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OBSERVATIONAL LEARNING AND CHILDREN WITH AUTISM: DISCRIMINATION TRAINING OF KNOWN AND UNKNOWN STIMULI

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We extended past observational learning research by incorporating stimuli already known to participants into training. We used a multiple-baseline design across three participants to determine the effects of discrimination training on the discrimination of consequences applied to modeled responses using both known and unknown pictures. During baseline, participants were exposed to modeled correct and incorrect picture labels and were observed to imitate modeled responses that were incorrect and followed by negative feedback. During discrimination training, we taught participants to label known pictures regardless of observed responses and consequences. With unknown pictures, we taught participants to imitate correct and reinforced modeled responses, and to say, "I don't know," when modeled responses were incorrect and received negative feedback. Test sessions measured responding to known and unknown pictures and showed acquisition over baseline levels. Generalization to pictures not associated with training was variable. Implications for teaching observational learning to children with autism are discussed.

Key words: autism, discrimination training, observational learning

Observational learning was defined by Catania (1998) as the learning of new responses that emerges following observation of modeled responses and their consequences. When modeled responses are followed by reinforcement, the observer is more likely to engage in that response later in time. When modeled responses are followed by extinction or punishment, the observer is less likely to engage in those modeled responses later in time. Masia and Chase (1997) offered a behavior analysis of observational learning, wherein they hypothesized that observational learning is influenced by generalized imitation, stimulus generalization, and acquisition of relevant conditional discriminations. For example, a math problem and the response of the model is a compound stimulus. The teacher's feedback (either positive or negative) following the modeled response changes the function of the compound stimulus; the model's response becomes a discriminative stimulus or s-delta for imitation conditional upon the teacher's feedback. Thus, the observer must respond conditionally to the presence and absence of reinforced and punished responses. Masia and Chase also argued that emitting the response later in time might be a function of the presence of contextual stimuli, or contextual control by additional instructions provided to the model, and that imitation will result in reinforcement. Perhaps the use of rules and rule-governed behavior is a good example of the role of contextual control during observational learning (e.g., "When he gets it right, say what he says"), but more research is required to evaluate this interpretation.

Given the complexity of observational learning, it is not surprising that early researchers demonstrated that children with autism do not readily learn by observing others (Lovaas, Koegel, Simmons, & Long, 1973; Varni, Lovaas, Koegel, & Everett, 1979). This has led to a developing body of research evaluating procedures for teaching observational learning responses to children with autism (e.g., Greer, Dudek-Singer, & Gautreaux, 2006; MacDonald & Ahearn, 2015;

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Pereira-Delgado & Greer, 2009; Rehfeldt, Latimore, & Stromer, 2003; Taylor & DeQuinzio, 2012). Targeting observational learning deficits has important educational, social, and economic implications; if children with autism are able to learn by observing others, it may lead to increased social and educational opportunities and may reduce reliance on costly one-to-one instruction. Although current research is promising in that it indicates that some children with autism may acquire observational learning responses and may learn new information during observational learning contexts, more research is needed to continue to evaluate variables that might influence learning through the observation of others.

Emerging research has indicated that some responses, if taught to children with autism, may facilitate learning during observational learning contexts. For example, in a study by Taylor, DeQuinzio, and Stine (2012), component skills (i.e., attending and imitation) hypothesized to be associated with observational learning were taught to three children with autism. Participants observed peers engaged in instructional interactions during which peers emitted correct responses to sight words unknown to participants. Participants were taught to attend to instructional stimuli and to monitor the correct responses of their peers by producing an imitative response and a matching response indicating the participant had observed the instructional stimuli. In the condition in which participants were taught to monitor the responses of peers, participants learned new sight words more quickly than in the condition in which they were not required to monitor the responses of peers. In addition, once monitoring responses were acquired in the training context, performance in reading the sight words in the nontraining condition increased, suggesting that generalization of the monitoring responses occurred. These results suggested that learning to monitor the responses of a model facilitated observational learning. In this study, however, participants observed only correct responses that were followed by reinforcement. They were not required to discriminate between reinforced (correct) responses and nonreinforced (incorrect) responses.

Expanding on these results, DeQuinzio and Taylor (2015) incorporated modeled correct and incorrect responses, as well as teacher-delivered consequences that either did or did not reinforce the model's response. In this study, the authors taught children with autism to discriminate between the reinforced and nonreinforced responses of the model. Acquisition of unknown picture labels was then measured during test sessions. During baseline, participants were exposed to modeled correct and incorrect responses and the respective consequences to each response, but participants were not taught to discriminate the consequences of modeled responses. During discrimination training, participants were taught to imitate the reinforced responses of the model and to say, "I don't know," when the model's responses were not reinforced. Training consisted of stating a rule to the participants (i.e., "Say what she says when she gets it right," or "When she gets it wrong, say, 'I don't know'") and reinforcing accurate discriminations. All participants learned the discrimination between reinforced and nonreinforced trials during the training sessions. Test sessions conducted 1 and 10 min after sessions throughout baseline, discrimination training, and generalization showed that the participants maintained the discrimination. More specifically, the participants said, "I don't know," in response to unknown picture labels emitted by the model and not reinforced by the instructor during training. By contrast, they said the correct picture label to unknown picture labels emitted by the model and reinforced by the instructor. Generalization to stimuli not associated with training was variable across the four participants. This study illustrated the importance of systematic instruction for teaching learners with autism to make conditional discriminations during observational learning sessions.

Although these studies elucidated many important considerations when teaching children with autism to learn through observation, there were two critical issues associated with each. First, the previous studies did not assess if the observed consequences were functional for the participants. Although we assumed that the observed consequences would have functioned as reinforcers and punishers for the participants, these consequences were not evaluated empirically prior to observational learning sessions.

Second, participants were exposed to modeled responses that were initially unknown to the participants. By learning to engage in component responses of observational learning (e.g., imitation, attention to instructional stimuli, and discrimination of consequences) participants acquired other responses (e.g., sight words) that were not previously in their repertoires. Still unclear from these studies is the effect of incorporating stimuli already known to participants (e.g., stimuli that evoke correct picture labels) into observational learning. Would participants continue to say the correct label if modeled responses were incorrect and followed by negative feedback, or would they imitate the incorrect response? Further, if participants with autism did indeed make this error, could we teach them to respond to known and unknown stimuli in the context of observational learning?

Thus, the purpose of the current study was to extend Taylor et al. (2012) and DeQuinzio and Taylor (2015) by ensuring that the observed consequences provided to the models were functional for the participants and by including both *unknown* and *know*n stimuli during observational learning sessions.

METHOD

Participants and Setting

The participants were three children with autism who attended a behaviorally based school where the primary teaching was based on applied behavior analysis. All participants had experience using token economies and had a history of learning simple discriminations as well as match-to-sample conditional discriminations. All demonstrated generalized imitative repertoires. All participants in this study had small-group instruction for a portion of the school day, in which a variety of academic subjects were taught such as science, social studies, and reading. All participants had learned to say, "I don't know," in the presence of unknown stimuli as part of prior instructional programming. Participants were selected to participate in this study because they had either observational learning goals or group-instruction goals that were specified within their Individualized Education Program. Sessions took place in rooms other than the participants' classrooms, such as other classrooms, offices, and meeting rooms. The sessions were all conducted by teachers familiar with the participants and trained in both applied behavior analysis and the procedures for this study.

Billy was 7 years old at the time of the study. His age-equivalent score on the Peabody Picture Vocabulary Test-Fourth Edition (PPVT-IV) (Dunn & Dunn, 2007) was 6 years, 3 months. His age equivalent score on the Expressive Vocabulary Test (EVT-II) (Williams, 2007) was 5 years, 11 months. His instructional programs targeted skills such as participating in group instruction, imitating behavior of a group, listening to and following directions related to worksheets, and describing events. Billy's other instructional programs at the time of the study included demonstrating a variety of functional responses in the community, tying shoes, and commenting to an individual about his own play. In addition, Billy had been taught to participate in dyad instruction, use the phrase "I don't know," and selectively imitate a model.

Hank was 12 years old at the time of the study. His age-equivalent score on the PPVT-IV was 7 years, 10 months. His age equivalent score on the EVT-II was 5 years, 8 months. Hank's instructional programming focused on expressive language, including describing topics, initiating conversations, and asking and answering social questions. His instructional programs also included prevocational skills, self-care skills such as brushing teeth, and community skills such as completing a schedule of prevocational tasks and ordering food from a fast food restaurant. Additionally, Hank had been taught to use the phrase "I don't know," to use "yes" and "no" functionally, and to participate in both dyad and group instruction.

Rich was 12 years old at the time of the study. His age-equivalent score on the PPVT-IV was 4 years, 3 months. His age equivalent score on the EVT-II was 6 years. His instructional programs included answering general knowledge questions, listening to and following directions related to worksheets, asking social questions, and following instructions with a delay. In addition, Rich's instructional programs included prevocational skills, self-care skills, domestic skills, and community skills such as replenishing supplies, operating a washing machine and dryer, and demonstrating a variety of functional responses in the community. Rich had been taught to imitate vocal models, label pictures, use the phrase. "I don't know," and participate in both dyad and group instruction.

Teachers were trained in the clinical application of applied behavior analysis and had worked at the school for 2 to 5 years. All teachers were trained by the first author to implement the observational learning protocol. Adult models were varied depending on schedules and availability, and consisted of adult staff members at the school including other teachers, instructional aides, supervisors, volunteers, and interns.

Experimental Design

A concurrent multiple-baseline-across-participants design was used to evaluate the effects of discrimination training on correct responding during the four trial types described below. The third baseline was delayed by five sessions for the third participant.

Dependent Measures

The main dependent measure was summarized as the percentage of correct responses during test sessions conducted 10 min after each baseline, discrimination training, and generalization session, as well as during discrimination training after the model. There were four correct responses and trial types that included (a) correctly labeling pictures in the presence of stimuli that were known by the participant, when modeled responses were correct and reinforced; (b) correctly labeling pictures in the presence of stimuli that were known by the participant, when modeled responses were incorrect and followed by negative feedback; (c) correctly labeling pictures in the presence of unknown stimuli, when modeled responses were correct and reinforced; and (d) saying, "I don't know," in the presence of unknown stimuli when modeled responses were incorrect and followed by negative feedback (see Table 1).

We also summarized data from the test sessions as a) the mean percentage of responses correct in the presence of known stimuli on both correct, reinforced trials and incorrect, negative feedback trials, and b) the mean percentage of responses correct in the presence of unknown stimuli on both correct, reinforced trials and incorrect, negative feedback trials.

Interobserver Agreement and Treatment Integrity

Interobserver agreement (IOA) was calculated for responses during test sessions conducted after baseline, discrimination training, and generalization. An agreement was counted if both the teacher and a second observer independently scored a response as correct or incorrect in the same trial. IOA was calculated on a

Table 1
Procedural Components Across Each Stimulus Category

Stimulus	Model's Response	Consequence	Correct Response for Participant	Error Correction Rule
Known to Participant	Correct	Reinforcement (Positive feedback +edible)	Says correct response used during pretest	You know it. She got it right. Say what you know.
	Incorrect	Negative feedback	Says correct response used during pretest Does not imitate model	You know it. She got it wrong. Say what you know.
Unknown to Participant	Correct	Reinforcement (Positive Feedback +edible)	Imitates model	You don't know it. She got it right. Say what she said.
	Incorrect	Negative feedback	Says "I don't know"	You don't know it. She got it wrong. Say, "I don't know."

trial-by-trial basis by dividing the number of agreements by the number of agreements plus disagreements and converting the result to a percentage. For Billy, IOA was collected for 25% of test sessions and for all conditions of the concurrent-operant assessment. The mean IOA was 94% (range, 94%-100%) during baseline, 100% during discrimination training, and 100% during generalization. Interobserver agreement for the concurrent-operant assessment for Billy was 95%. For Hank, IOA was collected for 30% of test sessions and was 100% during baseline, discrimination training, and generalization. For Rich, IOA was collected for 21% of the test sessions and was 100% during baseline, discrimination training, and generalization.

Treatment integrity (TI) data were collected on the accurate implementation of the independent variable during baseline, discrimination training, generalization, and test sessions. An independent observer used a checklist containing all of the procedures described above (i.e., environmental arrangement, accurate delivery of feedback based on trial and session type, use of error correction, schedules of reinforcement, and presentation of stimuli during test sessions). Data on TI were collected during 14%, 11%, and 13% of sessions for Billy, Hank, and Rich, respectively, and TI was 100%.

Materials

A set of 12 pictures was used as training stimuli during discrimination training sessions, including six known items (e.g., toaster, fork) and six unknown items (e.g., a pizza cutter, a garlic press, a pastry scraper) identified during the pretest. For each participant, we also chose 12 additional pictures of six known items (e.g., knife, cup, plate, microwave) and six unknown items (e.g., corkscrew, can opener, funnel, sharpening rod) to use during generalization sessions. Generalization sessions were conducted approximately every three training sessions. For both training and generalization sets, three of the known and three of the unknown stimuli were further divided into reinforced and negative feedback categories using random assignment. Pictures were presented on 7.6 cm x 12.7 cm index cards. None of the pictures chosen were used at other times during the participants' regular instructional programs.

Individualized token systems were used in each session to reinforce on-task behavior. Jelly beans and M&Ms® were used as reinforcers and were identified using a single-operant reinforcer assessment described below.

Single-Operant Assessment of Tangible Items

To ensure that the stimuli provided to the model contingent on correct responding functioned as reinforcers for participant behavior, we conducted a single-operant reinforcer assessment similar to the procedures used by Smaby, MacDonald, Ahearn, and Dube (2007). We compared the rate of responding (i.e., placing beads in a small plastic bin) across reinforcement and extinction phases, in which each response produced a putative reinforcer or no consequences, respectively. Reinforcement and extinction phases were alternated in an ABAB reversal design. Overall, for all participants, responding was higher during conditions in which candy was provided and lower during extinction conditions (data available upon request).

Concurrent-Operant Assessment of Verbal Feedback

To determine relative preference for the feedback statements (e.g., "That's right," "That's wrong") provided to the model, we conducted a concurrent-operant reinforcer assessment similar to the procedures described by Hanley, Piazza, Fisher, Contrucci, and Maglieri (1997). We measured the number of responses allocated to two simultaneously available response options during consecutive 2-min sessions. Response 1 was placing items in a bin 60 cm to the left of the participant, and response 2 was placing items in a bin 60 cm to the right of the participant. During the first phase, responding on the left produced negative feedback (e.g., "That's wrong.") and responding on the right produced positive feedback (e.g., "That's right!"). Negative feedback statements were variations of the statement "That's wrong," including, but not limited to, "I'm sorry that's wrong," "No, that's wrong," and "You are wrong." Positive feedback statements were variations of the statement "That's right!" including, but not limited to, "Terrific, that's right!" "Yes, that's right!," and "You are right!" These statements were later used during observational learning. During the second phase of the assessment, the contingency was switched; responding on the left produced positive feedback, and responding on the right produced negative feedback. These two phases were alternated with a baseline comparison condition during which no feedback was provided for either response within an ABAB reversal design. For all participants, responding was higher when positive feedback was provided as opposed to when negative feedback was provided (Figure 1).

Pretest

To determine which pictures were known and unknown, we conducted a pretest. We presented 30-35 pictures randomly, three times each, and asked, "What's this?" If the participant failed to label the picture on all three trials, we considered it unknown. If the participant labeled the picture correctly on all three trials, we considered it known. If the participant responded correctly on some trials and incorrectly on others, we removed it from the stimulus pool and excluded it from the study. We did not provide any prompts or reinforcement contingent upon participant responses. Pictures were assigned to the discrimination training and generalization conditions as described in the materials section above.

Baseline

We conducted baseline sessions to evaluate responding on test sessions prior to exposing the participants to modeled responses that were followed by reinforcement and negative feedback,

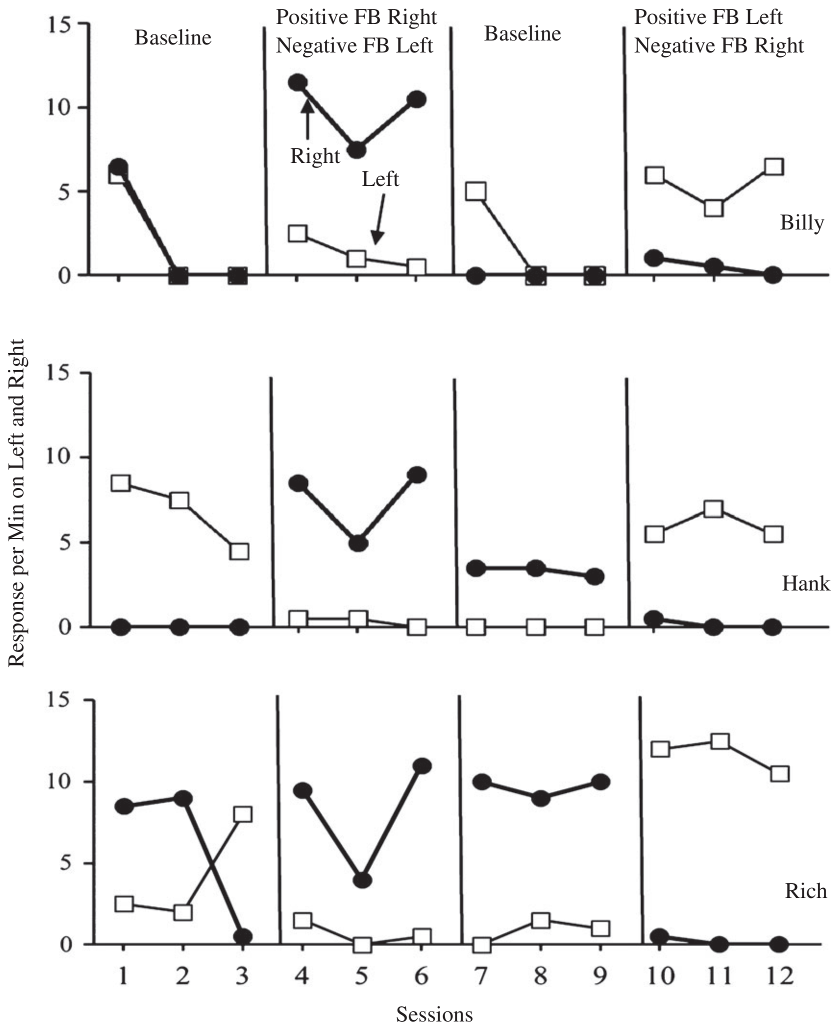

Figure 1. Response per minute on the left and right of the concurrent-operant assessment of feedback during baseline, when positive feedback (FB) was provided for responding on the right and negative feedback was provided for responding on the left, and when positive feedback was provided for responding on the left and negative feedback was provided for responding on the right.

in the presence of both known and unknown stimuli. There were six known/reinforced trials, six known/negative feedback trials, six unknown/reinforced trials, and six unknown/negative feedback trials all presented in random order throughout the session, totaling 24 trials (Table 1).

The participant and the adult model sat next to each other at a table, and the teacher sat across from them. An adult model was chosen rather than a peer model to better control for the arrangement of correct and incorrect responses. The edible reinforcer identified in the single-operant assessment was placed on the table in view of both the participant and the adult model. The teacher held either a known or unknown picture between the two, ensured that the participant was attending to the picture (Taylor et al., 2012), and said, “What is this?” to the adult model. If the participant did not look when the teacher held up the stimulus, she provided the instruction "Look" or "Everyone look" prior to asking, "What's this?" The adult model provided a preplanned correct or incorrect response, and the teacher provided a programmed consequence depending on the trial type (Table 1).

There were two trial types that differed with respect to programmed consequences for the model: reinforced trials and negative feedback trials. The order of reinforced and negative feedback trials was randomized. During reinforced trials, the adult model answered correctly, and the teacher provided the positive feedback statement (e.g., "That's right!" "Yes, that's right!" "You got it right!") and an edible reinforcer (e.g., jelly beans). The teacher never used the picture label in the feedback statement so that learning of new picture labels could be attributed to observation of the modeled response rather than to the teacher's label of the picture. During negative feedback trials, the adult model answered incorrectly, and the teacher provided negative feedback, (e.g., "I'm sorry, that's wrong," "No that's wrong," "You are wrong") to the model and removed the edible reinforcer from the table. Again, the teacher never used the correct label in the feedback statement. A fixed-time 30-s schedule of token delivery was used with the participants to promote sitting quietly with hands down throughout all baseline, discrimination training, and generalization sessions to decrease the likelihood of the occurrence of any problem behavior. After 15 tokens were earned, they were exchanged for one edible reinforcer.

Discrimination Training

Training was conducted to teach participants to discriminate the reinforced responses of the adult model from the responses that were followed by negative feedback in the presence of both known and unknown stimuli. One session was conducted 3 days per week. The arrangement and presentation of trials, as well as the teacher's interaction with the adult model, was similar to that of baseline, with one exception. After providing the consequence to the adult model, the teacher immediately presented the picture to the participant and said, "What is this?" Correct responses produced praise and an edible. Incorrect responses produced an error-correction procedure including a rule and additional practice opportunity. The praise statements and error-correction rules differed and were specific to each of the four trial types (described below; Table 1). During error correction, the teacher provided the error-correction rule, asked the adult model to label the picture again, provided the consequence, and gave the participant the chance to practice the response described in the rule statement. If the participant answered correctly on this error-correction trial, general praise was provided, but the edible reinforcer was not provided. If the participant still did not answer correctly, the trial was terminated, and the teacher moved on to the next trial. (Table 1).

Known/reinforced trials. If the participant said the correct answer when the teacher held up the card and asked, "What is it?" the teacher provided praise to the participant (i.e., "You are right! Good saying what you know!") and delivered the edible reinforcer. If the participant answered incorrectly or did not answer at all within 3 s, the teacher initiated the error-correction procedure by stating the rule, "You know it. She got it right. Say what you know."

Known/negative feedback trials. If the participant said the correct answer, the teacher provided praise (i.e., "You are right! Good saying what you know when she got it wrong!") and delivered the edible reinforcer. If the participant answered incorrectly, imitated the incorrect response from the model, or did not answer at all within 3 s, the teacher initiated the error-correction procedure by stating the rule, "You know it. She got it wrong. Say what you know."

Unknown/reinforced trials. If the participant said the correct answer, the teacher provided praise (i.e., "Good saying what she said when she got it right!") and delivered the edible reinforcer. If the participant answered incorrectly or did not answer at all within 3 s, the teacher initiated the error-correction procedure by stating the rule, "You don't know it. She got it right. Say what she said."

Unknown/negative feedback trials. If the participant said the correct answer (i.e., "I don't know"), the teacher provided praise (i.e., "Good saying 'I don't know' when she gets it wrong!") and delivered the edible reinforcer. If the participant answered incorrectly or did not answer at all within 3 s, the teacher initiated the error-correction procedure by stating the rule, "You don't know it. She got it wrong. Say, 'I don't know.'"

Generalization

To determine the extent to which the discrimination learned during the discrimination training sessions would occur in the presence of stimuli not associated with discrimination training, we conducted generalization sessions. Generalization sessions were conducted approximately every three to five training sessions, using a different set of pictures. Generalization sessions were, procedurally, the same as baseline and consisted of the same trial types presented during training.

Test Sessions

Test sessions were conducted 10 min after baseline and discrimination training sessions. During this 10-min interval, participants returned to regularly scheduled programs. During the test sessions, the model was not present. The teacher presented the pictures used in the prior baseline, discrimination training, or generalization session. The pictures were presented in a random order two times each. During each trial, the teacher sat across from the participant, held a picture in view, and asked, "What's this?" The teacher then recorded the participant's response without providing reinforcement or prompts and moved on to the next trial. A fixed-time 30-s schedule of token delivery was used to promote sitting quietly with hands down throughout the session. The mastery criterion was 90% of total responses correct for two consecutive sessions.

Procedural Modifications for Rich

One stimulus originally identified in the pretest as unknown (i.e., ice cream scoop) and another stimulus originally identified as known (i.e., grill) were removed from the training set on sessions 18 and 23, respectively. During training, Rich started to label the ice cream scoop correctly even though the correct response was never modeled (i.e., ice cream scoop was assigned to the unknown/negative feedback set in which the model never provided the correct label). The picture of the grill was identified as known in a pretest. However, over time, he stopped providing the correct response and instead said nothing at all on these trials. We decided to remove both stimuli from the set to prevent misinterpretation of the results.

RESULTS

Figure 2 displays the percentage of correct responses to training stimuli (top panels) and generalization stimuli (bottom panels) during test sessions on known/reinforced trials, known/negative feedback trials, unknown/reinforced trials and unknown/negative feedback trials for Billy, Hank, and Rich. With the systematic introduction of discrimination training, we observed increases in the total level of correct responding to training stimuli (top panels) for all participants. For Billy, baseline responding for known/reinforced trials was high but decreased slightly. On known/negative feedback trials, Billy's responding was moderate and increased to 100%. Responding on unknown/

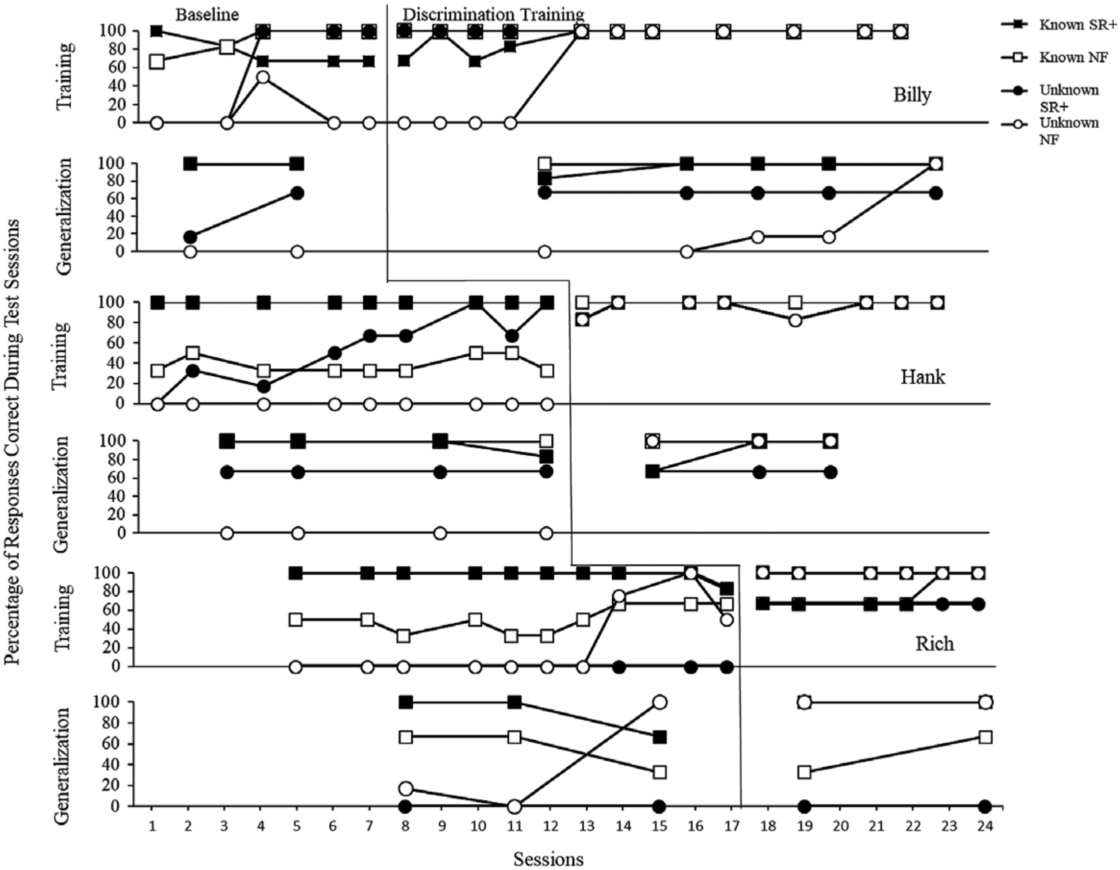

Figure 2. Percentage of responses correct to training stimuli (top panels) and generalization stimuli (bottom panels) during test sessions on known/reinforced trials (solid squares), known/negative feedback trials (open squares), unknown/reinforced trials (solid circles) and unknown/negative feedback trials (open circles) for Billy, Hank, and Rich.

reinforced trials was initially low and increased to 100%, and responding on unknown/negative feedback trials remained near zero with a slight increase on session 4. With the introduction of discrimination training, Billy's responding increased to 100% for all trial types. For Hank, baseline responding on known/reinforced trials was at 100%; on known/negative feedback trials, his responding was moderate and variable. Responding on unknown/reinforced trials gradually increased to 100%, and responding on unknown/negative feedback trials remained at zero. With the introduction of discrimination training, Hank's responding increased to 100% for all trial types. For Rich, baseline responding on known/reinforced trials was at 100% and decreased slightly near the end of baseline. Responding on known/negative feedback trials was moderate and variable. Responding on unknown/reinforced trials remained at zero, and responding on unknown/negative feedback trials was initially low and increased at the end of baseline. With the introduction of discrimination training, Rich's responding increased to 100% for known/reinforced trials, unknown/negative feedback trials, and known/negative feedback trials, and increased but remained under criterion levels for unknown/reinforced trials.

Responding to generalization stimuli (lower panels) was more variable across the three participants. For Billy, baseline responding to generalization stimuli on known/reinforced trials and known/negative feedback trials was 100%. Responding on unknown/reinforced trials increased slightly, and responding on unknown/negative feedback trials remained at zero. With the introduction of discrimination training, Billy's responding to generalization stimuli eventually increased to 100% for the unknown/negative feedback trials and remained at 67% for the unknown/reinforced trials. For Hank, baseline responding to generalization stimuli on known/reinforced and known/negative feedback trials was high. Responding on unknown/reinforced trials remained moderate at 67%. With the introduction of discrimination training, Hank's responding to unknown/negative feedback generalization stimuli increased to 100%, and responding to unknown/reinforced generalization stimuli remained at 67%. For Rich, baseline responding to generalization stimuli on known/reinforced and known/negative feedback trials decreased during baseline. Responding on unknown/reinforced trials remained at zero, and responding on unknown/negative feedback trials was initially low and increased at the end of baseline. With the introduction of discrimination training, Rich's responding to generalization stimuli persisted at 100% for unknown/negative feedback and known/reinforced trials but remained at zero for unknown/reinforced trials and remained relatively the same for known/negative feedback trials.

Figures 3 and 4 display the mean percentage of correct responses to training stimuli for all trial types. For all participants, pretest measures represent responding to known stimuli prior to exposure to the model. Responding on test sessions during baseline and discrimination training represent responding following exposure to the model. Figure 3 shows the mean percentage of correct responses to known training stimuli during test sessions for both reinforced trials (left panel) and negative feedback trials (right panel). During baseline, when modeled responses were correct and reinforced (left panel), correct responding (i.e., imitation of correct responses that were reinforced) remained high for Hank and Rich. For Billy, correct responding decreased from pretest measures during baseline. With the implementation of discrimination training, the mean percentage of correct responses increased for Billy. During baseline, when modeled responses were incorrect and followed by negative feedback, correct responding (i.e., stating the correct picture label) for all participants dropped from pretest measures. When discrimination training was implemented, correct responding increased for all participants. Figure 4 shows the mean percentage of correct responses to training stimuli on test sessions in the presence of *unknown* stimuli on both reinforced trials (left panel) and negative feedback trials (right panel). Participants did not label any pictures correctly during pretest measures. During baseline, when modeled responses were correct and followed by reinforcement (left panel), correct responding (i.e., imitation of modeled responses that were correct and reinforced) increased for Billy and Hank, but not for Rich. On these trials, correct responding increased for all participants once discrimination training was implemented. During baseline, when modeled responses were incorrect and followed by negative feedback (right panel), correct responding (i.e., saying, "I don't know") increased for Billy and Rich, but not for Hank. Correct responding increased for all participants on these trials when we implemented discrimination training.

DISCUSSION

One outcome of this study replicates those of DeQuinzio and Taylor (2015) in that children with autism learned to discriminate the contingencies applied to modeled responses when stimuli were unknown. That is, they learned new picture labels when modeled

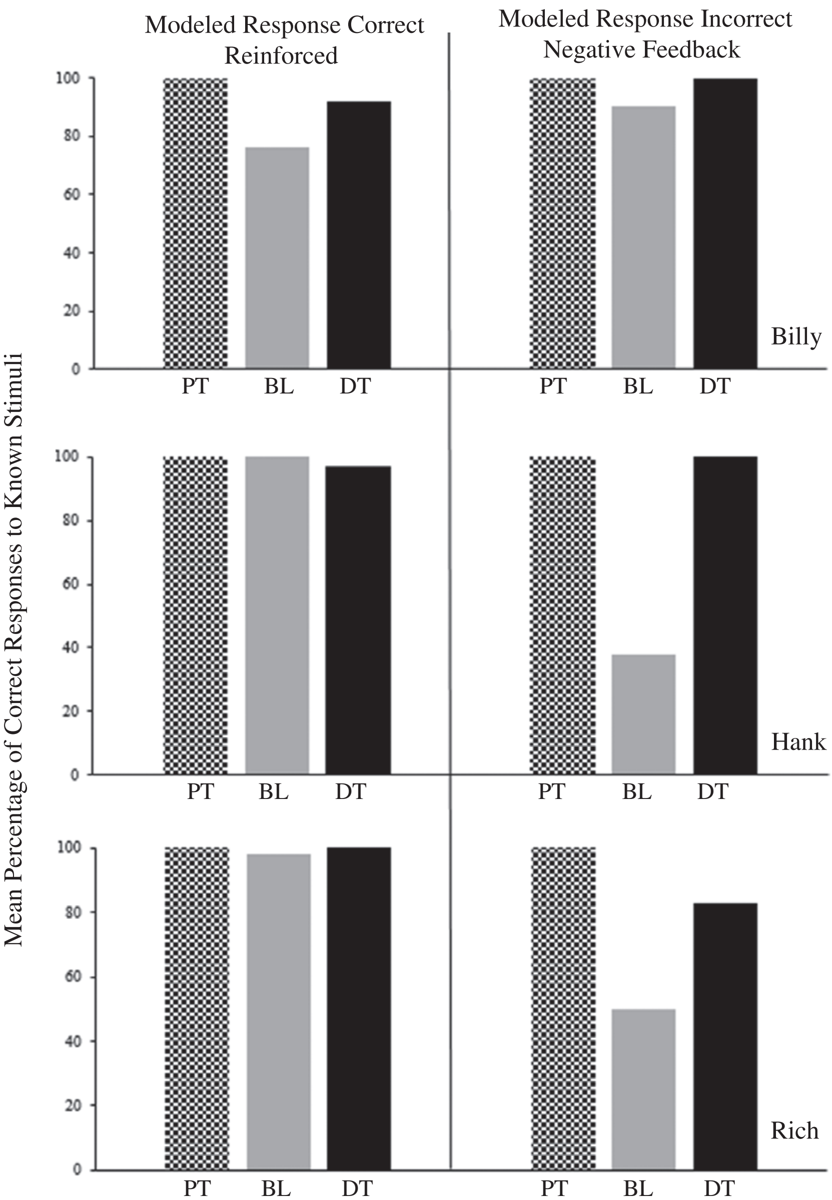

Figure 3. The mean percentage of correct responses to training stimuli on test sessions during pretest (PT), baseline (BL), and discrimination training (DT) in the presence of *known* stimuli on both correct reinforced trials (left panel) and incorrect negative feedback trials (right panel).

responses were accurate and reinforced, and to say, "I don't know" when modeled responses were inaccurate and followed by negative feedback. We extended the research on observational learning by incorporating known stimuli into discrimination training sessions. Inconsistent responding by participants to the known stimuli when the modeled response was incorrect and followed by negative feedback suggests that incorporating known stimuli into these sessions is a beneficial component to aid in acquisition of the conditional discriminations involved in observational learning.

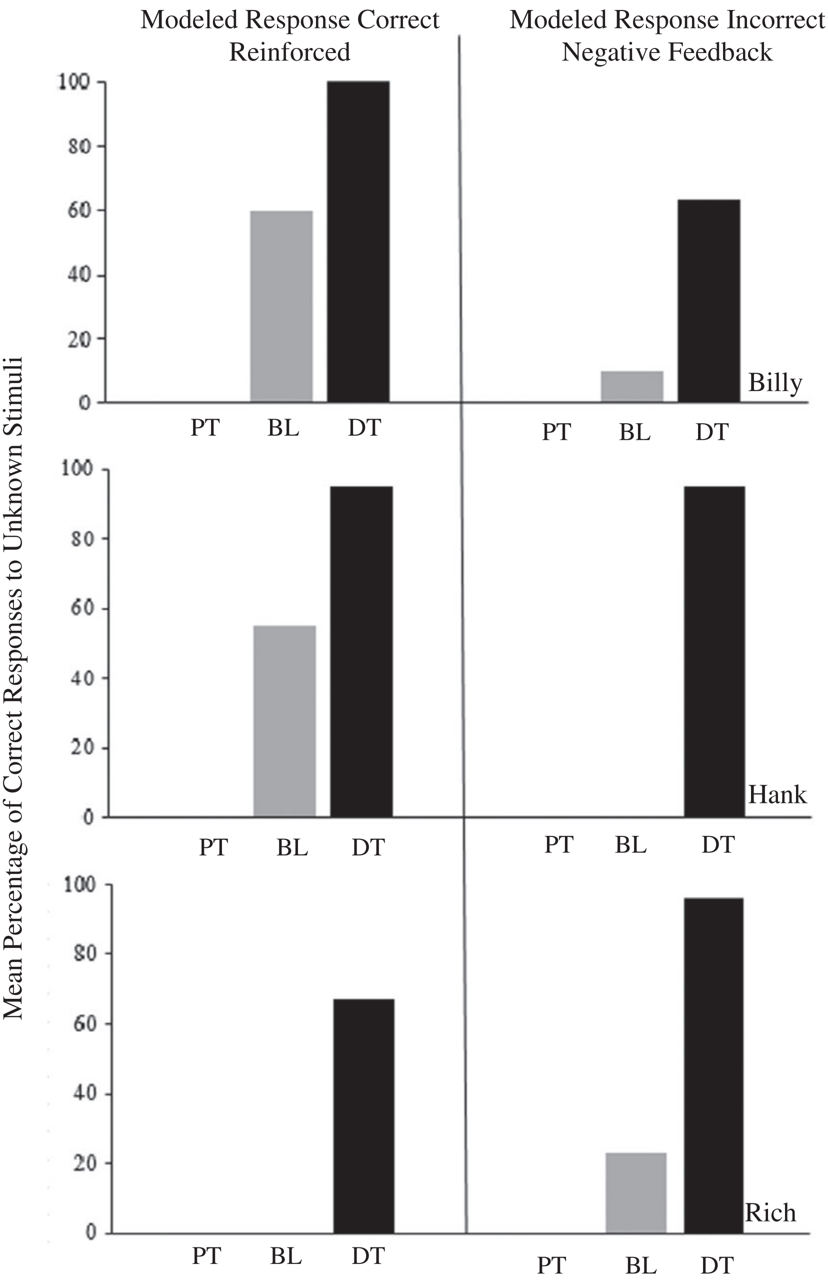

Figure 4. The mean percentage of correct responses to training stimuli on test sessions during pretest (PT), baseline (BL), and discrimination training (DT) in the presence of *unknown* stimuli on both correct reinforced trials (left panel) and incorrect negative feedback trials (right panel).

Furthermore, our results support those of Pereira-Delgado and Greer (2009) who incorporated known stimuli into observational learning training so that participants could learn to label the correct and incorrect respones of a model by choosing green and red blocks, respectively.

As Figure 2 illustrates, and consistent with past research (DeQuinzio & Taylor, 2015), some participants in the current study acquired a few of the unknown stimuli in baseline by being exposed to the model's correct and reinforced responses. Also, because participants had learned to say, "I don't know," in prior instructional programming, they occasionally used this response in baseline. Therefore, responding on these trials was scored as correct. However, once discrimination training occurred and participants were taught the rules (e.g., "You don't know it. She got it wrong. Say, 'I don't know'"), accuracy during test sessions increased.

Some of the participants' responding was inconsistent. As Figure 3 (left panel) illustrates, on the pretests participants always or almost always (Billy) responded accurately to known stimuli. During baseline, however, responding varied across participants. Correct responding maintained for Rich and Hank and decreased for Billy. This occurred even though all participants were exposed to a model saying a correct and reinforced response that matched their response during the pretest. For some trials, Billy added a suffix to his response (e.g., he responded correctly with the label "garlic press" during the pretest but changed it to "garlic pressing" during baseline). It was unclear why this shift occurred. It may have been related to being exposed to all trial types in baseline, which included correct and incorrect responses of the model and both negative feedback and reinforcing consequences to modeled responses. Billy may also have combined words from other picture labels with "ing" (e.g., "rolling pin" and "sharpening rod") that were targets in this set. Correct responding increased for Billy once discrimination training was implemented.

As Figure 3 (right panel) illustrates, when participants were exposed to the model saying an incorrect response that was followed by negative feedback during baseline, correct responding decreased for Hank and Rich. We observed participants imitating the inaccurate responses of the model even though these were known stimuli as was demonstrated during the pretest. This indicated that participants were not discriminating the contingencies applied to modeled responses and perhaps were relying on imitative repertoires with stronger histories of reinforcement. Once discrimination training occurred (i.e., learning the rule, "You know it. She got it wrong. Say what you know"), correct responding increased on these trials and we observed less imitation of incorrect responses.

Similar to DeQuinzio and Taylor (2015), we included unknown stimuli and analyzed responding in the presence of modeled responses that were either reinforced or followed by negative feedback. As Figure 4 (left panel) illustrates, participants did not respond correctly to any of the stimuli during pretest sessions. When baseline was initiated, Billy and Hank learned several new picture labels through exposure to the model's correct and reinforced responses. Rich, on the other hand, did not. The differences among participants in acquiring new labels by being exposed to the accurate responses of the model may be due to the absence of direct contingencies for imitation during baseline. Once discrimination training was implemented and contingencies for imitation were in place, all three participants showed an increase in correct picture labels during test sessions, with Billy and Hank reaching criterion levels. Rich, however, did not learn all the target stimuli.

When modeled responses were followed by negative feedback (Figure 4, right panel), Billy and Rich responded correctly on some trials in baseline by saying, "I don't know;" a response that had a history of reinforcement in their regular academic programming. Although this was also true for Hank, he did not use the "I don't know" response in baseline. Additionally, on some trials, all three participants occasionally imitated the incorrect responses that were modeled and followed by negative feedback, indicating a weak discrimination of consequences applied to modeled responses. With the introduction of discrimination training, however, all three participants showed increases in the use of "I don't know," indicating the effectiveness of discrimination training. Billy did not reach criterion levels of responding; on some trials, instead of saying, "I don't know," Billy continued to imitate responses of the model that were incorrect and followed by negative feedback. We are unclear as to why he did this, but we observed that Billy imitated one of the negative feedback statements used by the teacher (e.g., "I'm sorry, that's wrong") while laughing and looking at the teacher during some of the trials. These results are consistent with those of Ingvarsson and Hollobaugh (2010) and Ingvarsson, Tiger, Hanley, and Stephenson (2007) who found that young children with developmental disabilities displayed inconsistencies demonstrating generalization of "I don't know" responses or failed to discriminate between known and unknown stimuli following the training of this response.

In addition to the use of known stimuli, we expanded on past research by ensuring consequences for the modeled responses were empirically derived prior to use during observational learning. Specifically, we evaluated the reinforcing value of the edibles provided to the model using a single operant reinforcer assessment. We also determined relative preferences for the positive and negative feedback statements using a concurrent operant assessment. We did not, however, conduct an avoidance assessment to determine whether the removal of the edible and the negative feedback statement functioned as punishers. It is important to note that DeQuinzio and Taylor (2015) did not conduct empirical analyses of feedback statements or tangible items provided for correct responding, yet participants learned the target discriminations. Thus, we are unsure of the possible impact of these stimuli on observational learning. Future research could compare the effects of empirically and nonempirically derived consequences to determine this.

Past research has demonstrated that children with autism can learn to respond to rules containing "if/then" statements, describing the antecedent and behavior (Tarbox, Zuckerman, Bishop, Olive, & O'Hora, 2011). Similarly, in this study, we applied the use of rules to observational learning. The teacher used spoken rules describing the antecedent (e.g., "You know it. She got it wrong") and behavior ("Say what you know") as part of an error-correction procedure. It is unclear if these rules enhanced discrimination in the observational learning context. Future studies might compare the use of discrimination training with these rules to training without these rules. For example, a multiple baseline design can be used in which baseline includes a discrimination training procedure that does not use rules, such as differential reinforcement. The intervention could include differential reinforcement plus the rules. One could then determine if observational learning increases or is more efficient once the rules are introduced. In addition, because rules were used as part of an error-correction procedure in our study, it would be interesting to examine the effects of minimizing errors in an errorless-teaching format. It could be the case that allowing errors during conditional discrimination training negatively affected acquisition in this study. Employing errorless teaching procedures in a redesigned study could reveal whether permitting errors during the discrimination training in the current study negatively affected acquisition.

In this study, accurate responses during test sessions were not reinforced. We did this for two reasons. First, we wanted to ensure that responding was under the control of the instructional stimuli used during observational learning and that an operant reinforcement contingency did not influence responding during tests. Second, we wanted to more closely simulate naturally-occurring observational learning, in which the learner observes a reinforcement contingency for modeled responses and does not directly contact the reinforcement contingency for his or her own behavior (Catania, 1998). Future research could compare the effects of reinforcement and extinction during tests of observational learning.

There are several other variables that might have affected responding. For example, we taught four conditional discriminations simultaneously using mixed trials. This required many trials (i.e., 24) so that all trial types (i.e., known/reinforced, known/negative feedback, unknown/reinforced, unknown/negative feedback) could be presented an equal number of times. We also assigned three target stimuli to each trial type and required that each stimulus be presented at least two times. This combination of variables may have interfered with acquisition of the discrimination. It is possible that limiting the number of stimuli would have facilitated the discrimination and resulted in more consistent responding across participants. In addition, while the many trial types were necessary to evaluate observational learning variables, they were nonetheless cumbersome to implement. It may be that variations in instructional procedures, such as video-taped instructors and models, may be more efficient to implement as they would not require two adults (Spriggs, Gast, & Knight (2016).

Observational learning research with people with autism is still in its infancy. Even so, this study makes an important contribution to the foundational research in the field. We incorporated known stimuli and used explicit rules to enhance discrimination during observational learning and demonstrated that children with autism can learn complex conditional discriminations through observational learning. Succeeding research should continue to isolate variables that influence observational learning and strive toward the creation of a reliable teaching technology for improving this important repertoire.

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