Journal of
Applied Behavior Analysis

JOURNAL OF APPLIED BEHAVIOR ANALYSIS 2019, **52,** 439–450 NUMBER 2 (SPRING)

# Teaching a perspective-taking component skill to children with autism in the natural environment

Fernanda Welsh

THE ABRITE ORGANIZATION

Adel C. Najdowski

PEPPERDINE UNIVERSITY

Danielle Strauss and Lindabeth Gallegos

THE ABRITE ORGANIZATION

Jesse A. Fullen

PEPPERDINE UNIVERSITY

We evaluated procedures for teaching three children diagnosed with autism spectrum disorder the perspective-taking component skill of tacting what others are sensing across all five senses: see, taste, feel, hear, and smell. Using a multiple baseline across participants design, we evaluated a training package consisting of multiple exemplar training, reinforcement, and error correction. The treatment package was implemented in the natural environment and was effective for teaching participants to tact what others sensed. Generalization across untrained stimuli and people was observed from baseline to posttraining for all participants. We discuss how this component skill may be related to teaching further skills related to perspective taking such as tacting what others know, predicting future behavior based upon one's beliefs, and creating false beliefs in others for the purpose of adaptive deceptive behaviors such as keeping secrets, surprises, and bluffing during games.

*Key words:* autism, multiple exemplar training, perspective taking, senses, theory of mind

---

Perspective taking involves a complex set of behaviors and is widely acknowledged as necessary for engaging in successful social interactions with others (Barnes-Holmes, Barnes-Holmes, & McHugh, 2004). LeBlanc et al. (2003) defined perspective taking as observing another person's behavior and then (a) predicting their subsequent behavior or (b) responding in relation to private thoughts and emotions that would typically occur in others in that given situation. Perspective-taking skills have been found to be deficient in children diagnosed with autism spectrum disorder (ASD; Baron-Cohen, 1995).

Most of the existing literature on perspective-taking skills in children with ASD comes out of Theory of Mind (ToM) research. ToM is described as a set of complex cognitive processes that result in "the ability to infer the mental states of others" (e.g., their knowledge, intentions, beliefs, and desires; Ozonoff & Miller, 1995, p. 417). According to Howlin, Baron-Cohen, and Hadwin (1999), in order to take the perspective of another person, children must develop five increasingly complex levels of understanding of informational states. Levels 1-3 consist of simple visual perspective taking (identifying what others can see), complex visual perspective taking (identifying that a stimulus can look different to other people depending on each person's view), and applying

We thank Amelia Child for her assistance with this project.

Correspondence concerning this article should be directed to Adel Najdowski, PhD, BCBA-D, Pepperdine University. E-mail: adel.najdowski@pepperdine.edu

doi: 10.1002/jaba.523

information based on the principle of "seeing leads to knowing," such as identifying who knows what is in a box based on who looked inside the box (and also the link between hearing, smelling, or feeling and knowing information). Levels 1-3 are believed to establish the essential prerequisites for levels 4 and 5, which consist of the development of understanding true and false belief, respectively. In fact, the classic test for ToM in children is the false-belief task developed by Wimmer and Perner (1983) wherein the child must predict where a protagonist will look for an object the protagonist observed being placed in one location but did not observe being later moved to a new location. To demonstrate perspective taking, the child must state that the protagonist will look for the object in the original location based on the stimuli available to the protagonist (what the protagonist observed) even though the protagonist's belief is false.

Behavioral interpretations of ToM have suggested that, in many cases, perspective taking involves a shared interaction with physical events in the environment (Spradlin & Brady, 2008).

> For example, a child may be shown a card with a different picture on each side. If the child has learned to name each picture and to state what is on the opposite side when viewing one side of the card, the child will very likely be able to say what he/she sees and what an observer on the other side sees (Spradlin & Brady, 2008, p. 340).

Furthermore, Spradlin and Brady (2008) suggest that successful performances on tests of false belief require the ability to discriminate stimuli available to oneself versus stimuli available to others.

Schlinger (2009) also describes how one's ability to tact another person's "mental states" (i.e., private events) is based on directly observable stimuli in the environment that may correlate with the person's private events. Schlinger suggests Skinner's (1957, p. 131) writings about how the verbal community teaches children to tact their own private events, through observation of public events that are typically correlated with private events (e.g., teaching a child to identify feeling pain when the child scrapes her knee), are directly related to how one might learn to tact the private events of others. That is, being able to tact one's own private events appears to be helpful for learning to tact the private events of others.

Given the ToM and behavioral interpretations of perspective taking, it appears that a component skill to perspective taking involves attending to overt behavior of others and the stimuli they are interacting with, in order to describe their probable private events. Likewise, presumably, observing and describing the behavior of others is relevant to predicting others' behavior (Spradlin & Brady, 2008).

One component skill that appears related to this repertoire is the identification of stimuli in the environment on which another's eye gaze is fixed (for the remainder of this paper, we will refer to this behavior as tacting what others can see). In typical child development, being able to identify another's perspective based on their physical position when they are observing a stimulus emerges at around the age of 3 (Flavell, Flavell, Green & Wilcox, 1980). However, children with ASD often fail to follow the eye gaze of others (Baron-Cohen, Baldwin, & Crowson, 1997) and have difficulty identifying what others can see (Pearson, Ropar, & Hamilton, 2013).

Being able to follow the eye gaze of another person has been suggested to be a critical component skill relevant to the development of a larger perspective-taking repertoire (Baron-Cohen, 1997). Furthermore, being able to tact what others can see is relevant to everyday social interactions that involve perspective taking. For example, when playing hide-and-seek with a peer, one must tact what the seeker will be able to see when choosing a hiding location (i.e., one must make sure all of one's body parts are covered behind another object). When having a conversation, one would not provide unnecessary information about something that the peer can see for herself. Likewise, if the peer could not see an object, one might bring the object into view (move the object so that the peer can see the relevant features, such as the front cover rather than the back cover of a book) or describe the object (if there is no way for the peer to see it).

Teaching children with ASD to tact what others can see has been addressed in previous research. Gould, Tarbox, O'Hora, Noone, and Bergstrom (2011) used a multiple baseline across participants design to evaluate the efficacy of a multiple exemplar training package for teaching three children with ASD to identify what others could see. To examine this phenomenon, they used table-top procedures with a picture of a person's head and shoulders surrounded by four pictures of objects, wherein one each was placed above, below, left, and right of the picture of the person. During the training phase, the picture of the person faced either left or right (never looking up or down) with an arrow pointing left or right from the person's eyes toward pictures of objects placed in each direction. The participant was then asked, "What does he see?" A most-to-least prompting hierarchy was used, starting with a full arrow going from the person's eyes to the object the gaze was pointed toward. Across trials, the arrow became shorter, until eventually, there was no arrow (the arrow prompt had been faded out). All participants learned to identify the correct object that the person's eye gaze was pointed toward and demonstrated generalization to untrained pictures; however, generalization to tacting what a live person in the natural environment could see was limited.

Hahs (2015) used an AB design with three participants to replicate and extend the study conducted by Gould and colleagues (2011) in a number of ways. In an attempt to determine if a well-developed verbal repertoire was necessary to learn this skill, this study applied the table-top multiple exemplar procedure to children with ASD who had limited verbal repertoires. This study also extended the response requirement to include identification not only of pictures that were to the left and right, but also to pictures placed above and below the picture of the person placed in the center. Last, Hahs implemented procedures in an academic setting wherein peers and supervisors were present. All three participants learned to respond with 100% accuracy, but needed a gestural prompt (pointing to the correct picture) in addition to the arrows used in the study by Gould and colleagues to acquire the response. Two of three participants demonstrated generalization to untrained objects. The third participant (Hollis) likely did not demonstrate generalization to untrained objects because she moved schools and was not able to finish the study (time constraints did not allow the authors to fade prompts out completely). Finally, two participants (one of whom was Hollis) responded with 0% accuracy during generalization probes conducted with live people in the natural environment, and one participant responded with 75% and 63% accuracy across two sessions.

In both studies, participants were taught to tact what others could see based on public events (i.e., eye gaze on an object). Currently, there is no research on teaching children with ASD to tact what stimuli others are experiencing via the remaining four senses: taste, feel, hear, and smell. Tacts based on each of these senses likely contributes to perspective taking. For example, when reading a book or watching a video with a child, the child's caregivers may ask questions about what the characters can taste, feel, hear, and smell. Furthermore, when teaching more advanced perspective-taking skills, caregivers can teach children to follow social rules such as, "Do not tell someone something they already heard" or "You need to describe the object, because she cannot see it" (e.g., if the child is talking about an object with someone on the phone).

The purpose of the current study was to extend the studies conducted by Gould et al. (2011) and Hahs (2015) by teaching children with ASD to tact others' private events with reference to all five senses. Furthermore, given the lack of generalization to tacting what live people could see in the previous studies, the current study was conducted in the natural environment with live people instead of using table-top procedures and picture cards. Like the previous studies, multiple exemplar training was used to facilitate generalization to untrained stimuli. We used a behavioral approach by teaching learners to attend to public stimuli that are usually correlated with the private events of sensing. That is, another's eye gaze on an object was associated with seeing, an object in the person's mouth with tasting, rubbing an object with feeling, an audible sound with hearing, and sniffing an object with smelling.

## METHOD

### *Participants*

Participants included three children diagnosed with ASD. Dori (6-year-old girl), Emma (8-year-old girl), and Felipe (4-year-old boy) were receiving behavioral intervention from a community-based agency providing services rooted in applied behavior analysis (ABA) for 30, 15, and 25 hr per week, respectively. All participants received intervention in their homes. At the time of the study, all participants were performing at level three on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008), communicated using full sentences, and had prerequisite skills relevant to the skills targeted in the current study. Specifically, they could: (a) tact all stimuli targeted, (b) respond correctly to questions that included pronouns, (c) respond to questions that included names of familiar people, and (d) tact items they sensed (when asked, "What do *you* see/taste/feel/hear/smell?").

### *Response Measurement and Interobserver Agreement*

The dependent variable was labeling the stimulus with which another person was interacting when asked what the person could see/-taste/feel/hear/smell. A response was recorded as correct if the participant was able to tact the stimulus that the person was sensing within 5 s of being asked. For example, a participant might be asked, "What does (name) see?" The participant might respond, "The TV." A response was recorded as incorrect if the participant identified a stimulus with which the person was not interacting, if there was a sense-object mismatch (e.g., a participant was asked what [name] could hear and the participant responded, "My sweater"), or if the participant did not respond within 5 s of the instruction.

Two independent observers collected trial-by-trial data. An agreement was scored when both observers recorded a participant's response as either correct or incorrect. Interobserver agreement (IOA) was calculated by dividing the number of agreements by agreements plus disagreements and multiplying by 100%. IOA was collected on 85%, 88%, and 84% of sessions for Dori, Emma, and Felipe, respectively. Mean IOA equaled 100% for Dori and Felipe and 98.9% (range, 83%-100%) for Emma.

### *Experimental Design and Procedure*

A nonconcurrent multiple baseline across participants design was employed to evaluate the efficacy of the intervention.

*General procedure.* One to three sessions were conducted one to two times per week in participants' homes during their regularly scheduled ABA-based intervention sessions. For all participants, trials were conducted in various areas including the participant's bedroom, kitchen, living room, bathroom, front yard, and back yard. The target person to be observed by the participant was positioned 6 to 8 feet (1.8 – 2.4 m) away from the participant. Two additional people were present in the room to serve as distracters, and they were not instructed on how to behave. The participant and others in the room sat or kneeled on the floor, sat on the couch or a chair, or stood. The rooms contained everyday living items that were normally in the rooms; therefore, multiple stimuli were present (e.g., television on, sister eating) during sessions.

Each session consisted of 10 trials. During each trial, the participant was asked what a target person could see, taste, feel, hear, or smell. Because the target response was for the participant to tact what stimulus a target person was experiencing using a particular sense, and to control for the participant simply labeling his/her own sensing behavior, the experimenter ensured that the target person was engaging in a sensing behavior that was different than the participant during all trials. For example, when the experimenter asked what a target person could see, the experimenter did not deliver the question until the participant's eye gaze was on an object that was different than the target person's. Likewise, when the experimenter asked what a target person could taste, the participant was not eating the edible that the target person was eating. When the experimenter asked what a target person could feel, the experimenter ensured that the participant was either touching something different than the target person or was not touching anything before presenting the trial. This was done by either waiting for the participant to discontinue touching an item or by having the target person rub something different than what the participant was touching. When the experimenter asked what a target person could smell, the participant was not able to smell the item the target person was sniffing because the target person was 6 to 8 feet away. We did not use similar strategies with hearing; usually the participant was able to hear what the target person could hear.

Because it is possible for one to engage in more than one sensing behavior with a given stimulus (e.g., one can see and hear a television), we arranged for the target person to engage in only one sensing behavior in relation to the stimulus being targeted. For example, when the participant was asked what a person could see, the person's eye gaze was fixed on an inaudible, unscented object. When the participant was asked what a person could taste, the participant had just observed the person place a bite of food into his/her mouth and the person was chewing (thus the person was not gazing at, rubbing, or sniffing the object). When the participant was asked what a person could feel, the person was looking away from the inaudible, unscented object s/he was rubbing. When the participant was asked what a person could smell, the person leaned in to smell (did not touch) an inaudible object while looking up at the ceiling.

In order to control for the possibility that the participant would simply label the item that the target person was manipulating instead of attending to the sense being targeted in the question, the target person held (but did not rub, as this would indicate the "feel" sense) a distracter item during each trial. For example, if smelling lotion, the target person held an additional item such as a pencil. This was done to ensure the participant's behavior was under the appropriate stimulus control of the sense named in the question. However, when targeting the sense feel, rather than holding an additional item, the target person looked at an item different from the one being rubbed. This seeing behavior served as the distracter.

*Baseline.* Four people (e.g., a parent, sibling, and two experimenters) served as target people during baseline sessions. During every baseline session, the same experimenter asked all 10 questions, which were framed as either, "What can (name) see/taste/feel/hear/smell?" or

"What can I see/taste/feel/hear/smell?" (The pronoun "I" was used when the experimenter was asking questions about herself; in all other cases, the person's name was used.) Experimenters presented three questions pertaining to the senses of persons 1 and 2, and two questions pertaining to persons 3 and 4, for a total of 10 questions (trials) per session. Prior to each question, the experimenter asking the questions discretely instructed the target person how to engage with the target stimuli. It is unlikely that the participant observed this instruction occurring as sessions were conducted in the natural environment in which there were plenty of distractions.

New stimuli were presented on each trial; the same stimulus was never repeated (see Table 1 for a list of stimuli presented for each sense for Dori), and no feedback or reinforcement was provided for responses. In advance of sessions, a die was rolled to determine the order in which questions about senses would be presented and which people would engage in sensing behavior. For example, if the experimenter rolled a two for "sense," it was associated with "hear," and if the experimenter rolled a two for "person," it was associated with "Mom." The order was determined semirandomly, using the following rules: (a) the same person could not be the target more than twice consecutively, (b) the same sense could not be the target more than twice consecutively, and (c) each of the five senses must be targeted twice in the 10 trials.

*Training.* The same experimenter who asked all questions during baseline conducted training sessions with the participant. Although there were still two distracter people in the room during all sessions, all questions asked pertained

Table 1
Stimuli Targeted For Each Sense for Dori

| Baseline / Posttraining Stimuli | | | | |
|---|---|---|---|---|
| See | Taste | Feel | Hear | Smell |
| TV | popcorn | cat | phone | lotion |
| videotape | gum | pillow | teacher | bubbles |
| purse | chips | blanket | alarm | soap |
| paint | water | water | experimenter | marker |
| bench | goldfish | hair | Twinkle, Twinkle | leaves |
| Birthday card | juice | pants | bell | shirt |
| Training Stimuli | | | | |
| See | Taste | Feel | Hear | Smell |
| book | yogurt | ball | Mini Mouse | flower |
| watch | tomato | lotion | piano | orange |
| sky | string cheese | doll | tambourine | perfume |
| car | carrot | wipey | flute | shampoo |
| door | pickle | purse | drum | lip gloss |
| cat | cheerios | robe | lion | nail polish |
| cup | marshmallow | hat | cat | |
| backpack | chocolate | couch | Itsy Bitsy Spider | |
| doll | cheez-it | stuffed squirrel | pig | |
| toy box | pretzel | ice | sheep | |
| closet | banana | towel | rain | |
| puzzle | orange | pasta | | |
| pillow | grape | slinky | | |
| raccoon | strawberry | hat | | |
| dog | ham | socks | | |
| bike | celery | | | |
| brush | raspberry | | | |
| phone | muffin | | | |
| mirror | | | | |

to this one experimenter; thus, the question asked across all 10 trials was always, "What can I see/taste/feel/hear/smell?" The second experimenter was present only when collecting IOA data. This was done so that some of the remaining people presented in baseline could be used in posttraining (see next section) in order to test for generalization across people.

Training sessions consisted of a treatment package composed of multiple exemplar training (new stimuli were presented on each trial), error correction, and reinforcement. Prior to each 10-trial session, an informal preference assessment was conducted wherein two stimuli considered to be preferred in the past were presented to the participant, and the participant was asked if s/he wanted to earn one of the stimuli. Different items were included each time. The selected stimulus was provided with praise for correct responses on a continuous reinforcement schedule (CRF). Incorrect responses were followed by a three-step error correction procedure that consisted of: (1) a leading question, (2) an experiential prompt, and (3) a full vocal model. In the first step of the error correction procedure, the experimenter asked the participant a leading question such as, "Are my eyes looking at (incorrect stimulus)?" If the participant responded correctly to this leading question (i.e., said, "No"), the original question, "What can I see?" was re-presented. If the participant failed to respond correctly to the leading question or continued to respond incorrectly when the original question was repeated, the second step of the error correction procedure was implemented wherein the participant was positioned in the same viewpoint as the experimenter (experiential prompt), and the original question, "What can I see?" was asked. If the participant still did not correctly identify what the experimenter was able to see, the original question was repeated and the third step of the error correction procedure, a full vocal model, was immediately provided (e.g., "Say, 'You see [correct stimulus]'").

The first session of training included random rotation of only two senses (see and taste). Contingent upon the participant responding with at least 80% accuracy for one session with these two senses, a third sense was added (feel) into the next session, then a fourth (hear), and finally the fifth (smell). Once the participant responded with at least 80% accuracy to all five senses in random rotation, a novel person probe was conducted. During the novel person probe, reinforcement continued to be provided on a CRF. It was planned that if the participant responded below 80% accuracy with the novel person, then the novel person would be introduced into the intervention phase until 80% accuracy was achieved; however, this was not required for any participant. If the participant responded with at least 80% accuracy to the novel person probe, the experimenter thinned the reinforcement schedule to a variable ratio 3 (VR-3). Once the participant responded with at least 80% accuracy for two consecutive sessions in the VR-3 phase, posttraining was introduced.

*Posttraining.* Posttraining procedures were identical to baseline. The same people and stimuli used in baseline were re-presented, and none of the stimuli trained in intervention were presented. No prompting or reinforcement was provided. This phase was implemented in order to test for generalization across untrained people and stimuli.

## RESULTS

Figure 1 displays the percentage of correct responses for Dori (top panel), Emma (middle panel), and Felipe (bottom panel) during baseline, training, training with a VR-3 reinforcement schedule, and posttraining.

### *Dori*

During baseline, Dori was able to tact stimuli that others were sensing with 40% to 60% accuracy. Approximately half of Dori's errors

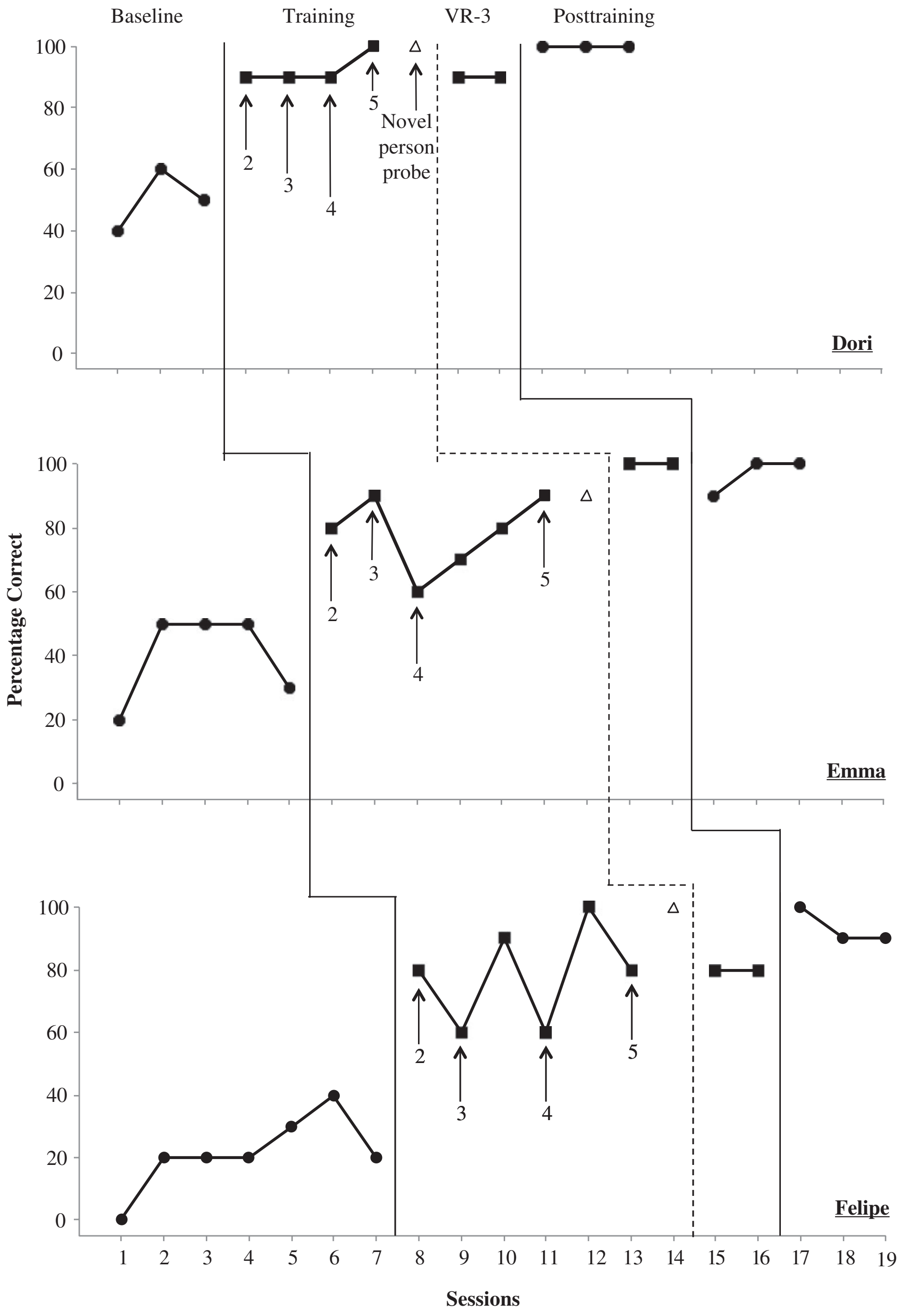


Figure 1. Percentage correct during baseline, training, training with a VR-3 reinforcement schedule, and posttraining. Open triangles represent novel person probes. Arrows with numbers represent the number of target senses included in the labeled and subsequent unlabeled sessions.

were due to identification of the incorrect object, a third of her incorrect responses were due to lack of responding, and a very small number were due to Dori giving random responses (e.g., answering "I like that song" when asked what someone could hear while music was playing). Upon implementation of training, there was an immediate increase in accuracy. During the fourth session of training, responding met the criterion of 80% to 100% accuracy for one session with all five senses, so a novel person probe was conducted, during which Dori responded with 100% accuracy. Then, the reinforcement schedule was thinned to a VR-3, and Dori responded with 90% accuracy. During posttraining, Dori responded with 100% accuracy in all sessions.

*Emma*

During baseline, Emma responded with 20% to 50% accuracy. Emma responded to every trial presented, and the majority of her incorrect responses were due to labeling the incorrect object, with a small number of her incorrect responses being random (e.g., answering "sit down" when asked what someone could feel). Upon implementation of training, there was an immediate increase in accuracy. By the end of the sixth training session, responding met the criterion to move on to a novel person probe. During the novel person probe, Emma responded with 90% accuracy. When the reinforcement schedule was thinned to a VR-3, Emma responded with 100% accuracy. During posttraining, Emma responded with 90% to 100% accuracy.

*Felipe*

During baseline, Felipe responded with 0% to 40% accuracy. The majority of Felipe's incorrect responses were due to answering with the incorrect object, a very small number of his incorrect responses were due to not responding, and nearly a fourth of incorrect responses were random generic responses that were repeated for the majority of questions asked about a particular sense. For example, on most trials when asked what someone could feel, Felipe responded "soft," and often when asked what someone could see, he responded, "elephant." Upon implementation of training, there was an immediate increase in accuracy. During the sixth training session, responding met the criterion to move on to a novel person probe. During the novel person probe, Felipe responded with 100% accuracy. When the reinforcement schedule was thinned to a VR-3, Felipe responded with 80% accuracy. During posttraining, Felipe responded with 90% to 100% accuracy.

## DISCUSSION

A training package consisting of multiple exemplar training, error correction, and reinforcement was effective for teaching three children diagnosed with ASD to tact what others could see, taste, feel, hear, and smell. Generalization across stimuli was observed from baseline to posttraining for all three participants, as none of the stimuli presented during baseline and posttraining were presented during training sessions. In addition, generalization across untrained people was observed in posttraining. These results are consistent with previous research (Gould et al., 2011; Hahs, 2015) in demonstrating that multiple exemplar training is effective for teaching children with ASD a component skill to perspective taking. This study extends these previous studies by demonstrating that children with ASD can be taught to tact what others can sense across all five senses in the natural environment, which may lead to generalization across stimuli and people.

It should be noted that we programmed for generalization across stimuli by using novel stimuli during each trial (except for using the same stimuli in baseline and posttraining), but we did not program for generalization across people. Rather, we started with one person as the trainer and conducted a novel person probe after all five senses were learned with that trainer. The plan was to introduce the novel person into treatment if generalization was not observed. However, because generalization to the novel person was observed, we moved to posttraining wherein generalization to three untrained people was observed. Although generalization to untrained people occurred with the three participants in this study, these results may not occur without more explicit programming for generalization by teaching across instructors with other individuals with ASD.

A limitation of this study is the lack of procedural integrity data evaluating implementation by experimenters and family members. Because sessions were conducted in the natural environment with many distractions occurring in the room, the experimenter was able to discretely instruct the target person as to what behaviors to engage in immediately preceding each trial. Family members were required only to engage in the instructed sensing behavior with a stimulus (e.g., taste a grape) and to hold a distracter stimulus during baseline and posttraining. During the training phase, procedures were always implemented by an experimenter. Future research should include procedural integrity data on the implementation of the independent variable both by experimenters and family members.

We attempted to decrease the likelihood that responses were under the control of sensations experienced by the participant by ensuring that only the target person was engaging in sensing behavior with the stimulus; however, we did not implement this control for the hearing sense. Given this potential confound, when asked, "What does (person) hear?" it is possible the participant simply labeled what s/he was hearing rather than attending to the perspective of the other person. To control for this in future research, one might have the target person wear headphones so that the participant would have to come over and ask to listen, or perhaps have the target person listen to something very quiet and undetectable by the participant without the participant moving to the location of the target person.

Although ToM research suggests that identifying what others can sense is a component skill to perspective taking, it is unclear whether this skill is indeed necessary in order to effectively establish a perspective-taking repertoire. While we successfully taught this skill, we did not address the necessity of teaching it. Additional research should focus on determining what skills are necessary to develop a perspective-taking repertoire and what an appropriate and efficient training sequence entails.

Additionally, future research should explore behavioral methods for teaching more complex skills related to perspective taking (see Peters & Thompson, 2018, for a recent review). As stated earlier, perspective taking involves observing another person's behavior and then (a) predicting their subsequent behavior or (b) responding with respect to private thoughts and emotions that would typically occur in others in that given situation (LeBlanc et al., 2003). Given this definition, it is clear that there are many additional skills that likely build on the basic component skill targeted in this study.

Although little behavioral research has examined methods to teach these skills, ToM research has begun to do so. Using a quasi-experimental group design, Hadwin, Baron-Cohen, Howlin, and Hill (1996) evaluated a teaching procedure that involved a question and answer format and corrective feedback to teach children with ASD a sequence of skills related to the identification of others' beliefs. First, they taught children to identify what others could see. Second, they taught them to identify how the stimuli appeared to others (i.e., objects can look different to various people depending on their position in relation to the location of stimuli). Third, they taught that "seeing leads to knowing" by hiding an object inside a box, allowing only one of two dolls to look inside the box, and then asking the children to identify who would know what was in the box. Fourth, they put two identical objects in different locations and allowed a story character to see only one of the objects and locations. Children were taught to predict where the character would look for the object. Finally, children were taught to identify their own and others' false beliefs using an unexpected transfer task (described in the introduction to this paper; Wimmer & Perner, 1983) and an unexpected contents task (Perner, Leekam, & Wimmer, 1987), which involves showing a person a container with a label on it, such as a candy box, asking what the child or others think is in the box, and then revealing that the box contains something unexpected (e.g., pencils) and that the belief that the box contained candy was false. Hadwin et al. taught these skills using dolls as the characters and they did not measure effects of teaching outside of the experimental setting. Therefore, future researchers could explore the effects of behavioral strategies for teaching such skills in the natural environment.

Being able to tact what another person "knows," according to which stimuli are available to that person, is important for many social skills. For example, one should not tell a detailed story about an event witnessed by the conversation partner, whereas providing more detail would be appropriate if the conversation partner did not observe the event. Identifying stimuli to which another person has access also helps identify if they have correct information (e.g., "Does she know we decided to meet at 5:00 pm instead of 6:00 pm?"). The answer to this question lies in whether the person heard that the time was changed ("No, she did not hear us talking about that, so she does not know we changed the time"). In this example, if the person does not know what time to meet and believes the plan is to meet at 6:00 pm, the person is holding a false belief. Future research should extend this research to show how effective social interaction may be facilitated by careful observations of others' interactions.

Behavioral research has demonstrated that children with ASD can be taught to identify the false beliefs of others via video modeling (e.g., Charlop-Christy & Daneshvar, 2003; LeBlanc et al., 2003). Once one can tact false beliefs held by others, it becomes possible to predict how they will behave; for example, "She thinks her bike is in the garage, so that is where she will look for it when it is time to ride to school tomorrow." Future research should confirm this predictive relation between teaching one to identify false beliefs and predicting important behavior of others.

Skills related to false beliefs may also be necessary for effectively responding in social situations involving deception. Behavioral intervention has been effective for teaching skills related to deception such as engaging in deceptive behavior during games (Reinecke, Newman, Kurtz, Ryan, & Hemmes, 1997), detecting and responding appropriately to deceptive statements (Ranick, Persicke, Tarbox, & Kornack, 2013), and telling socially appropriate lies (Bergstrom, Najdowski, Alvarado, & Tarbox, 2016). In addition to these skills, there are many other adaptive uses of deception as in keeping secrets and surprises, playing pranks, and telling jokes.

Future researchers should explore behavior-analytic ways to teach these types of skills, because, as the current and previous research has demonstrated, behavioral intervention appears promising for teaching basic component skills as well as more advanced perspective-taking skills, such as identifying false beliefs in others (e.g., Charlop-Christy & Daneshvar, 2003; LeBlanc et al., 2003) and skills related to deception (Bergstrom et al., 2016; Ranick et al., 2013; Reinecke et al., 1997).

## REFERENCES

Barnes-Holmes, Y., Barnes-Holmes, D., & McHugh, L. (2004). Teaching derived relational responding to young children. *Journal of Early Intensive Behavior Intervention, 1*, 3-12. https://doi.org/10.1037/h0100275

Baron-Cohen, S. (1995). *Mindblindness*. London: MIT Press.

Baron-Cohen, S. (1997). How to build a baby that can read minds: Cognitive mechanisms in mindreading. In S. Baron-Cohen (Ed.), *The maladapted mind: Classic readings in evolutionary psychopathology* (pp. 207-239. Erlbaum, UK: Taylor and Francis, Ltd.

Baron-Cohen, S., Baldwin, D. A., & Crowson, M. (1997). Do children with autism use the speaker's direction of gaze strategy to crack the code of language? *Child Development*, *68*, 48-57. https://doi.org/10.1111/j.1467-8624.1997.tb01924.x

Bergstrom, R., Najdowski, A. C., Alvarado, M., & Tarbox, J. (2016). Teaching children with autism to tell socially appropriate lies. *Journal of Applied Behavior Analysis, 49*, 1-6. https://doi.org/10.1002/jaba.295

Charlop-Christy, M. H., & Daneshvar, S. (2003). Using video modeling to teach perspective taking to children with autism. *Journal of Positive Behavior Interventions, 5*, 12-21. https://doi.org/10.1177/10983007030050010101

Flavell, J. H., Flavell, E. F., Green, F. L., & Wilcox, S. A. (1980). Young children's knowledge about visual perception: Effect of observer's distance from target on perceptual clarity of target. *Developmental Psychology, 16*, 10. https://doi.org/10.1037/0012-1649.16.1.10

Gould, E., Tarbox, J., O'Hora, D., Noone, S., & Bergstrom, R. (2011). Teaching children with autism a basic component skill of perspective-taking. *Behavioral Interventions, 26,* 50-66. https://doi.org/10.1002/bin.320

Hadwin, J., Baron-Cohen, S., Howlin, P., & Hill, K. (1996). Can we teach children with autism to understand emotions, belief, or pretence? *Development and Psychopathology*, *8,* 345-365.

Hahs, A. D. (2015). Teaching prerequisite perspective-taking skills to children with autism. *International Journal of Psychology and Behavioral Sciences, 5*, 115-120. doi:https://doi.org/10.5923/j.ijpbs.20150503.02

Howlin, P., Baron-Cohen, S., & Hadwin, J. (1999). *Teaching children with autism to mind-read: A practical guide*. Chichester, England: Wiley.

LeBlanc, L. A., Coates, A. M., Daneshvar, S., Charlop-Christy, M. H., Morris, C., & Lancaster, B. M. (2003). Using video modeling and reinforcement to teach perspective-taking skills to children with autism. *Journal of Applied Behavior Analysis, 36*, 253-257. https://doi.org/10.1901/jaba.2003.36-253

Ozonoff, S., & Miller, J. N. (1995). Teaching Theory of Mind: A new approach to social skills training for individuals with autism. *Journal of Autism and Developmental Disorders, 25*, 415. https://doi.org/10.1007/BF02179376

Pearson, A., Ropar, D., & Hamilton, A. F. D. C. (2013). A review of visual perspective taking in autism spectrum disorder. *Frontiers in Human Neuroscience*, *7*, 652. https://doi.org/10.3389/fnhum.2013.00652

Perner, J., Leekam, S. R., & Wimmer, H. (1987). Three-year-olds' difficulty with false belief: The case for a conceptual deficit. *British Journal of Developmental Psychology, 5*, 125-137.

Peters, L. C., & Thompson, R. H. (2018). A behavior-analytic approach to teaching perspective taking to individuals with autism spectrum disorders. *Behavior Analysis in Practice*. Advanced online publication. https://doi.org/10.1007/s40617-018-0207

Ranick, J., Persicke, A., Tarbox, J., & Kornack, J. A. (2013). Teaching children with autism to detect and respond to deceptive statements. *Research in Autism Spectrum Disorders, 7,* 503-508. https://doi.org/10.1016/j.rasd.2012.12.001

Reinecke, D. R., Newman, B., Kurtz, A. L., Ryan, C. S., & Hemmes, N. S. (1997). Teaching deception skills in a game-play context to three adolescents with autism. *Journal of Autism and Developmental Disorders, 27*, 127-137. https://doi.org/10.1023/a:1025835706522

Schlinger, H. D. (2009). Theory of mind: An overview and behavioral perspective. *The Psychological Record*, *59*, 435-448. https://doi.org/10.1007/BF03395673

Skinner, B. F. (1957). *Verbal behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Spradlin, J. E., & Brady, N. (2008). A behavior analytic interpretation of theory of mind. *International Journal of Psychology and Psychological Therapy, 8*, 335-350.

Sundberg, M. L. (2008). *Verbal behavior milestones assessment and placement program: The VB-MAPP*. Concord, CA: AVB Press.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13,* 103-128. https://doi.org/10.1016/0010-0277(83)90004-5

*Received February 16, 2017*
*Final acceptance March 29, 2018*
*Action Editor, Rachel Thompson*