



# Effects of Demand Complexity on Echolalia in Students With Autism

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## Abstract

Echolalia is a linguistic phenomenon common in individuals with autism spectrum disorder. We examined the relationship between demand complexity and immediate echolalia in four students with an autism diagnosis in a university-based academic setting. Mastered and novel antecedent verbal demands that required an intraverbal response were systematically alternated using a multielement design to test whether participants' immediate echolalia was socially mediated. Results showed that immediate echolalia was more likely to occur during complex novel intraverbal tasks than in any other condition. Implications for function-based treatment strategies are discussed.

**Keywords** Functional assessment · Echolalia · Functional communication training

Autism spectrum disorder (ASD) is a continuum of developmental disorders defined by both excesses and deficits in social, linguistic, and behavioral domains. Language patterns in ASD have been characterized as being repetitive, stereotyped, and excessively literal and often containing immediate or delayed echolalia (Walenski et al., 2006). Echolalia is typically defined as a contextually inappropriate verbatim repetition of all or part of a previously spoken utterance (Karmali et al., 2005; Stribling et al., 2007; Valentino et al., 2012). It can be further

subcategorized as being either immediate or delayed, with the former occurring following a brief latency between the initial utterance and the repetition and the latter involving longer durations (Foxy et al., 2004; Hetzroni & Tannous, 2004).

Echolalia can be disruptive in that it may interrupt educational programming and interfere with learners' semantic language repertoires, and it may also be related to challenging behavior (Valentino et al., 2012). Though sparse, previous efforts to identify the operant function of echolalia have yielded a variety of different results, ranging from automatic to socially mediated positive and negative reinforcement (Goren et al., 1977; Pizant & Duchan, 1981; Prizant & Rydell, 1984). Investigations focused on vocal stereotypy more broadly are far more common (Ahearn et al., 2007). Using the functional analysis methodology described by Iwata, Dorsey, Slifer, Bauman, & Richman (1982, 1994), Ahearn et al. (2007) determined that participants' vocal stereotypy was automatically maintained. Such conclusions are not uncommon; much of the literature on the assessment of idiosyncratic vocal language in ASD suggests that the behavior is largely maintained by sensory consequences (e.g., Rapp & Vollmer, 2005; Taylor et al., 2005). The determination that nonsocial reinforcement contingencies maintain some forms of stereotypy lead many researchers to include intervention procedures involving response blocking and/or interruption of the behavior (Hagopian & Adelinis, 2001). Additional procedures involving response interruption and redirection (Ahearn et al., 2007; Colon et al., 2012) have been shown to decrease automatically maintained vocal stereotypy and increase appropriate vocalizations. Despite progress toward understanding

## Research Highlights

- Antecedent relationships to target behavior can be idiosyncratic and often depend heavily on individuals' prior learning histories.
- Modifications of more widely used antecedent-based assessments may be important to determine variables evoking challenging behavior.
- Functional assessments of target topographies of challenging behavior are useful for developing appropriate treatments.

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idiosyncratic language in the population with ASD, there continues to be some divergence in the field with regard to the taxonomy, function, and social significance of echolalia.

In an effort to assess how specific environmental variables may impact the frequency of echolalia in children with ASD, Rydell and Mirenda (1994) examined correlations between antecedent utterances of a conversational partner and echolalia. Specifically, the authors categorized antecedent utterances as being either high constraint (i.e., directives or questions requiring a specific response) or low constraint (i.e., reflective questions or praise with little or no response requirement). Though the study was purely observational in nature (i.e., no experimental manipulation of antecedent utterances), the authors found that 63% of immediate echoes followed those high-constraint utterances. The results led to the suggestion of a relationship between the level of constraint (or demand) of an antecedent utterance and the corresponding likelihood of an echoic response.

A review of the literature on effective interventions for echolalia yielded procedures that are inconsistent with behavior-analytic precedent for function-based intervention. In their review of 11 publications detailing intervention procedures for echolalia, the authors noted that none of the studies in their systematic review assessed the operant function of the behavior (Neely, Gerow, Rispoli, Lang, & Pullen, 2016). The most frequently used treatment package involved a cue-pause-point intervention (Foxy et al., 2004), which involves using visual stimuli (e.g., picture cards) to replace participant echolalia with correct tacting responses. Various other intervention components were also noted, including error correction, time delay, and differential reinforcement strategies (Freeman et al., 1975; Nientimp & Cole, 1992). Again, although these studies were demonstrated to be effective in reducing rates of echolalia, none of them formally assessed the variables that evoked and/or maintained the behavior.

Neely et al. (2016) reviewed the literature on effective interventions for echolalia, which yielded procedures that are inconsistent with behavior-analytic precedent for function-based intervention. It should also be noted that an understanding of the environmental variables contributing to echolalia would be crucial for creating more targeted, function-based interventions. Given previous studies highlighting the role of preceding vocal utterances in echolalia (Rydell & Mirenda, 1994), an analysis of antecedent events may provide a starting place. For example, Smith, Iwata, Goh, & Shore (1995) evaluated antecedent events for escape-maintained problem behavior by varying demand characteristics (i.e., novelty, duration, and rate of presentation) while keeping consequences consistent across conditions. The authors were able to identify variables that served as establishing operations for escape across participants. The purpose of the present investigation was to create the first systematic evaluation of echolalia by manipulating the demand complexity of antecedent vocal utterances.

## Method

### Participants, Setting, and Data Collection

The participants were the first four students at a university-based center for developmental disabilities who were referred to the study and were identified by instructional staff as engaging in echolalia during the school day: Jasper (age 13 years 8 months), Katherine (age 16 years 8 months), Courtney (age 13 years 11 months), and Earl (age 14 years 0 months). Each participant had a diagnosis of ASD, and all of them communicated vocally using four- to eight-word sentences and exhibited a varied expressive communication repertoire of mands, tacts, and intraverbals. Sessions were conducted at the students' school in a small research room; the 7 ft × 8 ft room contained a small desk, a chair for the student, and a chair for the classroom teacher. Sessions were approximately 15 min in duration, and two to three sessions were conducted per day with no more than three conducted in a single week. Observers included the principal investigator and graduate students who had been trained in behavioral observation. Observers used laptop computers that recorded real-time data on the frequency of immediate echolalia and the frequency of teacher demands. *Immediate echolalia* was operationally defined as each instance in which a student engaged in lexically, prosodically, and/or syntactically faithful repetitions (Walenski et al., 2006) that occurred within three to five utterances after the antecedent utterances from the staff member. For example, if the staff member's antecedent utterances were singing the first four words of the song "The Itsy Bitsy Spider," the following student responses would be counted as immediate echolalia: (a) an exact replication of the words and intonation (i.e., tune) of the first four words of the song "The Itsy Bitsy Spider" immediately following the adult's last utterance, (b) a direct repetition of the adult's intonation (or prosody) using nonsense words or word approximations immediately following the adult's last utterance (e.g., repeating the tune of the song absent of the correct words), and (c) a word-for-word direct repetition of the prior utterances with the absence of a prosodic match (i.e. repeating the words but not singing the song) immediately following the adult's last utterance. The percentage of trials containing echolalia responses was calculated by dividing the total number of responses meeting the criteria for echolalia by the number of trials. To calculate interobserver agreement, each session was divided into 10-s partial intervals. Interobserver agreement was calculated for the frequency of echolalia in 30% of sessions. Agreements were scored when participants' responses met the operational definition of echolalia. In addition, agreements on the nonoccurrence of behavior were counted as 100% agreement. Nonoccurrence was scored for any participant vocalization that did not meet the criteria for echolalia, as well as in the absence of any participant vocal response. Mean

agreement of immediate echolalia was 97.8% (range 86.6%–100%). Interobserver agreement was also calculated on teachers' antecedent demands via the same method and on the same 30% of assessment sessions. Agreement for these antecedent demands was 100%.

Treatment integrity was assessed in 30% of assessment sessions and included a representative sample of each participant and type of condition. Graduate students independently coded videotaped sessions of the protocol for the following three variables in each trial: First, the teachers captured students' attention prior to delivering the intraverbal demand. Second, the teachers delivered the correct demand as listed in the written prompt provided. Third, the teachers correctly provided no consequence following the delivery of the intraverbal demand. If the coders answered yes for each of the three variables in a trial, that trial was considered to have been administered with 100% integrity. The total number of trials with 100% integrity was summed to calculate the total percentage integrity for each condition. Mean treatment integrity for 30% of sessions (25 conditions) was calculated to be 94% (range 70%–100%).

## Procedure

### Preassessment

Once the participants were identified, classroom staff were instructed to complete a preassessment data form (see Supplemental Materials). This form consisted of two "mastered" and two "novel" sets of 15 preselected questions that would require an intraverbal response from the student. For the mastered set of questions, staff were asked to indicate whether their identified student could answer each question with at least 80% accuracy. If they were unsure about whether a student could reliably answer a question correctly, they were asked to probe the questions throughout the day. For the novel set of questions, staff were asked to indicate whether, to the best of their knowledge, their identified student had any prior exposure to each question.

### Assessment Design and Conditions

Demands that require an intraverbal response were delivered by students' classroom teacher and were alternated in a multielement design between novel and mastered trials. In addition, both trials consisted of short-utterance demands and long-utterance demands, creating four separate demand conditions:

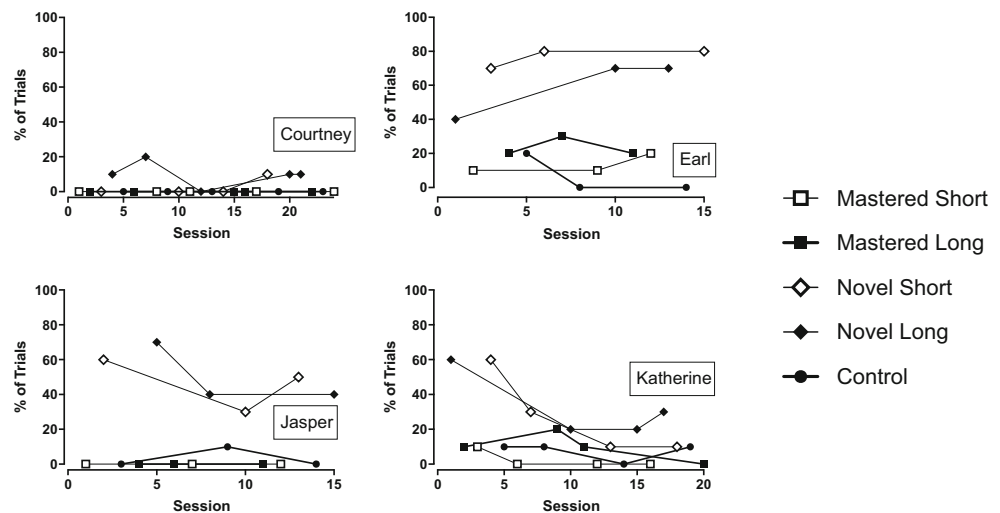
- **mastered skills and a short utterance (mastered short):** Short-utterance demands were defined as intraverbal demands consisting of no more than four words (e.g., "What's your name?").
- **mastered skills and a long utterance (mastered long):** Long-utterance demands were defined as intraverbal demands consisting of five or more words (e.g., "Who do you call when you are sick?").
- **novel skills and a short utterance (novel short):** This was defined as short intraverbal demands (less than four words) identified by staff as being novel to their student (e.g., "Where is Kazakhstan?").
- **novel skills and a long utterance (novel long):** This was defined as long intraverbal demands (five words or greater) identified by staff as being novel to their student (e.g., "Where do you buy discount sneakers?").

In addition, a control condition was included as a means of comparison and a test for an automatic function. During this condition, no demands were in place, and the student was allowed free access to preferred items. Staff were given a list of neutral statements, consisting of simple declarative short- and long-utterance phrases (e.g., "The wall is blue," "June is the best month of the year."). In addition, staff were instructed not to make eye contact when delivering the neutral statements; the rationale for avoiding eye contact in the control condition was to minimize the expectation that students were required to respond to the neutral statements.

Each session consisted of 10 trials in each condition. All intraverbal questions and neutral control statements were provided to the staff member in written form during the assessment (see Appendix B). Mastered trials (both short and long utterances) consisted of intraverbal tasks identified in the preassessment. Novel trials (both short and long utterances) consisted of 10 novel intraverbal tasks. The total length of each session varied depending on the attention of the participant, but sessions lasted no more than 2 min. The student's teacher delivered each demand once the student was attending and eye contact had been established between the staff member and student. After delivering each intraverbal question, regardless of the participant's response, the staff member was instructed to wait 10 s before delivering the next question. Staff were asked to not make eye contact after delivering each question and were not required to record their student's response. Each 10-s latency between questions was verified via a timer. Regardless of the student's response, the staff member was instructed to wait 10 s before presenting the next demand. Staff members were instructed to ignore incorrect responses and to not make eye contact contingent on a response from their student. The principal investigator was present throughout all sessions to ensure consistency across sessions and participants.

## Results

Figure 1 depicts the percentage of trials with immediate echolalia across all participants. Courtney's data are presented in

**Fig. 1** Percentage of Trials With Engagement in Echolalia

the top-left panel. Low rates of immediate echolalia were observed in both the novel short ( $M = 4\%$ ) and novel long ( $M = 10\%$ ) conditions. Results of the assessment suggest that she was only likely to engage in immediate echolalia during the conditions with the highest levels of demand complexity, though low levels of vocal responding were observed across all conditions. In each novel condition, when not engaging in immediate echolalia, she often attempted to answer each question by providing scripted responses that did not meet the criteria for immediate echolalia (e.g., when asked “What is the capital of North Dakota?” she consistently responded “United States of America”). In addition, Courtney occasionally engaged in contextually relevant though inaccurate responses (e.g., when asked “What is your favorite brand of toothpaste?” she consistently responded “Brush your teeth.”). It is likely that Courtney’s nonecholalic responding during the novel conditions reflects a failure of stimulus control (i.e., the wrong antecedent utterance is controlling the response).

Results of Jasper’s responding during the echolalia assessment are depicted in the bottom-left panel of Fig. 1. Immediate echolalia was observed in both the novel short ( $M = 46.6\%$ ) and novel long ( $M = 50\%$ ) conditions. Jasper did not engage in echolalia during any of the mastered conditions. During one control session (Session 9), he did engage in a single instance of immediate echolalia. The neutral antecedent utterance that preceded this instance was “I am hungry,” to which he responded “I am hungry.” During the control condition, Jasper had free access to preferred edibles for the duration of the session; after the session, staff reported that he had a prior history of being prompted to tact the private event that he is hungry before receiving edibles. Furthermore, the staff member who delivered the neutral statements during that session inadvertently made eye contact with Jasper at

several points during the session, representing an error in treatment integrity. It is therefore possible to explain the outlier in the control session as being the product of both previously mentioned factors.

Earl’s results are depicted in the top-right panel of Fig. 1. Immediate echolalia was observed in all five conditions and occurred most frequently in the novel short ( $M = 76.7\%$ ) and novel long ( $M = 60\%$ ) conditions. The data in Fig. 1 suggest that Earl’s echolalia was evoked most often for the novel short antecedent utterances, given that the majority of his responses contained immediate echolalia in that condition.

The bottom-right panel of Fig. 1 depicts the results of the echolalia assessment for Katherine. Immediate echolalia was observed in all five conditions and occurred most frequently in the novel short ( $M = 27.5\%$ ) and novel long ( $M = 32.5\%$ ) conditions. Similar to Jasper, Katherine engaged in a single instance of immediate echolalia following the “I am hungry” neutral statement in each of the control conditions. Katherine’s responding during this condition can similarly be explained by a history of prompting to tact private events in the presence of edibles. Decreasing trends in immediate echolalia in both the novel short and novel long conditions were observed across the assessment. Beginning in Session 7, Katherine began to respond to novel questions with an “I don’t know” response. Classroom staff later indicated that in the past, they had taught her to functionally provide that response when presented with ambiguous stimuli. Thus, the ambiguity in Katherine’s responding can best be accounted for by her history of reinforcement in the context of antecedent adult vocalizations. Although the “I don’t know” response did appear to functionally replace immediate echolalia for the majority of each session, instances of immediate echolalia continued to be observed at low levels in the novel long and novel short conditions.



## Discussion

This study examined whether increases in demand complexity produced corresponding increases in immediate echolalia in students with ASD. It was hypothesized that increased demand complexity would produce corresponding increases in participants' immediate echolalia if their echolalia was, at least in part, socially mediated. The results of these analyses suggest that participants' immediate echolalia may have been impacted by socially relevant antecedents. Katherine, Jasper, and Courtney engaged in the highest percentage of immediate echolalia during the novel long condition, which was hypothesized to be the condition with the highest amount of demand complexity. Earl engaged in higher rates of immediate echolalia in the novel short condition than in the novel long condition.

Although some studies have examined the possibility that stereotypy may be maintained by social functions (Cunningham & Schreibman, 2008; Durand & Carr, 1987; Mace, Lalli, & Lalli, 1991), there have been no formal assessments to date of relevant social antecedents that may evoke echolalia. Commonly used intervention procedures aimed at reducing rates of echolalia (e.g., cues-pause-point and verbal prompting) approached echolalia topographically rather than functionally (Kavon & McLaughlin, 1995; Valentino et al., 2012). Though these previous studies reported positive outcomes for participants, it is possible that the omission of a functional alternative replacement behavior negatively impacted the potential for maintenance and generalization.

By systematically evaluating the effects of demand complexity on immediate echolalia, we sought to add to the literature by determining whether echolalia is differentially evoked by environmental variables. The results are consistent with previous studies that found significant effects of novel demands on escape-maintained behavior (Smith et al., 1995). Formal assessment of the function of target behaviors has been shown to lead to effective interventions. In the case of immediate echolalia, evidence of a socially mediated function could lead to interventions designed to teach more functionally appropriate responses, such as an "I don't know" response (Schreibman & Carr, 1978). As the results of the present study suggest that participants differentially responded in the presence of ambiguous antecedent utterances, teaching an omnibus response (i.e., "I don't know") following these stimuli seems to be a reasonable, socially valid intervention. Indeed, the early literature on interventions for echolalia suggests that immediate echolalia is correlated with antecedent utterances (i.e., questions and/or commands) that were previously unknown to learners (e.g., Carr et al., 1975). In these studies, the authors posited that reductions in echolalia would be most meaningful by teaching generalized appropriate vocalizations in response to a variety of novel verbal stimuli. Evidence for the effectiveness of such an intervention was demonstrated in

this study by Katherine's responding during the novel conditions. Although she continued to engage in immediate echolalia following novel demands throughout the assessment, overall rates of immediate echolalia decreased from 60% to 30% in the novel long condition and from 60% to 10% in the novel short condition. It can be argued that such reductions represent a clinically meaningful improvement in functional responding.

One of the limitations of this study is that we only assessed the effects of demand complexity on immediate echolalia and chose to exclude delayed echolalia. Delayed echolalia, often referred to as "scripting," is a commonly reported verbal phenomenon in individuals with ASD (Prizant & Rydell, 1984). Delayed echolalia can be a challenging behavior to formally assess because it requires extensive knowledge of individuals' prior exposure to verbal stimuli across multiple contexts. Although acquiring the information necessary to conduct a formal assessment of delayed echolalia was beyond the scope of this study, future studies could systematically evaluate how demand complexity affects rates of delayed echolalia.

Another limitation of this study was that the consequences of echolalia were not manipulated: Only stimuli that evoked the behavior and not the maintaining variables of the behavior were identified. Thus, although it is possible to hypothesize how consequences may have maintained participants' echolalia (e.g., echolalia may have provided a form of escape, in that the teacher moved on to the next question), it was not experimentally tested in this protocol. Additional data that identified the maintaining consequences of participants' echolalia would have been helpful for interpreting the results obtained from the assessment. Future studies should examine how the manipulation of consequences affect participants' rates of echolalia (i.e., whether repeating the question contingent on echolalia has any effect on the rates of the behavior).

Additional limitations of the current study include the way that the procedures may have shaped participants' responding. Specifically, although there were no programmed consequences following occurrences of echolalia, participant responding may have been inadvertently reinforced (either positively or negatively) by staff behavior. Both the removal of the demand following echolalic responding and the quick successive presentation of the trials could have potentially served to increase the probability of similar responding. Again, these limitations may have been addressed had maintaining consequences been systematically evaluated.

Despite several limitations, the results of this study are promising and contribute to the relatively sparse literature on the functional assessment of echolalia. Echolalia can be a socially stigmatizing verbal behavior; further, it can be disruptive to academic learning in educational settings. Information about the behavioral function of echolalia can lead to the development of effective interventions, which can meaningfully improve individuals' quality of life.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s40617-020-00535-7>.

**Data Availability** All data and materials can be made available by the first author upon request.

**Code Availability** Not applicable.

## Compliance with Ethical Standards

**Conflict of Interest** The authors declare they have no conflicts of interest.

**Ethical Approval** The current study was approved by the Institutional Review Board of Rutgers University (#E14-676) and was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from legal guardians.

**Code Availability** Not applicable.

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