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Comparing Different Classes of Reinforcement to Increase Expressive Language for Individuals with Autism

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Abstract: One of the basic principles of applied behavior analysis is that behavior change is largely due to that behavior being reinforced. Therefore the use of positive reinforcement is a key component of most behavioral programs for individuals diagnosed with autism. In this study we compared four different classes of reinforcers (i.e., food, praise, toys, and feedback) on the rate of skill acquisition for three individuals diagnosed with autistic disorder. Using a parallel treatments design, the results of this study showed that all four classes of reinforcement were effective for teaching all of the participants. Results also indicated that food reinforecers were more efficient and more preferred. Finally, participants performance during teaching was idiosyncratic across the three participants.

One of the basic principles of Applied Behavior Analysis (ABA) is that behavior change can be instigated through the use of positive reinforcement (e.g., Catania, 1998). For individuals diagnosed with an Autism Spectrum Disorder (ASD), researchers have demonstrated reinforcement-based procedures to be effective in decreasing self-injurious behaviors (e.g., Worsdell, Iwata, Hanley, Thompson, & Khang, 2000), aggression (e.g., Repp & Deitz, 1974), and self-stimulatory behaviors (e.g., Singh, Dawson, & Manning, 1981). Additionally, researchers have shown that reinforcement can be used to increase pro-social skills such as: social skills (e.g., Leaf, Dotson, Oppenheim, Sheldon, & Sherman, 2010), language (e.g., Petursdottir, Carr, Lechago, & Almason, 2008), and academic and pre-academic tasks (e.g., Leaf, Sheldon, & Sherman, 2010).

Positive reinforcers can take many forms including food (e.g., Schreibman, 1975), toys (e.g., Leaf, Sheldon, & Sherman, 2010), praise (e.g., Schreibman, 1975), tokens (e.g., Allyon & Azrin, 1968), and even allowing the learner to engage in self-stimulatory behaviors (e.g., Rincover & Newsom, 1985). Since reinforcement-based procedures have been highly effective in changing behavior for people diagnosed with ASD, researchers have conducted numerous studies investigating various aspects of reinforcement. One area of interest has been studying various methods for determining learners preference of various stimuli and whether these preference assessment results are predictive of reinforcer effectiveness. Researchers have evaluated single-item presentation (e.g., Pace, Ivancic, Edwards, Iwata, & Page, 1985), paired preference assessment (e.g., Fisher et al., 1992), and multiple stimulus preference assessment (e.g., Carr, Nicolson, & Higbee, 2000) for evaluating learner preference among stimuli and the correlation of preference level with reinforcer effectiveness. The research has indicated that all three assessments are effective in determining both preference and reinforcement effectiveness and that these formal assessments are more accurate than asking teachers or parents (Green et al., 1988).

A second area that has been evaluated in the reinforcement literature is determining if children prefer contingent or non-contingent reinforcement (e.g., Luczynski & Hanley,

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2009). Luczynski and Hanley (2009) evaluated eight typically developing children's relative preference of contingent reinforcement as part of a differential reinforcement of alternative behavior (DRA) procedure versus noncontingent reinforcement to increase social interaction. Results indicated that 7 of the 8 participants preferred contingent reinforcement. Although these findings are important, they were conducted with typically developing children; therefore, it is not known if findings would be similar for children with ASD.

Additional areas of focus in the reinforcement literature include how the amount (magnitude) of reinforcement affects behavior change (e.g., Roscoe, Iwata, & Rand, 2003), the effects of various reinforcement schedules (e.g., Worsdell et al., 2000) on behavior change, the differences between positive and negative reinforcement on behavior change (e.g., DeLeon, Neidert, Anders, & Rodriquez-Catter, 2001), and how learners' choice of reinforcement influences behavior change (e.g., Smith, Iwata, & Shore, 1995; Tiger, Hanley, & Hernandez, 2006). Despite the amount of research on different components of reinforcement, very few studies have evaluated how different classes of reinforcers (e.g., food, toys, or social) can affect skill acquisition.

Ferrari and Harris (1981) evaluated three different classes of reinforcement: sensory reinforcers (i.e., vibration, music, and strobe light), social reinforcement, and food reinforcement on four children diagnosed with ASD. The first task evaluated was how frequently participants were able to press a clown's nose (e.g., bar pressing) during a 15 min session. The second task evaluated how well the participants were able to receptively identify objects in a field of three. Results were idiosyncratic across the five participants. The results did show that: (a) sensory reinforcement can be as effective as other classes of reinforcement for children with ASD; (b) that food and praise were reinforcing for the five participants; and (c) that vibration appeared to be the most effective of the sensory stimuli.

In a later study, Rincover and Newsom (1985) compared the satiation effects of two classes of reinforcement: sensory (e.g., tickles, therapist finger tapping, and hand clapping) to food reinforcers on a two-choice visual discrimination task. The authors selected five sensory reinforcers and five food reinforcers for each participant based on interviews and direct observations. Results of the study indicated that sensory reinforcement was more resistant to satiation when multiple reinforcers were presented during a teaching session.

In another study, Charlop, Kurtz, and Casey (1990) compared food reinforcers to using participants' self-stimulatory behaviors as reinforcers on skill acquisition for children diagnosed with ASD. Results of this study indicated that task performance was higher when the researchers used a participant's own self-stimulatory behaviors rather than food reinforcers. Thus, across the three studies it appears that sensory reinforcement can be more effective than food reinforcement when teaching children a variety of tasks. Furthermore, sensory reinforcement might be more resistant to satiation.

Despite these findings there are still several questions, which should be explored by researchers. For one, the research comparing reinforcement classes for children diagnosed with ASD remains limited. Second, the previous research did not utilize formal assessments of different potential reinforcers, so it is not known if the researchers did indeed choose the most preferred reinforcers within a reinforcement class. Third, none of the studies incorporated participant choice, which has been shown to influence the effectiveness of reinforcement. Finally, none of the studies have compared different reinforcement classes to feedback (e.g., "Yes" or "No") alone.

Thus, the purpose of this study was to evaluate three reinforcement classes (i.e., food reinforcement class, toy reinforcement class, social reinforcement class) and feedback-only on skill acquisition for three children diagnosed with autistic disorder. This study evaluated the skill acquisition, maintenance, efficiency, and participant preference for each of the five participants.

Method

Participants

The participants in this study were three boys who all: (a) had a formal diagnosis of autistic disorder from a licensed psychologist from an

outside agency, (b) were between the ages of 4 and 5 years old, (c) had a previous history with discrete trial teaching, and (d) were receiving intensive behavioral intervention services from a private agency for 10 to 21 hours per week.

Perry was a four year old boy who was diagnosed with autistic disorder. Perry had a Wechsler Preschool and Primary Scale of Intelligence (WPPSI) full scale IQ score of 128, a Vineland Adaptive Behavior Scale (VABS) score of 94, and a Gilliam Autism Rating Quotient (GARS) of 98. At the time of the study, he was receiving 20 hours of behavioral intervention per week. Intervention focused on increasing attending and responding to adults and peers, increasing language, initiating play with peers, and using humor with peers.

J.D. was a four year old boy diagnosed with autistic disorder. J.D. had a WPPSII full scale IQ score of 86, a VABS score of 83, and a GARS Autism Quotient of 80. At the time of the study, J.D. was receiving 10 hours of behavioral intervention per week. Intervention focused on following instructions the first time asked, tolerating frustrating situations, increasing language, and decreasing self-stimulatory behavior (i.e., fidgeting, silly/scripted talk, gazing).

Chris was a five year old boy diagnosed with autistic disorder. Chris had a WPPSII full scale IQ score of 111, a VABS score of 85, and a GARS Autism Quotient of 83. At the time of the study, Chris was receiving 21 hours of behavioral intervention per week. Intervention focused on speaking clearly, sportsmanship, increasing language, and staying on topic in conversation with peers.

Setting

The researchers conducted all sessions in a small research room that was a part of a private clinic that provided behavioral services to children and adolescents diagnosed with ASD. The research room measured 2 meters by 4 meters. The room was furnished with a table, chairs, cabinets, and a couch.

Preference Assessment

The researchers conducted two paired preference assessments (Fisher et al., 1992) to determine each participant's preference for 10 different food items, two paired preference assessments to identify each participant's preference for 10 different toys, and two paired preference assessments to evaluate each participant's preference for five different social activities prior to baseline. During the paired preference assessments the researchers directly compared food items to food items only, toys to toys only, and social activities to social activities only. Thus, no comparison was made of items across different reinforcement classes (e.g., no food items were compared to tangible items). The researchers selected items across each of the reinforcement classes by observing the participant in his natural environment, interviewing the parents of the participant, and interviewing the participant's clinical team (e.g., teachers and therapists who work with the participant in the clinical setting). The top ten food and toy items identified were used in the paired preference assessment and the top five social activities identified were used in the paired preference assessment. The researchers conducted two preference assessments on different days to ensure that these preferences were consistent across days. The top three items within each reinforcement class that were selected most frequently, across the two preference assessments, were used throughout the course of the study.

Skills Taught

The researchers taught each participant to expressively label pictures. Perry and Chris were taught to expressively label pictures of cartoon characters (e.g., Woody Woodpecker, Sylvester, Dennis the Menace); J.D. was taught to expressively label pictures of different food items (e.g., bok choy, parsley, figs). The researchers selected these targets for two reasons. For one, the participants' supervisors indicated that these were skills that needed to be worked upon. Second, the targets were not being intervened upon during clinical teaching, which minimized the chance of the participants inadvertently learning the skills outside of the research sessions.

Each participant was taught a total of eight different skills. The researchers randomly assigned the eight targeted skills to the four

TABLE 1

Targeted Skills for All Participants

Participant	*Food Class*	*Tangible Class*	*Social Class*	*Feedback*
Perry	Woody Woodpecker & Denis the Menace	Wilma Flintstone & Porky Pig	Sylvester the Cat & Willy the Penguin	Roger Rabbit & George Jetson
J.D.	Olives & Enchiladas	Grapefruit & Fig	Passion Fruit & Pecan	Bok Choy & Parsley
Chris	Woody Woodpecker & Denis the Menace	Wilma Flintstone & Porky Pig	Sylvester the Cat & Roger Rabbit	George Jetson & Willy the Penguin

different reinforcement conditions (i.e., food reinforcement, toy reinforcement, social reinforcement, feedback-only). Thus, two skills were taught at a time in each of the four conditions. Table 1 provides a list of the skills taught to each participant across the four reinforcement conditions.

General Procedure

The researchers conducted sessions 3 to 5 days a week with sessions running anywhere from 15 to 40 minutes in total duration. During each research session a participant received a probe to test skill acquisition (see below) and the various reinforcement conditions. The study was broken into three conditions: baseline, intervention, and maintenance.

Baseline and maintenance. The baseline and maintenance condition consisted of the researchers implementing probe sessions (see below) to test if the participant already had the targets in his repertoire prior to intervention or if the participants were able to maintain the skills directly taught to them following intervention. In the baseline and maintenance condition, probe sessions consisted of 32 probe trials (see below). After these probe trials the participant returned to his regular clinical setting.

Intervention condition. During the intervention condition, each research session started with the researcher implementing a probe session (8 to 32 probe trials) to test ongoing learning and mastery of skills taught. Mastery criterion was set at three consecutive probe sessions with 100% correct responding on both targets being taught within a reinforcement condition. Probe sessions were followed by one of the four different reinforcement conditions. After the first reinforcement condition the researcher gave the participant a 2 min break and then implemented the second reinforcement condition. This was continued until all reinforcement conditions had occurred. After all reinforcement conditions were implemented the participant returned to his regular setting. The order of the reinforcement conditions was randomly determined prior to the research session so that the researchers could minimize the potential of a sequencing effect.

During each reinforcement condition the researchers conducted a total of 10 teaching trials. Once a participant reached mastery criterion during the probe sessions with one of the reinforcement conditions, the researchers no longer implemented that reinforcement condition nor did they conduct probe trials for the skills that had reached mastery criterion. Therefore, the number of reinforcement conditions and the number of probe trials was reduced as participants reached mastery criterion on each of the four conditions.

Probe Session

The researchers implemented probe sessions prior to, during, and following intervention. Probe sessions were conducted to establish a baseline, to determine mastery, and to determine maintenance for each of the five participants. A probe trial began with the researcher presenting a picture to the participant, then providing an instruction to the participant

(i.e., "Who is this?", "What is his name?", "What is the name of the food?"). The participant had 5 sec to respond to the instruction. Regardless of the participants response (i.e., correct response or incorrect response) the researcher provided neutral feedback (e.g., "Thanks", "Thank You", or "Thanks for Trying"). If the participant did not respond (i.e., remained silent without providing any expressive label) within 5 sec then the investigator began the next predetermined trial without comment.

During the baseline and maintenance condition there were always a total of 32 probe trials. During the intervention condition there could be anywhere from 8 to 32 probe trials (dependent upon a participant reaching mastery criterion for skills in a certain condition). All targets were randomly sequenced prior to the probe session. During intervention, the criterion for learning a pair of stimulus items for an individual reinforcement condition was expressively labeling each item of a pair correctly on all probe trials (100%) across three consecutive sessions. Once participants met mastery criterion for a pair of stimuli, teaching on that pair stopped and the items were no longer probed. Therefore, as participants reached mastery criterion, the number of probe trials decreased. Following probe sessions during intervention, the researchers provided the participant with a 2 min break prior to beginning the first reinforcement condition.

Reinforcement Sessions

Each of the four reinforcement conditions consisted of 10 teaching trials. The order of targets was also randomly determined ahead of time. A teaching trial for each of the four reinforcement conditions began with the researcher presenting the picture to the participant. Next, the researcher provided the participant with an instruction (e.g., "Who is this?"). The researcher then gave the participant 5 sec to respond to the instruction. If the participant responded correctly (e.g., said the word "figs" when showed a picture of figs), the researcher made a general praise statement (e.g., "That's it") and provided the participant with a choice between the three reinforcers, (i.e., the three food items, the three toys, or the three social activities) depending on which reinforcement condition was being implemented. After the participant had access to the item for the specified duration (see below) the investigator started the next teaching trial. If the participant responded incorrectly (e.g., said the word "figs" when shown a picture of bok choy), or did not respond to the instruction, within 5 sec the researcher said "No" and stated the correct response (e.g., "It is figs.").

Food condition. Three potential food reinforcers were identified for each participant during the paired preference assessments. For Perry, the potential food reinforcers were animal crackers, marshmallows, and water (although not a food, was highly desirable). For J.D., the potential food reinforcers were fruit snacks, pop corn, and gummy bears. For Chris, the potential food reinforcers were licks of a lollipop, gummy bears, and fruit snacks. If the participant responded correctly, he had a choice of one of his three food items. Once the participant selected which food item he wanted, the researcher provided three small pieces of that food item and did not start the next teaching trial until the participant had consumed the food item.

Tangible condition. The assessments yielded three potential toy reinforcers for each participant. For Perry, the toy reinforcers were a book, a Superman action figure, and a car from the movie Cars. For J.D., the toy reinforcers were a book, a light wand, and a ball. For Chris, the toy reinforcers were a car from the movie Cars, a ball, and a Superman action figure. If the participant responded correctly, he had a choice of one of his three toy items. Once the participant selected which toy item he wanted, the researcher provided 10 sec access to that item and the researcher did not engage with the participant during this time.

Social condition. Three potential social reinforcers were identified for each participant during the paired preference assessments. For Perry, the social reinforcers were the researcher and Perry engaging in a silly dance, the researcher giving Perry high fives at a rapid pace, and the researcher taking Perry's arms and moving them up and down rapidly (spaghetti arms). For J.D. and Chris, the social reinforcers were the researcher and J.D./Chris engaging in a silly dance, the researcher giving J.D./Chris a foot high five, and the

researcher pretending to crack an egg on J.D./Chris' head. If the participant responded correctly he had a choice of one of his three social reinforcers (which were pictured on an index card) and the researcher provided 10 sec access to the social activity that the participant selected.

Feedback-only condition. Teaching trials in this condition were identical to the previous three conditions with the exception of the consequence that the researchers provided to the participant. If the participant responded correctly, the researchers simply said "Yes" and if the participant responded incorrectly, or did not respond at all, the researchers simply said "No" and stated the correct response. The consequent event (e.g., saying "No" and providing the correct response) was identical to the consequent events used in the other three reinforcement conditions. It should also be noted, that the use of "Yes" and "No" as feedback could also be classified as a conditioned social reinforcer, if it changed the behavior of the participants. Nevertheless, this conditioned social reinforcer is vastly different from the reinforcement used in the social condition and is different from how social reinforcement is used in best clinical practice.

Participant Preference among the Four Reinforcement Cconditions

To assess participant preference among the four reinforcement conditions, the researchers implemented a concurrent-chain arrangement (Hanley, Piazza, Fisher, Contrucci, & Maglieri, 1997). Prior to baseline the researchers conducted a single paired preference assessment across ten different shirt colors. The four shirts that the participant selected at a near equivalent frequency were randomly assigned to one of the four reinforcement conditions. The shirt color that the participant selected most frequently was used as a control shirt.

During every reinforcement session the researcher wore the color of shirt that corresponded to the reinforcement condition (e.g., the researcher wore a yellow shirt during the food condition if the yellow shirt was assigned to the food condition); additionally, a color mat of the same color was placed on the table. During every third research session, right after the probe session, the researcher placed all five colors of shirt on the floor or on the couch with the corresponding array of reinforcers displayed on top of the shirt. The researcher asked the participant to touch what he wanted to work for first. The reinforcement condition that corresponded with the colored shirt and reinforcers that the participant selected was then implemented first. After the first reinforcement session had concluded the researcher asked the participant to choose the next color of shirt and reinforcers that he wanted to work for and then implemented the corresponding condition; this occurred until all reinforcement conditions were implemented. If, at any time, the participant selected the shirt color that corresponded to the control condition, the researcher concluded that the student was not making meaningful choices and the researcher selected the order of the remaining reinforcement conditions.

Dependent Measures and Response Definitions

There were several dependent measures in this study. The main measure was participant's skill acquisition and maintenance of the targets taught for each of the four reinforcement conditions. Skill acquisition and maintenance were determined by participant responding during probe sessions. During probe trials, researchers recorded a correct response if the participant correctly labeled the picture that was shown (e.g., saying "figs" when shown a picture of figs) within 5 s of the researcher's instruction. The researchers also recorded whether the participant responded incorrectly or if they did not respond within 5 s of the instruction.

The second measure of this study was participant responding during each of the four reinforcement conditions. During teaching trials, researchers recorded a correct response if a participant labeled the picture that was shown within 5 s of the researcher's instruction. The researchers also recorded whether the response was incorrect, or if the participant did not respond.

The third measure of the study was the efficiency with which the participants learned each of the targets under the four reinforcement conditions. To measure the efficiency the researchers looked at the total number of sessions and the total amount of teaching tri-

als it took the participant to reach mastery criterion under each of the four reinforcement conditions. The fourth measure was the participants' preference for the four reinforcement conditions as determined by the concurrent chain operation described above (Hanley et al. 1997).

Interobserver Agreement and Treatment Fidelity

The instructor recorded all participant responding in vivo and an independent observer recorded participant responding by videotape during 37% (range, 33% to 45% across participants) of probe sessions, 35.7% (range, 33% to 37.5% across participants) of intervention sessions within the food condition, 37.5% (range, 33% to 42.6% across participants) of intervention sessions within the tangible condition, 35.8% (range, 33% to 36.4% across participants) of intervention sessions within the social condition, and 40% (range, 35.7% to 50% across participants) of intervention sessions within the feedback-only condition. Interobserver agreement was calculated by totaling the number of agreements (i.e., trials for which both observers scored the same participant behavior) on each type of participant response divided by the number of agreements plus disagreements (i.e., trials in which the two observers scored a different participant behavior) and converting this ratio to a percentage. Percentage agreement across all participant responses was 99.6% (range, 93.8% to 100% across sessions) of probe trials, 100% during the food condition, 100% during the tangible condition, 99.2% (range, 90% to 100% across sessions) during the social condition, and 100% during the feedback-only condition.

The final measure was correct instructor behaviors during the probe session and each of the four reinforcement conditions. Correct instructor behaviors during probe sessions were defined as the researcher: (a) showing the correct stimuli or placing the correct stimuli on the table; (b) delivering a correct instruction (e.g., saying "Who is it?") to begin the teaching trial; (c) allowing the participant 5 s to respond; (d) not providing a prompt; and (e) saying "thank you" or "okay" if the participant responded. Correct instructor behaviors during reinforcement sessions were defined as the researcher: (a) showing the correct stimuli to the participant; (b) delivering a correct instruction (e.g., saying "Who is it?") to begin the teaching trial, (c) allowing the participant 5 s to respond; (d) providing a general praise statement if the participant responded correctly; (e) giving the participant a choice between the three reinforcer items; (f) providing the participant with access to the correct reinforcer for the appropriate amount of time; and (g) providing corrective and informative feedback only when the participant responded incorrectly.

To assess treatment fidelity, an independent observer measured correct instructor behavior (as described above) via video recording during 37% (range, 33% to 45.4% across participants) of probe sessions, 35.7% (range, 33.3% to 37.5% across participants) of intervention sessions within the food condition, 37.5% (range, 33.3% to 42.8% across participants) of intervention sessions of the tangible condition, 35.8% (range, 33.3% to 36.4% across participants) of intervention sessions within the social condition, and 40% (range, 35.7% to 50% across participants) of intervention sessions within the feedback-only condition. Correct instructor behavior was displayed during 99.8% of probe trials, 100% of food teaching trials, 98.8% of tangible teaching trials, 100% of social teaching trials, and 100% of feedback-only teaching trials.

Experimental Design

The researchers used a parallel treatments design to evaluate the effectiveness of the four reinforcement conditions on each participant's acquisition of different skills. A parallel treatments design can be used when there are two or more sets of dependent variables and where there are two or more sets of independent variables being implemented. The dependent variables should be equivalent in terms of difficulty. Typically, when using a parallel treatment design there is a probe condition that is implemented prior to the reinforcement conditions. A baseline condition is not required, but is strongly recommended. It is important that the order of the independent variables is random and counterbalanced and that the participant is able to discriminate between the different independent variables.

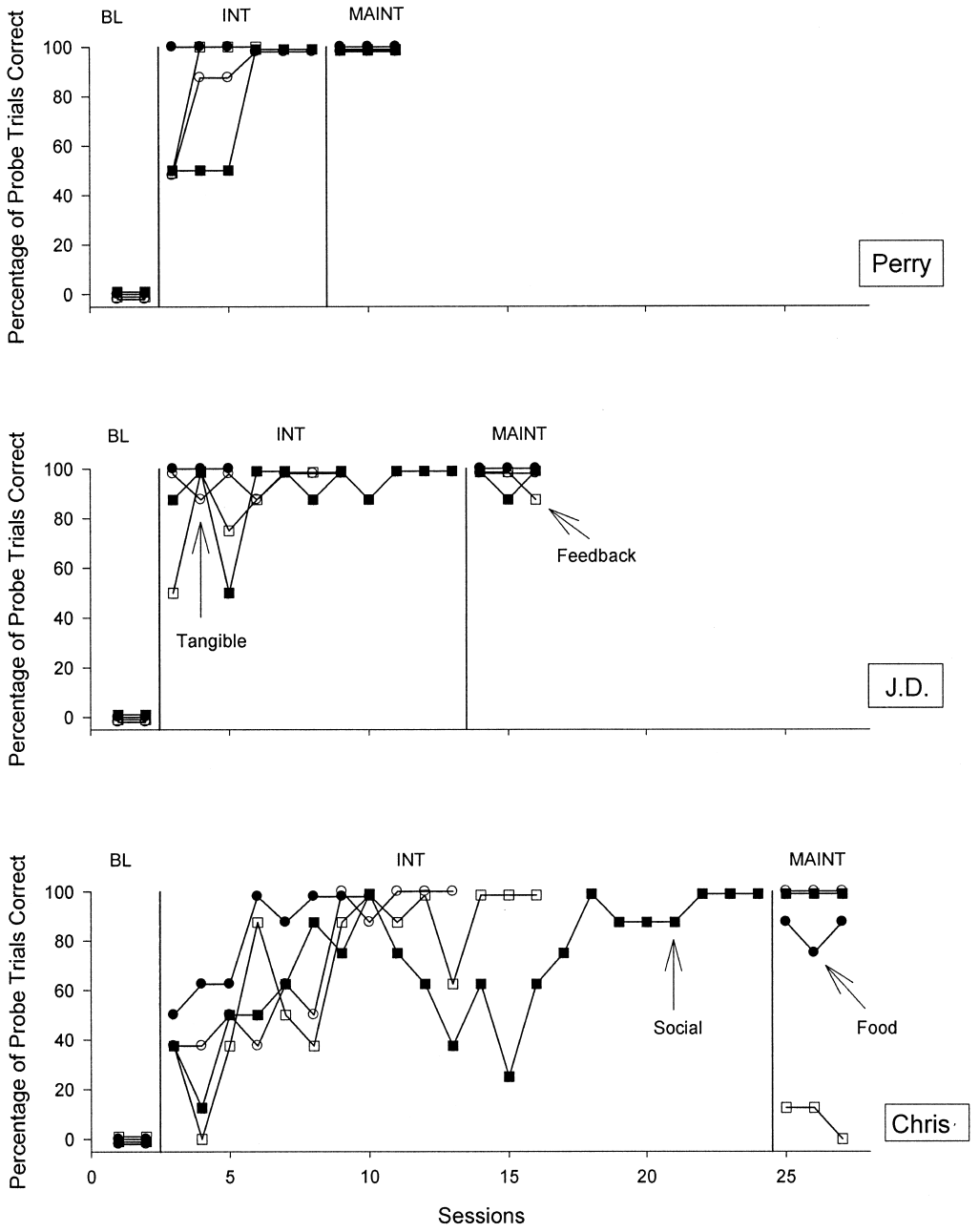

Figure 1. Probe Data for Perry, J.D., and Chris

Results

Skill Acquisition and Maintenance

Figure 1 displays the participants' performance during probe trials prior to intervention, during intervention, and once intervention was completed. Each panel of the graph represents a different participant. Sessions are displayed across the X-axis and percentage of correct probe trials are displayed along the

Y-axis. Closed circles represent the food condition, open circles represent the tangible condition, closed squares represent the social condition, and open squares represent the feedback-only condition. On Figure 1, the data points for the four conditions fall on the same session (e.g., the food condition for session one and the tangible condition for session one are both displayed on session one); thus, the graph does not show the order in which the independent variable was implemented each session. However, Figure 2, which represents participant responding during teaching (see below), does show the order of the implementation of the independent variable. It should also be noted that the first day in which the intervention was implemented there was no probe session conducted; thus, the first probe session of the intervention condition was implemented after the first reinforcement session.

Perry was able to reach mastery criterion on his eight targets across the four reinforcement conditions. Perry first reached mastery criterion on the food condition, followed by the feedback-only condition, and then reached mastery criterion on the social and tangible conditions during the same research session. During baseline probe sessions, Perry demonstrated 0% correct responding and during maintenance probe session demonstrated 100% correct responding, across the four reinforcement conditions.

J.D. was able to reach mastery criterion on his eight targets across the four reinforcement conditions. J.D. first reached mastery criterion on the food condition, followed by the feedback-only and tangible conditions during the same research session, and then the social condition. During baseline probe session, J.D. demonstrated 0% correct responding across the four conditions. During maintenance probe sessions, J.D. demonstrated 100% correct responding on the food, tangible and social conditions and an average of 96% correct responding for the feedback-only condition.

Chris was able to reach mastery criterion on his eight targets across the four reinforcement conditions. Chris first reached mastery criterion on the food condition, followed by the tangible condition, then the feedback-only condition, and then the social condition. During baseline probe sessions, Chris demonstrated 0% correct responding across the four conditions. During maintenance probe sessions, Chris demonstrated an average of 84%, 100%, 100%, and 9% correct responding for the food, tangible, social, and feedback-only conditions, respectively.

Teaching Trial Data

Figure 2 displays the participants' performance during teaching across the four reinforcement conditions. Each panel of the graph represents a different participant. Sessions for individual conditions are displayed across the X-axis and percentage of correct responding on teaching trials is displayed along the Y-axis. Closed circles represent the food condition, open circles represent the tangible condition, closed squares represent the social condition, and open squares represent the feedback-only condition. The order of reinforcement conditions is displayed on the graph.

Across all four reinforcement conditions, Perry's average correct responding during teaching trials was above 80%. For the food condition, Perry's average correct responding was 90%. For the tangible condition, Perry's average correct responding was 82%. For the social condition, Perry's average correct responding was 85%. For the feedback-only condition, Perry's average correct responding was 80%. Thus, Perry showed the best correct responding in the food condition and the least correct responding in the feedback-only condition.

J.D.'s average correct responding during teaching trials was above 80% for three of the four reinforcement conditions. For the food condition, J.D.'s average correct responding was 83%. For the tangible condition, J.D.'s average correct responding was 90%. For the social condition, J.D.'s average correct responding was 89%. For the feedback-only condition, Perry's average correct responding was 72%. Thus, JD showed the best correct responding in the social condition and the least correct responding in the feedback-only condition.

Chris's average correct responding during teaching trials was above 80% for three of the four reinforcement conditions. For the food

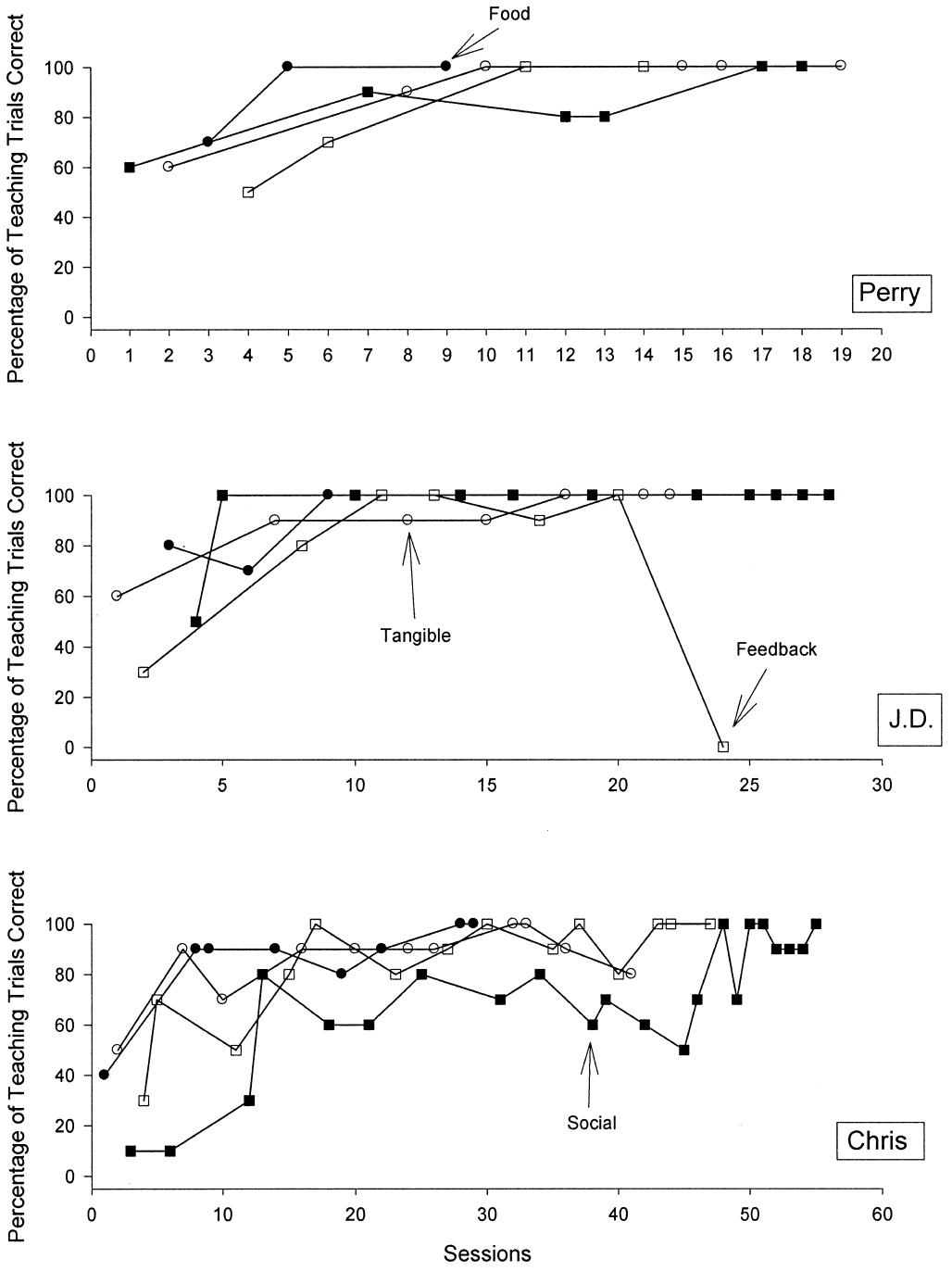

Figure 2. Teaching Data for Perry, J.D., and Chris

condition, Chris's average correct responding was 85%. For the tangible condition, Chris's average correct responding was 86%. For the social condition, Chris's average correct responding was 70%. For the feedback-only condition, Chris's average correct responding was

TABLE 2

Total Reinforcement Sessions and Teaching Trials

	Food Condition		*Tangible Condition*		*Social Condition*		*Feedback Condition*	
Participant	*Sessions*	*Trials*	*Sessions*	*Trials*	*Sessions*	*Trials*	*Sessions*	*Trials*
Perry	3	30	6	60	6	60	4	40
J.D	3	30	7	70	11	110	7	70
Chris	8	80	11	110	22	220	14	140

84%. Thus, Chris showed the best correct responding in the tangible condition and the least correct responding in the social condition.

Efficiency

Table 2 represents the total number of teaching sessions and teaching trials for each of the participants. For all three participants the food condition resulted in the fewest number of sessions and trials. For Perry, the tangible and social conditions took the most trials and sessions to reach mastery; for J.D. and Chris, the social condition took the most trials and sessions to reach mastery criterion.

Participant Preference

Across all participants the food condition was selected the most frequently. Perry had two opportunities to make a preference selection and selected the food and toy condition in these two selections. J.D. had three opportunities to make a selection and chose the food condition twice and the feedback-only condition one time. Chris had seven opportunities to make a preference selection; Chris selected the food condition four times, and the social condition, toy condition, and the control shirt one time each.

Discussion

This study evaluated the effectiveness of four different reinforcement classes on teaching expressive labeling for three participants diagnosed with autistic disorder. The results of the study indicated that all three participants were able to reach mastery criterion for skills taught with all four classes of reinforcement. Results were mixed as far as participants' correct responding during teaching trials; each participant had a better average rate of correct responding during different reinforcement conditions. For each participant, the food condition did result in the fewest number of trials and sessions for participants to reach mastery criterion and the social condition resulted in the most trials and sessions for the participants to reach mastery criterion. Finally, participants showed a strong preference for food reinforcers compared to the other reinforcement classes.

Findings from this study are similar to previous research in that a variety of reinforcement classes can be effective in teaching children with ASD a variety of skills. This study differs from the previous research in that food reinforcers were found to be more effective than other classes of reinforcement. This study also adds to the literature in several ways. For one, it is the first study to look at participants' preference among different reinforcement classes; all three of the participants preferred the reinforcement class that was the most efficient. Second, the study was the first to provide participant choice within reinforcement classes, which may help increase the effectiveness of a reinforcement class (e.g., Tiger, Hanley, & Hernandez, 2006). Finally, the study was the first to compare different reinforcement classes to instructional feedback (i.e., "Yes" or "No") alone and show that instructional feedback alone may be just as effective as using different reinforcers for teaching fairly easy tasks to some children with autism. Therefore, these results have several

implications for clinicians working with children diagnosed with ASD.

For one, clinicians may wish to analyze which reinforcement classes are the most effective prior to teaching new skills, so that the most effective and efficient teaching procedures are being implemented. Second, clinicians should not assume additional reinforcers (e.g., food, toys, social activity) are needed to teach new skills, as feedback alone might be just as effective. This could be because the feedback (e.g., yes or no) serve as a mild conditioned social reinforcer or punisher and that additional conditioned reinforcers are not warranted. Third, although social praise may not be the most effective, it may still be important for clinicians to teach the value of praise to children with ASD. Clinicians may wish to condition social praise using similar methods as described by Leaf et al. (2012). Finally, clinicians should use a variety of reinforcers, as the results from this study indicate that different reinforcement classes are effective in teaching new skills.

Despite the positive findings of this study and the potential implications for clinicians working with children diagnosed with an autism spectrum disorder there are several limitations of the current study. One limitation of this study is that the researchers did not measure the motivating operations for each of the participants under the four reinforcement classes; nor did we withhold the toys and food items from the participants throughout the course of the day. Therefore, it is possible that the participants were in a state of satiation prior to teaching and that this state of satiation may have decreased the reinforcers' effectiveness. Additionally, recent research has demonstrated that the motivational power of reinforcers can be significantly altered by the manner in which a student is exposed to them (Leaf et al., 2012). Thus, although one stimuli might not be the most effective reinforcer initially a teacher can condition that stimuli to be a powerful reinforcer. A second limitation is that we did not assess preference of items across different reinforcement classes; thus, it is not known what the participants' relative preferences were. This is important, as participants' preference for items are typically indicative of their effectiveness as reinforcers. Thus, a less preferred item across classes may be less reinforcing. Future researchers should implement preference assessments across different classes.

Third, we did not measure how long participants had access to the food item during the food condition. Instead, we did not start a new trial until the participant finished consuming the food item; this could have resulted in a longer or shorter intertrial interval, as compared to the other conditions. Future researchers may wish to hold the time constant during a food condition. A fourth limitation is that experimental control is partially weakened due to the rapid acquisition of skills across the four conditions. Ideally, when implementing a parallel treatments design, one independent variable results in more rapid skill acquisition than other independent variables. In this study there was rapid skill acquisition for most conditions across the three participants. Although there was rapid skill acquisition across conditions, differences can still be observed in the rate of skill mastery. The data still demonstrates that multiple types of reinforcers can be effective in teaching children diagnosed with autistic disorder.

A fifth limitation is that there were a limited number of participants (three) learning a fairly simple task (expressive labeling). Thus, the results are limited in terms of external validity. However, this was an initial study looking at the effectiveness of different reinforcers across different reinforcer classes. Future researchers can expand on these results by evaluating different reinforcer classes with a wide range of participants on a wide range of tasks. Additionally, future researchers may wish to compare the effectiveness and efficiency of reinforcer classes using a larger number of participants, perhaps evaluating the effects using a group design rather than a single subject design. A final limitation of the study is that each of the reinforcement conditions (e.g., food condition) was relatively short in duration; so it is not known how effective reinforcers in each of the four reinforcement classes would be during longer teaching sessions. Future researchers should examine how the use of reinforcers over more extended time periods could lead to more pronounced differences in factors such as satiation and the impact of reinforcer type on health and well being of the learner. It may be that certain

reinforcers that are less motivationally powerful (e.g., social reinforcers) could have fewer negative side effects and/or more positive side effects. Despite these limitations this study showed that a variety of reinforcement classes were effective in teaching three children diagnosed with autistic disorder expressive language skills.

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