Received: 4 November 2021 | Accepted: 20 February 2024

DOI: 10.1002/jaba.1071

REPLICATION

Journal of Applied Behavior Analysis SEAB

Evaluation of a discrimination training procedure for establishing praise as a reinforcer

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Editor-in-Chief: John Borrero
Handling Editor: Jeanne Donaldson

Abstract

We evaluated the effects of a discrimination training procedure for establishing praise as a reinforcer for three children with autism spectrum disorder. After establishing two praise words as discriminative stimuli and two nonsense words as S-deltas, we evaluated whether the stimuli then functioned as reinforcers by presenting each stimulus as a consequence for a new response. The results demonstrated that previously neutral praise words functioned as reinforcers and nonsense words did not. As in previous studies on establishing reinforcers, the effects were transitory, and praise words did not continue to function as reinforcers after repeated exposure without discrimination training. Recommendations are provided for future research and maintaining reinforcement effects.

KEYWORDS

autism spectrum disorder, conditioned reinforcement, discrimination training, praise

For some individuals with autism spectrum disorder (ASD), studies have shown that social stimuli (e.g., praise) may be less preferred or less effective as reinforcers than nonsocial stimuli (e.g., snacks; e.g., Butler & Graff, 2021; Clay et al., 2018; Goldberg et al., 2023; Leaf et al., 2014; Morris & Vollmer, 2021). However, there are several potential advantages of using social stimuli as reinforcers including that they may be (a) more efficient, (b) less disruptive to ongoing behavior, (c) effective under various establishing operations, and (d) used to specify the exact behavior being reinforced (Call et al., 2013; Morris & Vollmer, 2019; Polick et al., 2012). Using contrived nonsocial stimuli as reinforcers may limit the maintenance of social behaviors, particularly when the reinforcement schedules are thinned or those stimuli are removed. Praise may also be preferred to food for teaching and promoting maintenance of new behaviors because praise is commonly available in the natural environment. In addition, the establishment of social interactions as reinforcers may be related to positive outcomes of early intervention and the emergence of repertoires such as joint attention and bidirectional naming for children with ASD (Holth et al., 2009; Klintwall & Eikeseth, 2011; Olaff & Holth, 2020).

Although relatively few studies have been conducted on establishing previously neutral stimuli as reinforcers with humans, some research has examined three procedures that involve establishing a relation between neutral stimuli and existing reinforcers to establish social stimuli as reinforcers. These procedures include stimulus–stimulus pairing, response–stimulus pairing, and discrimination training. The first two procedures involve pairing the previously neutral stimulus with an established reinforcer and delivering both stimuli either independent of participant responding (stimulus–stimulus pairing, also called response-independent pairing; e.g., Dozier et al., 2012) or contingent on a target response (response–stimulus pairing, also called response-contingent pairing; e.g., Axe & Laprime, 2017; Dozier et al., 2012; Lauten & Birnbrauer, 1974; Rodriguez & Gutierrez, 2017). Overall, research on these procedures has shown that stimulus–stimulus pairing is often ineffective or minimally effective (e.g., Dozier et al., 2012; Holth et al., 2009) and that the effects of response–stimulus pairing have been variable within and across studies (e.g., Axe & Laprime, 2017; Dozier et al., 2012; Lauten & Birnbrauer, 1974; Rodriguez & Gutierrez, 2017). For example, Dozier et al. (2012) found that although stimulus–stimulus pairing did not establish praise as a reinforcer for any participants, response–stimulus pairing was effective in establishing praise as a reinforcer for 50% of participants. In addition, it is difficult to draw conclusions from most studies in this body of research due to the lack of proper controls or important information that would be used to interpret findings. For example, with respect to the former, some studies did not demonstrate neutrality or reinforcing effectiveness of stimuli prior to pairing (e.g., Lauten & Birnbrauer, 1974; Lovaas et al., 1966; Stahl et al., 1974). With respect to the latter, some response–stimulus pairing studies did not use different responses during and after pairing (e.g., Axe & Laprime, 2017; Dozier et al., 2012; Rodriguez & Gutierrez, 2017), a control that is necessary when using the new response method (Lovaas et al., 1966; Skinner, 1938). This control is important because if the same response is used during pairing and postpairing, any postpairing increase in responding could be due to reinforcement from the previously established reinforcer and not the stimulus being tested. Older studies that have evaluated procedures for establishing reinforcers have not provided sufficient procedural information to allow replication (e.g., Locke, 1969; Miller & Drennen, 1970; Stahl et al., 1974).

Other researchers have evaluated a third procedure, discrimination training, in which a neutral stimulus is first established as a discriminative stimulus (S^D; e.g., Holth et al., 2009; Lauten & Birnbrauer, 1974; Lovaas et al., 1966; Lugo et al., 2017; Olaff & Holth, 2020; Rodriguez & Gutierrez, 2017) and then tested for reinforcing effectiveness. For example, Lauten and Birnbrauer (1974) used a group design to compare the effects of discrimination training and a response–stimulus pairing procedure for establishing the word "right" as a reinforcer. The results showed that the discrimination training group engaged in higher rates of button presses than the response–stimulus pairing group did. Similarly, Holth et al. (2009) compared discrimination training with stimulus–stimulus pairing in establishing objects and sounds as reinforcers and found that discrimination training produced higher rates of responding than did stimulus–stimulus pairing for five participants. However, Rodriguez and Gutierrez (2017) found response–stimulus pairing to be more effective than discrimination training for preschoolers with ASD.

Although some studies have demonstrated the efficacy of the discrimination training procedure for establishing stimuli as reinforcers, most share the same limitations of the response–stimulus pairing and stimulus–stimulus pairing studies noted above including a lack of neutral and reinforcing stimulus assessments (e.g., Lauten & Birnbrauer, 1974; Lovaas et al., 1966), using the same response during discrimination training and posttraining (e.g., Rodriguez & Gutierrez, 2017), or omitting necessary procedural details (e.g., Lauten & Birnbrauer, 1974; Steinman, 1968). In addition, although a primary goal of these studies was to establish stimuli as S^Ds, none of them interspersed trials with stimuli programmed as S^Δs. Some studies that used stimulus–stimulus pairing to increase the vocalizations of children with ASD included trials to enhance stimulus salience, facilitate discrimination, and provide a control for the effects of exposure (e.g., Esch et al., 2009). During posttraining, if responding increases when both the S^D and S^Δ are delivered as consequences, this suggests that another variable (e.g., exposure to the stimulus being programmed as an S^D) may have produced the increase from baseline. It may also suggest that the neutral stimulus (intended to function as an S^D) did not come to function as an S^D. Conversely, evidence of the reinforcing effects of that S^D is provided if responding differentially increases only when the S^D is delivered as a consequence and not when the S^Δ is delivered as a consequence.

Taylor-Santa et al. (2014) attempted to address these limitations using discrimination training to establish previously neutral visual stimuli (asymmetrical designs displayed on a digital picture frame) as reinforcers for three children with ASD. Responses included manipulating a variety of switches (e.g., push, pull, twist), which were housed in an apparatus containing a battery-operated light for data collection. Reinforcing effects of snacks and neutral effects of visual stimuli, as well as neutral effects of stimulation from switch responding, were demonstrated during preexperimental free-operant reinforcer assessments. The switch responses used during discrimination training differed from those used during pre- and posttraining; in addition, the researchers interspersed S^Δ trials during pre- and posttraining. The effects of the discrimination training procedure were evaluated across three sets of stimuli with each participant. Taylor-Santa et al. showed that discrimination training was effective with these added controls with arbitrary visual stimuli; however, no studies have used the controls described by Taylor-Santa et al. when evaluating discrimination training as a method for establishing praise statements as reinforcers. Therefore, the purpose of the current study was to systematically replicate Taylor-Santa et al. and extend their procedures to establish praise words as reinforcers with children with ASD.

METHOD

Participants, setting, and materials

The participants were three boys (Zane and Noah, 11 years old; Michael, 15 years old) who were diagnosed with ASD and whose caregivers and teachers reported that praise did not appear to function as a reinforcer. We did not gather information on race or ethnicity. Overall scores (out of 170) on the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2008) were 96.5 for Zane, 103 for Noah, and 127.5 for Michael. All participants demonstrated proficiency across most skills in Level 1; relative strengths in listener responding, visual perceptual skills and match-to-sample, and imitation; and minimal scatter into Level 3. No participants demonstrated social skills in Level 3. Barriers assessment scores (out of 96) were 29 (21 out of

24 barriers) for Zane, 29 (17 out of 24 barriers) for Noah, and 19 (10 out of 24 barriers) for Michael. All participants demonstrated behavior resulting in barriers being scored in the areas of behavior problems, instructional control, social skills, prompt dependency, conditional discriminations, generalization, self-stimulation, obsessive behavior, and eye contact; none of the participants had barriers in visual perceptual or match-to-sample skills.

We conducted sessions in a quiet area of the participant's home or school. Materials included clear containers with preferred snacks, a 7.6- × 7.6-cm white piece of paper (reinforcer assessment), and a mobile phone used to play auditory stimuli on a wireless Bluetooth speaker. Participant responses were made to switches on the same wooden-box apparatus used by Taylor-Santa et al. (2014). Photographs of the apparatus appear in Appendix A of Taylor-Santa et al. This box had a square cut out of the middle in which different switches (one switch at a time) were placed. The switch was wired to a 9-volt battery and small light bulb inside the box. The switches required various participant responses (e.g., pull, twist, push) to activate the light. When a participant manipulated a switch, the light bulb quickly turned on, and the next switch response turned the light off; the light was only visible to the experimenters for data collection purposes.

Preexperimental procedures

We conducted a reinforcer assessment using procedures similar to those of Taylor-Santa et al. (2014) to (a) determine snacks that functioned as reinforcers and (b) ensure that the four auditory stimuli (two praise words and two nonsense words) did not function as reinforcers. Snacks included in the reinforcer assessment were the five highest ranked snacks from a paired-stimulus preference assessment (Fisher et al., 1992). The two praise words selected to be established as reinforcers were "brilliant" and "superb" because caregivers reported that participants did not have extensive histories with these words. The two nonsense words were "yekshum" and "dalguf," which had the same number of syllables but different sounds than the praise words. Auditory stimuli were prerecorded in a neutral tone by a person who was unfamiliar to the participants. During the reinforcer assessment, a white, square paper card was placed in front of the participant. Observers collected data on the frequency of paper card touches during each 1-min session. During all sessions, the experimenter manually prompted the participant twice to tap a paper card placed in front of him and delivered the consequence for that session after each response. Then the experimenter said, "Do whatever you like, but please stay in your chair." During baseline, no programmed consequences were delivered contingent on paper card touches and the session was terminated if the participant left his chair. Next, using a multielement design, each stimulus was individually assessed for three sessions until stable responding was observed. During each session, a preferred snack or auditory stimulus was delivered contingent on paper card touches on a fixed-ratio (FR) 1 schedule. We used three snacks with the highest level of responding as reinforcers throughout the remainder of the study; these items were restricted to experimental sessions. All four auditory stimuli met the criterion to be used as neutral stimuli (i.e., no more than two paper card touches per session).

We also conducted a response assessment with eight to 10 different switches (e.g., string pull, circle turn, button push) to identify six switches that could be used in the study. We included switches that participants could activate independently and to which they had no prior exposure. One 5-min session was conducted with each switch, and observers measured the frequency of responding to the available switch. Prior to each session, the experimenter manually prompted the participant to activate the switch, and then they delivered the following instruction: "Do whatever you like, but please stay in your chair." During the session, no consequences were delivered contingent on switch responses. For each participant, experimenters selected the six switches to which no responding occurred in the last 30 s of the session or if the participant left his chair during the session (Holth et al., 2009; Taylor-Santa et al., 2014). Three different switch responses were required (i.e., one for responding with the S^D, one for responding with the S^Δ, and one for responding during discrimination training) for each of two discrimination training evaluations for each participant. Different responses were programmed to avoid interaction effects across conditions (i.e., to avoid effects of different reinforcement histories with multiple stimuli). For the remainder of this article, the terms S^D and S^Δ will be used to refer to the stimuli that were taught as such.

Measurement, design, and procedure

First, we conducted a pretraining phase to evaluate the level of responding on switches that produced access to the stimuli that were assigned to be established as S^Ds and S^Δs. Second, we conducted discrimination training to establish stimuli as S^Ds and S^Δs. Finally, we conducted a posttraining phase to determine whether the discrimination training procedure resulted in an increase in the reinforcing efficacy of the S^D relative to the S^Δ. During pre- and posttraining sessions, observers collected paper-and-pencil data on the frequency of switch responses, which we converted to a rate during each 5-min session. During discrimination training sessions, observers collected data on independent switch responses that occurred within 3 s of the presentation of the S^D or S^Δ. The data were summarized as the percentage of trials with switch responses for each stimulus per session.

We used a concurrent multiple-baseline design across stimulus and response sets with an embedded multielement design (Taylor-Santa et al., 2014) to determine the effects of discrimination training for establishing neutral praise statements as reinforcers. The S^Ds, S^Δs, and switches were randomly assigned (without replacement) to two sets for each participant. Table 1 depicts switch responses and praise words for each participant. Each set comprised (a) one praise word to be established as an S^D ("brilliant" or "superb"), (b) one nonsense word to be established as an S^Δ ("yekshum" or "dalguf"), (c) one switch to evaluate the effects of the praise word, (d) one switch to evaluate the effects of the nonsense word, and (e) one switch to be used during discrimination training.

Pre- and posttraining

Prior to each session, the experimenter conducted two presession prompts in which they manually prompted the participant to activate the switch and then provided the auditory stimulus (either the S^D or S^Δ) programmed for that session. Next, the experimenter instructed the participant, "Do whatever you like, but please stay in your chair." During the session, the experimenter played the auditory stimulus contingent on each switch response. The container with snacks was not present during pre- or posttraining sessions. The order of sessions (S^D or S^Δ) was quasirandom such that there were never more than two consecutive sessions of the same type.

Discrimination training

Discrimination training included two phases. Phase 1 was conducted to teach responding in the presence of the S^D; Phase 2 was conducted to teach discriminated responding (i.e., respond in the presence of the S^D and not the S^Δ). Prior to all discrimination training sessions, the participant selected one snack to be used in that session from the three snacks identified in the reinforcer assessment. During Phase 1 sessions, the experimenter conducted 10 trials in which she played the S^D and delivered a small piece of the selected snack contingent on an independent switch response. If responding did not occur within 3 s of the presentation of the S^D, the experimenter manually prompted the switch response and then delivered the snack. The experimenter systematically faded prompts across trials from a full manual prompt, to a tap to the upper arm, and finally to a gestural prompt. Each prompt level was implemented for two trials before fading to the next prompt. However, if a prompt did not occasion the response, the experimenter implemented the previous prompt level for two trials. The experimenter blocked the participant from activating the switch more than once per trial.

After two consecutive sessions in which the participant engaged in independent switch responding across 100% of S^D trials, the experimenter implemented Phase 2. During this phase, the experimenter conducted 20 interspersed S^D or S^Δ trials; the order of trials was such that there were never more than two consecutive trials in which the same type of stimulus was presented. The S^D trials were conducted as described above. During S^Δ trials, the experimenter presented the S^Δ and, regardless of responding (response or no response), the next trial began after 5 s. After two consecutive sessions in which the participant engaged in independent switch responding in 100% of S^D trials and 0% responding on S^Δ trials, the experimenter conducted the posttraining phase.

TABLE 1 Switch response and praise word assignments for each participant.

Participant	Set 1	Set 2
Zane		
S^D	"brilliant," string pull	"superb," red button
S^Δ	"yekshum," double knife switch	"dalguf," yellow turn
Discrimination training	turning circle	push switch
Noah		
S^D	"superb," yellow turn	"brilliant," lamp switch
S^Δ	"dalguf," string pull	"yekshum," push switch
Discrimination training	peg	doorbell switch
Michael		
S^D	"brilliant," peg	"superb," turning circle
S^Δ	"yekshum," doorbell switch	"dalguf," lamp
Discrimination training	red button	fan pull

Note: S^D = discriminative stimulus; S^Δ = S-delta.

Interobserver agreement and procedural fidelity

An independent observer collected secondary and procedural-fidelity data during at least 50% of sessions during all phases and conditions and for all participants. During the reinforcer assessment, response assessment, and pre- and posttraining sessions, we calculated interobserver agreement using the exact agreement method with 30-s intervals. Mean interobserver agreement across all sessions was 98% (range: 86%–100%). During discrimination training phases, we calculated point-by-point agreement on switch responses, and agreement was 100%. During pre- and posttraining sessions, observers collected procedural-fidelity data using 30-s whole-interval recording and calculated the percentage of intervals with correct implementation of procedures. During discrimination training sessions, observers collected procedural-fidelity data on correct presentation of the auditory stimulus, delivery of prompts, and delivery of snacks. These data were collected for each trial and summarized as the percentage of trials with correct implementation of procedures. Procedural fidelity was 100% for all participants.

RESULTS

Pre- and posttraining switch responses for all participants are shown in Figure 1. During pretraining, participants engaged in zero or near-zero responses when the S^D and S^{Δ} stimuli were delivered contingent on switch activation, demonstrating that these stimuli did not function as reinforcers. Next, discrimination training was conducted to establish the stimuli as S^Ds and S^{Δ}s. During discrimination training, differential responding to the S^D and S^{Δ} occurred with all participants for each set of stimuli (see Supporting Information A). All participants met the criterion to begin posttraining with Set 2 stimuli more rapidly and with less variable responding than with Set 1 stimuli. For Set 1, participants met the criterion in a mean of 16.3 sessions (range: 8–21); for Set 2, participants met the criterion in a mean of 8 sessions (range: 6–10). During posttraining, in all six evaluations responding increased when the S^D words were delivered contingent on switch activation but not when the S^{Δ} words were delivered contingent on switch activation. Increased responding was fleeting, with increased responding during the following number of sessions: Zane (1 session), Noah (1–2 sessions), Michael (4–6 sessions).

DISCUSSION

The purpose of the current study was to establish praise words as reinforcers for three individuals with ASD by applying the same procedures and controls that were used by Taylor-Santa et al. (2014). For all three participants, posttraining responding increased relative to pretraining responding, demonstrating that all previously neutral praise words came to function as reinforcers. We interspersed S^{Δ} sessions with S^D sessions (e.g., Esch et al., 2009; Taylor-Santa et al., 2014) to control for exposure alone as the variable that may be responsible for increasing responding during the posttraining phase. For all participants and sets, switch responding during S^{Δ} sessions remained low (or at zero) during both pre- and posttraining sessions. Switch responding during S^D sessions was low (or zero) in pretraining sessions and increased in posttraining sessions, thus demonstrating that the discrimination training procedure, not just exposure to the stimulus, resulted in the S^D word becoming a reinforcer. If responding had been elevated in posttraining during both S^D and S^{Δ} sessions, this might have suggested that exposure to the stimuli alone resulted in an increase in responding or indicated generalization of effects to the S^{Δ} word. These outcomes replicate and extend those of Taylor-Santa et al. by using the same preparation with auditory stimuli (i.e., praise) rather than visual stimuli (i.e., pictures).

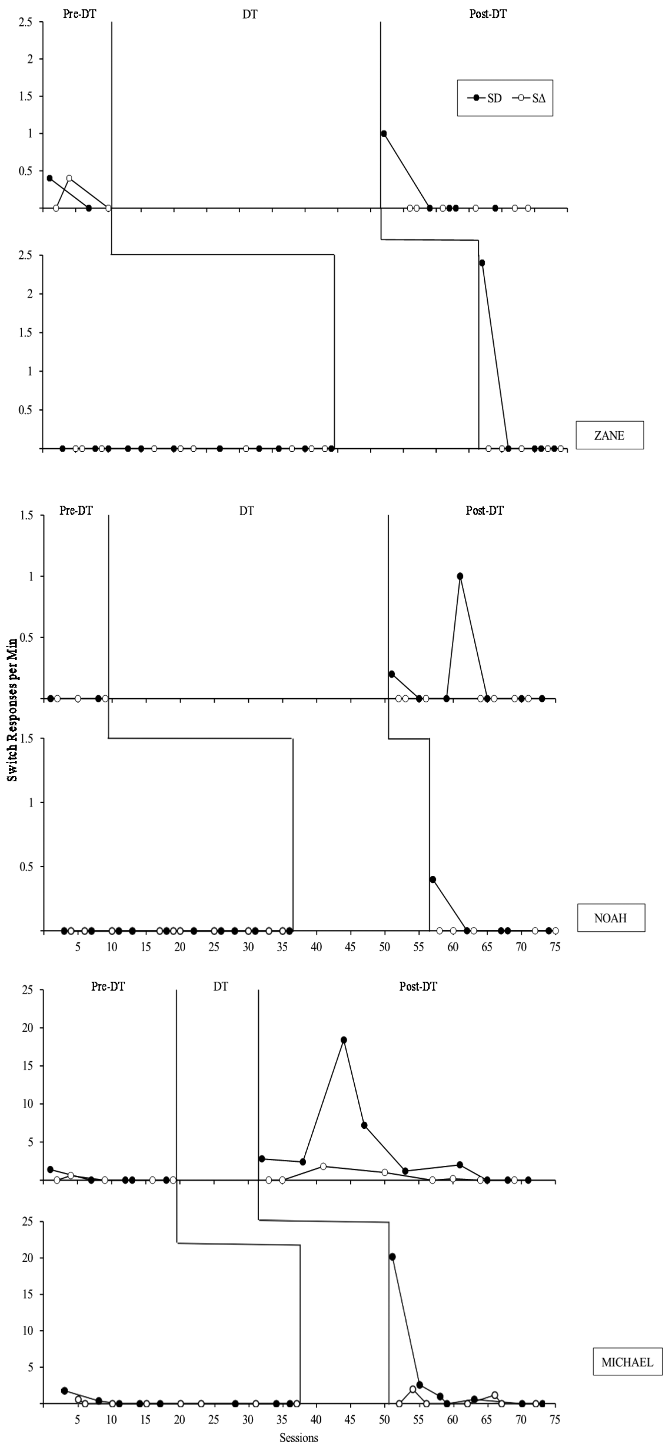

FIGURE 1 Pre- and postpairing switch responses across sets. DT = discrimination training; SD = discriminative stimulus; SΔ = S-delta.

One advantage of the discrimination training procedure over pairing procedures for establishing stimuli as reinforcers may be that it includes an observing response to the neutral stimulus. That is, the learner demonstrates attending to the neutral stimulus by engaging in some type of response before the consequence is delivered. This observing response may be particularly beneficial with individuals who may not attend to multiple, or relevant, parts of a complex stimulus (overselectivity; e.g., Lovaas et al., 1971). It is possible that the efficacy of stimulus–stimulus pairing and response–stimulus pairing, which do not include an observing response, has been limited in some studies because the participants did not attend to the presentation of the neutral stimulus. If this were the case, stimulus–stimulus pairing and response–stimulus pairing would be functionally similar to noncontingent reinforcement (i.e., reinforcer delivery, without the neutral stimulus) and contingent reinforcement (i.e., reinforcer delivery contingent on the participant's response, without the neutral stimulus), respectively. Future studies should evaluate the relation between participant skills and deficits (e.g., stimulus overselectivity) and the efficacy of pairing procedures. Of note, in the current study, Michael's highest levels of switch responding were higher than those of the other participants ("brilliant," 18.4 responses per minute; "superb," 20.2 responses per minute) and his VB-MAPP milestones scores were higher and his barrier scores were lower than those of the other participants. Another potential advantage of the discrimination training procedure could be that it provides a guide for the number of trials to be conducted (i.e., until discrimination is demonstrated). Because stimulus–stimulus pairing and response–stimulus pairing do not have a similar guide for the number of pairings to be conducted, researchers may conclude that these procedures are ineffective when, in fact, the number of pairings has been insufficient to produce an effect. Data from the current study also replicated the findings of Taylor-Santa et al. (2014) by demonstrating that participants engaged in more stable responding and met criterion faster with the second set of stimuli than with the first set of stimuli during discrimination training.

Although the discrimination training procedure effectively established neutral stimuli as reinforcers, it did not result in long-term responding during the posttraining phase. The level of responding and durability of the praise words as reinforcers differed for each participant. For Zane and Noah, switch responding occurred at less than 2.5 responses per minute during the first posttraining session and then it quickly decreased to zero by the second posttraining session. For Michael, "brilliant" continued to function as a reinforcer for six sessions before decreasing to 0 switch responses (the longest across participants and stimuli). The posttraining data obtained are consistent with Skinner's (1938) findings with nonhuman animals that responding did not maintain after discrimination training. These data also replicate previous research on establishing reinforcers with both humans and nonhumans (e.g., Morningstar et al., 1966; Myers, 1960; Taylor-Santa et al., 2014) that found that responding eventually decreased during the postpairing or posttraining condition when the stimulus was no longer paired with, or discriminative for, reinforcement (i.e., extinction).

Just as specific procedures are needed to program for the maintenance of skill acquisition, research is needed to identify procedures that will result in maintenance of established reinforcement effects. For example, Lovaas et al. (1966) used intermittent reinforcement to increase the durability of discrimination training based on effects observed by Zimmerman (1959) with rats. For one participant, after establishing "good" as an S^D for approaching the experimenter, two reinforcement schedules were employed simultaneously. One schedule was designed to test the effects of "good" as a reinforcer on a new response (i.e., lever pressing). Specifically, the experimenter said "good" contingent on lever presses on an FR 20 schedule; approaches to the experimenter (after he said "good") on this schedule did not result in food. The other schedule was designed to maintain "good" as an S^D for food. That is, when the participant remained sitting without lever pressing for a prespecified period, the experimenter said, "good." Approaches to the experimenter (after he said "good") on this schedule resulted in food on a variable-ratio (VR) 2 schedule. Although the new response (i.e., lever pressing) persisted in this study, the procedures may be prohibitively complicated for clinical use, and few studies have demonstrated methods for producing durability of new reinforcers with individuals with ASD. The literature on establishing reinforcers with typically developing children provides some information about pairing arrangements. For example, Myers and Myers (1963a) found that more responding occurred when the neutral stimulus and the reinforcing stimulus were presented together on an intermittent schedule and neither was presented alone at other times. Miller and Weidner (1965) found that VR 2 pairing of the neutral and reinforcing stimuli resulted in more responding than did FR 2 pairing. Fort (1965) found no difference in responding when neutral and reinforcing stimuli were paired intermittently during 20% and 60% of trials. Unfortunately, due to methodological considerations (e.g., lack of preference assessments), possible differences in skills (e.g., rule-governed behavior), and lack of replications, it is difficult to draw conclusions about how this information applies to clinical practice for individuals with ASD.

Similarly, the optimal posttraining arrangement for maintaining pairing effects with individuals with ASD is unknown. Studies evaluating the effects of delivering the neutral stimulus on different percentages of trials during postpairing have had mixed results. For example, McCrystal and Clark (1961) found that intermittent delivery during postpairing resulted in more responding; however, many studies have found the opposite to be true (e.g., Myers & Myers 1962, 1963b, 1964, 1965). In addition, McCrystal and Clark and Myers and Myers (1963a) reported more responding postpairing when the pairing schedule was the same during pairing and postpairing, but Myers and Myers (1962) found the opposite effect. Although consistent effects have not been demonstrated across studies, this literature may provide a basis for future studies evaluating how to facilitate maintenance with individuals with ASD. Future studies on establishing reinforcers with children with ASD may evaluate the effects of a practical way for clinicians to thin the schedule of reinforcement during discrimination training, extend reinforcement effects during posttraining, and report on relevant participant characteristics that might affect maintenance of responding (e.g., verbal behavior repertoires, stereotypic behavior, and stimulus overselectivity).

There are several limitations to the current study. First, we used nonsense words rather than actual words as S^{Δ}s. Thus, participant history with S^{D} versus S^{Δ} stimuli may have influenced the results. We decided not to use actual words as S^{Δ}s because of the potential for those stimuli to become aversive. However, future researchers might examine whether the novelty of the stimuli in either condition influences outcomes. Second, we used prerecorded praise and nonsense words instead of in vivo exemplars, which may limit the external validity of our findings. We did this to facilitate consistency of voice inflection and volume and to reduce the potential effects of experimenter facial expression and interaction (e.g., eye contact, smiles, and pats) that often accompany praise. For this procedure to be applicable for clinical populations, more natural praise statements that include different sensory modalities (e.g., auditory, visual) and their variations would likely also need to be established as reinforcers (Clay et al., 2018). Therefore, future research might evaluate methods for establishing various aspects of praise (e.g., facial expression, voice tone) as reinforcers. To address the limitations of previous research, we conducted reinforcer and response assessments (Taylor-Santa et al., 2014) to identify switch responses that resulted in low rates of responding, identify highly preferred snacks to be used as reinforcers to discrimination training, and to show that the praise and nonsense words used as S^{D} and S^{Δ} stimuli did not function as reinforcers. However, a limitation of the current study was that although caregivers and teachers of the participants reported that praise did not appear to function as a reinforcer, praise and social interaction in general were not evaluated as reinforcers prior to the experimental sessions. Future studies might include assessments (e.g., Morris & Vollmer, 2020a, 2020b, 2021) to determine the extent to which social stimuli function as reinforcers. It is possible that discrimination training might be particularly useful for establishing praise as a reinforcer because it commonly functions as a consequence leading up to, and possibly discriminative for, more potent reinforcers for continued performance. Finally, we used switch responses because they were discrete and could be readily measured. Future studies might evaluate whether stimuli established as reinforcers using discrimination training procedures would increase the occurrence of more relevant and effortful responses.

ACKNOWLEDGMENTS

This study is based on a thesis submitted by the first author under the supervision of the second author to the Department of Applied Behavior Analysis at Caldwell University for the master's degree in applied behavior analysis.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data available upon request from second author. Supporting Information A includes graphs showing percentage of trials with a correct response during discrimination training for all sets.

ETHICS APPROVAL

This study received approval from Caldwell University's Institutional Review Board and was conducted in accordance with the established ethical guidelines for the treatment of human participants.

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How to cite this article: Sainsbury, E. L., Sidener, T. M., Taylor-Santa, C., Reeve, K. F., & Sidener, D. W. (2024). Evaluation of a discrimination training procedure for establishing praise as a reinforcer. *Journal of Applied Behavior Analysis*, 1–8. https://doi.org/10.1002/jaba.1071