Clinical Application of a High-Probability Sequence to Promote Compliance with Vocal Imitation in a Child with Autism Spectrum Disorder

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Abstract

The current study aimed to evaluate the effects of the high-probability (high-*p*) instructional procedure involving motor imitation on the levels of compliance with vocal imitation in a 3-year-old boy with autism spectrum disorder (ASD). We used a multiple-baseline design across three stimuli sets to demonstrate effects of the procedure over compliance with vocal imitation responses. Results demonstrated that the high-*p* procedural sequence was effective in increasing the levels of compliance with vocal imitation. We discuss these findings in terms of the operant mechanisms and clinical applications of increased compliance.

Keywords High-*p* · Low-*p* · Motor imitation · Vocal imitation · Intervention · Autism spectrum disorder

Noncompliance to instructions is commonly observed in children with autism spectrum disorder (ASD) and other developmental delays (Luiselli, 2009). Although noncompliance represents a challenge for completion of common daily routines (e.g., dressing oneself, picking up toys, transitions between activities), it might also significantly impact the development of new functional skills if the child does not comply with therapist instructions during skill acquisition interventions (Fischetti et al., 2012). A procedure that has been commonly used to increase compliance to instructions is the high-probability (high-*p*) instructional sequence (Lipschultz & Wilder, 2017). Based on the theory of behavioral momentum, the high-*p* instructional sequence consists of presenting several instructions that a child is likely to comply with followed

immediately by the low-probability (low-*p*) instruction associated with low compliance (Mace et al., 1988).

Davis, Brady, Williams, and Hamilton (1992) successfully employed the high-*p* instructional sequence to increase levels of compliance to low-*p* instructions for two children with developmental disabilities. Participants' compliance with the low-*p* instruction increased and generalized to novel therapists. In a recent review of literature, Lipschultz and Wilder (2017) demonstrated the applications of the high-*p* instructional sequence across different populations, including children with ASD (e.g., Esch & Fryling, 2013; Riviere, Becquet, Peltret, Facon, & Darcheville, 2011). The high-*p* instructional sequence has also been applied to address compliance with different topographies of response, such as food acceptance (Dawson et al., 2003), social interaction (Jung, Sainato, & Davis, 2008), and medical examination (Riviere et al., 2011).

One of the advantages of the high-*p* instructional sequence is that it does not require the therapist to provide physical guidance for the child to complete a task (Bullock & Normand, 2006). This feature is particularly important when completion of the task involves responses that cannot be physically prompted (e.g., vocal imitation). In the context of language intervention, children with ASD are constantly presented with instructions to engage in vocal imitation responses while learning to request for preferred items, label common objects, and answer simple questions (DeSouza, Akers, &

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Fisher, 2017). Hence, reliably engaging in vocal imitation following the therapist instruction or model is crucial for the development of functional language skills.

There has been some evidence that the similarity of the topography between the high-*p* and the low-*p* instructions might increase the effectiveness of the procedure (e.g., Esch & Fryling, 2013; Ross & Greer, 2003). Although the topographies are not identical, the generalized imitation repertoire may increase the similarity of motor and vocal imitation. This similarity may mean that a high-*p* instructional sequence using mastered motor imitations might facilitate compliance with low-*p* vocal imitation. Tsiouri and Greer (2003) evaluated the effects of a high-*p* motor-imitation instruction procedure on compliance with low-*p* vocal imitation instructions in the context of mand and tact training with children with language and developmental delays. Both children had a history of compliance with motor imitation instructions but not with vocal imitation instructions. The intervention consisted of the experimenter presenting a rapid sequence of six motor imitation instructions followed by a vocal imitation instruction for a preferred item (i.e., mand training) or a nonpreferred item (i.e., tact training). Participants received the preferred item following a correct vocal imitation response in either condition, and the procedure was effective in increasing compliance with vocal imitation instructions.

Although the low-*p* vocal imitation instruction was always presented in the context of mand and tact training in the Tsiouri and Greer (2003) study, those results suggested that the high-*p* instruction sequence might be an effective procedure to increase compliance with vocal imitation in children with a repertoire of motor imitation. Therefore, the purpose of the present study was to evaluate the effects of presenting a high-*p* motor imitation sequence on the levels of compliance with low-*p* vocal imitation instructions. Furthermore, generalization to compliance with novel vocal imitation responses was evaluated.

Method

Participant, Setting, and Materials

Kyle, a 3-year-old African-American male diagnosed with ASD, served as the participant of the current study. Kyle attended a behavioral intervention clinic for 3 days per week. Results of the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2013) conducted 1 month prior to the start of the study indicated that Kyle emitted three different mands, five different tacts, and selected at least two reinforcers when presented with the name of the item. His total score on the VB-MAPP milestones assessment was 18.5. In addition, Kyle matched at least 10 identical items, imitated 2 gross motor actions, and vocalized 8 sounds or words with appropriate intonation and rhythm. At the start

of the study (i.e., after receiving 1 month of intensive intervention), Kyle had acquired a tacting repertoire and a generalized motor imitation repertoire and displayed strong visual matching skills. He did not respond to instructions to imitate words during tact and mand training. Consequently, Kyle acquired a variety of mands for preferred items through the Picture Exchange Communication System (PECS; Bondy & Frost, 1998) and emitted mands for preferred items more frequently through PECS than vocal behavior.

Sessions were conducted at Kyle's table in a classroom of an intensive behavioral intervention clinic focused on skill acquisition. Sessions were conducted 3 days per week and lasted for approximately five minutes. There were six vocal imitation targets that were randomly assigned to three sets. Set 1 was "ah" and "ee," Set 2 was "go" and "bee," and Set 3 was "mm" and "oh." The targeted sounds and words were chosen based on the observation that Kyle emitted each sound outside of the instructional context (i.e., away from the table). Preferred items were identified through parent report and a free operant preference assessment conducted prior to running sessions. Items used included water beads, dry rice and beans, sand, Play-Doh®, musical instruments, and a variety of pop-up toys and toys that lit up and made sounds.

Response Measurement and Interobserver Agreement

A correct vocal imitation response was recorded if Kyle emitted the same sound or word said by the experimenter within 2 s of the vocal imitation instruction "Say [target]" (e.g., the experimenter said, "Say ah," and Kyle said, "ah"). As articulation of individual sounds was not the primary goal but rather increasing instructional control, approximations of the target word (e.g., the experimenter said, "Say bee" and Kyle said, "baa") were also considered correct responses. To be scored as a correct vocal imitation response, an approximation must have included a component of the sound (i.e., at least one targeted phoneme). No vocal response was scored as an incorrect response. Motor imitation instructions included clap hands, arms up, roll arms, wave, tap table, touch nose, touch index fingers, index finger to table, stomp feet, touch head, and knock on table.

Interobserver agreement (IOA) of vocal imitation responses was collected for 30% of sessions across all conditions. An agreement was scored if both observers recorded a correct vocal imitation response or an incorrect vocal imitation response on a given trial. IOA was calculated by dividing the total number of trial-by-trial agreements by the trial-by-trial agreements plus disagreements and multiplying by 100. Mean IOA was 95.83% (range 67%–100%).

A concurrent multiple-baseline design across stimulus sets was utilized to assess the effects of the intervention on compliance with vocal imitation.

Procedures

Early Echoic Skills Assessment (EESA) The Early Echoic Skills Assessment (EESA; Esch, 2013) of the VB-MAPP was conducted prior to implementing the intervention and after treatment, according to the guidelines described in the protocol.

Identification of Motor Imitation Instructions A preassessment of motor imitation instructions was conducted prior to baseline sessions to evaluate if the motor imitation actions selected were high-*p* instructions. Five sessions were conducted. During every session, the experimenter presented three different motor imitation instructions in rapid succession (i.e., 1-s intertrial interval) three times each for a total of nine trials. For every trial, the experimenter said, “Do this,” while performing a motor action (e.g., wave). The experimenter provided praise and access to preferred items at the end of the session contingent on correct imitation responses to all actions presented in the session. If Kyle did not respond correctly, the experimenter terminated the trial and moved on to the next trial. Motor imitation tasks were considered a high-*p* instruction if Kyle responded correctly to all trials for 100% of sessions. In the end, 11 motor imitation instructions were identified as high-*p* instructions.

Identification of Vocal Imitation Instructions Vocal imitation instructions were identified prior to baseline and teaching sessions. The experimenters first evaluated if the words and sounds selected were low-*p* instructions by testing them in one six-trial session of each set of two target vocal imitations. The experimenter sat next to Kyle and said, “Say [target].” The experimenter provided praise and access to preferred items contingent on correct vocal imitation responses. There were no programmed consequences for incorrect responses or instances where Kyle did not respond. Low-*p* instructions were defined as incorrect on 100% of trials.

Baseline The experimenter sat across from Kyle at a table and presented each trial by saying, “Say [target]” (e.g., “Say ee”). The experimenter provided praise and access to preferred items contingent on correct vocal imitation responses. There were no programmed consequences for incorrect or no responses. The experimenter presented each vocal imitation instruction three times per session for a total of six trials.

Intervention Each trial consisted of three different high-*p* motor imitation instructions (e.g., clap hands, arms up, roll arms), which were randomly selected and varied across trials, followed by a fourth low-*p* vocal imitation instruction. The experimenter sat across from Kyle at a table and began each trial by saying, “Do this,” while performing a motor action (e.g., wave). The experimenter presented three different motor imitation instructions in rapid succession with 1-s intertrial interval between instructions. Presentation of the vocal imitation

instruction was dependent upon Kyle correctly responding to all three of the motor imitation instructions. That is, the experimenter presented the low-*p* vocal imitation instruction only if Kyle responded correctly to all three motor imitation instructions. If Kyle did not respond correctly to all three high-*p* motor imitation instructions, the experimenter terminated the sequence and began again until Kyle responded correctly with all three motor imitation instructions. The experimenter provided praise and access to preferred items contingent on correct low-*p* vocal imitation responses. There were no programmed consequences for incorrect or no responses to low-*p* vocal imitation instructions. The experimenter presented each vocal imitation instruction two times per session for a total of six trials. The mastery criterion was 100% correct vocal imitation for three consecutive sessions, but intervention continued with a target set if stability was not yet evident for the next set in baseline.

Posttest A posttest was conducted of vocal imitation instructions following mastery of all three sets during intervention. Procedures during the posttest were identical to baseline.

Results and Discussion

Figure 1 depicts the percentage of correct vocal imitation responses during baseline and intervention sessions for each set of vocal imitation instructions. During baseline sessions for Set 1, Kyle did not respond correctly to any of the vocal imitation instructions. The mastery criterion was met in four sessions. Across all intervention sessions for Set 1, the average percentage correct responding was 98% (range 83%–100%). During the posttest, average percentage correct responding was 96% (range 86%–100%).

During baseline sessions for Set 2, the average percentage correct responding was 7% (range 0%–16%). The mastery criterion was met in three sessions. Across all intervention sessions for Set 2, the average percentage correct responding was 98% (range 83%–100%). During the posttest, the average percentage correct responding was 93% (range 72%–100%).

During baseline sessions for Set 3, the average percentage correct responding was 44% (range 0%–83%). The mastery criterion was met in three sessions and the posttest was conducted. Kyle’s levels of correct responding were 100% across all intervention sessions for Set 3. During the posttest, average percentage correct responding was 82% (range 43%–100%). Responding maintained once the intervention was removed with no need to systematically fade the high-*p* sequence.

A postassessment of vocal imitation responding using the EESA was conducted following completion of the study. Results of the postintervention EESA yielded a total raw score of 38 as compared to the preintervention EESA raw score of 0. He could consistently engage in vocal imitation of a variety of

Fig. 1 Percentage of correct echoic sounds per session during baseline, treatment, and posttest phases for the participant

sounds and single-syllable words with simple and reduplicated syllables and had emerging skills in the ability to vocally imitate multisyllabic words.

Overall, results of the study provide support that using a high-*p* sequence can be an effective strategy for improving compliance with vocal imitation trials. This finding is important because vocal responses cannot be directly prompted if the child does not initially comply, which limits the opportunity for reinforcement if a child does not echo when teaching other verbal operants (e.g., mands, tacts, intraverbals). Kyle was observed to mand and tact throughout a 2-h intervention session but did not respond following vocal prompts. The lack of responding was conceptualized as noncompliance given that vocal language had been observed in other contexts but did not occur during direct task presentation. Similar to Ross and Greer (2003), the high-*p* sequence of motor imitation instructions resulted in generalized vocal imitation responses. Correct responding continued when previously identified low-*p* vocal imitation responses were presented in the absence of the high-*p* sequence.

Other studies, including Tsiouri and Greer (2003) and Ross and Greer (2003), have demonstrated the effectiveness of incorporating a high-*p* sequence to increase vocal imitation control, which the current study further supports. A couple of differences in the procedures are noted. For example, whereas in the current study only three motor imitation instructions were presented during the high-*p* sequence, in both of the aforementioned studies up to six motor instructions were presented. In addition, they broke the high-*p* sequence into large (e.g., clap hands, tap table) and small (e.g., touch nose, touch eye) motor actions. Collectively, these studies further expand the literature by providing an alternative approach to standard vocal

imitation training for developing vocal imitation skills consisting of delivering a preferred item only when the child engages in the targeted response. Although there has been support for this procedure (Baer, Peterson, & Sherman, 1967), withholding a preferred item may result in problem behavior. The results of the current study support the use of antecedent procedures to increase responding and extend the use of the high-*p* sequence to the area of vocal imitation. Targeting vocal imitation skills is especially important as it is a foundational skill that, once established, allows a therapist to prompt and reinforce a child's vocal language responses. Although an absence of verbal behavior may often be assumed to be a skill deficit, it may also be a form of noncompliance that can be addressed using a procedure that facilitates compliance. Using a high-*p* sequence is most appropriate for improving vocalizations in children who are vocal but noncompliant, rather than for establishing vocalizations in children who are nonvocal.

Although this study provides further support for this procedure, there are limitations worth noting. The researchers were unable to replicate the results with new sets of sounds or words as the skill became generalized. In addition, only one participant was included; therefore, we cannot make strong conclusions about the generality of the effects of procedures across individuals. The results of the current study should be replicated with additional participants. Another limitation is that the EESA was conducted as a pre- and postmeasure of generalization. Using the same test on both occasions means that it is not possible to rule out improvement in the EESA score being a result of previous test exposure. Additionally, the same therapist who conducted treatment sessions, rather than an independent assessor, conducted the EESA.

A variety of future studies could be conducted. Because this particular participant did not require fading of the rapid motor imitation sequence once the vocal imitation skills were established, future research may also evaluate a fading procedure for children in which this does not occur. Researchers could also extend the results of this study by evaluating whether a rapid sequence of other behaviors (e.g., one-step directions) produces similar effects or whether the imitative skill is important to include in the high-*p* sequence. Although the current study did include the EESA, future researchers may consider a more formal generalization probe to assess whether the intervention can produce a generalized vocal imitation repertoire. Future researchers may also evaluate whether the procedures can be applied when teaching other verbal operants and to evaluate the skill profile that is best suited for using this procedure.

Implications for Practice

- This research demonstrates a strategy to increase compliance to vocal imitation.
- A high-*p* instructional sequence can increase compliance to vocal imitation.
- Motor imitation might facilitate compliance with vocal imitation due to the similarity in topographies.
- Compliance with vocal imitation enables prompting of other verbal operants.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The current study was a retrospective study and formal consent was not required. This article does not contain any studies with animals performed by any of the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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