

ASSESSING THE VALUE OF TOKEN REINFORCEMENT FOR
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The use of token systems has been supported across a variety of populations, but little research has evaluated the reinforcing value of token systems for individuals with autism. We used progressive-ratio schedules to compare the reinforcing value of an established token system, primary reinforcement, and tokens unpaired with reinforcement. Token systems were variably reinforcing for 2 students with autism and more so than primary reinforcement for 1 student. Results support formal assessment of the effectiveness of token systems.

Key words: token economy, reinforcement, progressive-ratio schedules, autism

A *token* is defined as “an object or symbol that is exchanged for goods or services” (Hackenberg, 2009; p. 257). Tokens may be established as conditioned reinforcers through their relation with known, established reinforcers. Token systems have been used successfully with individuals with autism to increase verbal and printing skills (Steeves, Martin, & Pear, 1970), spontaneous questioning (Hung, 1977), attending (Tarbox, Ghezzi, & Wilson, 2006), verbal interactions (McDonald & Hemmes, 2003), and food consumption (Kahng, Boscoe, & Byrne, 2003). However, token systems are not universally effective (Ayllon & Azrin, 1965; Charlop-Christy & Haymes, 1998). Therefore, assessing the reinforcing value of token systems may be an important step in the evaluation of variables that contribute to limited skill acquisition or poor behavioral response to treatment.

Prior research has evaluated the value or potency of reinforcers using progressive-ratio (PR) schedules (e.g., Francisco, Borrero, & Sy, 2008; Roane, Lerman, & Vorndran, 2001; Trosclair-Lasserre, Lerman, Call, Addison, & Kodak, 2008). In the current study, we used PR schedules to assess the reinforcing value of tokens from preexisting token

systems, compared to primary reinforcement, for two individuals with autism who exhibited off-task behavior in demand settings.

METHOD

Participants and Setting

Two individuals with autism who attended a center-based school program participated. Intelligence quotients were measured using the Stanford-Binet Intelligence Test (Roid, 2003). Annie was a 7-year-old girl (IQ = 42), and James was a 14-year-old boy (IQ = 40). Annie’s seven-token system and James’s three-token system had been established 1 year and at least 5 years before the start of the study, respectively. Both students demonstrated variable performance in skill-acquisition programs in their classrooms; this led to an evaluation of the effectiveness of their current token systems.

Two sessions (Annie) or one session (James) were conducted per school day, with 5-min breaks scheduled between contiguous sessions. Sessions were randomly ordered and lasted from 1 to 18 min. Sessions took place in a small research room that contained a table, chairs, and instructional materials.

Response Measurement and Interobserver Agreement

The total number of task responses completed per session was recorded using a frequency count.

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Break points were determined for each student by identifying the last successfully completed PR step before session termination. Session duration, from the initiation of the first response to session termination, also was recorded.

A second observer collected interobserver agreement data for task responses during 72% of Annie's and 50% of James's sessions. Interobserver agreement data were calculated by dividing the smaller number of responses from the two observations by the larger and converting the result to a percentage. Interobserver agreement averaged 93% (range, 80% to 100%) for Annie and was 100% for James.

General Procedure

The five most highly preferred edible items identified using a paired-choice preference assessment (Fisher et al., 1992) were used in multiple-stimulus-without-replacement (MSWO) preference assessments (DeLeon & Iwata, 1996) conducted before and during each token and each primary reinforcement session. The most highly preferred item in the MSWO assessment was selected as the back-up reinforcer for the session. Consistent with classroom practice, an MSWO assessment was repeated after the completion of each token board during the token condition.

Reinforcer assessments were conducted using a PR schedule as described by Roane et al. (2001). Students were required to complete a predetermined number of responses that increased in size according to a PR schedule (PR 1, 2, 3, 4, 6, 8, 10, 15, 20, 30, 40, 50, 60, 70, 80). After each step completion, students received condition-specific stimuli (i.e., token, edible item) and were allowed 5 s to consume the edible item or place the token on the board before the next PR step was initiated. Each session ended when the student said he or she was "all done" or ceased responding for 1 min. Otherwise, the session terminated after the last PR step prescribed by the schedule.

Because students were removed from regular classroom instruction to participate, the tasks

used in the PR schedule were curriculum-related functional skills, and sessions were limited to 400 responses (PR 80). Annie's task was an orient-and-point task presented on a computer monitor using PowerPoint slides. Orienting to materials and using a distinct point to stimuli were target skills common to all students in the program and were regularly practiced in Annie's classroom. A black star (5 cm wide) appeared in varying locations on each slide, and Annie pointed to the star on the screen when it appeared. After each successful point, the researcher advanced the slide using a computer mouse that was out of Annie's view. The orient-and-point task was piloted with James, but his fluency with the skill resulted in undifferentiated responding across all conditions, and results are not presented here. James's task was stuffing envelopes, which required inserting index cards (7.5 cm by 12 cm) into standard envelopes and placing them in a box. The cards were presented individually, and the envelopes required for the current PR step were placed in front of him at the start of each step. Fluency in assembly tasks was a prerequisite vocational skill regularly practiced with students in James's classroom.

Conditions

Baseline. The student was provided with the materials for the task and given a simple vocal instruction to initiate the task (e.g., "Point to the star") before the first PR step. When the student completed each step (e.g., one response for PR 1, two responses for PR 2), no programmed consequence was delivered. After a 5-s pause, the next PR step was initiated without further instruction. Steps were presented according to the PR schedule until session termination criteria were met.

Paired token. The token systems used in this condition were already being used in the students' classrooms, which required Annie to engage in seven correct responses to access the back-up reinforcer and James to engage in three responses. Annie's board was constructed with

seven pieces of Velcro placed on a small clipboard, and James's was constructed from three pieces of Velcro placed on a laminated piece of paper. Pennies were used as tokens for both students. The session began when the student was provided with demand materials and given the verbal instruction to complete the task to earn tokens to access the back-up reinforcer (e.g., "Touch the stars to earn tokens for candy corn"). The token board was placed in front of the student, and the chosen back-up reinforcer also was visible.

When the student completed a PR step, a token was delivered immediately. A 5-s pause allowed the student time to place the token on the token board before initiating the next PR step without vocal instruction. When the student earned the required number of tokens, he or she handed the tokens to the experimenter in exchange for one piece of the back-up reinforcer, and a 5-s pause was provided for consumption of the edible item.

Primary reinforcement. Each session began when the student was provided with demand materials and given the verbal instruction to complete the task to access the primary reinforcer (e.g., "Touch the stars to get candy corn"). The primary reinforcer was placed on the table within sight. When the student completed each PR step, one piece of the edible reinforcer was delivered immediately. After a 5-s pause to allow consumption, the next PR step was initiated without further instruction. To control for the repeated MSWO assessments conducted after the completion of the token board in the paired token condition, in the primary condition an MSWO assessment was repeated after the number of PR steps that corresponded to the number of tokens on each student's board.

Unpaired token. The unpaired tokens were nickel-sized laminated paper smiley faces that had not previously been used by the students. The token board was a piece of laminated paper on which small pieces of Velcro had been secured to mark token placement. The number of tokens

on the students' unpaired and paired token boards was identical. Sessions began when the student was provided with demand materials and given the verbal instruction to complete the task to earn tokens (e.g., "Touch the stars to get tokens"). The token board was placed in front of the student. When the student completed a PR step, a token was delivered immediately and a 5-s pause allowed the student to place the token on the board before the next PR step was initiated without further instruction. When the student earned all tokens, they were removed from the board and the next PR step was initiated.

Design

The reinforcer assessment was conducted within a multielement design. For Annie, an initial baseline was conducted to evaluate whether she would meet the session limit (PR 80) under baseline conditions. For James, baseline sessions were included in the multielement design.

RESULTS AND DISCUSSION

Figure 1 shows the results of Annie's and James's reinforcer assessments. Both students demonstrated low levels of responding in baseline. James's responding in the unpaired token condition was consistent with baseline levels throughout the assessment. Annie's responding in the unpaired token condition was initially high, suggesting generalization of token effects from her own token board, but without back-up reinforcement, responding quickly dropped to baseline levels.

Both students demonstrated variable responding in the paired token condition. Annie's average responding was highest in the paired token condition at 161.5 responses per session, but responding was highly variable. James's variability was not as extreme, but his average of 15.8 responses per session also was highest in the paired token condition. James's responding during the primary reinforcement condition also

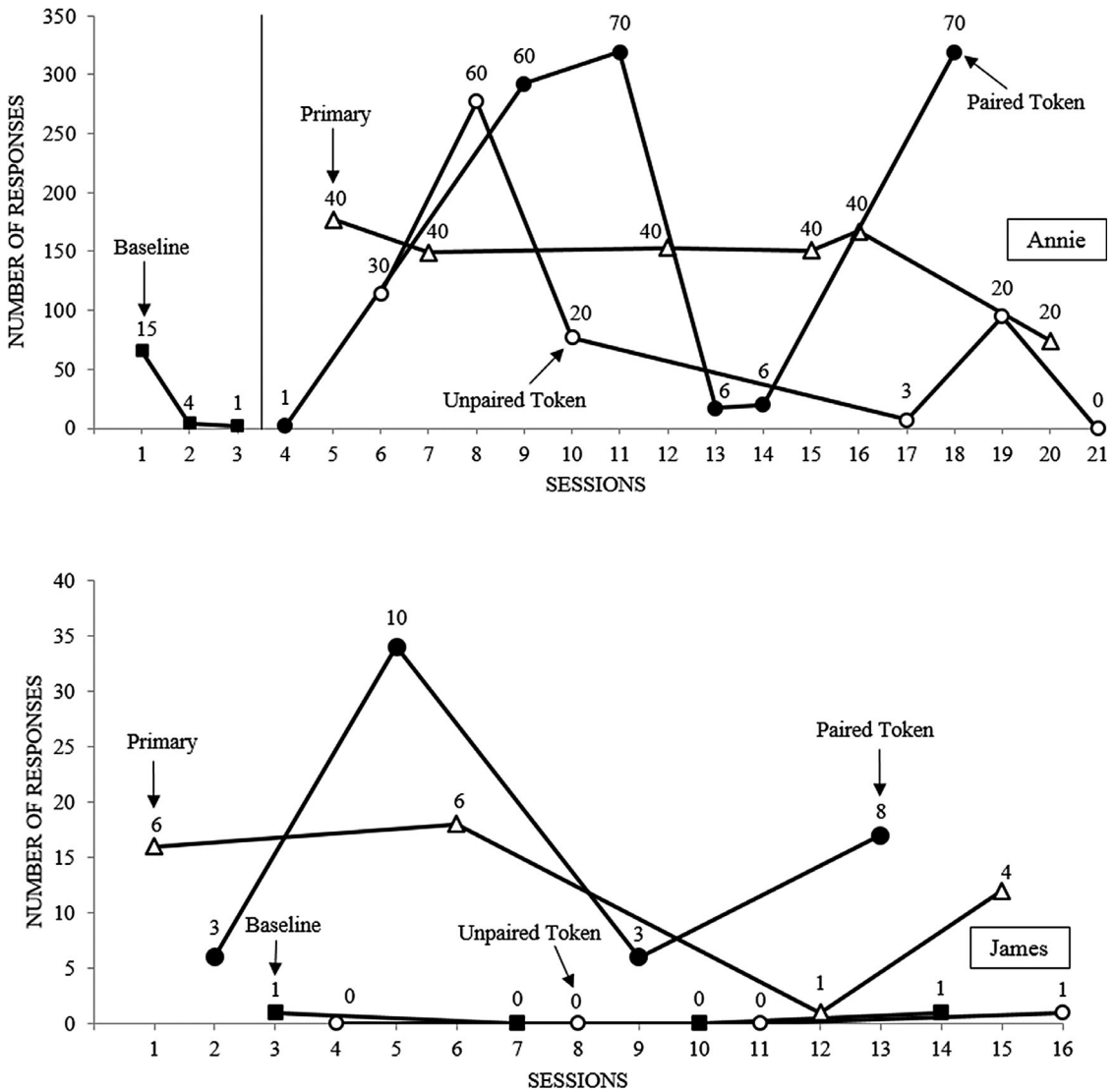


Figure 1. Reinforcer assessments for Annie (top) and James (bottom). Total number of responses summed across all PR steps is graphed for each session, with break point indicated above each session.

was variable, and his average responding (11.8 responses per session) was only slightly lower than in the paired token condition. In contrast, Annie's responding during the primary reinforcement condition was highly stable and produced an average number of responses (145.2 responses per session) only slightly lower than the paired token condition.

The results suggest that token systems resulted in inconsistent responding for both students. James's variability and overall level of responding were similar in the paired token and primary reinforcement conditions. Notably, he often chose different reinforcers when the MSWO assessment was presented, because he easily satiated on reinforcers. The similar

variability across conditions suggests that the token system may be just as effective as primary reinforcement, but that the back-up reinforcers, like primary reinforcers, were variably reinforcing. The results also suggest that the effectiveness of token systems may be dependent on frequent identification of potent back-up reinforcers.

Annie's variability and unpredictability using tokens was more problematic, especially when compared to the consistency of responding produced by primary reinforcement. Notably, Annie selected the same primary reinforcer and back-up reinforcer for every session; yet, her responding was much less consistent in the token condition than in the primary reinforcement condition. Because this inconsistency in performance could negatively affect skill acquisition, Annie's results suggest that her token system should be modified (e.g., by retraining tokens or decreasing the number of responses required for back-up reinforcers) and include frequent checks to ensure that her token system remains consistent with the reinforcing strength of primary reinforcement.

Collectively, these results suggest that token systems should be evaluated when academic responding is inconsistent or low. The total reinforcer assessment duration was 2 hr 29 min for Annie and 1 hr 26 min for James. In addition, the longest session lasted only 18 min, indicating that the assessment of token systems using PR schedules has practical utility.

A limitation of this analysis is that the token boards had been established in the classroom before the study began, and the initial token training method was not known. However, this type of assessment is analogous to the use of functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994) to establish the function of a behavior when the history of the behavior is unknown. Although the information derived from the token assessment might not result in findings easily generalized to all students and all token systems, the approach allows an

evaluation of how specific contingencies affect an individual's behavior.

Another potential limitation is that we did not completely isolate the reinforcing value of an individual token from the full token system in the PR schedule. The inclusion of a token-only condition in which back-up reinforcement was not delivered following trade-in of tokens previously paired with reinforcement could have isolated the effects of a token but was complicated by two issues. First, we could not be certain whether, even after a period of unpairing, the token would still signal the availability of a back-up reinforcer due to the long history of pairing between tokens and back-up reinforcement. Second, removing a back-up reinforcer from an established token system raised ethical concerns.

An additional limitation was that we did not determine whether student responses were due to motivational or reinforcing effects, because all putative reinforcers were visible during the start of conditions and could have served as "promises" of what was to come (see especially Annie). However, in Annie's case, the decrease in responding after back-up reinforcement was delivered suggests that her responding also may have been due, in part, to the reinforcement contingency to which she had been exposed. Future research should examine methods of isolating the value of a token and differentiating motivating and reinforcing effects.

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