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BRIEF REPORT

A Comparison of Intraverbal and Listener Training for Children with Autism Spectrum Disorder

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Abstract The present investigation compared acquisition of intraverbals and listener behavior by function, feature, and class (FFC) for two children with autism spectrum disorder (ASD). We also measured tacts during listener training to evaluate whether higher levels of tacts predicted the emergence of intraverbal behavior following training. The results showed that intraverbal training required as many or fewer sessions to reach the mastery criterion than listener training by FFC, and intraverbal training consistently produced emergent listener behavior. In comparison, listener training by FFC did not consistently lead to the emergence of intraverbal behavior.

Keywords Autism spectrum disorders · Intraverbal behavior · Listener training

Training listener (e.g., receptive identification) and speaker repertoires (e.g., expressive identification) commonly occurs during early intervention programming and in individualized education programs for children with developmental disabilities (Leaf and McEachin 1999). Several early intervention curriculum manuals suggest a particular sequence for teaching listener and speaker behavior. For example, Lovaas (2003) and Leaf and McEachin (1999) sequence listener training prior to speaker training with the same stimuli. Nevertheless, the extant literature on teaching listener behavior prior to conducting speaker training with children does not support this recommended sequence. Petursdottir and Carr (2011) reviewed prior research on sequencing listener and speaker training and found that tact training was more likely to produce the emergence of untrained listener behavior than listener training producing tacts.

It remains unclear whether the sequence of listener to speaker training is beneficial when teaching other types of speaker behavior, such as intraverbals. Sundberg and

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Partington (1998) indicate that teaching listener behavior by function, feature, and class (FFC; touching the picture of soap in an array after the presentation of the auditory stimulus "You wash with __.") should occur before teaching related intraverbals. This recommendation is based on the assumption that children will tact the visual stimulus during listener training by FFC (e.g., say soap while touching the picture of soap in the array), and tacts of stimuli that occur during listener training by FFC may lead to intraverbals. Yet, prior studies on listener training by FFC have not directly measured whether children tact the visual stimuli during training. In addition, only two prior studies evaluated emergence of listener behavior or intraverbals following each type of training with typically developing children (Petursdottir, Carr, Lechago, and Almason 2008; Petursdottir and Haflidadottir 2009). Nevertheless, tact and match-to-sample training with children with autism spectrum disorder (ASD) has led to the emergence of intraverbals (e.g., Grannan and Rehfeldt 2012). Grannan and Rehfeldt (2012) taught participants to emit category names to pictures during tact training and match pictures by categories during match-to-sample training. Both participants emitted more correct intraverbal responses following training. However, the authors conducted both types of training with participants, and they did not evaluate the separate effects of training on the emergence of intraverbals. Additional research is needed to evaluate the relevance of sequencing listener before intraverbal training with children with ASD.

The purposes of the current study were to (a) compare the number of sessions to mastery for listener training by FFC and intraverbal training, (b) evaluate the emergence of untrained listener behavior and intraverbals following each type of training, and (c) measure tacts during listener training by FFC to examine whether the occurrence of these behaviors related to the outcomes of emergent intraverbals.

Method

Participants and Setting

Two children with ASD participated. Participants received ongoing clinical services from a hospital-based early intervention program for at least 6 months prior to and throughout the study. Rosemary, age 4 years, 6 months, was diagnosed with disruptive behavior disorder not otherwise specified (NOS) and autistic disorder. She used three-word phrases to tact items and activities. Rosemary consistently followed multiple-step instructions (e.g., sit down and put your hands in your lap). Rosemary had acquired more than 1500 tacts (e.g., tacts of common objects, toys, family members, familiar children, food, animals, clothes, colors, shapes, body parts, community helpers, vehicles, sports equipment, musical instruments, locations, furniture, school supplies, actions, prepositions, pronouns) and 50 intraverbals prior to her participation in this study. She also previously acquired tacts of all of the target stimuli included in the study. The Peabody Picture Vocabulary Test-4, used to measure one type of listener behavior, was conducted prior to the study and provided an age-equivalent score of 2 years, 8 months.

Oscar was 3 years, 2 months and had a diagnosis of pervasive developmental disorder-NOS. He used three-word phrases to tact items and events and was able to follow multiple-step instructions (e.g., "Hang up your backpack and sit down."). Oscar

had previously acquired more than 2000 tacts (e.g., colors, shapes, letters, numbers, common objects, food, animals, clothes, community helpers, body parts, vehicles, locations, furniture, school supplies, sports equipment, toys, family members, familiar adults and children, items found in nature, actions, prepositions, pronouns) and 50 intraverbals. He acquired tacts of all targets included in the study prior to participation. Oscar's age-equivalent score on the PPVT-4 was 2 years, 6 months.

Response Measurement and Interobserver Agreement

Observers recorded data on correct responses, prompted responses, and tacts (only during listener training by FFC) during each session. We defined a *correct response* as the participant touching the target comparison stimulus (listener response) or emitting a predetermined vocal response (intraverbal) prior to the delivery of a prompt. We defined a *prompted response* as the participant touching the target comparison stimulus or emitting a predetermined vocal response within 5 s of the delivery of a prompt. We defined a *tact* as the participant stating the stimulus on the target picture card during listener training by FFC.

A second observer simultaneously collected data during a minimum of 50 % of the sessions in each condition. We scored an agreement in each trial in which the observers recorded the same behavior(s). We calculated trial-by-trial interobserver agreement (IOA) by dividing the number of trials with agreement by the number of trials with agreements plus disagreements and converted the ratio to a percentage. Mean IOA across all conditions for both participants was 100 %.

Pretest

The experimenter conducted pretests to identify target stimuli for each condition. We selected potential target stimuli from each participant's current program goals. Each stimulus was presented in three trials with no differential consequences for correct or incorrect responses. Interspersed trials of mastered tasks were presented approximately every three pretest trials and produced praise plus a tangible item for correct responses.

Targets included fill-in-the-blank statements for listener training by FFC and intraverbals. We selected four (Rosemary) or six (Oscar) targets to include in each condition (Table 1). The number of target stimuli for each participant was based on the participant's typical number of targets during instructional programs.

Design and General Procedure

We evaluated the effects of intraverbal and listener training by FFC on correct responding within an adapted alternating treatments design embedded within a concurrent multiple baseline design across participants. We also evaluated the effects of intraverbal and listener training by FFC on the emergence of the untrained repertoire within the target set with pre- and post-baseline probes. We conducted two to four sessions per day, 2 to 4 days per week. Each session consisted of 12 trials. Four stimuli were presented three times (Rosemary) or six stimuli were presented two times (Oscar) per session. We randomly alternated the order of training sessions within and across days.

Table 1 Targets for Rosemary and Oscar for stimulus sets 1 and 2

	Set 1		Set 2	
	Listener training	Response	Intraverbal training	Response
Rosemary	The person who keeps you safe is a	Policeman	The person who gives you medicine is a	Pharmacist
	The person who helps shoppers is a	Cashier	The person who tames lions is a	Trainer
	The person who checks your eyes is a	Optometrist	The person who does your nails is a	Manicurist
	The person who cleans buildings is a	Janitor	The person who builds houses is a	Carpenter
Oscar	You add with a	Calculator	You check the date with a	Calendar
	You buy things with	Money	You cook with a	Microwave
	You cover up with a	Blanket	You measure with a	Ruler
	You scoop with a	Spoon	You wash with	Soap
	You carry groceries in a	Cart	You carry things in a	Bag
	You talk to people on a	Phone	You put flowers in a	Vase

We conducted the first two sessions of training at a 0-s prompt delay (data not displayed in figures). During these trials, the experimenter immediately provided an echoic prompt during intraverbal training trials or a model prompt during listener training by FFC trials and waited 5 s for a prompted response. The experimenter increased the prompt delay to 1 s (up to 10 s) per session based on the participant's behavior. If at least 50 % of the participant's incorrect responses were errors, the prompt delay did not increase.

We implemented differential reinforcement during training once the participant engaged in correct responses during at least 50 % of trials in one session. That is, the experimenter provided praise and a tangible item following correct responses and praise only following prompted responses. All tangible items included in sessions were identified by a brief multiple stimulus without replacement preference assessment (Carr et al. 2000) conducted at least once per day. The mastery criterion during training was two consecutive sessions with correct responses at or above 90 %.

We conducted baseline probes prior to and following training to (a) establish that the response was not in the participants' repertoire prior to one type of training and (b) measure whether responses in the untrained repertoire emerged. The mastery criterion for responding during post-training baseline probes was two consecutive sessions with correct responses at or above 80 %.

Baseline We conducted two types of baseline sessions with each set of targets. During listener baseline trials, the experimenter placed three visual stimuli in an array in front of the participant, presented the conditional stimulus (e.g., "You wash with ___."), and waited 5 s for a response. During intraverbal baseline trials, the experimenter presented the antecedent verbal stimulus that did not include the final word in the sentence (e.g., "You wash with ___.") without a visual array and waited 5 s for a response. The

experimenter did not provide any differential consequences for correct or incorrect responses during baseline trials. However, the experimenter provided praise and a tangible item during the intertrial interval for appropriate session behavior (e.g., sitting with hands in lap) approximately four times per session.

Listener Training by FFC The experimenter placed three visual stimuli in an array on the table in front of the participant, ensured that the participant looked at the stimuli, presented the conditional stimulus (e.g., "You wash with ____."), and waited the allotted time period for a response. If the participant did not respond correctly, the experimenter repeated the conditional stimulus and provided a point prompt following the designated prompt delay interval and waited up to 5 s for a prompted response. The experimenter did not tact the picture of the item during prompts. The experimenter provided praise and a tangible item following correct and prompted responses until the participant met the criterion for differential reinforcement. Thereafter, the experimenter provided praise only following prompted responses. The experimenter also measured whether the participant emitted a tact of the correct stimulus during training.

Intraverbal Training The experimenter presented the antecedent verbal stimulus (e.g., "You wash with ____.") and waited the allotted time period for a response. If the participant did not respond correctly, the experimenter delivered an echoic prompt following the designated prompt delay and waited up to 5 s for a prompted response. The experimenter provided praise and a tangible item following correct and prompted responses until the participant met the criterion for differential reinforcement. Thereafter, the experimenter provided praise only following prompted responses.

Probes Following listener or intraverbal training, the experimenter conducted baseline probe sessions with the repertoire that was not directly trained. The procedures were identical to baseline.

Results and Discussion

Figures 1 shows the results of the participants' percentage of correct responses during listener training by FFC and intraverbal training. During baseline, the participants' correct responses were at or below chance level during listener sessions and at zero during intraverbal sessions. Rosemary's responding in listener training by FFC reached the mastery criterion following ten sessions. Although we observed some tacts of stimuli during listener training by FFC, tacts were low and variable. Her probe sessions following listener training by FFC indicated that intraverbal behavior did not emerge, as evidenced by no correct responding in all probe sessions. Rosemary's intraverbal training produced mastery of the targets in six training sessions. In addition, her baseline probes of listener responses following intraverbal training met the mastery criterion. Thus, Rosemary mastered targets more quickly with intraverbal training, and this was the only type of training which showed the emergence of an untrained repertoire.

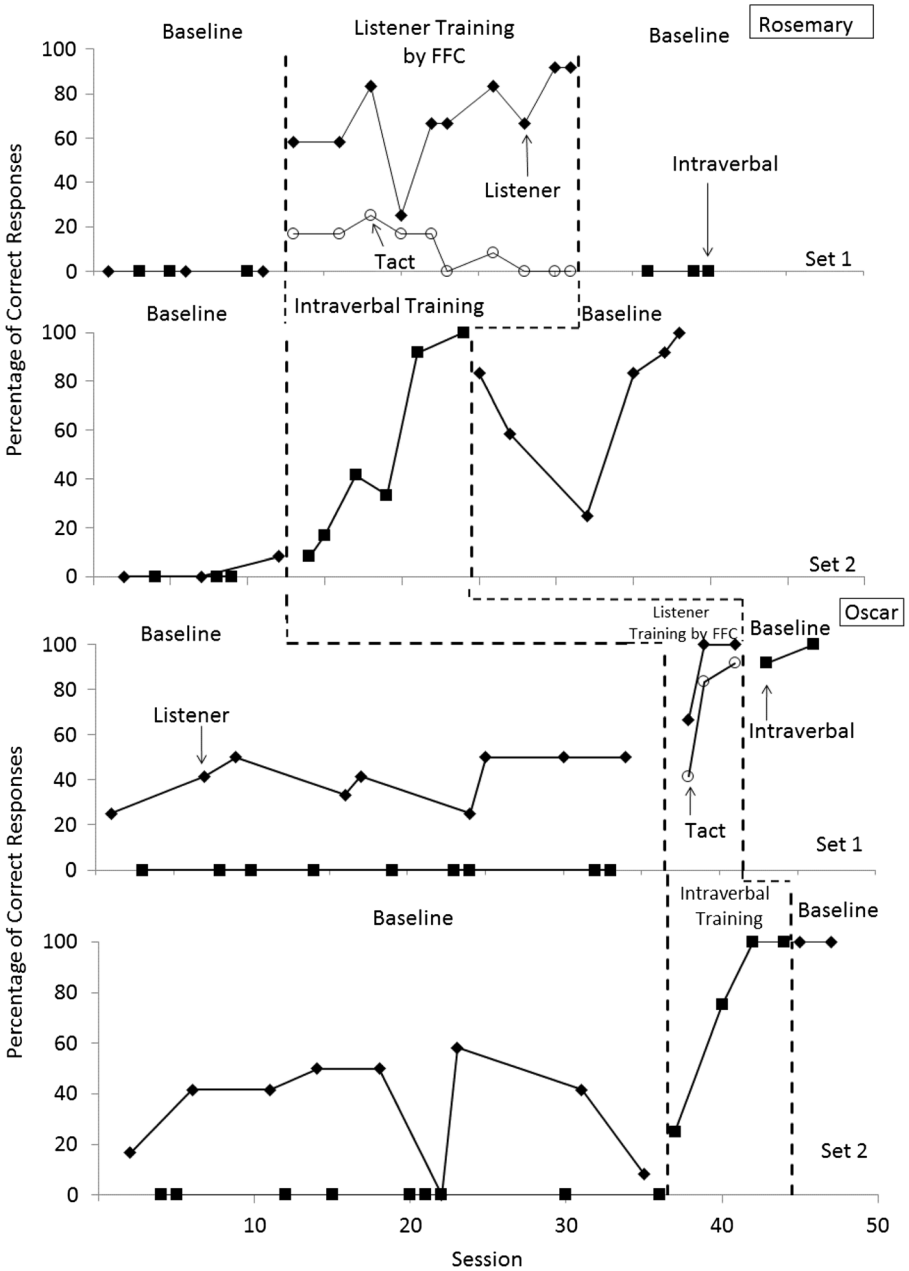

Fig. 1 The percentage of correct responses and tacts during listener training by FFC and intraverbal training for Rosemary (*top panels*) and Oscar (*bottom panels*)

Oscar's listener training by FFC produced mastery-level responding to targets in three training sessions. Oscar's tacts during listener training by FFC showed an increasing trend across training sessions. He displayed mastery-level responding during intraverbal probes following listener training by FFC. Oscar's correct responding met

the mastery criterion during intraverbal training within four training sessions. He responded correctly during 100 % of listener probes following intraverbal training. Therefore, Oscar met the mastery criterion in a similar number of sessions in both training conditions, and both conditions produced the emergence of the untrained repertoire.

The present study extended prior research on the listener-to-speaker recommended sequence by evaluating its benefit during listener training by FFC and intraverbal training. Our results were consistent with those of prior research (e.g., Wynn and Smith 2003) because intraverbal training required a similar number of or fewer training sessions to reach the mastery criterion than listener training by FFC.

Teaching intraverbals consistently produced the emergence of untrained listener responses; in comparison, listener training by FFC led to the emergence of intraverbal behavior for one participant only. These results differ somewhat from those of Petursdottir and Haflidadottir (2009) who showed that tact and intraverbal training led to the emergence of listener behavior. In comparison, listener training increased correct tact and intraverbal responses, but the participants' responses did not meet the mastery criterion. Their participants were two 5-year-old children with no known language delays. The authors did not measure other behavioral repertoires during training (e.g., tacts). Thus, it remains unclear whether typically developing children are likely to display tacts during listener training by FFC or if this behavior facilitates the emergence of untrained intraverbal behavior. The results of participants' tact behavior during listener training by FFC in the current study corresponded with correct responding during subsequent probes of emergent intraverbal behavior. Nevertheless, our preliminary results were based on the responding of two children, and future studies should attempt to replicate this finding with additional participants.

There were several limitations of the current investigation that warrant discussion. First, we did not replicate our findings within participants. All of our participants had prior exposure to intraverbal and listener training by FFC using the procedures included in this evaluation, and they previously displayed behavior consistent with the current results during their clinic-based services. However, it is beneficial to include additional comparisons of procedures to replicate results within and across participants. Also, we did not directly manipulate the presence of tacts during listener training. Instead, we measured the occurrence of tacts during instruction and compared levels of behavior to the outcomes of baseline probes following training. Future studies could require tacts during listener training by FFC to evaluate the benefits of tacts on emergent intraverbal behavior. Finally, only two children participated in this study. Additional research evaluating the appropriateness of the listener-to-speaker sequence for training listener responses by FFC and intraverbals is warranted.

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Compliance with Ethical Standards 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.

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

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