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A COMPARISON OF DIFFERENTIAL REINFORCEMENT PROCEDURES WITH CHILDREN WITH AUTISM

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The current evaluation compared the effects of 2 differential reinforcement arrangements and a nondifferential reinforcement arrangement on the acquisition of tacts for 3 children with autism. Participants learned in all reinforcement-based conditions, and we discuss areas for future research in light of these findings and potential limitations.

Key words: differential reinforcement, reinforcement magnitude, reinforcement quality

Differential reinforcement arrangements have been recommended for use during skill-acquisition programs (e.g., Leaf & McEachin, 1999; Lovaas, 2003). A small group of studies has manipulated either reinforcement schedule (e.g., Hausman, Ingvarsson, & Kahng, 2014) or reinforcer quality (Karsten & Carr, 2009). We identified two studies that involved a comparison of differential reinforcement arrangements for individuals with autism. Cividini-Motta and Ahearn (2013) demonstrated that manipulation of reinforcement quality was most effective for three participants, whereas manipulation of reinforcement schedule was most effective for one participant. Fiske et al. (2014) compared nondifferential reinforcement to manipulations of reinforcement magnitude and schedule. The results indicated that nondifferential reinforcement was most efficient for two participants, and the reinforcement schedule manipulation was most effective for one participant.

The purpose of the current study was to compare the effects of nondifferential reinforcement and the manipulation of reinforcement quality and magnitude on responding during tact training for children with autism. In doing so, the current study is the first to compare reinforcement magnitude and quality.

METHOD

Participants

Erin, Carl, and Mike were 10, 8, and 7 years old, respectively. All had a diagnosis of autism, had been receiving behavior-analytic services for at least 5 years, could imitate vocalizations, had

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previous exposure to 0-s prompt-delay procedures to learn tacts, and were primarily engaged in instruction that provided the manipulation of quality as a differential reinforcement contingency (e.g., praise and edible items for unprompted correct responses, praise for prompted correct responses). Additional participant information is available from the second author.

Setting and Materials

All sessions were conducted at a desk in the participants' learning areas in a school that provided behaviorally based educational services. A video camera recorded some sessions for purposes of collecting data on interobserver agreement and treatment integrity.

Five or 10 unknown tacts (e.g., pictures of food, vehicles, and animals) were identified for each condition (procedures for identifying unknown images are available from the second author). During the treatment conditions, each picture was affixed to one of four colored pieces of paper (associated with a specific treatment condition), placed in a page protector, and presented in a three-ring binder. In addition, a matching colored sheet of paper in a clear page protector was placed on top of each picture to prevent participants from viewing the picture before the experimenter's instruction to label the picture.

Dependent Variables and Interobserver Agreement

The experimenter scored correct unprompted, incorrect unprompted, correct prompted, and incorrect prompted responses on data sheets. A *correct unprompted response* was defined as the participant emitting the correct tact before the delivery of the prompt. Only correct unprompted responses were included in the session data. Other response definitions are available from second author.

A second independent observer scored a minimum of 34% of baseline and treatment sessions across all participants. Trial-by-trial interobserver agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and converting the result to a percentage. The mean agreement scores were 100% for Erin, 98% (range, 90% to 100%) for Carl, and 99% (range, 90% to 100%) for Mike.

Preference Assessments

We conducted separate paired-stimulus preference assessments (Fisher et al., 1992) to identify the edible items and colors (to be assigned as condition-correlated stimuli) to be used during the reinforcement evaluations and the treatment comparisons. A single-trial multiple-stimulus-without-replacement preference assessment was conducted before each reinforcer evaluation and treatment session using the top four or five items identified from the preference assessment. The first item selected was used during the subsequent reinforcer assessment or treatment session.

Edible Amount and Edible Size Assessments

An assessment was conducted to determine the number of pieces of an edible item (hereafter referred to as *edible amount*) to be delivered for correct unprompted responses during the quality, magnitude, and nondifferential conditions and following correct prompted responses during the nondifferential condition. On each trial of the assessment, the experimenter placed a large number of pieces of an edible item in a closed container (e.g., 50 Skittles) and presented the instruction, "You can open the box and eat the [edible item] if you want." The participant had a 5-min free access period for each of his or her top four or five edible items identified in the preference assessment. The number of pieces of an edible item consumed was counted and divided by the number of trials in a session (i.e., 20). If the total number of items consumed was not divisible by 20, the value was rounded to the nearest whole number. The edible amount identified (e.g., two Skittles) was then used in the reinforcer evaluations and treatment conditions.

We conducted an assessment to determine the size of the edible item that was provided after correct prompted responses during the magnitude condition (hereafter referred to as *small edible*). Rather than arbitrarily selecting this small magnitude value, we chose to identify the smallest size of an item that the participant would continue to respond to consume in order to maximize the difference between magnitude values. The experimenter placed a single piece of an item in a closed container and presented the instruction, "You can open the box and eat the [edible item] if you want." If the participant opened the container and consumed the item, it was reduced in size by 50%, and another trial was initiated. The assessment was terminated if the participant did not open the container to consume the item within 30 s of the experimenter's instruction or if the participant consumed the item when it was one eighth of the original size. This was repeated for each participant's top four or five edible items identified in the preference assessment.

Reinforcer Evaluations

Each participant completed three progressive-ratio reinforcer evaluations (Roane, Lerman, & Vorndran, 2001): praise versus no consequences, praise versus the edible amount and praise, and small edible and praise versus the edible amount and praise. An arbitrary response was selected for each participant to complete. Procedural details are available from the second author.

Design and General Procedure

An adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) was used. Sessions consisted of 20 trials, and one session per experimental condition was conducted per day, 1 to 5 days per week, with a minimum of 5 min between each condition. Session order was determined randomly without replacement. Each target was presented equally as often within a session and was not presented on more than two consecutive trials, and the order of targets was rearranged each session. A different color was associated with each condition, and the participant had to touch each colored binder before each session. A progressive prompt-delay procedure was implemented (details can be obtained from the second author). The experimenter provided a model prompt following incorrect unprompted responses and initiated the next trial if the participant did not respond correctly to the prompt. Teaching for all targets continued until participants demonstrated correct unprompted responding at or above 90% for two consecutive sessions.

Baseline. When the picture was in view, the experimenter said, "What is this?" The participant had 5 s to respond. The experimenter did not provide feedback for correct or incorrect responses.

Quality. After the participant touched the colored binder associated with the quality condition, the experimenter presented the instruction to label the picture. During the two sessions with trials conducted with a 0-s prompt delay, the experimenter provided praise and the edible amount after each correct prompted response. During sessions that involved trials conducted with a 1 s or longer prompt delay, the experimenter provided the predetermined edible amount (as identified in the edible amount assessment) and praise after each correct unprompted response and provided praise only after a correct prompted response.

Magnitude. Sessions were identical to those in the quality manipulation except the experimenter provided the predetermined edible amount and praise after correct unprompted responses and the small edible item (as determined in the edible size assessment) and praise after correct prompted responses.

Nondifferential reinforcement. These sessions were the same as above, except the experimenter provided the predetermined edible amount and praise after both correct unprompted and prompted responses.

Control. As in baseline, during these sessions, prompts and reinforcers were not provided.

Treatment Integrity

Treatment integrity data were collected for a minimum of 34% of sessions for each participant and were calculated by dividing the number of correctly implemented steps by the number of correctly implemented steps plus the number of incorrectly implemented steps and converting the result to a percentage. Mean treatment integrity scores were 99% for all three participants. A second observer also collected treatment integrity data for 10% of sessions. Mean treatment integrity interobserver agreement was 99% for Erin, 100% for Carl, and 99% for Mike.

RESULTS AND DISCUSSION

During the reinforcer evaluations, the participants engaged in an average of 191 (range, 60 to 380) more cumulative responses in the praise condition than in the no-consequence condition and an average of 170 (range, 119 to 258) more cumulative responses in the edible-amount-plus-praise condition than in the praise-alone condition. Participants engaged in an average of 249 (range, 57 to 508) more cumulative responses in the edible-amount-plus-praise condition than in the small-edible-plus-praise condition. These results demonstrate that the edible amount plus praise represented a more valuable reinforcer than praise alone and the small edible plus praise for all participants.

Figure 1 displays the results of the treatment comparison. During baseline, none of the participants engaged in unprompted correct responses. In the treatment comparison, all participants demonstrated increases in the percentage of unprompted correct responses in the three training conditions, and responding remained at or near 0% in the control condition. Carl demonstrated mastery in 14 (280 training trials), 17 (340 training trials), and 17 (340 training trials) training sessions for the magnitude, quality, and nondifferential conditions, respectively. Mike demonstrated mastery in 16 (320 training trials), 20 (400 training trials), and 23 (460 training trials) training sessions in the quality, nondifferential, and magnitude conditions, respectively. Erin demonstrated mastery in 18 (360 training trials), 23 (460 training trials), and 26 (520 training trials) training sessions in

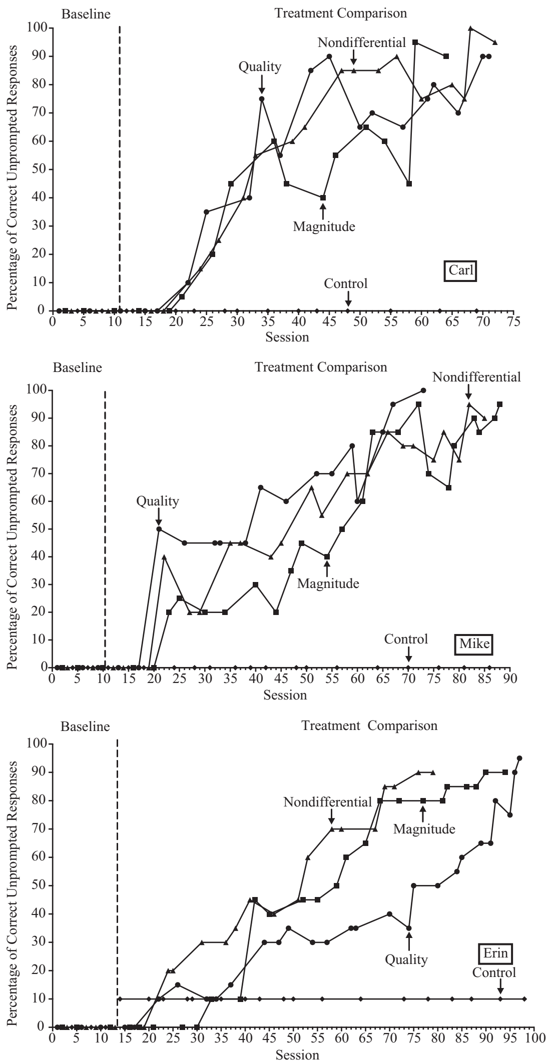

Figure 1. Percentage of correct unprompted responses for Carl, Mike, and Erin.

the nondifferential, magnitude, and quality conditions, respectively. Although a differential reinforcement procedure ultimately resulted in the most efficient acquisition for Carl and Mike, nondifferential reinforcement was not clearly detrimental in any given case or across participants. Carl and Mike acquired targets in the nondifferential condition, and Erin acquired targets in the least number of sessions under this reinforcement arrangement.

Although the results of the current study may demonstrate the need for clinicians to alter reinforcement arrangements based on each individual learner's responding instead of using one reinforcement arrangement across learners, future studies should address some potential limitations of the current evaluation. First, we arranged nondifferential reinforcement during the initial two training sessions while the 0-s prompt delay was in effect. Then, after the increase in the prompt delay, we implemented the differential reinforcement contingencies in the quality and magnitude conditions. We arranged this sequence to provide the highest quality or magnitude of reinforcers during initial training trials (as would be likely in clinical practice), but doing so may have introduced a confounding effect in that this sequence exposed all participants to nondifferential reinforcement across all conditions. It is unclear what, if any, effect this arrangement may have had on the responding of participants across conditions. Future studies could arrange training so that differential reinforcement contingencies are in place from the onset of treatment. Second, the amount of overlapping data may suggest carryover effects between conditions or that the participants failed to discriminate which condition was in effect. Future studies could take additional steps to facilitate the discrimination between conditions (e.g., arrange differential reinforcement from treatment onset). Third, the lack of intrasubject replication limits conclusions as to the consistency of these results. Future studies could conduct intrasubject replications to evaluate the consistency of outcomes, and determine if results would be similar if targets other than tacts were taught (e.g., intraverbals).

These limitations notwithstanding, the current study extends previous research, because it is the first to compare differential reinforcement quality and magnitude manipulations. Whereas previous differential reinforcement studies have largely evaluated the effects of reinforcer schedule manipulations, magnitude and quality manipulations were selected because these arrangements may be more practical than schedule manipulations in clinical settings. In addition, in previous studies it is unclear how experimenters selected the edible amounts and sizes, and this study proposes an empirical methodology for determining these variables.

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