine whether the effects continued across multiple brief sessions.

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METHOD

Participants, Settings, and Data Collection

Two children with autism who displayed vocal stereotypy participated in the study. Amy was a 5-year-old girl whose vocal stereotypy consisted of noises resembling vowels and simple syllables. We conducted her sessions in an empty room with a one-way observation window. Michael was a 6-year-old boy who hummed and repeated approximations of excerpts from his favorite television shows. We conducted his sessions in his bedroom, which included a bed, a chest of drawers, a cupboard, and a toy chest. Michael had access to toys that did not produce auditory stimulation during all of his sessions because a prior study conducted with the participant suggested that vocal stereotypy remained high and stable even when toys were present (data available from the first author).

Trained undergraduate and graduate research assistants videotaped all sessions and subsequently measured the duration of vocal stereotypy using computers equipped with data-collection programs. We defined *vocal stereotypy* as acontextual audible sounds or words produced by the vocal apparatus (e.g., tongue, lips, nasal cavity, vocal cords). Because the offset of vocal stereotypy was generally difficult to measure, the observers used a 2-s offset criterion. A second observer measured the duration of vocal stereotypy for at least 39% of sessions for each participant. We calculated interobserver agreement scores by using the block-by-block method with 10-s bins (Mudford, Taylor, & Martin, 2009). Mean interobserver agreement was 90% (range, 81% to 95%) for Amy and 93% (range, 88% to 96%) for Michael.

Design and Procedure

Before being included in the study, each child participated in a functional analysis for vocal stereotypy using the methodology described by Vollmer, Marcus, Ringdahl, and Roane (1995) with two exceptions: Within-session analyses were not conducted, and the duration of the sessions was reduced to 5 min. Then, a reversal design was combined with a three-component multiple-schedule and a multielement design to assess the effects of manipulating the intensity of music on vocal stereotypy. To assess the effects of music, we conducted one session per day, 3 to 5 days per week. Each session lasted 15 min and was divided into three consecutive 5-min components. During the baseline phase, we conducted three to five baseline sequences. In the baseline sequence, the three 5-min components were free-operant (FO) conditions during which only the stimuli mentioned previously were present and no social consequences were provided for the occurrence of vocal stereotypy. During the treatment phase, we alternated a high-intensity (HI) sequence with a low-intensity (LI) sequence in a multielement design for four to six sessions each. In the HI and LI sequences, the first and third components remained FO conditions identical to that in the baseline sequences. In the second 5-min component, the participant had noncontingent access to a song played at 70 dB during the HI sequences and noncontingent access to the same song played at 50 dB during the LI sequences.

Initially, each participant listened to the same song (excerpts of *The Carnival of the Animals* by Camille Saint-Saens) because (a) the song was novel for both participants and (b) a prior study using experimenter-selected music had been successful at decreasing vocal stereotypy (Lanovaz et al., 2009). However, the experimenter-selected song was ineffective at reducing immediate engagement in vocal stereotypy for Michael (data available from the first author). Because he repeated excerpts from his favorite shows, we next used songs from these shows as HI and LI stimuli. The average intensity of the HI stimulus was 70 dB, which is approximately the intensity of a vacuum cleaner at a distance of 3 m. An average is provided because intensity continuously varies within songs. The average intensity of the LI stimulus was 50 dB, which is approximately the intensity of someone talking at a distance of 1 m. Given that the children were free to move around the room, the actual intensity of the music varied slightly within sessions. A 20-dB difference and small rooms were used to ensure that the HI stimulus was generally louder than the LI stimulus wherever the child was located. Moreover, the perceived loudness increases approximately fourfold from 50 dB to 70 dB (Rossing, Moore, & Wheeler, 2002). The intensity of music was adjusted by using a digital sound-level meter (range, 50 dB to 126 dB, ± 2dB). To verify the intensity, the sound-level meter was placed 1 m in front of the sound source for the first 30 s of the song.

RESULTS AND DISCUSSION

The functional analysis showed that the vocal stereotypy of each participant persisted in the absence of social consequences, suggesting that the behavior was automatically reinforced (see Lanovaz & Sladeczek, 2011). The three upper panels of Figure 1 show the percentage of time Amy engaged in vocal stereotypy across baseline, HI, and LI sequences. Levels of vocal stereotypy in the first component were not depicted in reversal graphs, but remained undifferentiated within and across phases (data available from the first author). In the second component (first panel), Amy's vocal stereotypy was generally lower in the HI and LI sequences than in the baseline sequences, suggesting that both intensities decreased immediate engagement in the behavior. In the third component (second panel), levels of vocal stereotypy were marginally lower in the HI and LI sequences than in the baseline sequences, but unfavorable trends precluded the demonstration of experimental control. As proposed by Lanovaz, Rapp, and Fletcher (2010), we also compared the first component to the third component to examine the subsequent effects of music. To facilitate the within-sequence analyses, we depicted the first and third components of the HI sequences on the same graph and did the same with the LI sequences. The third panel of Figure 1 shows that levels of vocal stereotypy were somewhat lower in the third component than in the first component with the HI stimulus (left), suggesting that the HI stimulus may have marginally decreased subsequent engagement in vocal stereotypy. The LI stimulus (right) did not produce the same effect.

The three lower panels of Figure 1 show the percentage of time Michael engaged in vocal stereotypy across baseline, HI, and LI sequences. In the second component (fourth panel), levels of stereotypy were generally lower in the HI and LI sequences than in the baseline sequences, suggesting that both stimuli decreased immediate engagement in the behavior. However, increasing trends are apparent at the end of the last phase. In the third component (fifth panel), the data paths overlapped within and across phases, indicating that the stimuli did not decrease subsequent engagement in vocal stereotypy. Levels of stereotypy were generally higher in the third component than in the first component of HI sequences (sixth panel, left), suggesting that noncontingent access to HI music increased subsequent engagement in vocal stereotypy. We detected no clear effects in the LI sequences (sixth panel, right).

The results suggest that the HI and LI songs decreased immediate engagement in vocal stereotypy for both participants. This effect continued across multiple brief sessions for one of two participants, but an increasing trend was apparent in the last phase for Michael. These data suggest that the effects of music on vocal stereotypy should be monitored regularly to detect any changes to its reductive effects over time. Manipulating the volume of music at the intensity levels used in this study did not produce differential effects on immediate engagement in vocal stereotypy. The changes in vocal stereotypy observed in the third component were small compared to those produced in the second component and were only measured for 5-min periods, which may not be long enough to determine if the effect is clinically significant. Nonetheless, the dissimilar patterns observed between participants may suggest different clinical outcomes. For example, the HI stimulus led to a mean 17% increase (i.e., 51 s) in vocal stereotypy from pre- to postintervention for Michael, whereas the HI stimulus produced a mean 12% reduction (i.e., 36 s) for Amy. The nearly 30% difference between the two participants may be considerable when

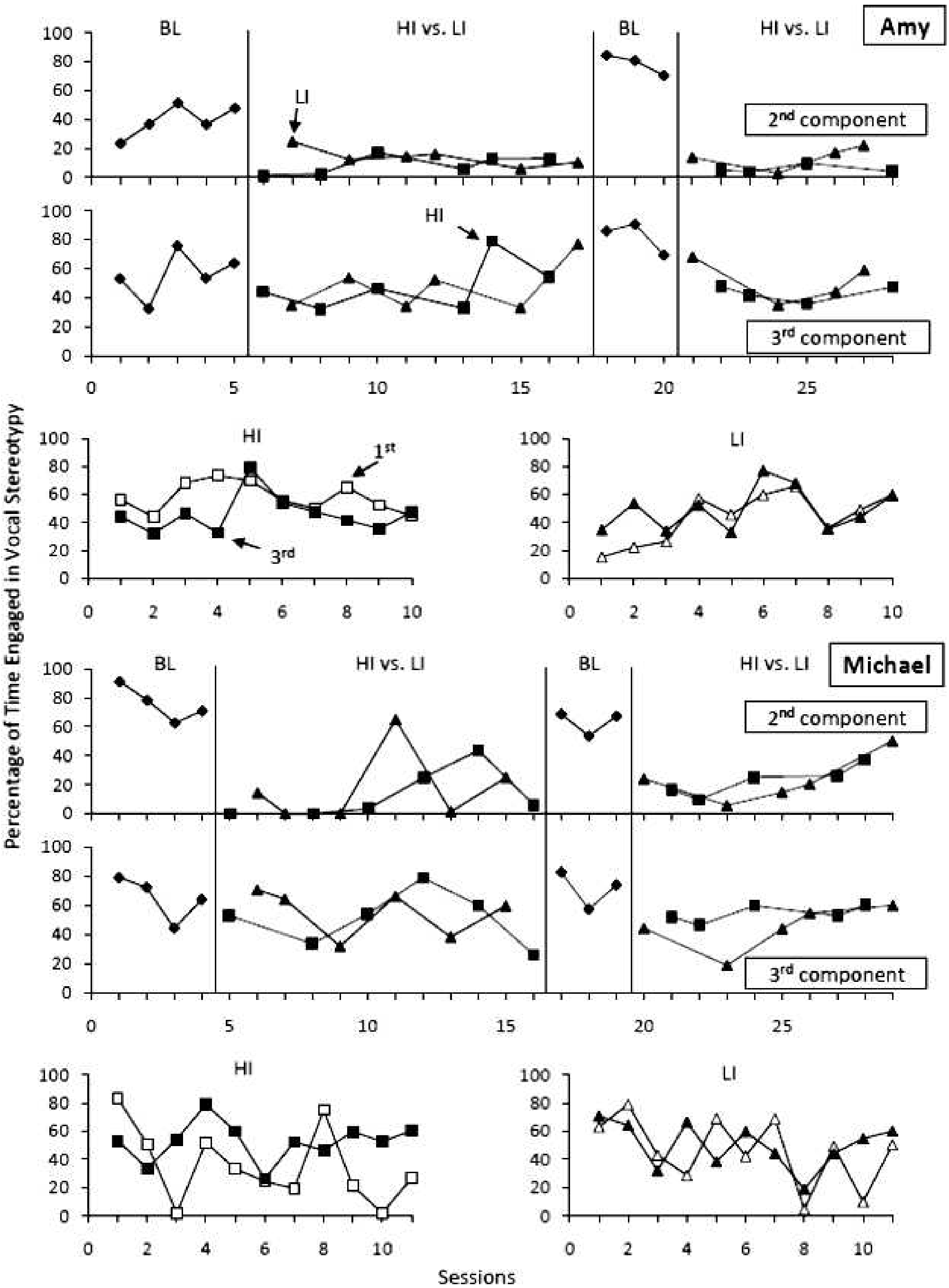

Figure 1. Percentage of time Amy and Michael engaged in vocal stereotypy in the second (first and fourth panels) and third (second and fifth panels) components of baseline (BL), high-intensity (HI), and low-intensity (LI) sequences. The third and sixth panels depict the first (open data points) and third (filled data points) components of HI (left) and LI (right) sequences.

teaching an individual with autism a new behavior. In two recent studies, Lang et al. (2009, 2010) showed that even small reductions in stereotypy may improve the acquisition of new behavior, but more research is clearly needed to validate their observation.

The implementation of noncontingent music as an intervention for vocal stereotypy presents several challenges that warrant future research. First, clinicians may typically provide noncontingent access to music for periods longer than 5 min, which limits the applicability of the current results. Thus, researchers should conduct a parametric analysis of session duration to examine whether the reductive effects of music persist across longer sessions (see Lindberg, Iwata, Roscoe, Worsdell, & Hanley, 2003). Second, continuous access to music may be as disruptive as vocal stereotypy in classroom environments. In future research, children who emit vocal stereotypy should wear headphones to listen to music, which would extend research by ensuring a constant intensity across sessions and preventing music from distracting others. Third, the subsequent effects of music have been shown to be variable within and across participants. Researchers should continue to explore the properties of music that may produce reductive effects. For example, the effects of a wider range of intensities or matching the intensity of music to the intensity of the child's vocal stereotypy may be examined.

The main advantage of noncontingent music compared to other treatments (e.g., differential reinforcement of other behavior, response interruption and redirection) is that the intervention does not require the undivided attention of a trainer. However, music may interfere with engagement in other behavior. Thus, researchers should examine whether music interferes with tasks that do not require listening. For example, the study may be replicated in conditions in which a trainer provides prompts at regular intervals. If music has less of an effect on task completion than vocal stereotypy, individuals with autism may listen to music while engaging in academic or vocational activities.

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