Teaching a Child with Autism to Mand for Answers to Questions Using a Speech-Generating Device

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Abstract The current study systematically replicates and extends the findings of Ingvarsson and Hollobaugh (2010) by teaching a boy with autism who used a speech-generating device to mand for answers to unknown questions. The effects of the intervention were evaluated via a multiple baseline across stimulus sets. The intervention resulted in acquisition of both the mand for information and intraverbal responses (i.e., correct answers to previously unknown questions). However, generalization of the mand for information was limited.

Keywords Autism · Intraverbals · Mand for information · Question answering · Speech-generating device · Verbal behavior

Skinner (1957) defined verbal behavior as behavior of a speaker that is reinforced through the mediation of another person's behavior. Verbal behavior can involve any topography (e.g., vocal or nonvocal) that provides a discriminative stimulus or motivating operation for a listener and a variety of topographies of responses by the listener. Skinner (1957) defined the mand as "...a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation" (pp. 35–36). The conditions of deprivation or aversive stimulation are collectively referred to as motivating operations (Laraway, Snyderski, Michael, & Poling, 2003). Mand for information occur when a speaker requests information from a listener (Ostry, Wolfe, & Rusch, 2008; Skinner, 1957; Sundberg & Michael, 2001). Mand for information are

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reinforced when the listener supplies the requested information (e.g., by answering a question), which then allows the speaker to act more effectively.

It is estimated that about 25 to 35 % of individuals with autism spectrum disorder (ASD) have little or no functional speech (Lord & Jones, 2012). These individuals are candidates for augmentative and alternative communication (AAC), such as manual signs, picture-based communication systems, or speech-generating devices (SGD) (Tager-Flusberg & Kasari, 2013; Mirenda, 2003; Wodka, Mathy, & Kalb, 2013). A number of empirically validated strategies for teaching AAC use exist. Reichle, York & Sigafoos (1991) suggested that AAC intervention could begin by teaching mands and a considerable amount of research has evaluated procedures for teaching children with ASD to use AAC to mand (Ganz, 2015; van der Meer & Rispoli, 2010). However, most of this research has focused on teaching mands for preferred objects. Only a handful of studies have focused on teaching children with ASD to mand for information, and these studies have mostly included children who communicate vocally (see Lechago & Low, 2015; and Raulston, Carnett, Lang, Tostanoski, Lee, Machalciek, Sigafoos, O'Reilly, Didden, & Lancioni, 2013, for a review). However, this research has not yet extended to mands with SGDs.

In addition to mands, it is important to teach other verbal operants, such as intraverbals (Ganz, 2015). Studies have evaluated procedures to teach intraverbals with vocal and textual prompts (Finkel & Williams, 2001; Vedora, Meunier, & Mackay, 2009), as well as picture and vocal prompts (Ingvarsson & Hollobaugh, 2011; Ingvarsson & Le, 2011).

Ingvarsson and Hollobaugh (2010) combined the research on intraverbal training and manding for information by teaching four children with autism to mand for the correct answer when presented with a question they could not answer. The children acquired the mand for information (i.e., “I do not know, please tell me”; IDKPTM), and the intervention led to the acquisition of intraverbals (i.e., answers to the questions). Given the importance of teaching intraverbal skills, the current research aims to extend the findings of Ingvarsson and Hollobaugh (2010) by applying their procedures, with the addition of textual prompts, to the use of an SGD to communicate.

Methods

Participant

Ryan was an 11-year-old boy with a previous diagnosis of autism. He was selected to participate in this study from a pool of children who had been attending a university-based clinical program for children with developmental disabilities. He was selected because he used an SGD to communicate (i.e., typing/written communication). Ryan had initially learned to communicate via handwriting, but had been using an SGD for approximately 2 years. Specifically, he used the keyboard feature of Proloquo2Go® (McNaughton & Light, 2013; Sennott & Bowker, 2009) to type a word or a phrase, insert it into the sentence strip, and activate the sentence strip to produce the corresponding synthesized speech output. Prior to the study, he was assessed using the Childhood Autism Rating Scale (CARS; Schopler, Reichler,

Devellis, & Daly, 1980), scoring a 42.5, which indicates a severe level of autism symptoms. The Vineland Adaptive Behavior Scales, second edition (Vineland-II; Sparrow, Cicchetti, & Balla, 2005) indicated an expressive language age equivalency of 2 years, 1 month (i.e., low adaptive functioning), a receptive equivalency of 1 year, 11 months (i.e., low adaptive functioning) and a written equivalency of 7 years, 1 month (i.e., moderately low adaptive functioning). His standard score for the overall communication domain was 61. Lastly, he was assessed using the Verbal Behavior Milestone Assessment and Placement Program (VB-MAPP; Sundberg, 2008). He was rated at an emerging level two, which indicated that he was functioning at an age equivalency of about 18 months in terms of his expressive language development. He was able to make specific requests for items that were not visually present by naming the item and its features (e.g., color, size, quantity). He could mand for approximately 15 missing items, and would spontaneously mand for at least 50 different items. He was able to exchange greetings with a speaker, and could engage in intraverbal fill-ins. Based on informal observations and reports from school personnel, praise and other attention (i.e., high fives, being told “good job”, etc.), functioned as reinforcers for Ryan’s behavior.

Setting

Sessions were conducted in a small conference room at Ryan’s school. The room contained a table, chairs, cabinets, and shelves. Ryan sat across from the experimenter at the table, and a second experimenter typically sat a few feet away. Sessions were held twice per day and 2 or 3 days a week.

Measurement

An observer coded the responses that Ryan typed into the keyboard feature of Proloquo2Go®, which was installed on an Apple iPad® mini. For each trial, the observers coded whether the participant said *I do not know, please tell me* (IDKPTM) or gave the correct answer to the question. The observer also scored if the response was prompted (i.e., verbal and textual prompt) or independent. Responses were scored as correct if they were initiated within 5 s of the question without a prompt, and as prompted if they occurred within 5 s of the prompt.

A second independent observer collected data during each phase of the experiment, for 59 % of total sessions. IOA was calculated on a trial-by-trial basis by dividing the number of trials with agreement by the total number of trials and multiplying by 100. The mean percentage of agreement was 97.5 % (range 86.7 to 100 %).

During the sessions in which IOA was collected, the second observer also assessed procedural fidelity using a checklist of the procedural steps. These steps included delivering the correct verbal stimulus for each trial, implementing randomized trial order, the presence and availability of the iPad, the use of a constant prompt delay when appropriate, 5-s response time for each trial, prompts for IDKPTM when appropriate, and differential verbal praise for correct answers. The percentage of correctly implemented steps was calculated for each session. The mean of correctly implemented sessions was 98.0 % (range 93.3 to 100 %).

Experimental Design

The effects of IDKPTM training were evaluated in a multiple baseline across stimulus sets. Additionally, pre- and post-test probes were conducted with an additional stimulus set not used in training (Unknown Set 3).

Procedures

Pretests and Question Selection The pretests were similar to those used by Ingvarsson and Hollobaugh (2010). The unknown questions targeted the functions of common objects (e.g., “What do you do with a bike?”), and known questions targeted tacting common objects. We could not use equivalent intraverbals for the known set, because Ryan had not learned any such responses at the beginning of the study. Pretests were conducted until a sufficient number of items were identified to create one known and three unknown sets. Each question was tested three times across three different days. For each trial, the experimenter praised correct answers and ignored incorrect answers. Questions were classified as unknown only if Ryan never gave a correct answer. Similarly, questions were classified as known only if Ryan always answered them correctly.

Baseline For baseline sessions, the Known Set, Unknown Set 1, and Unknown Set 2 were targeted (i.e., 15 questions per session, five questions per set). A randomized trial order was determined prior to each session. IDKPTM responses resulted in the experimenter telling the participant the correct answer (i.e., “You ride a bike”). Correct answers were followed by descriptive praise (i.e., “That’s right, you ride a bike”) for all sets. If the participant did not initiate an answer within 5 s or gave an incorrect answer, the next question was presented.

IDKPTM Training This phase was similar to baseline, except unknown sets were targeted for IDKPTM training. A vocal and textual model prompt (i.e., “Say, I don’t know please tell me” and presentation of printed card with the answer) and constant time delay (similar to Ingvarsson & Hollobaugh, 2010) were used to teach Ryan to type IDKPTM following unknown questions. Unknown Set 1 was targeted for training first, followed by Unknown Set 2.

First, the experimenter prompted the IDKPTM response by providing an immediate vocal and textual prompt for the IDKPTM response immediately after asking an unknown question (e.g., “What do you do with a bike?”). When the participant imitated the modeled IDKPTM response, the experimenter provided the answer using a vocal and textual model (e.g., “You ride a bike”; written answers on the back of the card). When he stated the correct prompted answer, neutral descriptive praise (e.g., “Yes, you ride a bike”) was provided. Throughout the study correct answers that were unprompted resulted in enthusiastic praise (e.g., “Nice! You ride a bike”). If Ryan emitted an independent IDKPTM response during an Unknown Set 2 trial in the intervention phase for Unknown Set 1, the experimenter provided the answer to the question, using the same reinforcement procedures described above.

When Ryan responded to the vocal and written prompt on two consecutive trials, a 5-s time delay was inserted between the question and the IDKPTM prompt. The consequences for independent IDKPTM responses were the same as for prompted responses. If he did not engage in either IDKPTM independently or an independent correct answer for two consecutive trials, the experimenter reverted back to a 0-s prompt.

Generalization Probes Generalization was assessed for IDKPTM responses by conducting pre- and post-intervention probes with Unknown Set 3 questions. The procedures during probes were identical to the baseline condition.

Generalization Training Because generalization to Unknown Set 3 was not observed in the post-test probes, the set was trained. Training procedures consisted of prompting the IDKPTM response for the first question of Unknown Set 3, and assessing for generalization to the other four questions. However, generalization was not observed initially, so training continued with additional questions in Set 3 until some generalization was observed.

Results

During baseline, Ryan responded correctly to the items (i.e., tacts) in Known Set, but did not answer any questions correctly for Unknown Set 1 throughout baseline nor Unknown Set 2 during initial baseline sessions (see the Fig. 1). During IDKPTM training for Unknown Set 1, the frequency of IDKPTM responses increased for that set, and led to the acquisition of correct answers for. Some generalization of IDKPTM to Unknown Set 2 was evident during the continued baseline. Specifically, Ryan emitted the IDKPTM response at least once or twice during eight sessions for Unknown Set 2. However, this did not lead to acquisition of correct answers for Unknown Set 2 (i.e., only 2 correct answers occurred throughout this phase). Due to the limited generalization and limited emergence of correct answers for Unknown Set 2, IDKPTM training was implemented, resulting in an immediate increase in the frequency of the IDKPTM response and the acquisition of correct answers for that set.

During training phases for both Unknown Set 1 and Unknown Set 2, there was very little undesirable generalization of IDKPTM to the Known Set (i.e., only one response, which occurred in session 21). Additionally, during IDKPTM training with Unknown Set 2, there was no undesirable generalization to the previously unknown questions that had been acquired during the first training (i.e., he did not resume responding IDKPTM to Set 1 questions).

During generalization probes with Unknown Set 3, Ryan did not emit the IDKPTM response in either pre or post-tests (data are not graphed, but summarized here). Thus, generalization training was provided. Generalization did not occur until direct training had been provided for four out of the five questions in Unknown Set 3. At that point, he emitted one unprompted IDKPTM response for the remaining untrained question (Table 1).

Fig. 1 The number of correct answers and IDKPTM responses for Ryan. The top panel shows Unknown Set 1, the middle panel Unknown Set 2, and the bottom panel the Known Set

Discussion

The findings of this study replicate and extend the previous research of Ingvarsson and Hollobaugh (2010) by teaching a minimally verbal child with autism who communicated using an iPad® based SGD, to mand for answers to questions. Ryan acquired the IDKPTM response (i.e., the mand for information), and learned the answer to ten questions (intraverbals) as a result of manding for the answers. However, generalization of IDKPTM was more limited in the current study than in the previous study.

The positive findings of this study are consistent with previous research investigating interventions to teach question-asking skills to children with autism when presented with unknown stimuli (e.g., Ingvarsson et al., 2007; Ingvarsson & Hollobaugh, 2010; Taylor & Harris, 1995). In the current systematic replication, a general mand for information was taught, which lead to the acquisition of new intraverbals (i.e., answers to questions).

Further, this study extends previous research on teaching mands to children with autism using SGDs by teaching a mand for information. Much of the previous research in this area has focused on teaching basic manding skills (e.g., asking for preferred items; Ganz, 2015; van der Meer & Rispoli, 2010). Although current research seems to be extending towards more complex mands (see Achmadi, Kagohara, van der Meer,

Table 1 *Stimulus sets and correct answers*

Set	Question	Answer
Unknown Set 1	What do you do with a bike?	Ride a bike
	What do you do with an apple?	Eat an apple
	What do you do with a book?	Read a book
	What do you do with a hat?	Wear a hat
	What do you do with a ball?	Bounce a ball
Unknown Set 2	What do you do with a cup?	Drink from a cup
	What do you do with blocks?	Build with blocks
	What do you do with a knife?	Cut food with a knife
	What do you do with a chair?	Sit in a chair
	What do you do with a TV?	Watch TV
Unknown Set 3	What do you do with crayons?	Color in with crayons
	What do you do with a drum?	Bang on a drum
	What do you do with a broom?	Sweep with a broom
	What do you do with a trampoline?	Jump on a trampoline
	What do you do with a spade?	Dig with a spade
Known Set (Tacts)	What is this?	Car
	What is this?	Tennis racket
	What is this?	Camera
	What is this?	Spinning top
	What is this?	Pencil

O'Reilly, Lancioni, Sutherland, & Sigafos, 2012; Waddington et al., 2014), limited research exists on mands for information and intraverbal behavior using SGDs. Thus, the current study could be viewed as a preliminary effort towards teaching more complex mands and communication exchanges via SGD.

The experimental control demonstrated in the current study is somewhat limited, because some generalization of the IDKPTM response to Unknown Set 2 occurred during training for Unknown Set 1. The generalization seen in Unknown Set 2, which decreased back to zero rates, may be the results of acquiring correct answers with the first set. An upward trend for IDKPTM responses was evident immediately following intervention with Unknown Set 2, but overall differences in the level of responding between baseline and intervention are not pronounced. However, experimental control over acquisition of correct answers was demonstrated, because a substantial increase in correct answers occurred when and only when IDKPTM training was implemented. Additionally, experimental control is shown by the fact that the IDKPTM response occurred only when the establishing operation was in effect (i.e., when Ryan did not know the answer), and not when the abolishing operation was in effect (i.e., when Ryan knew the answer).

The overall findings of this study are positive in that Ryan acquired both the IDKPTM response and the correct answers to the original question. However, there are some aspects of IDKPTM acquisition that warrant discussion. It is possible that the shift in responding from IDKPTM towards correct answers may be due to the potential

effects of negative reinforcement; that is, Ryan may have been avoiding the use of IDKPTM (i.e., increased response effort) by answering questions correctly. Additionally, social praise for correct answers may have been the most important consequence maintaining responding. If that was the case, the information (i.e., correct answers) provided by the experimenter may have been established as a conditioned reinforcer because it was associated with social reinforcement (i.e., praise). Future research could evaluate these possibilities by systematically manipulating the effort involved in manding for information, as well as the availability and quality of praise for correct answers. Finally, it is possible that the response effort involved in typing out IDKPTM, and then typing out the correct answer, may have contributed to the limited generalization of IDKPTM to novel questions (i.e., Unknown Set 3). Future research could examine ways to reduce the response effort in an attempt to establish a generalized repertoire of manding for information in children who use SGDs. Lastly, future research could focus on procedures to teach intraverbal skills to children who use SGDs within naturally occurring social conversations.

Compliance with Ethical Standards

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 the individual participant included in the study.

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

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