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THE DISCRIMINATION OF OBJECT NAMES AND OBJECT SOUNDS IN CHILDREN WITH AUTISM: A PROCEDURE FOR TEACHING VERBAL COMPREHENSION

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We assessed whether 2 preschoolers with autism learned to discriminate between the sounds of musical instruments more rapidly than the spoken names of the instruments. After the children learned the sound-object relations more rapidly than the name-object relations, we then evaluated a prompt-delay procedure for transferring stimulus control from the sounds to the names of the instruments. The prompt-delay procedure facilitated the acquisition of name–object relations for both children.

DESCRIPTORS: autism, language delay, stimulus control, transfer, verbal stimulus

Language impairment is one of the defining characteristics of childhood autism (American Psychiatric Association [APA], 1994; Shillingsburg, Kelley, Roane, Kisamore, & Brown, 2009), and teaching verbal comprehension to these children can be challenging. One approach to teaching verbal comprehension (e.g., pointing to a ball after hearing the word ''ball'') is to transfer stimulus control from an existing controlling stimulus to the target stimulus using a prompt-delay procedure (e.g., Clark & Green, 2004; Halle, Marshall, & Spradlin, 1979). For example, several studies have demonstrated that teaching children with autism who display echoic responses to echo object names may facilitate acquisition of verbal comprehension (Charlop, 1983; Leung & Wu, 1997; Wherry & Edwards, 1983). However, this approach is viable only for children with existing echoic repertoires.

Another alternative for children with limited echoic repertoires may be to transfer stimulus control from a nonverbal auditory stimulus to the desired spoken stimulus. Prior research has shown that children with language impairments may show deficits in discrimination of verbal stimuli (certain speech sounds) but unimpaired discrimination of nonverbal auditory stimuli (see McArthur & Bishop, 2005; Saygin, Dick, & Bates, 2005; Saygin, Dick, Wilson, Dronkers, & Bates, 2003; Uwer, Albrecht, & von Suchodoletz, 2002; Van Petten & Rheinfelder, 1995). For example, a child with autism may learn to point to a phone after hearing its ring but not after hearing the word ''phone.'' In such cases, it may be possible to use the sound of an object as a controlling stimulus (e.g., pointing to a phone after hearing its ring) and to use a prompt-delay procedure to transfer stimulus control to the name of the object (e.g., pointing to a phone after hearing the word ''phone'').

The current study was designed to evaluate this transfer-of-control strategy. First, we assessed whether 2 preschoolers with autism and severe language delays learned to discriminate the sounds of musical instruments (e.g., selecting a flute from a pair of musical instruments after hearing the sound of a flute) more rapidly than the spoken names of the instruments (e.g., selecting a flute after hearing

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the spoken word "flute"). Next, we evaluated a fading procedure for transferring stimulus control from the sounds to the names of the instruments.

METHOD

Participants and Setting

Two boys with autism and severe language delays, ages 3 years 9 months and 3 years 3 months, participated. Their diagnoses were made by an independent agency based on criteria of the *Diagnostic and Statistical Manual of Mental Disorders* (APA, 1994) and the Autism Diagnostic Interview–Revised (Lord, Rutter, & Le Couteur, 1994). Both participants were nonvocal but could accurately respond to a few simple instructions (e.g., "clap hands," "stamp feet") and match identical objects and pictures. Sessions were conducted in Participant 1's home and in Participant 2's preschool classroom.

Measurement and Interobserver Agreement

Trials were scored as correct if the participant sounded the correct instrument (e.g., shaking the maracas) within 3 s of the sample stimulus (i.e., the sound of the instrument or the spoken instrument name), incorrect if he sounded the wrong instrument, or prompted if he sounded the instrument following an additional gestural or physical prompt provided by the experimenter. Interobserver agreement was assessed by having a second observer simultaneously but independently score the participant's responding during 25% of sessions with each child. Observers' records were compared on a trial-by-trial basis and were scored in agreement only if both observers scored the trial as a correct or incorrect response. Mean interobserver agreement across participants and sessions was 92% (range, 87% to 100%).

Procedure

Ten musical instruments, selected for the distinctness of their sounds, were used as teaching stimuli. Each instrument was randomly assigned to the sound–object or name–object condition. Prior to each session, a brief multiple-stimulus-without-replacement preference assessment (DeLeon & Iwata, 1996) was conducted to identify edible items, toys, or other stimuli that were delivered as putative reinforcers contingent on prompted responses during the initial massed trials and for correct independent responses during all training phases.

Pretest. A pretest was conducted to determine if participants would correctly sound musical instruments when presented with either (a) the sound of the instrument or (b) the name of the instrument. Reinforcers were delivered on a fixed-time (FT) 10-s schedule to promote in-seat behavior. Each target instrument was presented with two distracter stimuli placed on a table and equidistant from the participant. A duplicate instrument was used to produce the sound of the target instrument behind a visual screen during sound–object trials. The experimenter vocally stated the name of the target instrument during name–object trials. The experimenter presented each instrument a total of 10 times (five in the sound–object test and five in the name–object test). A combined score of less than 70% correct was required for instruments to be included in the remainder of the evaluation. Acquisition of the discrimination between musical instruments was then compared when the sample stimulus involved either the name of the instrument (name–object) or the sound of the instrument (sound–object). Ten 40-trial sessions were conducted per week.

Comparison of sound–object and name–object training. Sample stimulus presentation was similar to that described during the pretest. The experimenter sounded instruments for 2 s from behind a screen during sound–object sessions and named the instrument vocally during name–object sessions. Other than this difference in the sample stimulus that was

presented at the start of each trial (i.e., sound vs. name), the experimenter conducted discrimination training using the same errorless teaching procedure in both conditions.

During the initial training trials, the experimenter presented the target instrument in the absence of distracter stimuli, the experimenter provided the sample stimulus (e.g., stated "shaker" or sounded the shaker behind the screen), and physically prompted the participant to sound the instrument (Step 1). The physical prompt was faded to a gestural prompt and finally removed entirely across trials. If the participant responded to the target instrument correctly on the first four consecutive independent trials or after 9 of 10 consecutive trials, the experimenter presented a second musical instrument (e.g., triangle) as a distracter (Step 2). Initially during this step, the experimenter presented the target instrument in front of the child, and the distracter instrument was further from the child's reach. The experimenter gradually moved the distracter instrument closer to the target instrument across successive trials until they were parallel. The experimenter then randomly rotated the two comparisons across trials until the participant sounded the target instrument (e.g., shaker) on the first four consecutive trials or 9 of 10 consecutive trials. Training for the second target instrument then began. Similar to Step 1, the experimenter presented the instrument (e.g., triangle) first in isolation (Step 3; requiring the first four consecutive trials or 9 of 10 consecutive trials with a correct response to advance) and then presented it with a distracter instrument (i.e., the other member of the training pair; in this example, the shaker; Step 4). After the participant correctly and independently selected the target instrument on the first four consecutive trials or 9 of 10 consecutive trials, experimenter requests for the first and second instrument were gradually interspersed. The experimenter presented prompts to sound the first trained instrument (e.g., shaker) until the participant sounded it on three consecutive trials with the position of the target and distracter stimuli held constant (Step 5), followed again by prompts for the second trained instrument (e.g., triangle) until the participant sounded it on three consecutive trials (Step 6).

Next, the experimenter prompted sounding of the first trained instrument (e.g., shaker) until the participant sounded it on two consecutive trials (Step 7). Finally, the experimenter alternated prompts to sound both instruments and the positions of the comparison stimuli until the participant sounded the correct instrument on 9 of 10 consecutive trials (Step 8), meeting criterion for acquisition of the discrimination.

Transfer of stimulus control. Stimulus control of the instrument sound was transferred to the vocally stated names for those instruments presented in the sound–object conditions. This was accomplished using the following errorless training procedures. First, the experimenter stated the name of one target instrument (e.g., shaker) immediately before sounding the object behind the screen. The experimenter then faded the sound prompt by decreasing the intensity and duration of the sound presentation (Step 1). This continued until the child sounded the correct instrument on the first four trials or 9 of 10 consecutive trials. The experimenter then presented and faded the sound for the second instrument (e.g., triangle) using the same procedure and criterion (Step 2). Finally, the experimenter prompted the sounding of both instruments in a random order until the participant responded correctly on 9 of 10 consecutive trials (Step 3), which was the mastery criterion.

RESULTS AND DISCUSSION

Prior to training, no systematic differences were found in either participant's responding to instruments assigned to name–object or sound–object conditions (pretest data can be obtained

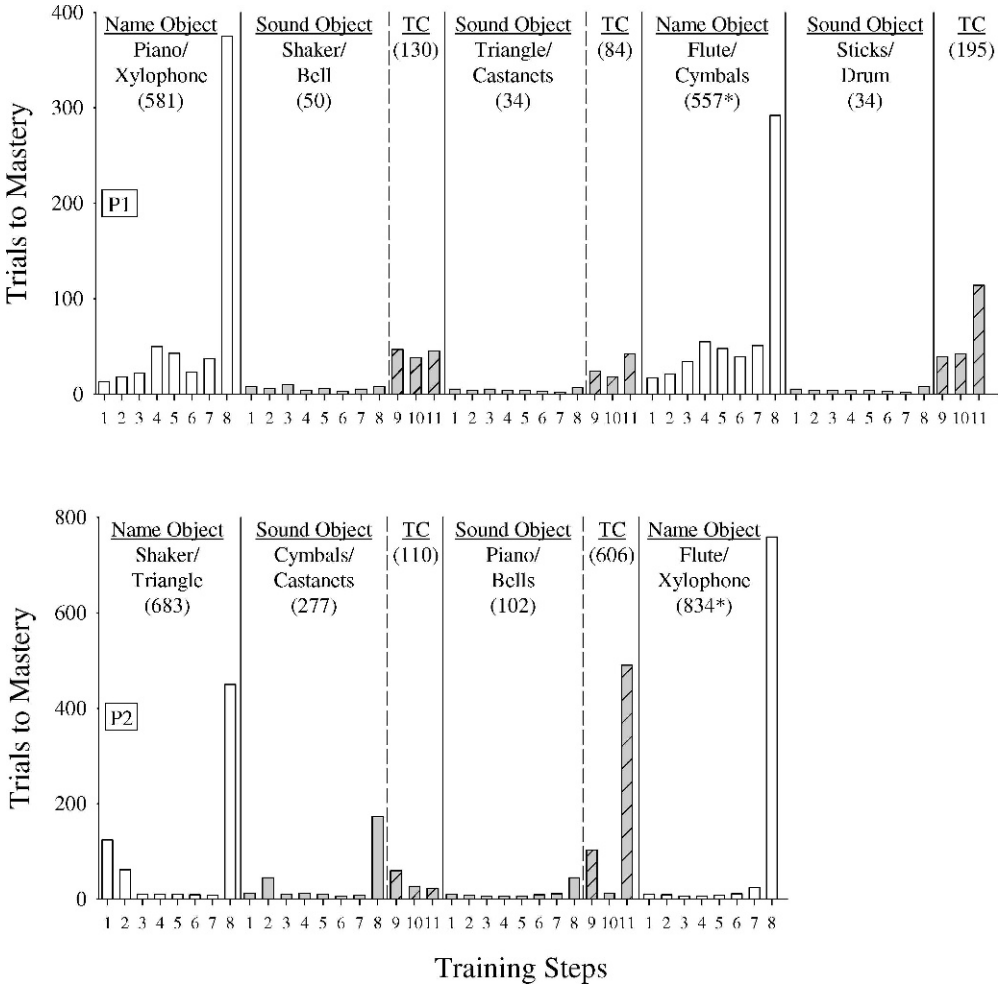

Figure 1. Trials to mastery across training steps for the acquisition of each discrimination when the spoken names or the object sounds were presented as sample stimuli and when stimulus control was transferred from the sound to the name of the instruments (TC condition). The number in parentheses is the total number of trials to meet mastery criterion within each condition.

from the first author). Outcomes of the training procedure for both participants are shown in Figure 1. Participant 1 met all mastery criteria for the piano–xylophone discrimination after a total of 581 trials and failed to meet mastery criteria for the flute–cymbals discrimination after a total of 557 trials when the experimenter presented instrument names as the sample stimuli. By contrast, he met all mastery criteria for the shaker–bell discrimination after only 50 trials, the triangle–castanets discrimination after 34 trials, and the sticks–drum discrimination after 34 trials when the experimenter presented the instrument sounds as sample stimuli. Stimulus control was transferred from the sound to the name of the shaker and bell in 130 trials, from the sound to the name of the triangle and castanets in 84 trials, and from the sound to the name of the sticks and drums in 195 trials.

Participant 2 met all mastery criteria for the shaker–triangle discrimination in 683 trials, but failed to meet mastery criteria for the flute–xylophone discrimination after 834 trials when

the experimenter presented instrument names as the sample stimuli. By contrast, he met all mastery criteria for the cymbals–castanets discrimination after 277 trials and for the piano–bells discrimination after 102 trials when instrument sounds were presented as sample stimuli. Stimulus control was transferred from the sound to the name of the cymbals and castanets in 110 trials and from the sound to the name of the piano and bells in 606 trials.

In sum, both participants learned to respond to instrument sounds more quickly than instrument names, and stimulus control from the instrument sounds was transferred to their vocally stated names. For Participant 2, the transfer of control from the instrument sounds to the instrument names was achieved; however, the combination of sound–object training with the transfer-of-control procedures did not reliably produce more rapid acquisition than the name–object training. Additional research will be necessary to determine the utility of such a procedure and to enhance its effectiveness.

These results support the assertion that children with autism or language impairments may learn to discriminate nonverbal stimuli more readily than verbal stimuli. However, the current procedures may have been weighted in favor of the sound–object condition. That is, the response of sounding the instrument produced an auditory product that was identical to the sample stimulus provided in the sound–object condition (i.e., essentially this was an identity matching task), but clearly differed from the vocally stated name in the name–object condition. Future research should control for this possibility by identifying a selection response that does not generate a product similar to the sample stimulus (e.g., a simple pointing response).

Assuming, however, that the more rapid acquisition was a result of the presentation of the instrument sound, the results of this study appear to be limited to teaching discriminations between items associated with characteristic sounds. However, it is plausible that pairing arbitrary sounds with teaching stimuli could facilitate acquisition of discriminations (e.g., pairing the sound of a horn with a fork to teach the fork–spoon discrimination). This remains an interesting area of future research.

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