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A Comparison of Two Procedures to Condition Social Stimuli to Function as Reinforcers for Children With Autism

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An interesting and growing body of literature supports the notion that symptoms in autism may be related to a general reduction in social motivation (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). A review of the literature suggests that social orienting and social motivation are low in individuals with autism, and that including social motivation as a target for therapeutic intervention should be pursued (Helt et al., 2008). Through our understanding of learning processes, researchers in behavior analysis and related fields have been able to use conditioning procedures to change the function of neutral social stimuli such as arbitrary facial expressions (Gewirtz & Pelaez-Nogueras, 1992) and nonreinforcing praise (Dozier, Iwata, Thomason-Sassi, Worsdell, & Wilson, 2012). The current study aimed to compare operant and respondent procedures in their effectiveness to condition previously neutral social stimuli to function as reinforcers. Using a multiple-baseline, multielement design, 1 social stimulus was conditioned under each procedure to compare the different response rates following conditioning. Six children diagnosed with autism between the ages of 18 months and 3 years participated. Results show that the respondent procedure (pairing) resulted in more robust and enduring effects than the operant procedure (discriminative stimulus procedure).

Keywords: autism intervention, social stimuli, social reinforcement

According to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM–5*; American Psychiatric Association, 2013), one of the core deficits in autism is in the impairment of social interaction. Some have suggested that underlying these deficits is the reality that social stimuli do not seem to function to reinforce behavior as readily as in typically developing children (Dawson, 2008; Dawson et al., 2004). If changes can be made early in development in the way social stimuli function, other socially motivated behaviors may develop (Dawson, 2008; Helt et al., 2008).

Social Orienting

One of the earliest markers of autism is a failure to orient to social stimuli (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). A study using retrospective analysis of home videos of children in their first year of life showed pronounced differences in eye contact and eye-contact quality in children later diagnosed with autism (Clifford & Dissanayake, 2008). Additionally, L. R. Watson et al. (2007) showed that high-risk scores on social orienting tended to be rare among children with developmental delays, but were common among chil-

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dren with autism spectrum disorder, indicating that the social orienting deficit may be specific to autism. Elison, Sasson, Turner-Brown, Dichter, and Bodfish (2012) showed that children with autism have a "disproportionate attentional bias for [nonsocial] stimuli from very early in life" (p. 849). These studies seem to show that children with autism do not have the initial bias to attend to social stimuli that their typically developing peers do (Klin, Lin, Gorrindo, Ramsay, & Jones, 2009). Failure to orient to social stimuli during early development can have detrimental effects (Dawson et al., 1998, 2004; 2008; Helt et al., 2008; L. R. Watson et al., 2007). When infants and children observe the social environment around them, they learn about the meaning of facial expressions, the association between words used and objects in the environment, and how to communicate effectively with other people (Mundy, Sullivan, & Mastergeorge, 2009). Orientation to social stimuli may be an important target for early intervention because of the potential for its effects on subsequent development. However, the method for training these responses is unclear and requires further investigation.

Social Reinforcement

Skinner (1953) discussed the amplitude of social stimuli that can function as reinforcers. Some empirical examples using children include improving achievement and behavior in elementary-age students (Fisher & Wollersheim, 1986; Stein, 1969), increasing positive affect in young children (Furman & Masters, 1980), obtaining better outcomes in parent–child interaction therapy (Borrego & Urquiza, 1998), and increasing vocalizations in infants (Pelaez, Virués-Ortega, & Gewirtz, 2011), among others. Social stimuli have been shown to reinforce many of the behaviors acquired very early in life (Gewirtz, 1969; Skinner, 1953). Even in infancy, behaviors such as crying and smiling are sensitive to social reinforcers, and entire patterns of behavior, including infant attachment, fear of the dark, fear of strangers, jealousy, and depression, can be attributed to maternal interaction (Gewirtz & Pelaez-Nogueras, 2000). However, social stimuli do not always function to increase the frequency of specific behaviors in individuals with autism (Lovaas et al., 1966). Some children may even find social interaction aversive (Hagopian, Wilson, & Wilder, 2001; Taylor & Carr, 1992). Behavior analysts who provide interventions for individuals with autism attempt to use social reinforcers in most cases (Vollmer & Hackenberg, 2001), but when the reinforcing effects of social stimuli are not evident, other, nonsocial reinforcers are used. For some behaviors, the use of nonsocial reinforcers is sufficient to increase adaptive behaviors like appropriately requesting preferred objects (Gutierrez et al., 2007) and breaks from a task (Lalli, Casey, & Kates, 1995). However, communicative behaviors that are maintained exclusively by social reinforcement may not be maintained when nonsocial reinforcers are used. One particular example is in the training of joint attention, wherein a major limitation remains the generalization and maintenance of the response after training with nonsocial stimuli (Whalen & Schreibman, 2003).

Establishing Social Conditioned Reinforcers

Although children with autism have a reduced tendency to orient to social stimuli, the potential that these stimuli can be conditioned to be more effective as reinforcers exists. Researchers in behavior analysis and related fields have used conditioning procedures to change the function of a variety of neutral stimuli (e.g., Ayllon & Azrin, 1968). Neutral social stimuli have also been successfully conditioned to function as reinforcers (Dozier, Iwata, Thomason-Sassi, Worsdell, & Wilson, 2012; Gewirtz & Pelaez-Nogueras, 1992; Pelaez, Virués-Ortega, & Gewirtz, 2012). The most frequently used method to change the function of a stimulus is through respondent conditioning (Catania, 2007). Dozier et al. evaluated several aspects of the pairing procedure that can affect the likelihood of successful conditioning, including the reinforcing effectiveness of the conditioning stimulus. In their study, Dozier et al. used reinforcer tests to determine the reinforcing effectiveness of food as a reinforcer prior to successfully pairing the social and edible stimuli. They also compared stimulus-stimulus (S-S) pairings that were noncontingent with pairings that were contingent on the completion of a simple task. The study showed that the contingent pairing procedure was more successful in establishing praise as a reinforcer than the noncontingent procedure.

An alternative method to change the function of a stimulus is the discriminative stimulus (S^D) procedure. In this procedure, an antecedent stimulus, which consistently signals the availability of reinforcement contingent on some response, becomes reinforcing in its own right. In one of the earliest documented examples of this procedure, Lovaas et al. (1966) established the word "good" as discriminative for approaching an experimenter by delivering an edible item only when the word "good" was presented. Isaksen and Holth (2009) also used an operant method to condition social stimuli prior to training joint attention in children with autism. In their procedure, the social stimulus (an experimenter's smiling face) was attended to before an already-established reinforcer was delivered. What is interesting about this procedure for joint attention and other social behaviors is that, following the logic of behavior chains, stimuli that indicate reinforcement come to have reinforcing properties themselves, thus making social stimuli both the antecedent stimulus and the reinforcer.

The Current Study

The current study aimed to use operant and respondent procedures to condition social stimuli that were empirically shown to be neutral prior to conditioning. Particularly, this study aimed to compare the two procedures in their effectiveness to condition social stimuli to function as reinforcers for a simple task, as well as in their ability to maintain conditioning effects after the training. The implications for this study include the refinement and selection of procedures used to condition neutral or ineffective social stimuli, as well as the potential benefits of conditioning social stimuli in young children with autism.

Method

Participants

Six male participants diagnosed with autism spectrum disorder between the ages of 18 months and 3 years participated. Before the study, an independent research-reliable Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, Di Lavore, & Risi, 2001) administrator confirmed diagnoses for all participants. Participants were recruited from responses to a flyer posted in the monthly University of Miami—Nova Southeastern University Center for Autism and Related Disorders e-newsletter, as well as from the Early Intensive Behavioral Intervention program at the Center for Children and Families at Florida International University.

Materials

An ADOS (Lord et al., 2001) kit was used to conduct the ADOS assessments prior to intervention. A Preference Assessment Parent Interview Form was created for this study and used to generate a list of preferred social and nonsocial stimuli according to parental input. Tangible items identified by the participant's parents were purchased or borrowed in order to conduct reinforcer assessments, which then determined the stimuli that were used to condition social stimuli. Picture cards representing the social and nonsocial stimuli were created to represent access to the stimuli during reinforcer assessments.

Reinforcer Assessment

In order to determine the child's preferences for both social and nonsocial stimuli, parents were first interviewed using the Preference Assessment Parent Interview Form. Then, the five nonsocial stimuli ranked highest, and the five social stimuli ranked lowest were validated using a free-operant, concurrent-choice reinforcer assessment (Gutierrez et al., 2009; Smaby, MacDonald, Ahearn, & Dube, 2007).

For the reinforcer assessment, picture cards of the preferred stimuli were created to represent access to the ranked stimuli. One at a time, the picture cards were presented to test how many times the child engaged in a simple task (handing or touching a picture card) to obtain access to the stimulus. Each stimulus trial began with five forced exposures, in which the researcher used prompting and verbal instructions (i.e., "If you want bubbles, give me the card") to have the child engage in the task, resulting in brief access to the stimulus (~30 s). After the forced exposures, the participant was asked to engage in the task in a free-operant manner during a 1-min interval in order to receive brief access to the stimulus (i.e., "As many times as you want, give me the card"). Each time the participant engaged in the task, the timer was paused to allow the child to engage with the stimulus being tested without detracting from the assessment interval. This was done to control for the differences in the duration of access to the stimuli, which varied depending on the stimulus. After the 1-min interval, the stimuli were reset and the procedure was repeated until all 10 stimuli were tested. This process was repeated three times in varying order of presentation to control for order effects. The nonsocial stimulus that resulted in the highest rates of responding, and the two social stimuli that resulted in the lowest rates of responding were selected for the conditioning procedure.

The social stimulus "smile" was ranked lowest or second lowest for each participant. In line with the results of the reinforcer assessment, as well as in an attempt to replicate the procedure conducted by Isaksen and Holth (2009), smile was selected for the S^D procedure for all participants. Clapping, shouting "Hooray!", a hug, and saying "Yay!" resulted in the lowest response rates and were selected for the pairing procedure according to the individual participant's assessment results. The nonsocial stimuli that resulted in the highest rates of responding were a car-shaped book, a video played on an iPad, chocolate chip cookies, balloons, an iPad game, and bubbles, and were used to condition social stimuli in both conditions according to the individual participant's assessment results.

Design

This study used a multiple treatment with reversal, embedded in a multiple-baseline design (Pierce & Cheney, 2008; P. J. Watson & Workman, 1981). The conditions were as follows: Baseline A (extinction), Baseline A_1 (preconditioning), Reversal A (postconditioning), Baseline B (preconditioning, second procedure), Reversal B (postconditioning, second procedure), Probe A, Probe B. In order to control for treatment effects, the order of treatment presentation was counterbalanced such that Participants 1 through 3 received the pairing procedure first, and Participants 4 through 6 received the S^D procedure first.

Procedure

Baseline sessions were very similar to the reinforcer assessment sessions, in which, following a forced exposure, the child engaged in a simple task in order to receive the stimulus in a free-operant manner within a 1-min interval. However, in this condition, the picture card had a nonspecific image (a smiley face, with different colors for each condition). Baseline was broken down into two parts. The first set of baseline trials were labeled extinction because no programmed consequences were given contingent on task completion. This was done to test whether the child found the task itself reinforcing and to see whether they would engage in the task without a programmed reinforcer. In the second set of baseline trials, the social stimulus to be conditioned was presented contingent on task completion. This was used as a preconditioning measure, to determine how many times the child would complete the task in order to receive the social stimulus prior to conditioning. Both baselines continued until stability was reached or until there were at least three more trials in the condition than the previous participant. This was done to demonstrate experimental control in the multiple-baseline design (Pierce & Cheney, 2008).

Reversal baselines were repeated following conditioning trials to test the social stimuli after conditioning. In the test trials, only the social stimuli were presented contingent on touching or handing the card to determine the reinforcing effectiveness of the previously neutral stimulus. Rather than running these trials to stability, test conditions were conducted for only six trials because of the likelihood that responses would drop off after repeated trials. This decision was based on data from a pilot study that was conducted prior to beginning this study. These trials were labeled as "postpairing" and "post-S^D," but are the same as the baseline trials (prepairing and pre-S^D), except that they followed conditioning.

The pairing procedure was conducted as follows: Beginning with five forced exposures, the social stimulus and the nonsocial stimulus (conditional stimulus) were presented in a delay conditioning fashion (Catania, 2007) following task completion. The task was the same as in the baseline conditions (handing or touching a picture card). Then, as in the reinforcer assessment and baseline conditions, the child was asked to complete the task in a free-operant fashion within a 1-min interval. Intervals were repeated as many times as were necessary to reach a total of 80 conditioning trials. Forced exposures were repeated any time that intervals were interrupted by breaks or the end of a session. Participants reached 80 trials in as few as two 1-min intervals (Participant 2) or as many as eight 1-min intervals (Participant 8). Most participants finished the pairing condition within two sessions.

The discriminative stimulus (S^D) procedure was conducted as follows: Beginning with five forced exposures, the participant was asked to look at the experimenter in order to attend to the discriminative stimulus (a smile) before being allowed to reach for the card. Verbal, gestural, and physical prompts were used as necessary only during the forced exposures. After the forced exposures, prompts to observe the discriminative stimulus were only provided when the participant attempted to reach for the card prior to attending to the discriminative stimulus. As soon as the participant looked at the experimenter's face, the experimenter smiled. The participant then completed the task and the nonsocial stimulus was delivered. In order to ensure that the smile was discriminable, the experimenter maintained a neutral affect throughout the session, and only smiled as soon as the participant looked at the experimenter's face. Then, as in all other conditions, the child was asked to complete the task in a free-operant manner within a 1-min interval. Intervals were repeated as many times as were necessary to reach a total of 80 conditioning trials. Forced exposures were repeated any time that intervals were interrupted by breaks or the end of a session. Participants reached 80 trials in as few as six 1-min intervals (Participant 4), or as many as 18 1-min intervals (Participant 6). Two participants (Participant 3 and Participant 5) never reached 80 conditioning trials. The decision to stop running conditioning trials was reached when less than 40 trials had been completed in 20 1-min intervals. Those participants who finished the discriminative stimulus condition reached 80 trials within three to six sessions. There were no programmed breaks in between any of these conditions. The only conditions that had programmed breaks were the probes for each procedure.

Follow-up baseline trials testing for maintenance were repeated for each conditioned social stimulus at least 3 weeks after the last conditioning trial was completed. The procedure was identical to the original baseline procedure, except that only three 1-min intervals were completed for each stimulus. If pairing was done first, the pairing probe was conducted first, and vice versa.

Data Collection and Validity Measures

The primary dependent variable across all phases was rate of responding, particularly the number of times that a task was completed within each 1-min interval. Data were collected during all the live sessions by a second observer who was trained in data collection, using paper and pencil. Interobserver agreement (IOA) for frequency of responding was collected by the researcher and another trained observer for one third of all sessions via video recording of the sessions. The total average IOA score was 99.94%, with a range of 96% to 100% across participants and conditions.

Results

Results varied for each participant and for each condition (see Table 1). On average, the extinction condition had lower response rates than all other

Table 1
Mean Response Rate per Condition Across Participants

PP no.	BL	Prepair	Postpair	Probe- Pair	Pre-S^D	Post-S^D	Probe-S^D
1	.67	.67	19.20	3.33	8.00	4.33	
2	.11	9.68	15.00	11.67	3.10	6.40	8.33
3	1.33	.92	15.83	.67	2.75	1.33	.00
4	1.25	.50	.50	.00	.00	2.50	.33
5	.11	.44	2.00	.33	.11	.00	2.00
6	1.67	1.33	3.00	7.33	2.50	1.22	1.67
Mean	.86	2.26	9.26	3.89	2.74	2.63	2.47

Note. PP no. = participant number; BL = baseline (extinction); Pre-pair = before pairing condition; Post-pair = after pairing condition; Probe-pair = at least three weeks after pairing condition; Pre-S^D = before SD condition; Post-S^D = after SD condition; Probe-S^D = at least 3 weeks after SD condition.

conditions. When looking at mean response rates across the six participants, the largest difference occurred following the pairing procedure, in which the mean response rate prior to conditioning was 2.26 and following conditioning was 9.26. In contrast to the pairing procedure, the discriminative stimulus (S^D) procedure appeared to have no effect, in which the mean response rate prior to conditioning was 2.74 and following conditioning was 2.63. Probes conducted at least 3 weeks after conditioning ended demonstrated some maintenance of effects for pairing and continued to show no effect for the S^D procedure.

Participants 1 through 3 had the pairing condition presented first, immediately following extinction. Participant 1 was exposed to the pairing procedure to condition clapping as a reinforcer, whereas Participants 2 and 3 were exposed to the pairing procedure to condition the word "Hooray!" as a reinforcer. All participants received the S^D procedure to condition a smile as a reinforcer.

The number of responses for Participant 1 increased following the pairing procedure, and although the data show a decreasing trend, the level of response rates is higher than in the prepairing condition (Figure 1). Response rates in the pre-S^D condition, although stable, were not as low as in the prepairing condition. However, response rates in the post-S^D condition were even lower than in the pre-S^D condition. The probe, conducted 3 weeks after the pairing procedure, resulted in one trial of relatively high response rates, but immediately dropped off to zero after the first trial. Participant 1 was not available for testing in the S^D -probe condition.

Despite unusually high response rates in the prepairing condition for Participant 2, the post-pairing condition still had higher response rates, on average, and although the data were variable, they were noticeably higher than the stable portion at the end of the prepairing condition (Data Points 30 to 37). Median response rates reflected similar

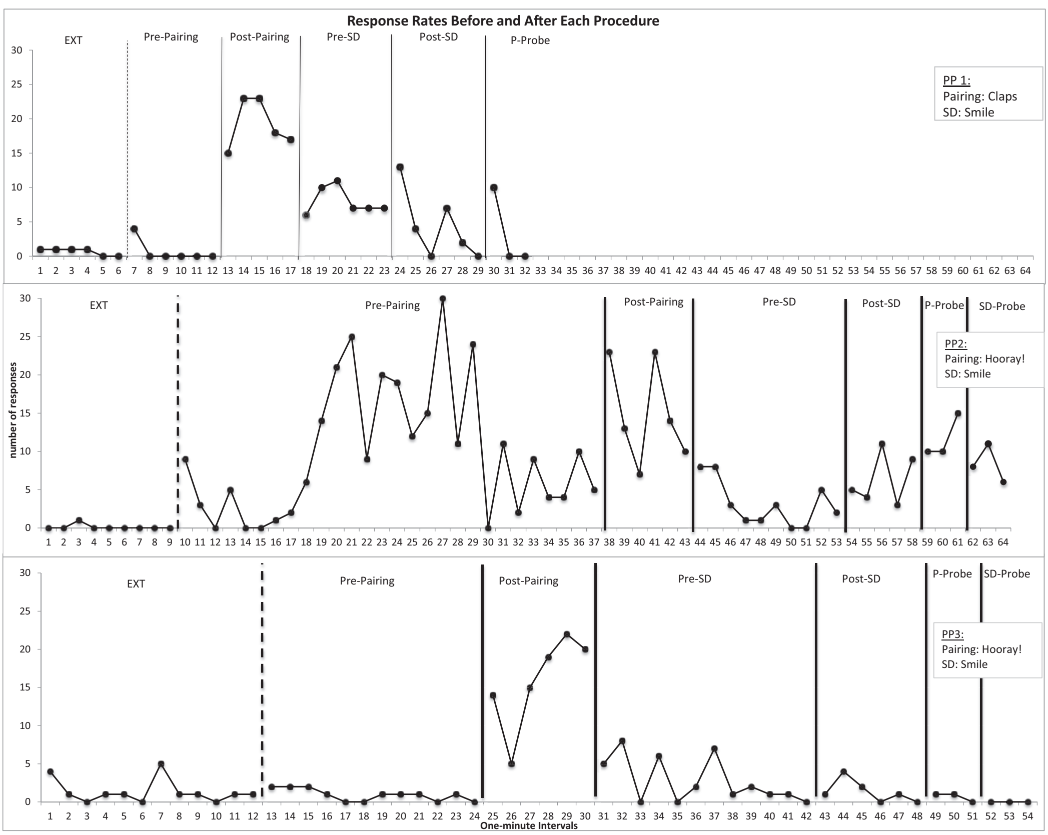

Figure 1. Response rates across conditions, with pairing presented first (Participants 1–3).

results, in which the median response rate in the prepairing condition was 7.5, and was 13.5 in the postpairing condition. The S^D procedure also had a positive conditioning effect, although the increase in response rates was not as high as with the pairing procedure. The probes, conducted 4 weeks after conditioning, reflected the initial postconditioning results, with higher rates of responding in the pairing probes than in the S^D probes.

Only the pairing procedure had an effect for Participant 3. After a long, low, and very stable prepairing condition, his response rates were much higher in the postpairing condition, and were beginning to stabilize at a high rate, after an ascending trend. The pre-S^D condition had higher response rates than the prepairing condition, but the data stabilize at a low rate after seven trials. Because of this instability in the initial portion of the pre-S^D condition, the mean response rates are lower in the post-S^D condition. However, even without this effect, the descending trend indicates that any effects from the S^D procedure quickly faded out. It should be noted here that Participant 3 did not finish the S^D procedure. For this participant, both sets of probes demonstrated a lack of maintenance of effects.

The S^D condition was presented first for Participants 4 through 6, immediately following extinction. The pairing procedure was used to condition a hug as a reinforcer for Participant 4, to condition the word "Yay!" for Participant 5, and to condition clapping for Participant 6. The S^D procedure was used to condition a smile as a reinforcer for all of the participants.

Median response rates were almost identical for Participant 4 in the post-S^D and pre-S^D conditions, with a median rate of zero in the pre-S^D condition and a median rate of .5 in the post-S^D condition (Figure 2). Although mean response rates show a greater difference, this is

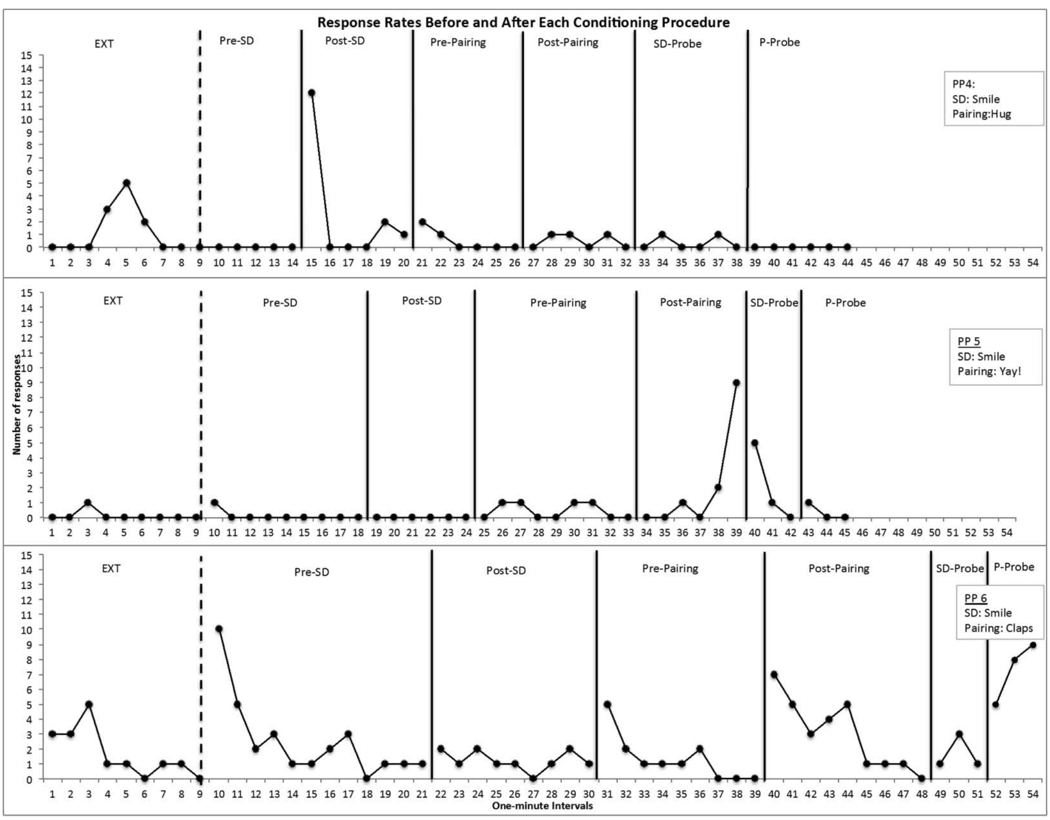

Figure 2. Response rates across conditions, with discriminative stimulus procedure presented first (Participants 4–6).

primarily because of a single data point. The pre- and postpairing conditions have the same mean response rates. Graphical analysis confirms that there is no obvious change in trend or level across these conditions, demonstrating a lack of an effect. Both probe conditions, conducted 3 weeks later, also showed very low or no responding, confirming the lack of an effect for this participant.

Response rates were at zero across almost all of the pre-S^D and all of the post-S^D conditions for Participant 5, demonstrating no effect from the S^D procedure. It should be noted that Participant 5 did not complete the S^D procedure because his response rates were so low during conditioning that it would have taken too long to finish. Response rates during the postpairing condition were higher, on average, than in the prepairing condition, and end on an increasing trend. However, median response rates show a much smaller difference, with a median of zero responses in the prepairing condition and .5 responses in the postpairing condition. Although the probe for the S^D procedure is slightly higher on average, both probes, which were conducted 3 weeks later, ended on zero response rates following a decreasing trend.

Response rates were relatively high during preconditioning for Participant 6. However, preconditioning conditions were run until stability was reached, and doing so produced low response rates in both conditions. The post-S^D condition had lower response rates than the pre-S^D condition, with fairly stable rates of responding. The postpairing condition had higher rates of responding than the prepairing condition, but still had a decreasing trend and ended on a zero response rate trial. However, the probes for Participant 6, which were conducted 3 weeks later, showed a fairly different set of results, with the pairing procedure demonstrating much higher response rates than the S^D procedure. The increasing trend also demonstrated that the maintenance of effects was more robust for the paired stimulus than for the S^D stimulus.

For most participants, the pairing procedure had more robust and enduring effects. However, maintenance of effects is not clear, and although it is more evident with the pairing procedure, response rates were not nearly as high as they were immediately following pairing. The S^D procedure did not result in response rates that were as high as those achieved following pairing, and the long-term effects were essentially nil.

Discussion

Pairing

Results from the pairing procedure demonstrated that, for some participants, the procedure was more effective in conditioning social stimuli to function as a reinforcer than the S^D procedure. In some cases, the response rates following pairing were much higher than they were before conditioning, and in most cases, they were at least slightly higher following pairing. However, graphic analysis of the data for the pairing procedure only demonstrated clear effects from the intervention for two of the participants. Participants 1 and 3 had very stable and low response rates prior to the pairing procedure, and much higher and relatively stable response rates following intervention, demonstrating a substantial effect. Participant 2 had a very unstable and long prepairing condition. This may have been a result of some previous pairing conducted for another set of stimuli that had to be discontinued because of a change in dietary restrictions prohibiting the use of cookies as a reinforcer. Regardless of this confounding data, his postpairing response rates were still relatively high, though they were variable. Moderate increases in mean response rates between the pre- and postpairing conditions were observed for Participants 5 and 6; however, those data were not stable when the condition was ended. The only participant who showed no effect from the pairing procedure was Participant 4. The moderate success from the pairing procedure was similar to the data reported by Dozier et al. (2012), for which contingent pairing resulted in an increase in responding for the social stimulus.

The literature on pairing suggests that the number of trials is an important variable determining the likelihood of successful conditioning (Catania, 2007), and may have had an effect on the overall success of each of the conditioning procedures. The number of conditioning trials was equal for both procedures and was determined from data gathered during a pilot study. The number selected was considered just high enough to have an effect without detracting from the child's daily intervention schedule. However, many conditioning studies reported much higher total conditioning trials. Dozier et al. (2012) used thousands of pairings in the S-S condition, in which the pairings were noncontingent, without success. Although it is unclear how many pairing trials occurred, or if they were equal for all participants, it is possible that substantially fewer trials were conducted in the contingent pairing procedure. Additionally, the number of pairing trials needed may depend on the individual's learning history with the particular stimulus being paired. Although great care went into selecting stimuli that were neutral in terms of their reinforcing effects, these stimuli are by no means novel, and each participant is likely to have a unique learning history with the stimuli selected for conditioning. Perhaps future studies should control for learning histories by using social stimuli that are uncommon or arbitrary.

Another potential factor that may have affected the outcome of the pairing procedure is the type of stimulus conditioned. The stimuli that were conditioned using pairing, particularly cheers, claps, and hugs, can all be classified as stimuli that are multimodal. This may be important because of the increased likelihood that the stimuli were in fact attended to during the pairing procedure. Increasing the saliency of the paired stimulus may make the pairing procedure more robust. Thus, perhaps part of the effect from the pairing procedure may be attributed to the fact that these stimuli were more salient than a smile, which was the only stimulus conditioned under the S^D procedure. Although conditioning the same stimuli using both procedures excludes them from being compared, future research should ensure that the stimuli being compared under each procedure are equally salient.

The pairing procedure seemed to have slightly better maintenance of effects, but those effects were only present for two of the six participants. One possible explanation for the maintenance of effects for the two participants for whom response rates maintained is that the procedure may have functioned as a way to boost the reinforcing effects of these stimuli, which then continued to be intermittently paired in the natural environment. Cheers and claps are often presented contingent on correct responding during applied behavior analysis (ABA) interventions, making this a distinct possibility. The postconditioning conditions were essentially brief respondent extinction conditions, in which the newly conditioned stimuli would inevitably have started to loose some of their reinforcing qualities. This may be one explanation for why conditioning did not maintain for most participants. This is also why the postconditioning conditions were not presented until stability was reached. It was assumed that if the social stimulus continued to be presented independently of the reinforcer, response rates would have dropped to zero, reversing the effects of conditioning. Another reason that maintenance may have suffered is that the contingency of handing the experimenter the card that resulted in access to the reinforcer was on a continuous schedule of reinforcement. It may be worthwhile to test whether the effects of pairing are more likely to maintain if pairing trials are interspersed with nonpairing trials to mimic an intermittent schedule of reinforcement. Another alternative could be to use schedule thinning, in which the pairings are continuous at first, and are gradually interspersed until the unconditioned stimulus is no longer presented (Hopkins, 1968).

Discriminative Stimulus Procedure

The S^D procedure used in this study was not found to be very effective in conditioning social stimuli to be reinforcing. In some cases, it was difficult to compare response rates because some pre-S^D conditions had higher response rates than prepairing conditions in an example of carry-over effects. The first three participants had the pairing procedure presented first, creating the potential for carry-over effects to the pre-S^D condition. For example, Participant 1 had higher response rates in the pre-S^D condition than in the prepairing condition, occluding the difference in response rates across conditions. However, the post-S^D response rates were lower than the postpairing response rates, demonstrating less of an effect from the S^D procedure compared with the pairing procedure. Participant 2 also had relatively high and variable pre-S^D response rates that did not increase substantially in the post-S^D condition. Participant 3 had higher and more variable response rates that eventually decreased and stabilized in the pre-S^D condition, again reflecting potential carry-over effects from pairing. However, response rates in the post-S^D condition are even lower than response rates prior to conditioning, reflecting a weak or nonexistent effect. All of the participants who received the S^D conditions first (Participants 4–6) had relatively low response rates in the pre- and post-S^D conditions, with little to no evidence of carry-over effects to the pairing conditions.

The only two participants that had higher mean response rates in the post-S^D condition compared with the pre-S^D condition were Participants 2 and 4. Again, Participant 2 had very unstable data that were relatively high in the pre-S^D condition, in another example of carry-over effects, so it is noteworthy that he still had some increase in his response rates following conditioning.

There are a few variables that may have contributed to this procedure being less effective, including the number of trials conducted and the type of stimulus conditioned. Lovaas et al. (1966) conditioned the word "good" to function as a reinforcer using the same procedure; however, in their study, Participant 1 received 1,530 trials of conditioning and Participant 2 received 900 trials. These participants were institutionalized and were likely available for longer sessions with minimal time constraints. Although it was possible to provide more conditioning trials, it could have taken upward of 6 months to complete that many trials of conditioning under this procedure. Further, it is evident that this many trials were not required for the pairing procedure. One of the important findings of this study may be that even if both procedures are effective, the contingent pairing procedure was more efficient than the S^D procedure, in that the children were able to complete the requisite number of conditioning trials in fewer sessions.

One of the reasons that smile was selected as the social stimulus to condition in this study was to replicate the Isaksen and Holth (2009) procedure. In their study, Isaksen and Holth only conducted between 35 and 75 trials of the S^D procedure. However, they conducted nine other trainings related to joint attention behaviors before conducting their final assessment, which tested joint attention in general. The researchers did not independently test smile to determine whether it was indeed reinforcing after their attempts to condition the stimulus. Therefore, it is difficult to determine if the procedure in the current study had the same effects as those found in their study.

Another potential variable affecting the difference in results could be the difference in the type of stimulus conditioned. As mentioned above, the S^D procedure was used to condition smile, which is a unimodal stimulus. Even though the child was required to observe the smile before the reinforcer was delivered, it is still possible that the smile was less salient or required more effort to observe than the stimuli conditioned under pairing. A smile is a subtle social stimulus that is likely to function as a reinforcer for adults and older children (Skinner, 1953), but it is unclear if a smile functions as a reinforcer in younger, typically developing children. Future studies in this line of research should include conditioning stimuli that are equally salient across both procedures. Alternatively, more extensive counterbalancing may be useful. For example, a smile may be conditioned with the pairing procedure for some participants and a vocal or multimodal stimulus with the S^D procedure, and vice versa. Replications with additional stimuli across procedures would also add robustness to the outcome of the procedures.

One final consideration related to the type of stimulus used with the S^D procedure is that there was an additional response requirement that was not present with the pairing procedure. Because the stimulus to be conditioned had to be attended to prior to the reinforcer being delivered, the child was required to look at the experimenter's face before touching or handing the card. S^D trials took longer and required more instructions and redirection than the pairing procedure, providing further evidence that this procedure required more response effort. As mentioned in the literature review, children with autism are less likely to orient to faces, making this response even less likely (Dawson et al., 1998). For the two participants that did not complete the S^D procedure, it seemed as though the reinforcer provided was simply not potent enough to evoke the response. After the procedure was officially ended for purposes of this study, a reinforcer manipulation was made for one of the participants, which resulted in much higher response rates during the S^D procedure. Though those data were not reported, there was sufficient evidence to show that had the reinforcer been more valuable, the S^D procedure would have likely been completed. This, however, does not speak to whether or not his response rates would have increased following conditioning.

Four of the six participants did, however, complete the S^D procedure, demonstrating that it was possible to garner orienting to the experimenter's face. In fact, for those participants that completed the S^D procedure, very little redirection was needed after the forced exposures. Future studies should consider increasing the magnitude of reinforcement provided for completing responses under this paradigm in order to better match the response effort required.

General Discussion

Conditioning social stimuli to function as reinforcers is a promising and different way to intervene with young children with autism. Many intervention programs target behavioral skills deficits, such as verbal behavior and social skills directly (e.g., Verbal Behavior Milestones Assessment and Placement Program [Sundberg, 2008]; Assessment of Basic Language and Learning Skills [Partington, 2006]), without addressing the social-emotional aspect of the autism diagnosis. Although many skills are successfully taught without social reinforcers, it may be worthwhile to include a component that targets specifically how social stimuli function. Although it is likely that many associations, or pairings, between social and nonsocial stimuli do occur during typical ABA interventions, it is unknown whether they are made in a systematic and programmatic fashion. Even basic textbooks recommend the use of pairing to increase the likelihood that social reinforcers are effective in increasing or maintaining novel responses (e.g., Kazdin, 2012), but the literature is sparse on how to do so effectively in this type of setting. Although the concept of classical conditioning is well established, using it systematically and in an applied setting to increase the reinforcing effectiveness of social stimuli, especially in young children with autism, is not part of clinical best practice. The current study showed that conditioning social stimuli to become reinforcing is not as straightforward as it might seem, and that the methods chosen for conditioning may have an impact on the effectiveness and success of such procedures. Therefore, it is important to continue to investigate what makes these procedures more efficient, as they have very important implications for clinical practice.

Limitations

Although the findings of the current study are consistent with previous literature, some possible limitations should be considered when interpreting the results. Some possible limitations of this study include the use of only one stimulus as the conditioning stimulus, the difference in the type of stimuli selected for conditioning, and the lack of a discrimination training procedure to determine if, in fact, the conditioned social stimuli resulted in differential responding compared with another similar stimulus.

First, the fact that only one stimulus was used to condition social stimuli in both conditions increases the likelihood that the reinforcing effectiveness of those stimuli was affected by satiation (Kazdin, 2012). Although edible items were only used for one participant, other tangible and nontangible reinforcers are also susceptible to satiation by virtue of repeated exposures (Hagopian, Crockett, van Stone, DeLeon, & Bowman, 2000). Only one stimulus was used in order to reflect the results of the reinforcer assessments. However, different versions of the same stimulus could have been used to diminish the effects of satiation. For example, Dozier et al. (2012) used a variety of preferred edibles as the conditioning stimulus in a quasi-random order to prevent satiation.

The most substantial limitation of this study is in the difficulty of comparing the procedures because of the difference in the types of stimuli conditioned under each procedure. Indeed, great care was taken to make sure that the social stimuli in both conditions were attended to; however, as was mentioned before, there is a difference in the saliency of each of the stimulus types, particularly between a smile and the other stimuli conditioned under the pairing paradigm. This difference in salience affects the response effort required to attend to the stimulus, making it a distinct possibility that a higher magnitude reinforcer was necessary for the smile to become conditioned. In other words, the reinforcer that was presented following task completion was not sufficient to make a smile discriminative for touching or handing the card.

Finally, a discrimination-training component that included training in an S-delta condition may have bolstered the effects of conditioning in the S^D procedure. It is possible that training a discriminative stimulus is more effective in the context of responding to (or not responding to) an S-delta. However, this is an issue that was not addressed in either the Lovaas et al. (1966) or Isaksen and Holth (2009) studies, and would require further investigation. A secondary test of the function of the discriminative stimulus to evoke the response in the presence of the social stimulus, but not in the presence of another similar stimulus (e.g., a neutral face), may have provided evidence of a conditioning effect that was not demonstrated effectively using a free-operant procedure. However, because the aim of this study was to test the reinforcing effectiveness of these stimuli before and after conditioning, the discriminability of the stimulus was not considered, which may be an important limitation.

Future Directions

This study represents the beginning of an interesting and long line of research. Many more studies need to be conducted to determine the ways to refine and improve each of these procedures. Specifically, studies should be done to determine whether the stimulus type affects the effectiveness of the procedures, and for which stimulus types each procedure is best. For example, the S^D procedure may only be effective for stimuli that need to be actively attended to, or it may be more effective if the stimulus is multimodal. Future studies should also test the number of pairing and S^D trials to determine the range of effective trials. There may be a minimum number of trials required for conditioning to be effective, or it may depend on the stimulus itself and the individual's learning history with the stimulus. Another extension that may be useful would be in testing the reinforcing effectiveness of the newly conditioned stimuli on other behaviors, such as those typically trained in ABA interventions. It would be interesting to compare the reinforcing effectiveness of social stimuli after conditioning and nonsocial stimuli on the same type of response, as well as to evaluate the maintenance and generalization of effects.

Summary

In summary, an operant and a respondent procedure were tested in their ability to condition social stimuli to function as reinforcers. After 80 trials of conditioning under each paradigm, the respondent (pairing) procedure, in which pairings were presented contingent on a simple task, was found to be more effective. The pairing procedure also had slightly more durable effects, but, overall, the maintenance of both procedures was limited. These results show promise for the viability and practicality of a conditioning procedure to improve the reinforcing effectiveness of social stimuli in children with autism. Improving the effectiveness of social stimuli to function as reinforcers in children with autism has far-reaching implications for clinical work as well as for research on the social-emotional aspects of autism. .

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