ACQUISITION OF INTRAVERBAL BEHAVIOR: TEACHING CHILDREN WITH AUTISM TO MAND FOR ANSWERS TO QUESTIONS

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Four boys with autism were taught via echoic prompting and constant prompt delay to mand for answers to questions by saying "I don't know please tell me" (IDKPTM). This intervention resulted in acquisition of the IDKPTM response for all 4 participants and in acquisition of correct answers to most of the previously unknown questions for 2 participants. For 1 participant, tangible reinforcement resulted in increased frequency of correct answers, and direct prompting of correct answers was eventually conducted for the final participant. The IDKPTM response generalized to untargeted unknown questions with 3 participants. Results of person and setting generalization probes varied, but some generalization eventually occurred for all participants following additional training or interspersal of probe trials with training trials.

Key words: autism, generalization, intraverbals, manding for information, question answering, verbal behavior

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Autism is a developmental disability that affects an increasing number of families worldwide. Recent estimates indicate that 1 of every 150 8-year-old children in the United States has an autism spectrum disorder (Centers for Disease Control and Prevention, n.d.). One of the defining characteristics of autism spectrum disorders is marked delay in or absence of functional language or other communication (Filipek et al., 1999). Any comprehensive intervention program for children with autism should therefore emphasize the goal of increasing language and communication skills. Some early intensive behavioral intervention (EIBI)

approaches (e.g., Sundberg & Partington, 1998) emphasize language and communication interventions based on B. F. Skinner's *Verbal Behavior* (1957). In this approach, verbal behavior is defined as any behavior whose reinforcement is mediated by other people. A distinction is made between verbal operants based on characteristic features of stimulus control, motivational operations, and reinforcement.

Four verbal operants—the tact, the mand, the echoic, and the intraverbal—are relevant to the current discussion. The *tact* is under specific stimulus control and is maintained by a generalized social reinforcer (e.g., a child may say "cookie" in the presence of a cookie, and the response is reinforced with praise). The *mand* is evoked by a specific motivating operation and reinforced with a characteristic consequence related to the motivating operation (e.g., a child may say "cookie" when hungry, and the response is reinforced with access to the cookie). The *echoic* is a verbal operant that is under the stimulus control of a preceding verbal

stimulus, maintained by generalized reinforcement, and has a point-to-point topographical correspondence to the preceding stimulus (e.g., a child says "cookie" when an adult says "cookie," and the child receives praise as a result). The *intraverbal*, which is the main focus of the current experiment, is a verbal operant that is under the stimulus control of a preceding verbal stimulus, without point-to-point correspondence, and is maintained by generalized reinforcement (e.g., a child says "cookie" when asked "What did you have for snack?" and the child receives praise).

Target behaviors in intraverbal training include conversational turns, categorization, and fill-in-the-blank tasks; the current study focused on question answering. Question answering is commonly included in EIBI curricula, either targeted directly as a separate program (Sundberg & Partington, 1998; Taylor & Jasper, 2001; Taylor & McDonough, 1996) or indirectly through programs that target other general skills (e.g., concepts such as yes–no, emotions, functions of body parts, and general knowledge; McEachin & Leaf, 1999). Previous research has indicated that transfer-of-function procedures are effective in establishing intraverbal behavior (Braam & Poling, 1983; Partington & Bailey, 1993). Transfer-of-function procedures include the delivery of prompts that reliably evoke the desired response topography. The prompts are then faded (e.g., through delayed prompting), and stimulus control is transferred to the desired antecedent.

A handful of studies have evaluated the use of such procedures to teach question answering and other intraverbal behavior to children with autism. Finkel and Williams (2001) found that textual prompts (i.e., printed text) were more efficient than echoic prompts in establishing question answering in a young boy with autism. The target answers were multiword phrases, and the prompts were faded by reducing the length of the prompts one word at a time until the

child acquired intraverbal responding. Goldsmith, LeBlanc, and Sautter (2007) taught 3 young boys with autism to answer questions related to categories (e.g., "What are some things you wear?") using tact prompts (e.g., pictures of clothing) and prompt delay.

Although it is clearly desirable to teach correct answers directly (as in Finkel & Williams, 2001; Goldsmith et al., 2007), an alternative strategy is to teach a general response that may lead to acquisition of intraverbals. In other words, the children may be taught to mand for information (Sundberg & Michael, 2001). Some support for this notion comes from research by Sundberg, Loeb, Hale, and Eigenheer (2002) and Endicott and Higbee (2007). These researchers taught children with autism to ask the questions "Where is it?" and "Who has it?" with regard to items initially presented noncontingently and then hidden out of view in specified locations or on people in the immediate environment. These investigators found that the children manded equally with high-preference and low-preference items, suggesting that the information regarding the location of the item may have taken on reinforcing quality that may not have been completely dependent on the value of the hidden item. This lends some support to the notion that questions such as "Where is it?" may be maintained by getting access to "information" and may thus be conceptualized as mands for information. In addition, Williams, Perez-Gonzalez, and Vogt (2003) taught 2 children with autism to ask "What's in the box?," "Can I see it?," and finally "Can I have it?" regarding preferred items placed out of sight in a box. In the latter two cases the questions (i.e., mands) were reinforced by the sight of the object and access to the object. However, the question "What's in the box?" may be conceptualized as a mand for information because the reinforcer consisted of a verbal statement describing which preferred item was hidden in the box.

Previous research has evaluated similar procedures in order to establish verbal operants other than intraverbals. For example, Taylor and Harris (1995) presented children with autism with items they were able to tact, along with some items they were not able to tact. A prompt-delay procedure established the phrase ''What is that?'' as a mand for information, which generalized across environments and resulted in the acquisition of novel tacts. A second example was provided by Esbenshade and Rosales-Ruiz (2001), who found evidence of tact acquisition in a 5-year-old boy with autism after he was taught to ask ''What is that?'' in the presence of unknown items across a variety of tasks. However, we are aware of only one study that has evaluated procedures to teach a mand that led to the acquisition of new intraverbals. Ingvarsson, Tiger, Hanley, and Stephenson (2007) first taught the participants to say ''I don't know'' (IDK) in response to unknown questions. Desirable generalization across teachers and unknown questions was found, but undesirable generalization to previously known questions also occurred (i.e., the children started responding to previously known questions by saying IDK). Second, the children were taught to say ''I don't know, please tell me'' (IDKPTM) in response to unknown questions. Every time the children engaged in the IDKPTM response, they were provided with the correct answer to the question. IDKPTM generalized across teachers and questions, but correct answers increased to acceptable levels only after toy access was made contingent on their occurrence.

Teaching a mand for information, such as the IDKPTM response, may be valuable for at least three reasons. First, research has suggested that levels of stereotypic behavior (e.g., echolalia) in children with autism are greatest when unfamiliar tasks (e.g., unknown questions) are presented (Charlop, 1986; Turner, 1999). Other studies have shown that demand-related problem behavior is more likely to occur under difficult rather than easy demand conditions (Weeks & Gaylord-Ross, 1981). A mand for information may morph a difficult and unfamiliar demand situation into an easier demand situation, thereby reducing stereotypy and other undesirable behavior. Second, the IDKPTM response may enable children to mand for a more intrusive prompting level while avoiding errors. This may reduce the overall numbers of errors that may otherwise occur as less intrusive prompts are introduced during most-to-least prompt fading, progressive prompt delay, or other errorless teaching procedures. Third, the IDKPTM response may enable children to benefit from a broad range of programmed and naturally occurring learning opportunities if shown to generalize across settings, people, and stimuli.

To date, the majority of research on verbal behavior has focused on tacts and mands rather than intraverbals (Dymond, O'Hora, Whelan, & O'Donovan, 2006; Sautter & LeBlanc, 2006). Although a handful of studies on intraverbal behavior have been published in the last 2 to 3 years (e.g., Perez-Gonzalez, Garcia-Asenjo, Williams, & Carnerero, 2007; Petursdottir, Carr, Lechago, & Almason, 2008; Petursdottir, Ólafsdóttir, & Aradóttir, 2008), more research is needed. Hence, a broad goal of the current study was to strengthen the empirical basis for intraverbal training for children with autism. A more specific goal was to replicate and extend the Ingvarsson et al. (2007) study systematically. The current study differed from the previous one in the following manner. First, the participants were children with autism spectrum disorders rather than children with language delays. Second, it is possible that in the previous study, a history of saying IDK to unknown questions reduced the acquisition of correct answers after IDKPTM training occurred. Therefore, IDK was not taught prior to teaching IDKPTM in the current study. Third, we added generalization measures that consisted of asking the partici-

pants' regular teachers to carry out generalization probes in their classrooms. Fourth, in the previous study, teaching was implemented in the context of toy play, two trials were presented per minute, and all question sets were interspersed randomly in each session (i.e., known and unknown, targeted and untargeted questions were interspersed). This arrangement mimicked everyday classroom interaction and probably supported the generalization of IDK and IDKPTM to untargeted sets. However, it may also have reduced the speed of acquisition of IDK, IDKPTM, and correct answers. Therefore, in the current study, we conducted brief sessions with rapidly presented trials and did not intersperse question sets.

METHOD

Participants

The participants were 4 boys with a diagnosis of autism—Chris, Neil, Matt, and Jim—who were 10, 7, 6, and 4 years old, respectively. Chris, Matt, and Jim were Caucasian, and Neil was African American. All the boys attended a university-based school for children with autism, where they received full-day educational services 5 days per week. The participants were selected based on the recommendations of the speech-language therapist who worked at the school and who was familiar with the verbal abilities of all the students. Specifically, she was asked to nominate children who had difficulty answering common questions. Based on information from the speech-language pathologist, as well as informal observations conducted by the first author, Chris, Jim, and Neil had fairly well-established echoic, manding, and tacting skills. Matt also had relatively strong echoic skills, but more limited tacting and manding repertoires compared with the others. All the participants had relatively undeveloped intraverbal skills compared with same-age peers, with Matt displaying the greatest deficiency in that skill area.

Setting

Sessions were conducted in small classrooms (henceforth referred to as training rooms) designed for small group or individualized teaching, located at the participants' school. The training rooms contained child-sized furniture, art materials, and toys. During each session, the experimenter and the participant sat in chairs facing each other, and the observers sat 2 to 3 m to the side. We conducted classroom generalization probes in the participants' regular classrooms with other children present. These classrooms varied in size and layout, but were large enough to accommodate eight to 10 students and two or three teachers. During the classroom generalization probe sessions, the classroom teacher asked questions while seated next to the child at a child-sized desk, and the observers stood or sat 2 to 3 m to the side.

Measurement

Observers scored the participants' verbal responses using event recording. For each trial (i.e., the presentation of a single question), the observers circled codes on a data sheet indicating whether the participants gave the correct answer to the question or whether they said IDKPTM. The observers also scored whether these responses were prompted (i.e., preceded by an echoic prompt) or independent. The observers scored responses as prompted if they were initiated within 5 s after the prompt presentation and independent if they were initiated within 5 s of the question and before the prompt.

Interobserver Agreement

A second observer simultaneously but independently collected data during 55% of sessions for Chris, 58% for Neil, 45% for Matt, and 51% for Jim. We scored a trial (i.e., the presentation of a single question) as an agreement if both observers circled the same code or as a disagreement if any scoring for a given trial differed. For each session, the number of trials scored in agreement was

divided by the total number of trials and converted into a percentage. Mean agreement was 99% (range, 87% to 100%) for Chris, 98% (range, 80% to 100%) for Neil, 99% (range, 89% to 100%) for Matt, and 99% (range, 90% to 100%) for Jim.

Procedure

Pretest and question selection. The pretests were similar to those described by Ingvarsson et al. (2007) and included similar questions. The questions targeted personal information (e.g., "Where do you live?"), general knowledge (e.g., "Where do you buy groceries?"), and academic skills (e.g., "How much is a dime?"). A total of 56 questions were included in the pretest. We divided the questions into four sets, three of which contained 15 questions and one contained 11 questions. Each set was targeted three times. Thus, we conducted a total of 12 pretests and asked each question three times. The pretests were conducted over a span of 3 to 7 days. We delivered no prompts during the pretest. The experimenter praised correct answers and ignored incorrect answers.

Based on the pretest results, we classified each question as *unknown* if it was always answered incorrectly (or no answer occurred) and *known* if it was always answered correctly. We then created four unique sets of unknown questions and two unique sets of known questions based on this classification, with five unique questions in each set (due to experimenter error, Matt's Unknown Set 3 included four questions). In subsequent experimental sessions, the first author targeted Known Set 1 and Unknown Sets 1 and 2 in experimental sessions in the training room. One of the research assistants targeted Known Set 2 and Unknown Set 3 in generalization probes in the training room, and each participant's classroom teacher targeted Unknown Set 4 and Known Set 1 in classroom generalization probes. Questions that were sometimes answered correctly and sometimes incorrectly during the pretest were not given any classification and were not used in

subsequent experimental phases. The participants' teachers agreed to refrain from including the selected questions in educational activities during other parts of the school day.

Baseline. In baseline, the experimenter targeted questions from Known Set 1, Unknown Set 1, and Unknown Set 2. Thus, a total of 15 questions were targeted in each session. This number remained constant for experimental sessions (but not generalization probes, see below) throughout the experiment. The questions were always asked in the same order; Known Set 1 first, followed by Unknown Set 1, and finally Unknown Set 2. The order of questions within each set also remained the same. The experimenter asked the 15 questions in rapid succession, allowing 5 s for an answer to occur. The responses "I don't know, please tell me" and "I don't know" would have been praised, but no such responses occurred ("I don't know" never occurred throughout the experiment). Correct answers were followed by descriptive praise (e.g., "That's right, a cow says moo"). The experimenter delivered descriptive praise throughout the experiment whenever correct answers occurred to any question. If the participant gave an incorrect or no answer, the experimenter asked the next question but provided no other consequence.

IDKPTM training. This phase was identical to baseline, except that the questions from Unknown Set 1 were targeted for IDKPTM training. The experimenter used echoic prompting and constant prompt delay (Wolery et al., 1992) to teach the participants to engage in the IDKPTM response in the following manner: Initially, the experimenter prompted the IDKPTM response by providing an immediate verbal prompt after asking a question from Unknown Set 1. (e.g., "How much is a dime? Say 'I don't know, please tell me'"). After the participant's IDKPTM response, the experimenter modeled the correct answer (e.g., "A dime is 10 cents"). If the child did not repeat the correct answer ("10 cents"), the experi-

menter provided a prompt (e.g., "say '10 cents'"). When the child stated the correct answer (with or without a prompt), the experimenter provided descriptive praise (e.g., "That's right, a dime is 10 cents").

When the participant echoed the IDKPTM prompt on two consecutive trials, we introduced a 5-s delay between the question and the prompt. We reintroduced an immediate prompt if the participant did not engage in either the IDKPTM response or the correct answer for two consecutive trials. When the IDKPTM response occurred unprompted (i.e., during the 5-s delay), only the latter part of the teaching sequence was implemented (i.e., the experimenter provided the correct answer and prompted the participant to say it if necessary). We also implemented only the latter part of the teaching sequence if the IDKPTM response occurred following questions from Unknown Set 2 and Known Set 1 (i.e., if the IDKPTM response generalized to untargeted questions). Otherwise, the contingencies for Known Set 1 and Unknown Set 2 were identical to baseline (i.e., no prompting was conducted, and incorrect answers were ignored). An exception occurred for Matt, with whom we eventually conducted IDKPTM training for Unknown Set 2, because generalization across questions did not occur following initial IDKPTM training with Unknown Set 1.

Additional interventions. With Neil and Matt, IDKPTM training did not lead to acceptable acquisition of correct answers. We therefore implemented additional interventions, but the procedures differed for these 2 participants as a function of their response patterns. With Neil, correct answers occurred at intermediate levels during the IDKPTM training phase, but the target level of at least 80% correct across two consecutive sessions was not reached. We therefore added edible items contingent on correct answers while other contingencies were kept intact from the previous phase (i.e., correct answers and IDKPTM were praised, and

incorrect answers were ignored). We chose this intervention because his classroom teachers indicated that food was used successfully in the past to increase participation in the classroom, and the use of these reinforcers was acceptable to the teachers and his family. His preference hierarchy was determined by obtaining a list of 10 potentially preferred edible items from his teachers and then conducting a paired-choice preference assessment based on the methods of Fisher et al. (1992). The experimenter then delivered the three most preferred items in alternation according to the prevailing schedule.

In the initial stages of the edible reinforcement phase, the experimenter delivered edible items contingent on correct answers on a fixed-ratio (FR) 1 schedule (note that correct answers were reinforced only if they were not preceded by IDKPTM). Schedule thinning began after random question order had been implemented according to the criteria described below. The schedule of edible delivery was thinned when Neil answered at least 60% of the questions in each unknown set (Unknown Sets 1 and 2) correctly across two consecutive sessions. The schedule thinning proceeded as follows: FR 1, FR 2, FR 3, FR 4, FR 5, NCR. The NCR schedule involved delivering the mean number of edible items that had been delivered in the preceding FR 5 sessions; however, they were made available as each session started, independent of any particular behavior other than attending the session. We chose to deliver edible items independent of correct answers following schedule thinning to strengthen the case that the answers functioned as intraverbals and to reduce the likelihood that the answers were maintained primarily by access to edible items rather than praise and approval.

We could not implement additional reinforcement for correct answers with Matt, because no independent correct answers occurred during the IDKPTM training phase. Therefore, the experimenter conducted one

session (Session 38) in which correct answers to the questions in Unknown Set 1 were directly prompted (using 5-s constant prompt delay) while IDKPTM training was suspended. Because independent (unprompted) correct answers started to occur immediately, we suspended direct prompting of correct answers following Session 38, in order to evaluate whether the correct answers would continue to occur under simple differential reinforcement. During Sessions 39 to 47, correct answers were praised, and IDKPTM resulted in provision of the correct answer. No prompting was conducted during these sessions. We reinstated the IDKPTM training contingencies starting with Session 48 after we noticed a reduction in correct answers.

Random question order. As described above, the experimenter always asked the questions in the same order during baseline and initial stages of IDKPTM training. However, after acquisition of correct answers had become evident, the experimenter asked the questions in random order to ensure that question answering was under the stimulus control of the relevant questions and not other aspects of the experimental context. This was accomplished by the experimenter asking the questions from all three sets (Known Set 1, Unknown Set 1, and Unknown Set 2) in random order from session to session, such that all 15 questions were intermixed randomly.

Generalization probes. The purpose of the generalization probes was to evaluate whether IDKPTM would generalize to questions (Unknown Sets 3 and 4) not included in the IDKPTM training sessions, across persons (research assistant and classroom teacher), and setting (classroom). The procedures during the generalization probes were identical to those used during baseline in that the experimenter praised correct answers, ignored incorrect answers, provided the correct answer if IDKTPM occurred, but delivered no prompts. Two types of generalization probes were

conducted. Research assistants conducted probes in the training room, and each participant's classroom teacher conducted probes in their regular classroom. A unique set of unknown questions was used for each type of probe: Unknown Set 3 in the training room probes and Unknown Set 4 in the classroom probes. These sets were never targeted in any other condition. A unique set of known questions (Known Set 2) also was targeted in the training room probes, but the classroom probes included the same set of known questions that had been targeted in the experimental sessions (Known Set 1). We chose this approach because only a limited number of known questions were identified for some participants. The questions were always asked in the same order, with known questions first, followed by unknown questions.

One or both of the authors supervised all probe sessions and instructed the research assistants and classroom teachers how to proceed. The instructions specified that questions should be asked in sequence, incorrect responses ignored, correct answers praised, and IDKPTM should result in the participant being given the correct answer and prompted to repeat the correct answer if necessary.

Preintervention probes consisted of two training room probes and one classroom probe, conducted in that order. The experimenter conducted the first probe following Session 1 for Chris, Session 2 for Neil, Session 3 for Matt, and Session 1 for Jim. The experimenter conducted the remaining two probes following Session 2 for Chris, Session 5 for Neil, Session 9 for Matt, and Session 12 for Jim. The experimenter conducted postintervention probes when acquisition of IDKPTM had been seen with Unknown Sets 1 and 2 and when relative stability in the levels of both IDKPTM and correct answers had been observed. The postintervention probes were conducted following Session 24 for Chris, Session 32 for Neil, Session 35 for Matt, and Session 19 for Jim.

If generalization of the IDKPTM response to Unknown Sets 3 and 4 did not occur during the probe sessions, we implemented additional interventions. For Chris and Neil, a research assistant conducted a single session of direct training with Unknown Set 3. The procedures during this training were identical to the IDKPTM training described above. For Neil, the classroom teacher also conducted direct training with Unknown Set 1 (previously targeted during initial IDKPTM training) after generalization to the classroom failed to occur for the second time. For Matt, the research assistant conducted a single interspersal session, in which Unknown Set 3 trials were inter-spersed randomly with trials containing questions from Unknown Sets 1 and 2 (with which Matt had already shown acquisition of IDKPTM).

Experimental Design

The direct and indirect effects of the IDKPTM training (and additional interventions) were evaluated in a nonconcurrent multiple baseline design across participants. Generalization of the IDKPTM response across questions was evaluated by including nontargeted (Unknown Set 2) questions in the experimental sessions. In addition, generalization across questions, people, and settings was evaluated via pre- and postintervention generalization probes.

RESULTS

The results for the experimental sessions are shown in Figure 1. Only unprompted responses are shown. Results for Chris are presented in the top two panels. Chris answered the known, but not the unknown, questions correctly in baseline. There were no instances of IDKPTM in baseline. When we implemented IDKPTM training, evidence of acquisition of the IDKPTM response was seen quickly, both with the target (Unknown Set 1) and the generaliza-tion (Unknown Set 2) sets. Undesirable

generalization of IDKPTM to known questions was not evident, in that correct answers to Known Set 1 remained stable throughout. Moreover, the data show that Chris gradually learned the correct answers to the questions in Unknown Sets 1 and 2 during this phase. After an initial increase in IDKPTM, a gradually decreasing trend of IDKPTM was seen, in that correct answers increased for both question sets. Toward the end of his participation, he was answering at least 80% of questions from both sets correctly across repeated sessions. His accuracy remained high during the last five sessions, which were implemented with random question order.

Neil's results are shown in the third and fourth panels of Figure 1. Like Chris, Neil answered known questions, but not unknown questions, correctly in baseline. There were no instances of IDKPTM in baseline. With the initiation of IDKPTM training, acquisition of IDKPTM was quickly evident across both the target (Unknown Set 1) and the generalization (Unknown Set 2) sets. Undesirable generaliza-tion of IDKPTM to the known questions was minimal (there were only three instances in the IDKPTM training phase). An increase in correct answers was seen across both unknown sets after three sessions of IDKPTM training. However, the number of correct answers remained variable throughout this phase and did not reach the stable high levels that had been seen with Chris. Therefore, starting with Session 38, preferred edible items were deliv-ered contingent on correct answers while other procedures remained identical to the IDKPTM phase. With this intervention, Neil consistently answered three to five questions from each unknown set correctly for the remainder of the experimental sessions. Undesirable generaliza-tion of IDKPTM to the known questions occurred infrequently in this phase, with a total of five instances. This performance remained stable while the schedule of edible delivery was thinned from FR 1 to FR 5 and during
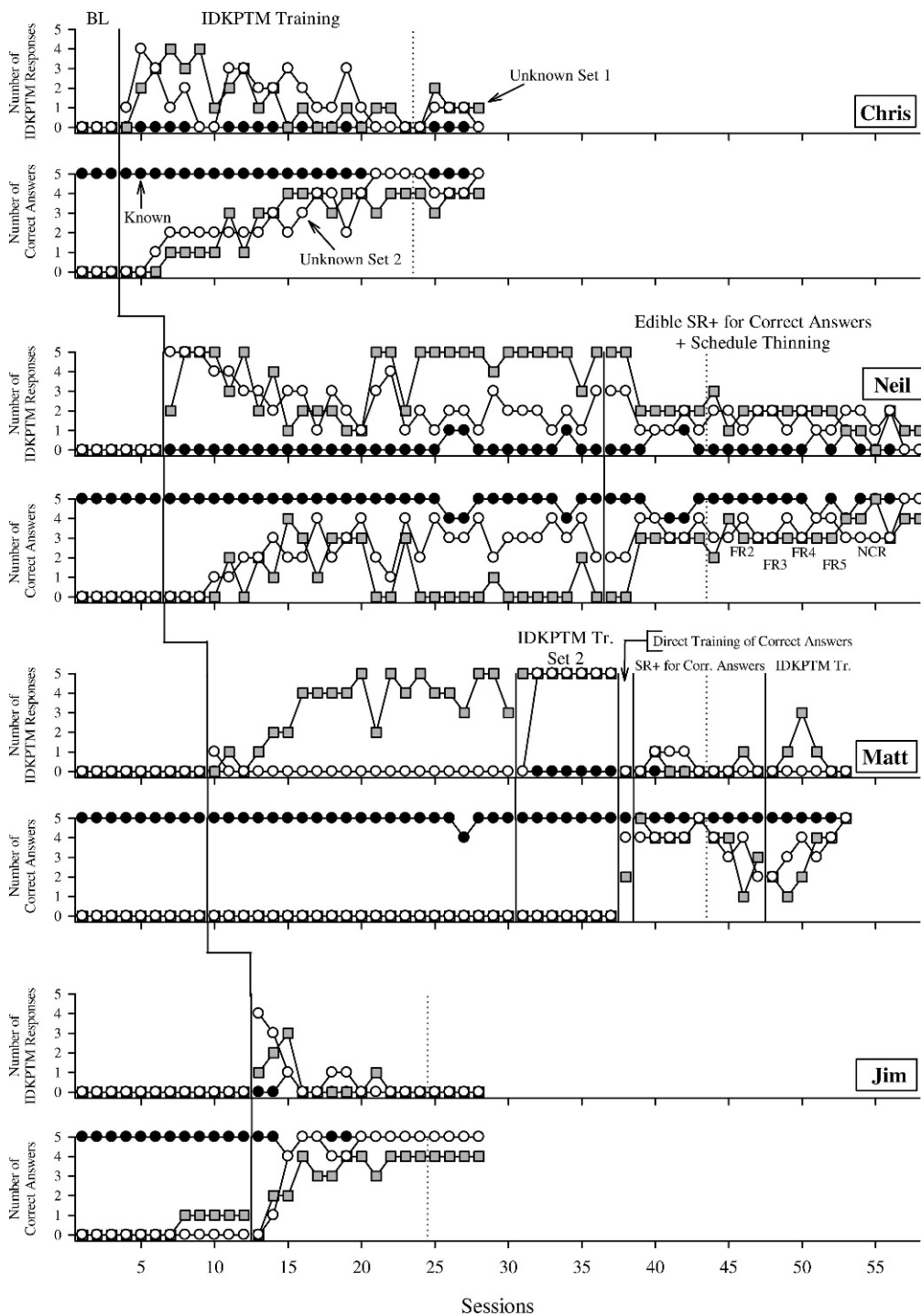
Figure 1. The number of correct answers and IDKPTM responses for Chris, Neil, Matt, and Jim. The dotted phase lines indicate when randomized question order began with each participant.

noncontingent edible delivery. His accuracy remained high after the order of question was changed to random during the last 15 sessions.

Matt's results are shown in the fifth and sixth panels of Figure 1. In baseline, he answered all of the known questions and none of the unknown questions correctly. There were no instances of IDKPTM in baseline. When IDKPTM training was implemented, IDKPTM increased for Unknown Set 1 but did not generalize to Unknown Set 2 (with the exception of one response in Session 10). No undesirable generalization of IDKPTM to known questions occurred. No evidence of acquisition of correct answers was observed in this phase. Because of the lack of generalization of the IDKPTM response across unknown questions, IDKPTM training was next carried out with Unknown Set 2, resulting in immediate acquisition of IDKPTM with that set of questions. However, correct answers did not emerge. Because no correct answers occurred, we could not implement additional reinforcement of correct answers as we had with Neil. Therefore, we carried out a single session of direct training of correct answers (Session 38) while IDKPTM training was suspended. In the subsequent sessions, correct answers increased across both unknown sets. However, a decrease was seen later without an accompanying increase in IDKPTM. Therefore, IDKPTM training was reinstated, resulting in a brief increase in IDKPTM and an eventual recovery of high levels of correct answers. The last 10 sessions were carried out using random session order. Accuracy was high during the majority of these sessions.

Jim's results are shown in the bottom two panels of Figure 1. Jim answered all known questions correctly in baseline, and there were no instances of IDKPTM. Initially, Jim answered all unknown questions incorrectly, but during the last five sessions of baseline, he answered one question in Unknown Set 1 correctly. When we implemented IDKPTM

training, Jim showed quick acquisition of that response, which generalized to Unknown Set 2. There was only one instance of undesirable generalization of IDKPTM to the known questions. Acquisition of IDKPTM was quickly followed by an increase in correct answers across both unknown sets and a corresponding decrease in IDKPTM. The last four sessions included random question order; Jim's accuracy remained high.

To evaluate the extent to which individual unknown questions were acquired by each participant, we counted the number of questions answered correctly from Known Set 1, Unknown Set 1, and Unknown Set 2 during the last two sessions of baseline, as well as the last two sessions of the last intervention phase for each participant. To be counted as correct, an individual question had to be answered correctly in two consecutive sessions. All 4 participants answered all five known questions correctly towards the end of both baseline and intervention. None of the participants answered any unknown questions correctly in the last two sessions of baseline, except for Jim, who answered one question from Unknown Set 1 correctly. All 4 participants answered either four or five (out of five) questions from the two unknown sets correctly in their last two sessions of intervention, indicating that acquisition of correct answers had taken place for most of the previously unknown questions.

The results of the generalization probes are shown in Figure 2. Results are shown only for Unknown Set 3 (training room probe) and Unknown Set 4 (classroom probe). Known Sets 1 and 2 also were included in these probe sessions; however, all 4 participants answered the known questions 100% correctly in each generalization probe session. Therefore, to simplify the data presentation, the results for the known questions are not presented.

Results for Chris are shown in the top panel of Figure 2. No instances of IDKPTM were evident in the preintervention probes. Follow-
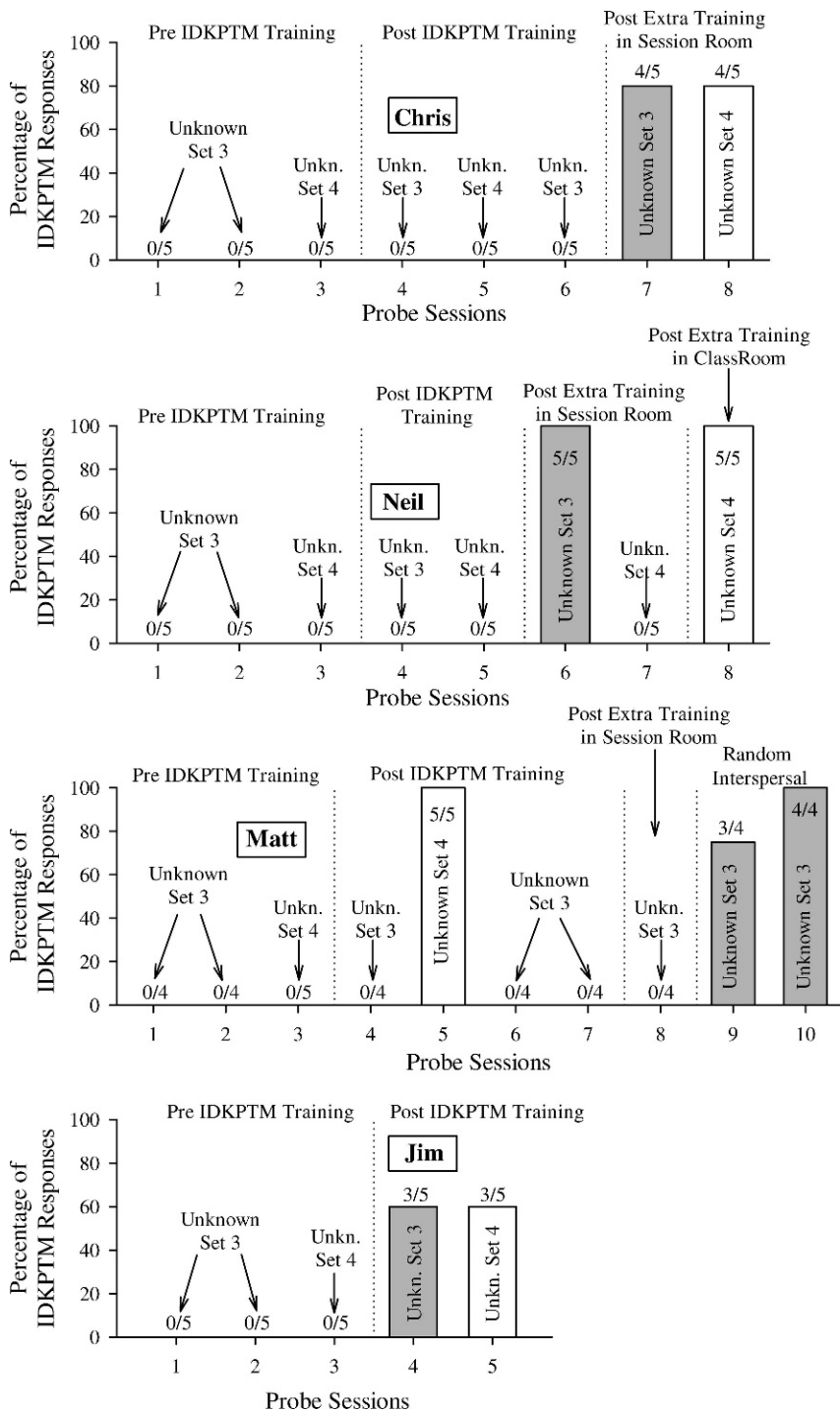
Figure 2. The percentage of correct IDKPTM responses by Chris, Neil, Matt, and Jim during the generalization probe session. A research assistant conducted all the probe sessions with Unknown Set 3 in the training room, and each participant's classroom teacher conducted all the probes involving Unknown Set 4 in the classroom.

ing intervention, IDKPTM initially did not generalize to either the training room or the classroom probes. After the research assistant conducted direct training with Unknown Set 3 in the training room, generalization of IDKPTM to the classroom occurred (Probe Session 8). It is important to note that although Chris answered four of the five training room probe questions with IDKPTM during Probe Session 7, this is not evidence of generalization, because direct training was carried out with that set of questions in that setting.

Neil's generalization probe results are shown in the second panel of Figure 2. No IDKPTM responses occurred in preintervention probes, and generalization was not evident initially in postintervention probes. Unlike Chris, generalization to the classroom did not occur for Neil following direct training with Unknown Set 3 in the training room. As with Chris, Neil's performance in the training room probe (Probe Session 6) is not evidence of generalization because direct training had been conducted with that set. Generalization to the classroom with Unknown Set 4 did occur after the classroom teacher conducted direct training with the target set previously targeted in the training room (Unknown Set 1).

Matt's generalization probe results are shown in the third panel of Figure 2. No instances of IDKPTM were seen in the preintervention probes. Similar to Chris and Neil, generalization of the IDKPTM response to the training room probes was not seen with Matt (Probe Session 4). However, generalization of IDKPTM was seen in the classroom probe (Probe Session 5). Because of these unexpected results, two additional training room probes were conducted, but no generalization was found. Because he had shown generalization to the classroom already, we attempted to produce generalization in the training room probes without the kind of direct training that we had conducted with Chris and Neil. The research assistant therefore conducted training

with Unknown Sets 1 and 2 (previously only targeted by the first author in experimental sessions). However, in the subsequent training room probe, generalization did not occur with Unknown Set 3 (Probe Session 8). The research assistant then conducted two interspersal probe sessions in which Unknown Set 1 and 2 questions were interspersed randomly with Unknown Set 3 questions (Unknown Set 3 was never trained directly). Generalization occurred under these conditions (Probe Sessions 9 and 10). In these interspersal sessions, the research assistant delivered a total of one IDKPTM prompt (with the first question in Unknown Set 1).

Jim's generalization probe results are shown in the fourth panel of Figure 2. No instances of IDKPTM were seen in the preintervention probes. Jim was the only participant who showed generalization of the IDKPTM response in both the training room and classroom generalization probes immediately following IDKPTM training. He answered three of the five questions in each set with IDKPTM. In both the training room and the classroom probe sessions, he gave the correct answer to one of the unknown questions.

DISCUSSION

Four boys with autism were taught to mand for answers to questions by saying IDKPTM. For 2 participants (Chris and Jim), this intervention led to quick acquisition and generalization (across questions) of the IDKPTM response, as well as acquisition of correct answers to previously unknown questions. For Neil, acquisition and question generalization of IDKPTM occurred, but correct answers did not increase to acceptable levels until edible items were made contingent on their occurrence. For Matt, IDKPTM acquisition occurred, but the response did not generalize to untargeted questions. Matt's correct answers did not increase until after brief direct training of correct answers.

These findings provide a replication and extension of the Ingvarsson et al. (2007) study, in which preschool children with and without disabilities were first taught "I don't know" (IDK) and later IDKPTM in response to a subset of unknown questions. In both studies, IDKPTM was acquired readily as a result of intraverbal training. In both studies, IDKPTM generalized to untargeted unknown questions for most or all participants. The current study extends previous research on manding for information (e.g., Sundberg et al., 2002; Taylor & Harris, 1995), in which children with autism were taught to ask questions when presented with unknown stimuli or unknown locations of preferred objects. In these studies, the children acquired either new tacts (Taylor & Harris) or mands that allowed the children to better control their access to reinforcers (Sundberg et al.). In the current study, intraverbal training was used to establish mands for information that led to the acquisition of new intraverbals (answers to questions). The current study also demonstrates that IDKPTM training can be applied with children with autism.

An important aspect of IDKPTM training is that stimulus control by each question over its relevant answer is likely to develop, whereas with IDK training (as in Ingvarsson et al., 2007), other aspects of the training context are relatively more likely to gain stimulus control over the IDK response. Because in the current study IDKPTM training was implemented immediately following baseline, the probability of the development of this appropriate stimulus control was likely increased. In the earlier study, IDK training followed baseline and may have led to undesirable stimulus control of the broader training context over IDK responding, resulting in undesirable generalization of the IDK response to known questions. When IDKPTM training replaced IDK training, this undesirable stimulus control may have partially transferred such that it now controlled IDKPTM responding, preventing the acquisi-

tion of correct answers. Thus, the fact that IDK training was not conducted in the current study may in part explain why there was increased probability of acquisition of correct answers following IDKPTM training and less undesirable generalization to known questions, compared to the earlier study.

In the current study, acquisition of correct answers following IDKPTM training may have been facilitated by relatively fast-paced blocked training trials. By contrast, Ingvarsson et al. (2007) presented only two questions per minute and interspersed training trials with trials that contained either known questions or unknown questions (i.e., the generalization sets). There is some evidence that interspersal of training trials with unknown tasks may slow acquisition (Rowan & Pear, 1985). Conversely, interspersal of multiple training items may produce greater generalization when compared with serial training in which the same item (or set of items) is targeted repeatedly (e.g., Panyan & Hall, 1978). Future research should explore the effects of blocked versus interspersed trials and longer versus shorter intertrial intervals on the acquisition of intraverbal behavior.

There are several aspects of the IDKPTM procedure that may have influenced the shift in response allocation to correct answers following IDKPTM acquisition. The training procedure included potential sources of negative reinforcement, a differential delay to reinforcement, potential increases in reinforcement density, and differences in response effort following different responses. First, negative reinforcement may have been in place because by engaging in the correct answer, the participants could avoid the IDKPTM teaching procedure and avoid a prolonged session. This negative reinforcement contingency may have been operating if exposure to the IDKPTM training was relatively nonpreferred. Second, IDKPTM training involved a relatively long delay to praise if the participants engaged in either an incorrect answer or the IDKPTM response (due to the

requirement to engage in the correct answer or prompting of the IDKPTM response). Engaging in the correct answer, however, led to a relatively shorter delay to praise. This aspect of the IDKPTM training arrangement may have led to response allocation shifting from IDKPTM to the correct answers after acquisition of correct answers had occurred (Chung & Herrnstein, 1967; Hursh & Fantino, 1973). Third, as a result of the shorter delay, engaging in correct answers may have resulted in a higher density of reinforcement (i.e., more reinforcement delivered per unit of time) compared with engaging in the IDKPTM response or an incorrect answer. This may have increased the likelihood of response allocation shifting to correct answers. Fourth, it may be argued that during IDKPTM training, engagement in the IDKPTM response or an incorrect answer led to relatively greater response effort (again, because of the prompting of the IDKPTM response and the requirement to say the correct answer). The correct answer resulted in a relatively lower response effort because it did not lead to additional instruction with the same question but rather to the delivery of praise and the presentation of the next trial (cf. Neef & Lutz, 2001). Future research should evaluate the extent to which each of these variables contributes to the effectiveness of intraverbal training procedures. For instance, it is possible that the implementation of additional training trials during each instance of IDKPTM training (effectively increasing the response effort and delay to reinforcement associated with engagement in IDKPTM and incorrect answers) might further increase the likelihood of response allocation shifting to correct answers following their acquisition.

The suggestion that the IDKPTM response may have functioned as a mand for information points to additional behavioral processes of potential interest. One interpretation is that manding for information is evoked by a transitive conditioned establishing operation (CEO; see Michael, 2000). In this case, the presentation of an unknown question might serve as a transitive CEO, establishing the value of the information (i.e., being told the correct answer) as a reinforcer. In this interpretation, the information (i.e., the correct answer, as spoken by the experimenter) functions as a conditioned reinforcer, retaining its reinforcing effect through an association with the terminal reinforcer (e.g., praise) that maintains the correct answer. Deprivation from the reinforcer that maintains the correct answer (e.g., attention) should serve to increase the reinforcer establishing and evocative effects of the transitive CEO (Laraway, Snycerski, Michael, & Poling, 2003). However, the answer spoken by the experimenter should not be an effective reinforcer if the participant already knew the answer to the question; thus, the IDKPTM response would not be evoked under those conditions. The results of the current study are broadly consistent with this interpretation because the IDKPTM response generalized to unknown questions but not to known questions. Future research should attempt to further elucidate the function of the IDMPTM response (and other similar information-seeking responses) by systematically evaluating the variables that establish information as a reinforcer and the extent to which information (e.g., being told the correct answer) may be said to derive its reinforcing value by association with other reinforcers.

The current study included setting generalization probes that were conducted in the participants' regular classroom. In addition, person generalization was assessed across two people, a research assistant and the participant's regular classroom teacher. The results of these probes varied across participants. The Ingvarsson et al. (2007) study included no setting generalization conditions, but person generalization sessions alternated frequently with the IDKPTM training condition within the same setting. This arrangement led to reliable

generalization of the IDKPTM response across untargeted question sets and across people. The less reliable person generalization in the current study was perhaps a function of generalization probes not being conducted until several sessions after the first instances of the IDKPTM response for each participant, whereas in the previous study, opportunities for generalization occurred early and often.

Two aspects of Matt's data merit discussion. First, unlike the other participants, generalization of the IDKPTM response was not seen across questions or to the research assistant. However, the IDKPTM response generalized to his regular classroom teacher. Although the reason for this idiosyncratic pattern is unknown, it is possible that a history of learning multiple exemplars from that particular teacher played a role. Perhaps if Matt were provided with a history of learning of multiple exemplars across many teachers and a variety of environments, skills might generalize more easily because such a history might reduce the likelihood of the development of restricted or irrelevant stimulus control over question answering (Baer, Peterson, & Sherman, 1967). Future research should examine the effects of providing such a history with children who show limited generalization. It also became apparent that when questions that had received IDKPTM training previously were interspersed with untargeted questions, IDKPTM responding emerged with the untargeted questions. It is possible that interspersal of previously learned and novel items might increase the likelihood of generalization with Matt, and question generalization might have occurred earlier if such interspersal had been conducted during his training phase. More research is needed on prerequisite skills or histories of reinforcement that produce reliable generalization.

Second, Matt did not show acquisition of correct answers until correct answers were directly prompted during one session. In that session, the experimenter directly prompted

only three answers, yet many more emerged immediately afterwards. It appears that Matt's behavior of saying the correct answer without the preceding IDKPTM procedure simply had to contact praise for previously learned correct answers to emerge. Anecdotally, it appeared that Matt often said the correct answers to the questions after engaging in the IDKPTM response, without necessarily waiting for the experimenter's prompt to say the correct answer. However, our measurement system was not sensitive enough to capture this behavior because we scored only the first response that occurred after each question (i.e., IDKPTM and the correct answer were mutually exclusive and could not both be scored in the same trial). This suggests that Matt had learned some correct answers previous to the direct prompting condition, but this learning had not been expressed in measured performance.

It is noteworthy that Neil's correct answers did not increase to acceptable levels until edible items were included. Future research should investigate procedures that lead to the establishment of naturally occurring aspects of the teaching situations (e.g., praise, smiles, nods of teachers) as effective reinforcers. The establishment of such stimuli as reinforcers is crucial for children to learn effectively from their social environments and may be essential for the establishment of important social skills in children with autism (Holth, 2005/2007).

Although directly teaching children the answers to questions (e.g., "What is your name?") is undoubtedly valuable, the current intervention has the advantage of targeting a general skill that may lead to learning a variety of new answers to questions across a number of environments. Future research should evaluate procedures that enable children with autism and other developmental disabilities to seek out learning opportunities and recruit prompting and instruction from adults and peers in their everyday environments.

REFERENCES

Baer, D. M., Peterson, R. F., & Sherman, J. A. (1967). The development of imitation by reinforcing behavioral similarity to a model. *Journal of the Experimental Analysis of Behavior, 10*, 405–416.

Braam, S. J., & Poling, A. (1983). Development of intraverbal behavior in mentally retarded individuals through transfer of stimulus control procedures: Classification of verbal responses. *The Analysis of Verbal Behavior, 4*, 279–302.

Centers for Disease Control and Prevention. (n.d.). *Autism information center.* Retrieved June 17, 2009, from http://www.cdc.gov/ncbddd/Autism/

Charlop, M. H. (1986). Setting effects on the occurrence of autistic children's immediate echolalia. *Journal of Autism and Developmental Disorders, 16*, 473–483.

Chung, S. H., & Herrnstein, R. J. (1967). Choice and delay of reinforcement. *Journal of the Experimental Analysis of Behavior, 10*, 67–74.

Dymond, S., O'Hora, D., Whelan, R., & O'Donovan, A. (2006). Citation analysis of Skinner's *Verbal Behavior*: 1984–2004. *The Behavior Analyst, 29*, 75–88.

Endicott, K., & Higbee, T. S. (2007). Contriving motivating operations to evoke mands for information in preschoolers with autism. *Research in Autism Spectrum Disorders, 1*, 210–217.

Esbenshade, P. H., & Rosales-Ruiz, J. (2001). Programming common stimuli to promote generalized question-asking: A case demonstration in a child with autism. *Journal of Positive Behavioral Interventions, 3*, 199–210.

Filipek, P. A., Accardo, P. J., Baranek, C. T., Cook, E. H. Jr, Dawson, G., Gordon, B., et al. (1999). The screening and diagnosis of autistic spectrum disorders. *Journal of Autism and Developmental Disorders, 29*, 439–473.

Finkel, A. S., & Williams, R. L. (2001). A comparison of textual and echoic prompts on the acquisition of intraverbal behavior in a six-year-old boy with autism. *The Analysis of Verbal Behavior, 18*, 61–70.

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*, 491–498.

Goldsmith, T. R., LeBlanc, L. A., & Sautter, R. A. (2007). Teaching intraverbal behavior to children with autism. *Research in Autism Spectrum Disorders, 1*, 1–13.

Holth, P. (2007). An operant analysis of joint attention skills. *European Journal of Behavior Analysis, 8*, 77–91. (Reprinted from *Journal of Early and Intensive Behavioral Intervention, 2,* 160–175, 2005)

Hursh, S. R., & Fantino, E. (1973). Relative delay of reinforcement and choice. *Journal of the Experimental Analysis of Behavior, 19*, 437–450.

Ingvarsson, E. T., Tiger, J. H., Hanley, G. P., & Stephenson, K. M. (2007). An evaluation of intraverbal training to generate socially appropriate responses to novel questions. *Journal of Applied Behavior Analysis, 40*, 411–429.

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36*, 407–414.

McEachin, J., & Leaf, R. (1999). The autism partnership curriculum for discrete trial teaching with autistic children. In R. Leaf & J. McEachin (Eds.), *A work in progress: Behavior management strategies and a curriculum for intensive behavioral treatment of autism* (pp. 127–344). New York: DRL Books.

Michael, J. (2000). Implications and refinements of the establishing operations concept. *Journal of Applied Behavior Analysis, 33*, 401–410.

Neef, N. A., & Lutz, M. N. (2001). A brief computer-based assessment of reinforcer dimensions affecting choice. *Journal of Applied Behavior Analysis, 34*, 57–60.

Panyan, M. C., & Hall, R. V. (1978). Effects of serial versus concurrent task sequencing on acquisition, maintenance, and generalization. *Journal of Applied Behavior Analysis, 11*, 67–74.

Partington, J. W., & Bailey, J. S. (1993). Teaching intraverbal behavior to preschool children. *The Analysis of Verbal Behavior, 11*, 9–18.

Perez-Gonzalez, L. A., Garcia-Asenjo, L., Williams, G., & Carnerero, J. J. (2007). Emergence of intraverbal antonyms in children with pervasive developmental disorder. *Journal of Applied Behavior Analysis, 40*, 697–701.

Petursdottir, A. I., Carr, J. E., Lechago, S. A., & Almason, S. M. (2008). An evaluation of intraverbal training and listener training for teaching categorization skills. *Journal of Applied Behavior Analysis, 41*, 53–68.

Petursdottir, A. I., Olafsdottir, A. R., & Aradottir, B. (2008). The effects of tact and listener training on the emergence of bidirectional intraverbal relations. *Journal of Applied Behavior Analysis, 41*, 411–415.

Rowan, V. C., & Pear, J. J. (1985). A comparison of the effects of interspersal and concurrent training sequences on acquisition, retention, and generalization of picture names. *Applied Research in Mental Retardation, 6*, 127–145.

Sautter, R. A., & LeBlanc, L. A. (2006). Empirical applications of Skinner's analysis of verbal behavior with humans. *The Analysis of Verbal Behavior, 22*, 35–48.

Skinner, B. F. (1957). *Verbal behavior.* Acton, MA: Copley.

Sundberg, M. L., Loeb, M., Hale, L., & Eigenheer, P. (2002). Contriving establishing operations to teach mands for information. *The Analysis of Verbal Behavior, 18*, 15–29.

Sundberg, M. L., & Michael, J. (2001). The benefits of Skinner's analysis of verbal behavior for children with autism. *Behavior Modification*, *25*, 698–724.

Sundberg, M. L., & Partington, J. W. (1998). *Teaching language to children with autism and other developmental disabilities*. Pleasant Hill, CA: Behavior Analysts, Inc.

Taylor, B. A., & Harris, S. L. (1995). Teaching children with autism to seek information: Acquisition of novel information and generalization of responding. *Journal of Applied Behavior Analysis*, *28*, 3–14.

Taylor, B. A., & Jasper, S. (2001). Teaching programs to increase peer interaction. In C. Maurice, G. Green, & R. M. Foxx (Eds.), *Making a difference: Behavioral intervention for autism* (pp. 97–162). Austin, TX: Pro-Ed.

Taylor, B. A., & McDonough, K. A. (1996). Selecting teaching programs. In C. Maurice, G. Green, & S. C. Luce (Eds.), *Behavioral intervention for young children with autism* (pp. 63–177). Austin, TX: Pro-Ed.

Turner, M. (1999). Annotation: Repetitive behavior in autism: A review of psychological research. *Journal of Child Psychology & Psychiatry*, *40*, 839–849.

Weeks, M., & Gaylord-Ross, R. (1981). Task difficulty and aberrant behavior in severely handicapped students. *Journal of Applied Behavior Analysis*, *14*, 449–463.

Williams, G., Perez-Gonzalez, L. A., & Vogt, K. (2003). The role of specific consequences in the maintenance of three types of questions. *Journal of Applied Behavior Analysis*, *36*, 285–306.

Wolery, M., Holcombe, A., Cybriwsky, C., Doyle, P. M., Schuster, J. W., Ault, M. J., et al. (1992). Constant time delay with discrete responses: A review of effectiveness and demographic, procedural, and methodological parameters. *Research in Developmental Disabilities*, *13*, 239–266.