



# The Effects of Tact Training on Echolalia in Children with Autism Spectrum Disorder in China

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## Abstract

Echolalia can negatively impact multiple skill areas in children diagnosed with autism spectrum disorder (ASD), including skills related to academic and social performance. The purpose of this study was to employ a multiple probe across participants design to evaluate the effects of tact training on delayed echolalia in three children in China diagnosed with ASD. The results of this study indicated that tact training was effective in decreasing echolalia and increasing appropriate tacts for all three children. The effects were maintained 7 weeks following the completion of training.

**Keywords** Autism spectrum disorder · China · Echolalia · Tact training

Many children with autism spectrum disorder (ASD) exhibit echolalia, a speech disorder involving complete or partial repetition of words. Immediate echolalia refers to repetitions that occur immediately or briefly after the modeled utterance, whereas delayed echolalia refers to utterances repeated later (Prizant, 1983). Echolalia can negatively impact social interactions (Cunningham & Schreibman, 2008), academic performance (Valentino et al., 2012), and community inclusion (Wells et al., 2016). As such, it is important to evaluate methods to reduce echolalia to enhance the quality of the life for people with ASD.

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Interventions aimed at reducing echolalia include textual prompts (e.g., a “quiet” card) (Ganz et al., 2008), non-contingent reinforcement (Athens et al., 2008), tact or mand training (Colón et al., 2012; Karmali et al., 2005), response interruption and redirection (RIRD; Wunderlich & Vollmer, 2015), a package consisting of discrimination training, response cost, and a social story (Lapime & Dittrich, 2014), cues-pause-point language training (Kodak et al., 2012; McMorro et al., 1987), and intraverbal training (Ingvarsson et al., 2007).

Despite their effectiveness in reducing echolalia, most of the above-mentioned strategies focused on behavior reduction without teaching a replacement skill. Tact and mand training, on the other hand, can incorporate a child’s echolalia as a strategy for emitting context-related tact or mand responses, which results in acquiring new verbal behavior and can reduce echolalia. Karmali et al. (2005) evaluated the effects of tact training on echolalia in preschool children with ASD. During tact training, the experimenter arranged an activity (e.g., painting) for the participant, and gave the instruction, “It’s time to paint.” If the participant engaged in echolalia, the experimenter immediately interrupted by modeling a tact associated with the activity. If the participant echoed the tact, the experimenter delivered praise and the drawing activity continued. If the participant did not echo the tact but stopped emitting echolalia, the experimenter did not repeat the tact and the drawing activity continued. The results demonstrated a reduction in echolalia for all five participants and an increase in tacts. However, when experimenters returned to the baseline condition, echolalia returned to the same level as observed in the initial baseline condition. Guzinski et al. (2012) replicated Karmali et al. (2005) with four older participants (6–16 years old) with ASD and obtained the same results. Follow-up data were not collected so it is not known whether the effect was maintained.

Currently, only one study has been conducted in China on the reduction of echolalia in children with ASD. He and Hong (2017) used an intervention package that included RIRD and differential reinforcement of alternative behavior, to reduce echolalia in two Chinese children with ASD. Their intervention was effective in reducing echolalia. However, there was no improvement in the participants’ verbal skills, and maintenance data were not collected.

Given the benefits of tact training and the practical need for empirical evidence that focus on reducing echolalia for Chinese-speaking children with ASD, the present study aimed to replicate Karmali et al. (2005) in China. The purposes of the study were to evaluate whether tact training reduced echolalia while increasing independent tacts, and whether the results maintained for 7 weeks.

## Method

### Participants and Settings

Participants were recruited from a university-affiliated autism research center and an early intervention center in China. Participants emitted full sentences (Yun and Jie) or phrases (Li) to tact common objects and their uses, locations (e.g., left, right), and actions (e.g., jumping, eating). Participants also responded to basic social questions

(e.g., “What’s your name?”). Yun was a 6-year-old boy with an IQ score of 51, as indicated by the Chinese version of the *Wechsler Intelligence Scale for Children, 4th edition* (WISC-IV; Wechsler, 2003; Zhang, 2008). His score on the Chinese version of the *Childhood Autism Rating Scale* (CARS; Lu et al., 2004; Schopler et al., 2002) was 34, indicating mild to moderate symptoms of autism. He manded independently for preferred food items with a full sentence (e.g., “I want an apple”). Delayed echolalia occurred often during his sessions, which disrupted his learning. He also exhibited delayed echolalia when alone. Yun repeated lines from television shows.

Jie was 6 years old with a WISC-IV IQ score of 42. His score on the CARS was 37, indicating severe symptoms of autism. He manded for preferred items by pointing or with phrases. His interactions with others were interrupted by delayed echolalia. During play time, Jie engaged in delayed echolalia and ignored other children who talked to him. His echolalia involved repeating what he heard earlier from family members (e.g., “Dad is coming to pick you up”) or teachers (e.g., “Please sit down”).

Li was 7 years old and had a CARS score of 39, indicating severe symptoms of autism. She manded for preferred items with phrases. She frequently made non-contextual utterances (e.g., “dididdidi”) and repeated statements of others (e.g., “Say goodbye to mom”). Her delayed echolalia also frequently interfered with her interactions with others. Li sometimes displayed noncompliant behavior and refused to follow directions during instruction.

The study was conducted with Yun and Jie in an individual treatment room at the autism center. The room (2.5m x 2.5m by size) had a child-sized table, two chairs, and a drawer to store teaching materials. The room also had a two-way mirror for observation. Li’s training was conducted in a treatment room (5m x 3m) of the early intervention center. The teaching area had a rectangular table, two chairs, and a cabinet that contained teaching supplies next to the table.

## Experimental Design

A multiple probe design across participants (Ledford & Gast, 2018) was used to assess the effects of tact training on rates of echolalia and independent tacts. Baseline sessions were initially staggered between participants but were conducted simultaneously in later sessions. During tact training, daily sessions were conducted simultaneously for all three participants. When the first participant’s echolalia decreased to 50% of the baseline average for three consecutive sessions, training was introduced to the second participant. When the participant’s echolalia decreased below 10% of the baseline average for two consecutive sessions, tact training was completed. Follow-up sessions were conducted at 1 week and 7 weeks after training was completed.

## Response Measurement, Interobserver Agreement, and Procedural Integrity

The dependent variables included the rates of delayed echolalia and independent tacts. Delayed echolalia was defined as the repetition of non-functional words

that were unrelated to the current context, such as a clip from a show or something said earlier by a family member or therapist. One instance of echolalia was defined by a 2-s break between sentences or phrases. Examples and non-examples of each participant's echolalia are displayed in Table 1. An independent tact was defined as the emission of a situation-related vocal response by the participant without any prompt. For example, the participant said, "I am painting the sun" while painting. A prompted tact was defined as the participant echoing the tact modeled by the experimenter within 5 s. Rates of echolalia or independent tacts were calculated by dividing the total number of instances of echolalia or independent tacts by the total observation time per session (10 min). Data were collected by watching videos of recorded sessions.

All sessions were recorded for data collection and calculating interobserver agreement (IOA) and procedural integrity. IOA and procedural integrity were assessed for 30% of the sessions across conditions. IOA was calculated for all dependent variables. Total count IOA was calculated by dividing the smaller count by the larger count of target responses and multiplying by 100 to obtain a percentage. Mean agreement for echolalia was 98.1% (96.2–100%) for Yun, 98.5% (97.7–100%) for Jie, and 98.8% (98.3–99.5%) for Li. Mean agreement for prompted tacts was 100% for Yun, 98.7% (96.2–100%) for Jie, and 97.6% (95.8–100%) for Li. The agreement for independent tacts was 100% for all participants.

To collect data on procedural integrity, the experimenter recorded the accuracy of the implementation of steps described in the procedure, including presenting the activity using the appropriate materials, presenting an echoic prompt contingent on echolalia, reinforcing a correct response, and presenting a different echoic prompt, if necessary. Procedural integrity was 100% for all participants.

## Procedure

Sessions were conducted once per day, five days per week. Activities were chosen by participants prior to each session, although all three participants selected the same activities across conditions. Yun chose a birthday cake toy, and both Jie and Li chose painting. The participants were not allowed to access these activities at least one hour prior to sessions.

## Baseline

The participant engaged in an activity for 10 min. The experimenter sat next to the participant and observed. Echolalia was ignored; independent tacts resulted in specific praise (e.g., "That's right, you're painting"). None of the participants emitted independent tacts during baseline.

## Tact Training

Ten minute sessions were conducted during the participant's play time. The experimenter presented the activity with an instruction (e.g., "Let's paint"). Contingent on

**Table 1** Examples and non-examples of each participant's episodes of echolalia

Participant	Examples	Non-examples
Yun	Statements from cartoon (e.g., George is a big "girl"; Mummy pig is awesome; George, come on; You should go to kindergarten, George; This is Peppa's; George is going to make a potato; I'm George."	Singing (e.g., Xiyangyang; Let's learn to meo)
Jie	Repeating what was heard earlier (e.g., Dad is coming to pick you up. Queuing up, queuing up. Sit down. Mom wants to buy something)	Manding for snacks (e.g., Rainbow candy; Biscuit. Drink water; Bread, eat bread)
Li	Non-contextual utterances; Repeating what was heard earlier (e.g., hahahah; dididididi; You are great; Put your hands down; Do not talk; Wait a minute. Say goodbye to mom)	Vocal noncompliance; Mandts for snacks (e.g., Do not attend class; Come back home; Rainbow candy; Looking for dad)

echolalia, the experimenter immediately interrupted and provided an echoic prompt (e.g., “I am painting.”). If the participant stopped echolalia and echoed the experimenter’s modeled tact or emitted an alternative, appropriate tact, the experimenter provided praise. If the participant did not echo the modeled tact and continued with echolalia, the experimenter prompted a different but related tact (e.g., “I’m painting an apple”). The experimenter continued to provide a different echoic prompt until the participant echoed the model; participants typically responded to the first or second prompt.

### Follow-up

Sessions were conducted at 1 and 7 weeks following the completion of training. Procedures were identical to baseline.

### Social Validity

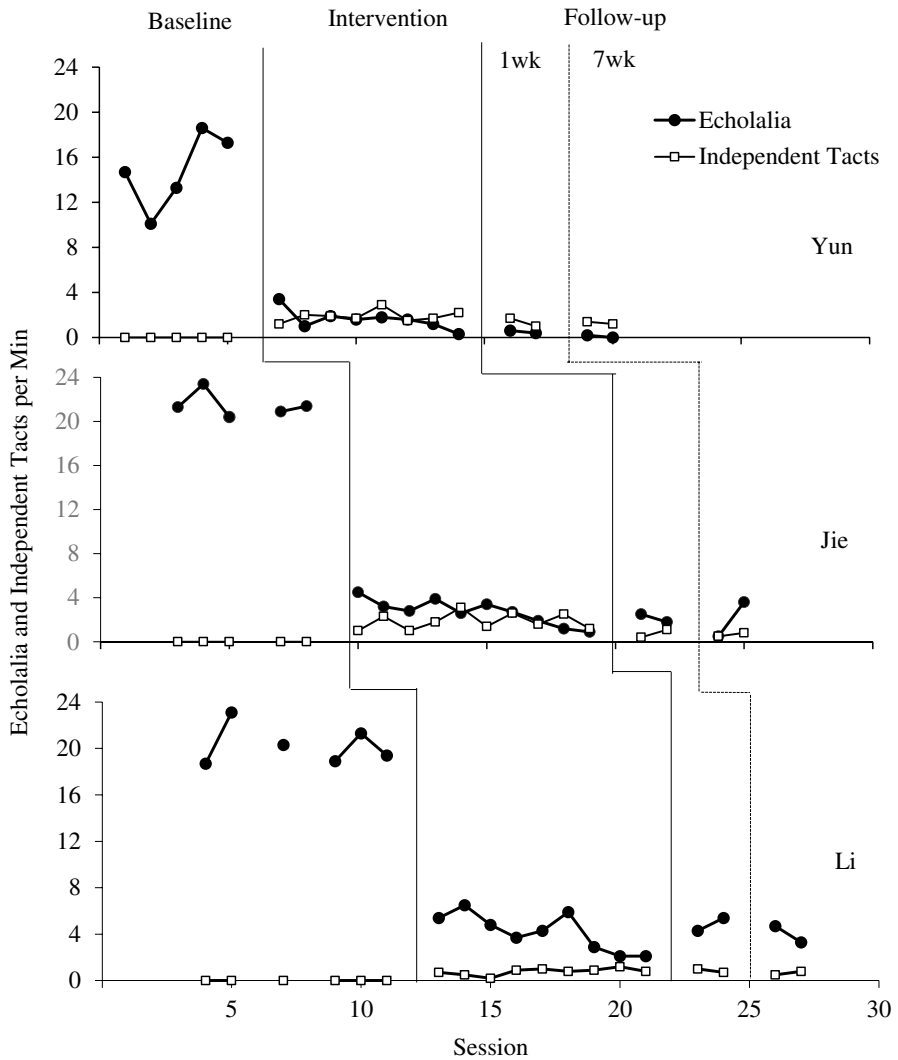
A questionnaire (available from first author upon request) developed by the research team was provided to each participant’s parent to assess social validity after the study. The questionnaire contained 11 items rated on a 1 (*strongly disagree*) to 5 (*strongly agree*) Likert scale, including acceptability (items 1–5), feasibility (items 6–8), and satisfaction (items 9–11) of tact training. The average rating for each item and standard deviation were calculated.

## Results and Discussion

Figure 1 depicts participants’ rates of echolalia and independent tacts across conditions. During baseline, high rates of echolalia occurred across participants, and none of the participants emitted independent tacts. During tact training, rates of echolalia immediately decreased and remained low for all participants. The average number of echoic prompts per min (not shown in figure; available upon request) for Yun, Jie, and Li was 1.7 (range, 0.3–3.5), 2.7 (range, 1.0–4.6), and 4.3 (range, 2.0–6.7), respectively. Rates of independent tacts increased during tact training compared to baseline. For all three participants, echolalia remained at low rates for 7 weeks following training. In addition, increases in independent tacts were also maintained for 7 weeks.

Caregivers of the three participants completed the social validity survey. The average rating was 5 ( $SD = 0$ ) on acceptability, 4.6 ( $SD = 0.31$ ) on feasibility, and 5 ( $SD = 0$ ) on satisfaction of the training.

The current results replicate those of Karmali et al. (2005) and Guzinski et al. (2012). In addition, reductions in echolalia and increased tacts continued for 7 weeks following the completion of tact training, which differed from the results of Karmali et al. (2005) who found participants did not maintain responding during a return to baseline. One procedural difference in the present study was that activities were chosen by the participants and not by the experimenters, perhaps increasing



**Fig. 1** Echolalia and independent tacts per minute across conditions for Yun, Jie, and Li

motivation to engage in the activities during sessions (Reinhartsen et al., 2002). Additionally, Karmali et al. (2005) only conducted four to five tact training sessions, whereas twice as many sessions were conducted in the present investigation. It is possible that more tact training sessions were necessary to maintain the effects.

Reductions in echolalia may be attributed to the experimenter's model prompts, which interrupted echolalia, similar to the effects of an RIRD procedure (i.e., response interruption). The modeled tacts may have functioned as a form of positive punishment for echolalia. Tact responses (prompted or independent) appropriate to the contexts were incompatible with echolalia (Ahearn et al., 2007; Guzinski et al., 2012), which

may have also contributed to the reduction in echolalia. However, it is important to note that echolalia maintained at low rates during follow-up probes in which no prompts were provided, suggesting that interruption alone may not be responsible for the results.

It is also possible that the independent tacts increased because of a transfer of stimulus control from echoic prompts to tacts. Independent and prompted tacts resulted in generalized reinforcement (e.g., praise). This transfer of stimulus control coupled with reinforcement likely resulted in increases in independent tacts. Once stimulus control was established during tact training, participants could emit and maintain independent tacts without prompts. It is also likely that echoic prompts, which increased prompted tacts (a similar topography of immediate echolalia), facilitated the stimulus control for tact responses and the participant's corresponding activity, thereby increasing independent tact responses. Additionally, all three participants had a strong tacting repertoire, which may have contributed to the maintenance of independent tacts.

There were several limitations. First, a functional analysis of echolalia was not conducted, making the functions of echolalia for the participants unknown. Future studies should identify the potential functions of echolalia to tailor treatment accordingly. Second, we did not conduct preference assessments prior to initiating the study. Future researchers should conduct structured preference assessments to ensure a variety of preferred activities are available during conditions. Third, generalization of the effects of treatment across activities, settings, or instructors was not evaluated. Fourth, Jie displayed an increase of echolalia during the last follow-up session. Future research should continue collecting follow-up data to evaluate long-term maintenance. Finally, the study used total count IOA, which may overestimate the degree of agreement. A more stringent assessment of IOA, such as exact count-per-interval IOA, should be considered in future studies. Despite these limitations, the study successfully demonstrated that tact training was effective in reducing echolalia and increasing independent tacts for Chinese-speaking children with ASD in China.

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## Declarations

**Conflict of Interest** All authors declare that they have no conflicts 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.

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

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