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Teaching children with autism to detect and respond to sarcasm

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ABSTRACT

Previous research has demonstrated that children with autism often have difficulty using and understanding non-literal language (*e.g.*, irony, sarcasm, deception, humor, and metaphors). Irony and sarcasm may be especially difficult for children with autism because the meaning of an utterance is the opposite of what is stated. The current study evaluated the effectiveness of a training package, including rules and *in vivo* multiple exemplar training, to teach three children with autism to detect and respond appropriately to sarcastic statements. The training package was effective and generalization was obtained across novel exemplars, settings, and people.

Many aspects of human communication depend upon the ability to use and understand non-literal language (Capelli, Nakagawa, & Madden, 1990) including metaphor, metonymy, rhetorical questions, understatements, hyperbole, indirect requests, and verbal irony (MacKay & Shaw, 2004). In a recent study on psycholinguistic literature, Gibbs (2000) investigated the use of irony in everyday language by systematically reviewing sixty-two 10-min conversations. The results indicated that ironic language accounted for 8% of all conversational turns. In addition, per each taped conversation, there were approximately 4.7 instances of irony, indicating that ironic utterances may occur about once every 2 min in everyday speech. A further analysis of 289 utterances revealed that in 28% of cases, sarcasm was the specific form of irony used. These findings suggest that the general use of verbal irony and specific use of sarcasm is common in everyday language and communication.

Sarcasm is a form of verbal irony that is characterized by an incongruity between what is said and what is meant (Capelli et al., 1990). Sarcasm can be linguistically defined as a form of non-literal language in which someone subjectively states the opposite of what is objectively known to be true in reality. In this form of ironic language, the speaker intends to communicate a message contradictory to its literal meaning and the listener must subsequently reason a figurative interpretation. Understanding this specific form of counterfactual, non-literal language has been found to serve significant social and communicative functions. Mainly, verbal irony and sarcasm are used to either indirectly convey attitudes and beliefs or for the purposes of generating humor (Harris & Pexman, 2003; Pexman et al., 2011). Thus, comprehension of sarcasm requires an ability to identify the social cues necessary to differentiate between the speaker's intended meaning and the literal meaning of the utterance. The ability to judge the literal meaning of a statement while simultaneously inferring the speaker's intended meaning is said to reflect an advanced understanding of other people's thoughts or intentions, *i.e.*, perspective-taking (Uchiyama et al., 2012).

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Research conducted with typically developing children has found that the ability to derive sarcastic intent from verbally ironic utterances naturally begins to emerge around the age of 5 or 6, and continues to develop throughout middle childhood (Creusere, 2000; Dews et al., 1996; Harris & Pexman, 2003; Pexman et al., 2011). On the other hand, research conducted on children with autism spectrum disorders (ASD) has found this population to be distinctively deficit in perspective taking abilities necessary for the comprehension of verbal irony (Filippova & Astington, 2008; Happé, 1994; Pexman et al., 2011). In a study conducted by Kaland et al. (2002), twenty-one children and adolescents with Asperger's Disorder and twenty typically developing age-matched controls were presented with several short stories that were used to assess the ability of participants to infer physical and mental states. The content of these short stories included sarcastic remarks, among other forms of figurative speech. In order to determine whether the children could identify the use of sarcasm, following each story the researchers asked a comprehension question (*i.e.*, "Is it true what X says?") and a justification question (*i.e.*, "Why does X say that?"). Participants with Asperger's Disorder had far more difficulty with the tasks and were impaired in their ability to infer mental states in their responses and instead provided irrelevant or idiosyncratic explanations.

These deficits may have significant negative implications for social functioning, when taking into account the prevalence of verbal irony and sarcasm used in everyday language described earlier. Indeed, researchers have highlighted the importance of understanding non-literal language for everyday communication and overall social integration (Rajendran, Mitchell, & Rickards, 2005). For example, if a child with autism shoots a basket and misses and a peer sarcastically says "Nice shot," and the child with autism responds as though the peer is being literal (*e.g.*, "No, it wasn't a nice shot, I missed"), then such a misunderstanding would likely set the occasion for the child with autism to be the subject of further ridicule. Research on the prevalence of bullying among individuals with ASD has indicated that this population has a greater risk of victimization compared to typically developing peers (Van Roekel, Scholte, & Didden, 2010). Higher rates of bullying among individuals with ASD may very well be due to deficits in social interactions and an overall lack of understanding of the behavior of others, *i.e.*, perspective-taking.

Given the potential social importance of ironic language, identifying effective interventions for teaching individuals with ASD to understand and use ironic language would seem to be a priority. However, the vast majority of previous research has focused on identifying deficits and constructing hypothetical explanations for them. Such hypothetical explanations range from general theories of weak central coherence and theory of mind abilities (Happé, 1994; Jolliffe & Baron-Cohen, 1999; Martin & McDonald, 2004), to domain specific impairments in mental inference abilities and the ability to attribute mental states (Kaland et al., 2002). While this research contributes to our knowledge regarding the existence of deficits, it does not address language as learned behavior that is amenable to teaching. Considering the multitude of studies demonstrating that children with ASD have substantial difficulty comprehending sarcasm, it is important for current research to expand its focus from identification of deficits to interventions for remediating them.

Persicke, Tarbox, Ranick, and St. Clair (2012) recently conducted a study that taught metaphorical reasoning, a form of non-literal language, to children with ASD. Participants were presented with short stories and were then asked a series of three metaphorical questions about each story. Answering the questions correctly depended on the ability to figure out the meaning of the metaphors in relation to particular aspects of the story. During teaching, participants were first told how to reason through a metaphor by identifying multiple features of the metaphorical statement, then identifying multiple features of the thing which the metaphor was used to describe, and finally, identifying the feature that both had in common, thus solving the metaphor. For example, "Why did I call the boy a race car? Well, the boy is a person, he's wearing clothing, and he was running really fast. Race cars are vehicles, they are made of metal, and they go really fast. So when I said the boy is a race car, I meant he is really fast." Participants were then trained across multiple exemplars of metaphors until generalization to untrained metaphors was obtained. All participants demonstrated generalization across multiple untrained metaphors, and two of the three participants began creating their own metaphors, a performance that was never targeted during the intervention. The results of the study suggested that multiple exemplar training can be effective for teaching metaphorical reasoning, a form of non-literal language, to children with ASD.

In the study by Persicke et al. (2012), children with ASD were taught to relate two stimuli in terms of a shared feature (the feature shared between an object and the metaphor used to describe it). Sarcasm requires relating of a different sort. In sarcastic statements, the intended meaning of the statement is *opposite* to the literal meaning. However, the results of the Persicke study are encouraging for the possibility of teaching sarcasm because, from a behavioral standpoint, there is no reason to assume that teaching one type of relating would be any more or less possible than teaching another. Research in Relational Frame Theory (RFT), a contemporary behavioral account of human language and cognition, suggests that the behavior of relating, *per se*, is learned operant behavior (see Rehfeldt & Barnes-Holmes, 2009, for a volume-length application of RFT to autism and related disorders). Furthermore, preliminary research suggests that some forms of relating can be strengthened in individuals with ASD *via* multiple exemplar training (Murphy, Barnes-Holmes, & Barnes-Holmes, 2005; Tarbox, Zuckerman, Bishop, Olive, & O'Hora, 2011). Understanding a sarcastic statement involves responding to the literal meaning of the statement and the inferred intended meaning of the speaker in terms of the relation of opposition. According to RFT research, this ability should be teachable through practice across multiple exemplars with clear and immediate feedback.

The purpose of the current study was to teach children with ASD to accurately detect and appropriately respond to sarcastic comments in the course of normal everyday conversation. Training began in a contrived format, with the use of video clips and directly prompted performance. Training progressed to more natural formats, culminating in natural conversational interactions, and continuing until generalization to untrained sarcastic statements was observed.

1. Method

1.1. Participants and setting

Participants included 3 children receiving applied behavior analytic services from a community-based in-home service provider. Children ranged in age from 6 to 7 years old and had current diagnoses of autistic disorder. At the time of the study, participants were receiving 2–10 h per week of behavioral therapy, and had been receiving in-home behavioral therapy for approximately 3–4 years. To be included in the study, participants' parents and clinical supervisors needed to prioritize the detection of sarcasm as an important component of the children's overall treatment plan. In addition, participants all had prior training in skills that may be prerequisites for understanding sarcasm, including prosody, body language and facial expressions, physical context of conversation, conversational audience, desires, emotions, sensory perspective taking, cause and effect, preferences, knowing, beliefs, and intentions. None of the participants had previous direct training in detecting or responding to sarcasm. Additionally, this skill was not targeted by the participants' clinical treatment teams throughout the course of the study, and parents were asked to not provide any training outside of specified research sessions. Sessions were conducted at participants' homes, with the exception of generalization sessions, which were conducted at various locations in the community. Training sessions were video recorded using a digital video camera mounted on a tripod. For baseline and post-training sessions, video recording was surreptitiously prepared before sessions so that participants could not detect they were being recorded. Approximately two to three sessions were conducted each week. Training sessions lasted no more than 30 min and baseline/post-training sessions no more than 1 h. All sessions were conducted by the first and third authors, both of whom had 4–6 years of experience teaching skills to children with autism. To ensure treatment fidelity, all procedures were rehearsed before the study began and fidelity was anecdotally monitored on a regular basis by the first author through video tape review.

1.2. Response measurement and interobserver agreement

Data were collected on the accuracy of each participant's responses to sarcastic and sincere comments made by therapists and family members across all phases of the study. A correct response to a sarcastic comment was defined as smiling, laughing or stating a reciprocal sarcastic comment. An incorrect response to a sarcastic comment was defined as responding as though the sarcastic comment was literal, as in disagreeing with it. However, for the purposes of remaining as stringent as possible, any response that did not meet the definition of a correct response was scored as an incorrect response. Correct responses to sincere comments were defined as anything other than disagreeing with the comment. Data were only collected on sincere comments in order to ensure that participants were learning to discriminate between sarcastic and sincere comments and not rotely respond to all therapist comments as sarcastic after training. Accuracy data on sarcastic trials were summarized and graphed as percent correct.

A second independent observer scored videos from 36% of sessions in all phases. Trial-by-trial interobserver agreement (IOA) was calculated by dividing the number of agreements by the sum of agreements and disagreements and multiplying by 100. IOA averaged 99.4% across all participants and phases, with no individual session scoring lower than 97% agreement (range = 97.1–100%).

1.3. Procedure

1.3.1. Baseline

Baseline sessions were designed to be indistinguishable from regular everyday conversational interactions between participants and adults. As a regular part of participants' in-home therapy, participants engaged in conversation with therapists and family members during frequent breaks from therapy. "Sessions" of sarcasm trials were embedded into these breaks, without any overt indication that testing or data collection was occurring. Each session consisted of the therapist making three sarcastic comments over the course of an hour or more. In addition, one sincere comment was made on the same subject as each sarcastic comment (*i.e.*, sarcastic: "Worms would taste *so* good!" and sincere: "I would never eat worms."), spread over the course of the same hour. In other words, therapists had numerous conversational interactions with participants over the course of an hour and the six comments were randomly interspersed throughout. None of these six comments were made as the initial interaction with the participants on a given day.

Table 1 displays a sample of the sarcastic comments included in the study (contact the corresponding author for a full list of comments). Sarcastic comments were created prior to study sessions and included discrete contextual cues

Table 1
Sample context and corresponding sarcastic and sincere comments.

Context	Sarcastic comment	Sincere comment
warm sunny day	*"It's definitely going to snow today."*	*"It's so warm outside today."*
non-preferred food item	*"You would love to eat broccoli every day."*	*"I know you don't like broccoli."*
messy room	*"You didn't make a mess at all."*	*"This room is so messy."*
preferred activity	*"Playing video games is never fun."*	*"It's so much fun to play video games"*

(*e.g.*, object size) or the participant's individual preferences (*e.g.*, favorite foods or toys). Sarcastic comments that would require participants to make inferences about the therapists' preferences were avoided. Participants were not given any feedback regarding correct or incorrect responses to any of the six comments. However, if the participant did not respond, the therapist would say, "Did you hear me?" and repeat the comment, as he/she normally would during conversation. Comments were repeated no more than 3 times before the response was recorded as a non-response.

1.3.2. Rules and videos

The first phase of training consisted of providing rules, modeling, practice, and specific feedback, across multiple exemplars. At the beginning of each session, the following rule was presented, "When someone says the opposite of what they mean, they are probably being sarcastic." Short video clips (10 s or less) were then shown that contained clear contextual cues allowing the participant to make a comparison between the sarcastic/sincere comment and what was occurring in the clip. For example, one video clip showed a child riding a skateboard at an extremely slow pace and the sarcastic comment was, "Wow, he is going *really* fast." After each video clip, the therapist would say "This is being sarcastic" and would make a sarcastic comment. Following the comment, the therapist would ask the participant leading questions about the comment, including what was said, if the therapist meant what was said, why it was said, and the appropriate response to the comment. The purpose of asking these questions was to help the child develop a repertoire of asking himself questions to determine the meaning of ambiguous comments. Ten-to-fifteen practice trials were then conducted, in which the therapist played the video clips again and stated either sarcastic or sincere comments. Correct responses were reinforced with praise and incorrect responses were corrected using the leading questions described above. Exaggeration of the therapist's facial expression and intonation, including eye rolling and smiling, was faded across training trials. The video and rules phase of training was concluded when a participant scored 80% or higher on practice trials across 3 consecutive sessions.

1.3.3. In vivo training

The second phase of training consisted of rules and *in vivo* rehearsal across multiple exemplars. This phase was adapted from a lesson on detecting sarcasm in the Skills© curriculum (www.skillsforautism.com). Each session consisted of 10–12 trials. At the beginning of the session, the therapist stated the rule and asked the participant to repeat the rule. Sarcastic and sincere comments were then stated during natural conversation throughout the session. If the participant responded correctly the therapist provided verbal praise. If the participant responded incorrectly, the therapist gave corrective feedback in the form of leading questions. Initially, sarcastic comments were stated with exaggerated intonation and facial expression and this was faded across successive sessions. Specifically, during the first training session, facial expression and intonation were exaggerated, during the second training session the exaggerations were decreased, and finally, were absent for the third training session. During any given session, approximately half of all comments had never before been presented during training (*e.g.*, if 10 comments were stated, 5 of these comments were novel). All sarcastic comments, including novel comments, were predetermined for each session. *In vivo* training sessions were conducted in three different settings (*e.g.*, home, park, and coffee house) and with three teachers (*i.e.*, two therapists and one parent or nanny) to promote generalization. Therapists used modeling, practice and feedback to train caregivers to state sarcastic comments prior to each session in which the caregivers participated. Training was concluded after the participant achieved 80% correct or higher with novel exemplars across 3 consecutive sessions.

1.3.4. Post-training and follow-up

Post-training sessions were identical to baseline (*i.e.*, the procedures were identical and the sarcastic comments were the same) and none of the sarcastic comments included in this phase were present during training. In addition, in order to rule out any possible practice effects, additional novel probes were conducted that included sarcastic comments that were never before present during any prior baseline or training phases. Finally, follow-up probes were conducted at one, two, and three-months for Reggie and Kevin (Hans was not available for follow-up sessions). Follow-up sessions also included completely novel comments that were never present during any prior sessions.

2. Results

Fig. 1 depicts the percentage of correct responses to sarcastic statements across all phases of the study. Note that asterisks represent accuracy on novel exemplars. In baseline, two of the three participants, Reggie and Kevin, did not respond correctly to any sarcastic comments, for example, saying with frustration "No, worms are not yummy!" Hans responded correctly to 1 out of 3 comments during baseline sessions 2 and 4. All participants showed immediate increases in correct responding to sarcastic statements at the onset of the rules and video training phase and continued to respond correctly during the second phase of training, *in vivo* multiple exemplar training. Hans and Reggie had greater difficulty than Kevin during *in vivo* training, but both achieved mastery after 9 *in vivo* training sessions.

During post-training, all participants demonstrated correct responding to the vast majority of sarcastic comments presented. Two-to-four additional probes of novel exemplars (never before included in any previous session), depicted by asterisks, were conducted for all three participants. Following these novel probes, three monthly follow-up probes were conducted with Reggie and Kevin and accurate responding maintained. Note that none of the exemplars presented during

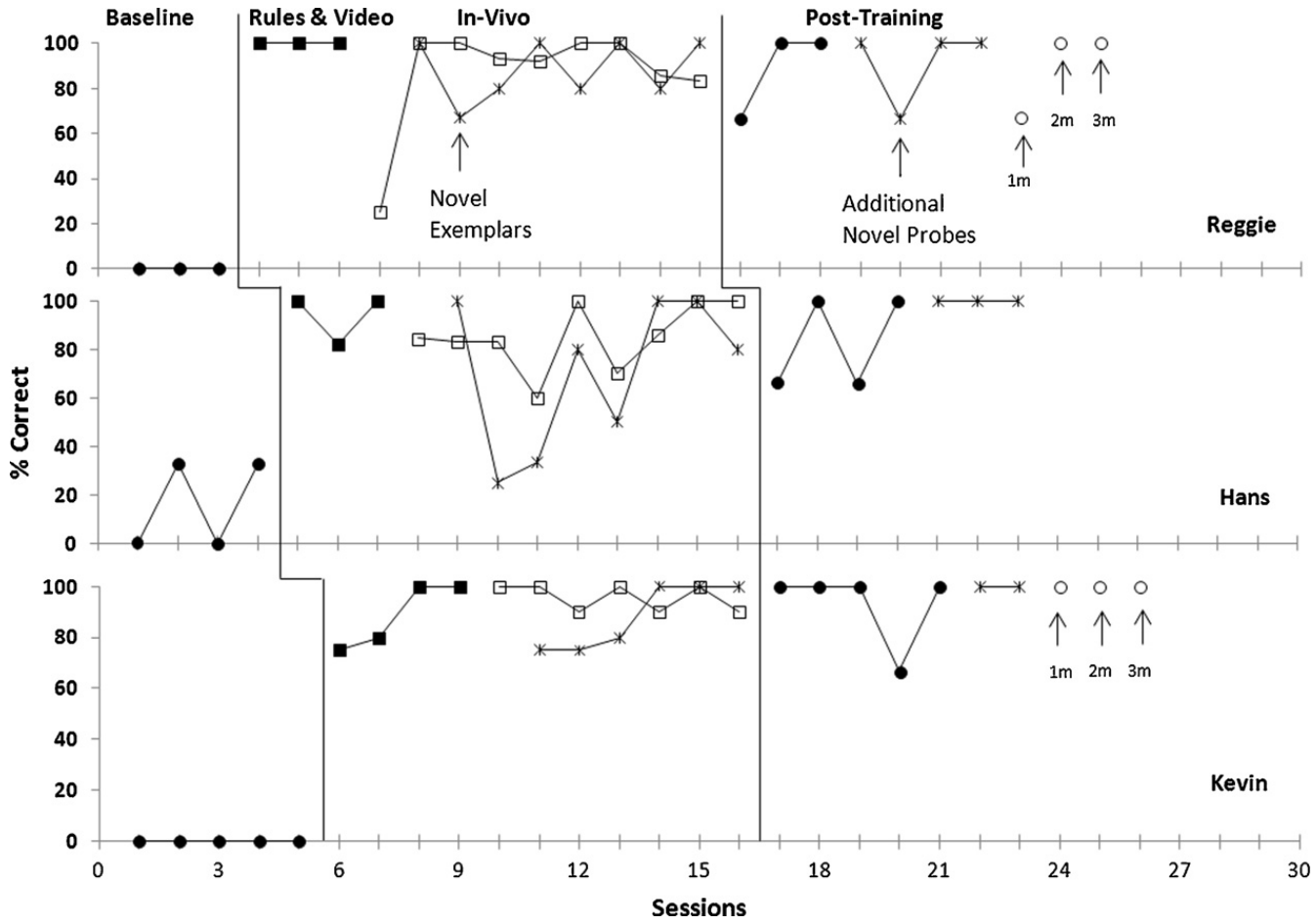

Fig. 1. Percentage of correct responses to sarcastic comments across all phases of the study for Reggie, Hans, and Kevin.

any post-training sessions were ever present during training. Therefore, all responding during post-training sessions represents generalization across exemplars. Hans demonstrated generalized correct responding to 22 untrained exemplars and Reggie and Kevin demonstrated generalized correct responding to 31. In addition, one setting in which training was never conducted was included in post-training sessions for all three participants and all demonstrated correct responding. Finally, generalization across people was assessed by including two people in post-training sessions who were never present during training (*i.e.*, one therapist and one parent or nanny). All three participants demonstrated correct responding to these people during post-training.

3. Discussion

This study used rules, video clips, and *in vivo* training across multiple exemplars to successfully teach three children with autism to detect and respond appropriately to sarcastic comments. These results are encouraging because they provide further evidence that non-literal language deficits can be remediated using simple behavioral teaching procedures such as the provision of rules and multiple exemplar training. Perhaps most importantly, all three participants not only mastered the skill, but also demonstrated generalization to novel people, settings, and exemplars. That is, all participants demonstrated the ability to respond appropriately to new sarcastic statements, made by people who did not participate in training, and in locations that were not included in training. The ability to respond appropriately to sarcasm, then, was established as a generalized operant, rather than teaching children to memorize appropriate responses to particular sarcastic comments.

The verbal repertoire targeted in this study was relatively narrow but the success of the intervention has relatively broad implications for the remediation of complex and subtle social behavior in individuals with ASD. There is a common misconception that behavioral intervention procedures are effective for teaching simple skills but that addressing deficits in complex language and cognition may require cognitive and/or relationship-oriented approaches. The results of the current study do not support this conclusion. Much further research into the application of behavioral procedures for teaching a wider variety of perspective-taking and pragmatic language skills is needed, but this study provides preliminary evidence that complex skills such as these are amenable to remediation through behavioral teaching strategies.

The current results have implications for the utility of RFT for constructing programs for teaching complex language and cognition to individuals with ASD. The core concept of RFT, that cognition consists of relating behavior, which is learned *via*

multiple exemplar training, seems to be supported by this study. The complex ability of responding to sarcastic comments, in which the intended meaning is the opposite of the literal meaning, was successfully taught *via* practice across multiple exemplars with clear and immediate feedback. In addition, the rules provided in the earlier sessions of training directed participants to attend to the relational properties of the context, that is, the fact that sarcastic comments are the *opposite* of what is true in the current context.

The ability of participants to expressively produce sarcastic language was never targeted during the study. However, two of the three participants created their own sarcastic comments during research sessions, and the third participant's mother reported that he created his own sarcastic comments when conversing with her outside of sessions. These findings, although uncontrolled and anecdotal, suggest that the participants may have learned how to produce their own sarcastic language without direct training. Future research on teaching sarcasm or other forms of non-literal language should include systematic evaluation of the expressive repertoire and/or other untrained repertoires.

A limitation of this study is that the rules and video phase may not have been necessary for the participants to learn the skill. This phase was included to ensure that the participants were attending to the discrete contextual cues in the video that contradicted the sarcastic statement stated by the therapist. It seems likely that this phase helped establish the repertoire that was perfected in the *in vivo* phase, but the current data do not allow for an assessment of this possibility. It is possible that the participants would have learned the skill just as quickly from *in vivo* training alone and future research should attempt to identify which treatment components are truly necessary for teaching sarcasm.

In conclusion, this study used rules, video clips, and *in vivo* training across multiple exemplars to teach the generalized skill of detecting and responding appropriately to sarcastic statements with 3 children with autism. All 3 participants successfully demonstrated this skill with untrained exemplars, as well as novel exemplars not contacted in any phase of the study. Furthermore, the two participants who were available for maintenance probes demonstrated maintenance of the skill across 3 months. This study provides further evidence that behavioral teaching procedures can be used to teach complex language and cognitive skills, including non-literal language, to children with ASD. Much research is still needed in areas such as deception, humor, and intentions, among many others, but the current data suggest that ASD research can be successful in progressing from merely identifying deficits in complex language and cognition to remediating them.

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