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Effects of and Preference for Fixed Ratio and Time-based Exchange Production Schedules in a Token System

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EFFECTS OF AND PREFERENCE FOR FIXED RATIO AND TIME-BASED EXCHANGE PRODUCTION SCHEDULES IN A TOKEN SYSTEM

A Thesis

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Abstract

Token systems have been implemented to change behavior across species and settings. Token systems involve token-production, exchange-production, and token-exchange schedules. In the current study, we evaluated the effects of fixed-ratio and yoked time exchange-production schedules on 4 preschoolers' rate of responding on a marble spooning task, mean pause duration between responses, and percentage of session spent engaging in the target task. Following an initial reversal demonstrating a primary reinforcement effect, we used a multielement design to compare exchange-production schedule conditions and a control condition in which participants earned tokens that were not exchangeable. Following the exchange-production schedule comparison, we examined participants' preferences for the control and exchange-production schedule arrangements. For all participants, tokens exchangeable for backup reinforcers functioned as generalized conditioned reinforcers; however, no consistent differences in rates of responding, percentage of session spent engaging in the task, or mean pause duration occurred between the fixed-ratio and yoked time exchange-production conditions. Clear but different preferences for one of the exchange-production schedules emerged for both participants whose preferences were assessed via repeated measurement. These findings support the use of token systems with tokens exchangeable for backup reinforcers with children and arranging the exchange-production schedule based on the practical benefit given the context and/or learner preference.

Key words: conditioned reinforcement, exchange production, preference assessment, token economy, token reinforcement

Introduction

A token system is an arrangement of reinforcement in which an organism earns tokens contingent on one or more target behaviors. Those tokens can later be exchanged for terminal or backup reinforcers such as food, leisure activities, and privileges. Tokens can be any symbol or object that has a price or set value corresponding to backup reinforcers, the most ubiquitous example of which is currency such as the euro or the U.S. dollar (Cooper et al., 2007). The first token systems documented in the literature demonstrated that the behavior of chimpanzees could be changed via a token system (Cowles, 1937; Wolfe, 1936). The chimpanzees lifted a weight or pulled a tray out with a cord and received food or tokens paired with food contingent on lifting the weight a predetermined height or pulling the tray out a predetermined distance. In the conditions in which tokens paired with food were delivered contingent on correct responding to the tasks, the chimpanzees' rate of responding was equal to or greater than their rate of responding when only contingent food was delivered, providing initial demonstrations of tokens as reinforcers. Token reinforcement systems have also been implemented with humans in a variety of settings such as hospitals (e.g. Ayllon & Azrin, 1965, Hickey et al. 2018), classrooms (e.g. Donaldson et al., 2014; McLaughlin & Malaby, 1972; Staats et al., 1962), and group homes (e.g. Phillips, 1968; Phillips et al., 1971) to increase appropriate behaviors and decrease challenging behaviors. For example, at Achievement Place, a group home for adjudicated youth at-risk for habitual criminality, Phillips and colleagues implemented a home-wide token system with points exchangeable for snacks, allowance, leisure activities, and privileges to decrease anti-social behaviors and increase pro-social

behaviors among the youth. Using both point-loss and point-earn contingencies, Phillips and colleagues decreased the frequency of aggressive statements and incorrect grammar usage and increased arriving to dinner promptly, room cleaning, monetary saving, and news watching (Phillips, 1968; Phillips et al., 1971; Fixsen & Blase, 2019).

Hackenberg (2009) described three schedules involved in token systems: the token-production schedule, the exchange-production schedule, and the token-exchange schedule. Target responses produce tokens according to the token-production schedule. Opportunities to exchange tokens for terminal reinforcers are produced according to the exchange-production schedule. Tokens are then exchanged for terminal reinforcers according to the token-exchange schedule, which dictates how many tokens must be exchanged to earn each unit of a terminal reinforcer.

Tokens bridge the delay between responding and access to primary reinforcers by functioning as conditioned or generalized conditioned reinforcers. Previous basic and applied research has demonstrated that tokens function as conditioned reinforcers (Cowles, 1937; DeFulio et al., 2014; Fiske et al., 2015; Wolfe, 1936), previously neutral stimuli that become reinforcing by pairing them with unconditioned terminal reinforcers such as preferred food. Additionally, tokens paired with multiple terminal reinforcers have been shown to become generalized conditioned reinforcers, improving their durability as reinforcers (Moher et al., 2008; Russell et al., 2018). One method to assess the reinforcing value of tokens is through a progressive ratio (PR) assessment. PR schedules are those in which completion of the first ratio requirement produces a given reinforcer, but the next ratio requirement to access the same reinforcer is systematically increased until the individual does not complete the next ratio requirement. PR

schedules can increase arithmetically (e.g., 2, 4, 6, 8) or geometrically (e.g., 2, 4, 8, 16). The highest response requirement completed before the individual stops responding is the breakpoint. In a PR assessment, two or more reinforcers are delivered according to the same PR schedule of reinforcement and the breakpoints are compared. The higher the breakpoint, the more valuable the reinforcer (Hodos, 1961). PR assessments have been implemented with children to assess the reinforcing value of tangibles and leisure activities as well as tokens (DeLeon et al., 1997; Roane et al., 2001; Roane, 2008; Russell et al., 2018; Wilson & Gratz, 2016). Russell et al. (2018) conducted PR assessments in three reinforcement conditions (edible, leisure, and tokens) with three children with developmental disabilities. In the first phase of the study, experimenters determined breakpoints in each condition as the ratio response requirement at which participants indicated they were finished or did not respond for 2 min. In the second phase of the study, they compared how pre-session access to the edible reinforcers affected the breakpoints in the edible and token conditions. Breakpoints in the token condition were similar to the edible and leisure conditions, demonstrating that tokens functioned as conditioned reinforcers. Additionally, pre-session access to food did not affect the breakpoint in the tokens condition, rather participants' choice of backup reinforcer shifted from food to leisure activities when given pre-session access to food, demonstrating that the tokens functioned as generalized reinforcers.

Becraft and Rolider (2015) examined how pre-session access to food impacted the durability of tokens as generalized conditioned reinforcers when multiple similar versus multiple dissimilar edible backup reinforcers were available. After conducting a reinforcer assessment with tokens that demonstrated tokens functioned as conditioned

reinforcers for an adolescent with a developmental disability, Becraft and Rolider conducted a satiation analysis to assess whether tokens functioned as generalized conditioned reinforcers. During the satiation analysis, experimenters provided pre-session access to the average number of pieces of the most highly preferred edible (cheese balls) earned by the participant in the conditioned reinforcer assessment across three backup reinforcer conditions: highly preferred only, similar backups, and dissimilar backups. In the similar backup reinforcer condition, all cheese flavored, crunchy edibles (e.g., cheese balls, Cheez-its®, and Goldfish®) were available as backup reinforcers. In the dissimilar backup reinforcer condition, cheese balls, Kit Kats®, and Oreos® were available as backup reinforcers. The rate of correct responding was highest in the dissimilar backup reinforcers condition. This demonstrates that tokens in this condition functioned as generalized conditioned reinforcers because they were paired with multiple backup reinforcers and were insensitive to satiation effects, unlike in the similar backup reinforcers condition. These results are consistent with the basic literature that suggests that tokens function as generalized conditioned reinforcers that can maintain responding and increase tolerance for delays to terminal reinforcers (Cowles, 1937; DeFulio et al., 2014; Wolfe, 1936).

The role of tokens as conditioned and as generalized reinforcers are two main features of tokens that make token reinforcement schedules useful in applied settings (Hackenberg, 2009; Moher et al., 2008; Russell et al., 2018). That is, arranging tokens exchangeable for a variety of backups as reinforcers can bridge delays to larger backup reinforcers that may not be easily delivered immediately (e.g., a trip to the movies) and are not as sensitive to current changes in motivating operations (Laraway et al., 2003).

For example, after a series of responses that result in the delivery of and subsequent consumption of food, food consumption leads to satiation (Laraway et al., 2003) and/or habituation (McSweeney et al., 1996), which weaken the reinforcing value of food and abates the responses that have previously been reinforced by food. In contrast, the reinforcing effect of tokens that are established as generalized conditioned reinforcers is independent of deprivation or satiation from individual terminal reinforcers because the tokens can be exchanged for multiple terminal reinforcers (Cooper et al., 2007).

Token reinforcement systems are commonly implemented as part of behavioral programming, but there are many remaining scientific and practical questions related to specific components of token systems and token reinforcement schedules that, when answered, could improve token system implementation in applied settings. There are some studies in the applied literature that identify components of token reinforcement schedules such as the quality of backup reinforcers (Fiske et al., 2015) and the immediacy of reinforcer delivery (Leon et al., 2016; Tarbox et al., 2006), that are important to the successful implementation of token systems. Fiske et al. (2015) evaluated the reinforcing value of tokens in a preexisting token system with two children with developmental disabilities who exhibited off-task behavior when presented with academic demands by comparing the participants' rates of responding with primary reinforcement, pre-existing tokens, and novel tokens. Both participants engaged in highly variable, inconsistent responding with tokens from their pre-existing token systems and with novel tokens. One participant also engaged in variable responding in the primary reinforcement condition, suggesting that the value of his primary reinforcers varied. This pattern of responding highlighted the need for frequent preference

assessments to ensure the availability of a variety of highly preferred backup reinforcers to maintain tokens as conditioned reinforcers and promote more consistent responding. The other participant engaged in steady state responding in the primary reinforcement condition, suggesting that other features of her token system needed to be modified other than the backup reinforcers available. Tarbox et al. (2006) demonstrated the importance of immediate delivery of high-quality backup reinforcers upon earning an exchange opportunity. Using a reversal design, they implemented a token system to maintain attending behavior for a child with a developmental disability. The token system was most effective when backup reinforcers were available and when delivery of backup reinforcers was immediate upon the child earning an opportunity to exchange his tokens. Leon et al. (2016) also demonstrated that the efficacy of tokens is highly sensitive to the immediacy of token delivery but less sensitive to delays in the opportunity to exchange. They increased the delay to food, tokens, and exchange opportunities using a parametric design with three participants. For all three participants, responding persisted during the longest delays in the food reinforcement condition and decreased under the shortest delays when token delivery was delayed. For the two participants who experienced delays to exchange tokens, their responding to produce immediate tokens persisted longer than when token delivery was delayed. Collectively, these studies demonstrate that the availability of a variety of highly preferred terminal reinforcers to exchange for tokens and the immediate delivery of tokens are critical components of successful token systems.

The effects of the schedules that comprise token reinforcement schedules (token production, exchange production, token exchange) have not been examined as

thoroughly in the applied literature as they have in the basic literature, though there have been a few applied studies examining the effects of token-production schedules on rates of responding (Repp & Deitz, 1975; De Luca & Holborn, 1990), and one study to date that evaluated the effects of the exchange-production schedule on rates of responding (Argueta et al., 2019). Repp and Deitz (1975) compared the effects of a fixed ratio (FR) token-production schedule versus a variable ratio (VR) token-production schedule on the rate of button pressing with two boys. In the first phase, the VR and FR schedules alternated after the completion of each schedule requirement. In the second phase, a changeover button that switched the VR to the FR schedule and vice versa was available. In the first phase, the rate of button-pressing was approximately the same for both token-production schedules. In the second phase, changeovers to VR were highest for all participants, indicating that they preferred the VR schedule. The results of this study are limited in that after earning only one token, a mandatory exchange opportunity was produced and only one backup reinforcer (a penny) was available on an FR 1 token-exchange schedule, both uncommon schedule arrangements in applied settings. De Luca and Holborn (1990) compared the effects of fixed interval (FI) and FR token-production schedules on the rate of stationary bike pedaling by four boys, two obese and two non-obese. The participants received points on an FI 1 min token-production schedule in the first treatment phase and on an FR token-production schedule in the second treatment phase in which the criterion number was set as the average revolutions per minute in the preceding FI phase. The rate of pedaling for all participants increased substantially from baseline in both treatment conditions, but the response rate for three of the four participants was higher in the FR

condition than the FI condition, likely because they could earn more points in the FR condition. That is, the maximum amount of points available in the FI condition was 30 because sessions were 30 min long, whereas the amount of points available in the FR condition was dependent on response rate and not limited by session duration.

Exchange-production schedule variations and their effects on the rate of responding during token production are important to understand in applied settings because the frequency of exchange opportunities affects the pace of instruction, which impacts the rate of acquisition of target behaviors and the rate of challenging behavior exhibited during instruction for both children with developmental disabilities and of typical development (Cariveau et al., 2016; Carnine, 1976; Francisco & Hanley, 2012; Koegel et al., 1980; Smith et al., 1995). Exchange opportunities also likely impact the maintenance of tokens as conditioned reinforcers because exchanges facilitate the repeated pairing of tokens with backup reinforcers. In the basic literature, exchange-production schedules have produced varying effects on rates of responding during token production. Waddell et al. (1972) compared the rates of responding in progressively increasing FI exchange-production schedules. Rats engaged in lever pressing on an FR 20 token-production schedule and an FR 1 token-exchange schedule with each food pellet costing one token. The exchange-production schedule was gradually increased from 1.5 min to 9 min. The results indicated that increasing the value of the exchange-production schedule decreased the overall rate of responding. Similar effects with FR exchange-production schedules have been demonstrated with pigeons (Foster et al., 2001). Consistent with response patterns on VR and FR schedules with primary reinforcers, Foster et al. (2001) as well as Webbe and Malagodi

(1978) demonstrated that VR exchange-production schedules produced higher rates of responding than FR schedules.

In the applied literature, only one study to date has investigated exchange-production schedule effects on rate of responding in token production. Argueta et al. (2019) directly compared the effects of FR and VR exchange-production schedules on responding during token production with a child with autism, a modified replication of the Foster et al. (2001) investigation with pigeons. As in Foster et al., following a brief baseline phase, Argueta et al. alternated three FR (2, 5, 10) and VR (2, 5, 10) exchange-production schedules, followed by a return to baseline. The child in the study earned tokens on an FR 1 schedule each time she stuffed an index card in a box and was provided an opportunity to exchange her tokens for access to an iPad immediately upon completing the exchange-production schedule requirement. In contrast to Foster et al. (2001), Argueta et al. (2019) observed no substantial difference in rates of responding between the two exchange-production schedule types, except at ratio value 2, at which a difference was observed but in the opposite direction of Foster et al. (2001), as the rate of responding at FR 2 was greater than VR 2. Argueta et al. (2019) also evaluated the child's preference for the exchange-production schedule arrangements, and she displayed an exclusive preference for the VR arrangement.

FR exchange-production schedules like the one evaluated by Argueta et al. (2019) are commonly implemented as a component of behavioral interventions in the applied literature (e.g., Cividini-Motta & Ahearn, 2013; Kahng et al., 2003). Kahng et al. (2013) implemented a token system with an FR exchange-production schedule in which escape from the meal served as the backup reinforcer to increase food acceptance in a

4-year-old girl. For each bite of food accepted, the participant received a token, and after earning the specified number of tokens, she earned an opportunity to exchange the tokens for meal termination. This procedure increased the number of bites accepted and reduced food refusal. However, it is not clear from the results whether the implementation of the token system was necessary to increase food acceptance, because the escape contingency was not implemented independently of the token system. Although FR exchange-production schedules are common in the applied literature time-based schedules are also common (e.g., Ayllon & Azrin, 1965; Gilley & Ringdahl, 2014; Phillips et al., 1971). For example, Gilley and Ringdahl (2014) utilized a fixed time exchange-production schedule in a token system that was part of an intervention to increase instances of independent sharing. Gilley and Ringdahl directly compared the intervention's effectiveness with and without the token system in place. Token exchange occurred at the end of each sharing intervention session, a time-based exchange-production arrangement. Although examples of both FR and time-based exchange-production schedules can be found in applied settings and in the applied literature, a direct comparison of the two has not yet been made.

One factor to consider when deciding between an FR and a time-based exchange-production schedule is the practical benefit of each given the context in which the token system will be arranged. For example, an FR exchange-production schedule allows behavioral technicians to keep track of when an exchange opportunity has been earned (i.e., when the board is filled with tokens). This allows for a relatively even and dense schedule of backup reinforcement. Alternatively, if a learner's daily routine is divided in units of time (e.g., 15 min work period followed by a brief break or transition),

then token exchange in between work periods may be less disruptive to the learning environment. Additionally, in settings in which it is convenient to delay opportunities to exchange backup reinforcers until a certain time of the day or the week (e.g., waiting until recess to exchange tokens for additional time on the swings, waiting until Friday to visit the school store to trade in tokens for trinkets), time-based exchange-production schedules are practical.

Another factor to consider when deciding how to arrange the exchange-production schedule in a token system is learner preference. One way to directly assess learner preference for interventions is through a concurrent chains procedure in which two independent schedules are arranged. Responding in the first schedule, the initial link in the chain, determines access to another schedule, the terminal link in the chain (Catania & Sagvolden, 1980). For young children and individuals with developmental disabilities, such a concurrent chains procedure is a more appropriate approach to determine preference as opposed to indirect assessments of preference (i.e., self-report rating scales) due to limited communication skills, allowing them to participate in the process of social validation of behavioral assessment and treatment (Hanley, 2010). Additionally, concurrent chains preference assessments provide an empirical method of assessing preference in which the individual experiences the selected procedure and has repeated opportunities to choose. Hanley et al. (1997) provided one early example of the use of a concurrent chains preference assessment with individuals with developmental disabilities. In this study, they utilized a concurrent chains procedure to assess learner preference for functional communication training (FCT) or noncontingent reinforcement (NCR) as treatments to reduce challenging behavior. After conducting a

functional analysis for two individuals with developmental disabilities exhibiting challenging behavior and determining that attention maintained the behavior for both individuals, Hanley et al. used a multielement design to compare FCT and NCR treatments. Both treatments reduced challenging behavior to clinically acceptable levels. Following the treatment comparison, they conducted a concurrent chains preference assessment. Experimenters taught participants to press different colored switches that corresponded to FCT, NCR, and extinction as the initial link of the chain, and participants received access to the treatment condition corresponding with the selected switch in the terminal link of the chain. Both participants preferred FCT as evidenced by higher mean frequency of switch presses for the switch corresponding with FCT. Subsequently, concurrent chains preference assessments have been used to assess learner preference for a variety of procedures, including forward versus backward chaining (Slocum & Tiger, 2011), error correction strategies (Kodak et al., 2016), foreign language instruction using various verbal operant relations (Matter et al., 2019), and the presence or absence of mnemonic devices during flashcard instruction (Lozy et al., 2020).

The purpose of the current study was to examine how FR versus time-based exchange-production schedules affect the rate of correct responding during token production and assess learner preference for these arrangements. In alignment with previous research on effective components of token systems, we arranged multiple, dissimilar items as backup reinforcers and made backup reinforcers immediately available for exchange once participants met criteria for exchange.

Method

Participants, Setting, and Materials

Four pre-kindergarten students participated in the study: Ezra, Kyle, Ryan, and Burt. All participants were 4 years old when they participated. Ezra was male, multiracial, and was receiving no special education services. Kyle was male, African American, and was receiving special education services for a developmental delay. Ryan was male, multiracial, and receiving special education services for a speech impairment. Burt was male, African American, and was receiving no special education services. All sessions took place in an empty classroom or the cafeteria at the pre-kindergarten center the participants attended.

Necessary materials for all sessions included marbles, bowls, and a spoon for the target task; a card with “ALL DONE” printed on it (Ezra only); blocks for the alternative task (Kyle only); coloring sheets and crayons for the alternative task (Ryan and Burt); nitrile gloves for experimenters to handle edibles; tokens, and token boards. Tokens were laminated 1” paper circles affixed to token boards (laminated paper rectangles) with hook-and-loop dots which were arranged in uniform rows and columns. Edibles used in the edibles preference assessment included the following: corn chips, veggie sticks, miniature Oreos®, miniature chocolate chip cookies, Teddy Grahams®, miniature M&Ms®, popcorn, pretzels, candy corn, and Goldfish®. Menus to display the top three edibles specific to each participant identified in the edibles preference assessment were used in the primary reinforcement and exchange-production schedule conditions. Ezra’s top three edibles in descending order were candy corn, miniature Oreos®, and miniature chocolate chip cookies. Kyle’s top three edibles in descending

order were candy corn, pretzel sticks, and miniature M&Ms®. Ryan's top three edibles in descending order were candy corn, miniature M&Ms®, and Teddy Grahams®. Burt's top three edibles in descending order were candy corn, veggie sticks, and pretzel sticks. Observers used Surface Pro 3® tablets to record correct responses in the Lily Data Collector application.

Response Measurement and Interobserver Agreement

Dependent variables were the rate of correct responses per minute, the percentage of session spent engaging in the target task (Ezra only), mean pause duration from the delivery of reinforcement to the next response, and selection responses in preference assessments. Observers recorded a response as correct when a participant used a spoon to move one marble from a bowl on their left to an empty bowl on their right. The bowl on the left contained 20 marbles at the start of every session. During edible preference assessments, observers recorded a selection response when a participant picked up and consumed an item from the array. During the concurrent chains preference assessment, observers recorded a selection response when a participant pointed to a token board in the array.

Interobserver agreement (IOA) for correct responding was calculated using the proportional agreement method in which each session was divided into 10-s intervals. The smaller number of responses recorded by an observer within each interval was divided by the larger number, the proportions from each interval added, and the summation of all proportions divided by the total number of intervals and converted into a percentage. If both observers recorded zero responses in an interval, this was considered exact agreement and the proportion from that interval was 1. IOA for

selection responses was calculated using an exact trial-by-trial method in which an agreement was scored when both observers recorded the same selection response at each opportunity. Agreements were divided by the total number of selection opportunities and multiplied by 100 to yield a percentage. IOA was assessed across all phases of the study for all participants. For Ezra, mean IOA for correct responses was 95.39% (range, 78.21%-100%) across 52.83% of sessions. For Kyle, mean IOA for correct responses was 96.86% (range, 84.09-100%) across 81.48% of sessions. For Ryan, mean IOA for correct responses was 96.15% (range, 83.33-100%) across 42.85% of sessions. For Burt, mean IOA for correct responses was 97.06% (range, 84.02-100%) across 60.78% of sessions. IOA for selection responses for all participants during edible preference assessments, token color preference assessments, and selections during the choice phase was 100%.

Pre-assessments

The experimenter conducted a series of pre-assessments with each participant before sessions began. First, the experimenter instructed each participant to sample each edible item. Then, the experimenter presented a plate with a piece of each of the 10 items on it and 10 empty cups in a row. The experimenter asked the participants to rank the items by placing one item in each cup from their favorite to least favorite, left to right. Next, the experimenter conducted a multiple stimulus without replacement (MSWO) preference assessment with the same 10 edibles (DeLeon & Iwata, 1996). During the MSWO, the experimenter presented all edible items in small cups in a row on the table in front of the participant and delivered the instruction to “pick your favorite, and you can eat it right now” until all items from the array had been selected. The

experimenter asked the participant to choose their next favorite and consume it until the participant consumed all the snacks or indicated they did not want to eat any of the remaining snacks. If the participant declined to continue consuming snacks, the experimenter asked them to choose their next favorite by pointing to the snacks until the participant had pointed to all snacks. If a participant indicated equal preference for two items (e.g., said, “I like both of these the same”), the experimenter recorded that the items had the same rank. If the ranking and the MSWO produced the same top three items, those items were used in the experimental conditions. If the top three items differed across the ranking and the MSWO, the experimenter conducted a second MSWO and used the items with the top three average ranks across all three assessments.

Next, an MSWO was conducted twice consecutively to determine the most preferred token color among black, white, and grey tokens, which enhanced discriminability of the exchange-production schedule conditions and served as the stimuli presented in the initial link of the concurrent chains preference assessment. If the rank order was different across assessments, the experimenter conducted a third MSWO and used the average ranking of each item to determine the overall rank. The most preferred token type was used in the control condition and the two least preferred token types were counterbalanced across exchange conditions across participants.

Then, the experimenter oriented the participants to three tasks: using a spoon to move marbles from one bowl to another, using tongs to move counting bears from one bowl to another, and using a shoelace to lace around a lacing card. The task orientation sessions began with an instruction that briefly described the task, and the experimenter

also modeled the correct response to each task. The experimenter recorded correct responses for 2 min or 20 responses, whichever came first. If a participant attempted to engage in more than one response at a time, the experimenter blocked the responses and prompted the participant to engage in only one response at a time. The experimenter selected using a spoon to move marbles from one bowl to another as the task the participants would complete during the following experimental condition sessions, because all participants were able to perform the task independently with minimal blocking of incorrect responding required.

Procedure

The experimenter evaluated the effects of edibles as reinforcers in a reversal design and then compared FR and time-based exchange-production schedules of token reinforcement and a control condition using a multielement design. The exchange-production condition conducted in the first session of the day alternated across days. Finally, a concurrent chains arrangement was used to assess preference for the token conditions. The experimenter conducted one to four sessions per day, 2 to 5 days per week with two of each exchange-production schedule sessions conducted for every control session.

Each session began with a specific instruction about session contingencies. For Kyle, Ryan, and Burt, an alternative task (coloring for Ryan and Burt and playing with wooden blocks for Kyle) was available. Though coloring was initially presented to Kyle as the alternative task, he engaged in problem behavior across several days when it was time to return to his classroom after coloring. Subsequently, blocks were available as his alternative task, which did not result in problematic behavior upon termination of

sessions. Prior to the start of the session, Kyle, Ryan, and Burt stood approximately equidistant between the two task stations while the experimenter explained that they could engage in the target task (i.e., spooning marbles) or an alternative task and that they could switch between tasks during the session. Participants then chose where they would begin the session. Any time during session when the participants chose to engage in the alternative task, the experimenter delivered noncontingent praise approximately every 3 s. Ezra had an "ALL DONE" card on the table in front of him that he could exchange at any time during the session to terminate the session prior to other termination criteria being reached. Following the preliminary instructions, the session began with participants sitting in front of either the target or alternative task materials. Across all conditions, when a participant attempted to move multiple marbles or use their hands to move a marble, the experimenter blocked responding and briefly stated the correct response (e.g., "Move just one marble at a time" or "Use the spoon to move a marble."). The experimenter responded briefly to any questions or comments made by participants during session. All correct responses produced experimenter praise. In control and exchange-production schedule sessions, following each correct response, the experimenter also placed a token on the participant's token board (i.e., FR 1 token-production schedule).

Baseline

Baseline sessions began with the following instruction: "We are going to play a game! This is how you play this game. [Experimenter moved a marble from one bowl to the other with the spoon]. I'll let you know when the game is over." For Kyle, Ryan, and Burt, the experimenter presented the alternative task and delivered the following

instruction, “If you do not want to play the game, you can [play with blocks or color].” For Ezra, the experimenter presented the “ALL DONE” card and delivered the following instruction, “If you want the game to end before I say it is over, you can hand me this card.” The experimenter recorded correct responses for 2 min or 20 responses, whichever came first. The experimenter provided praise for correct responses to the target and alternative tasks and blocked incorrect responses to the target task. When the participant reached one of the termination criteria, the experimenter informed the participant that the session was over.

Primary reinforcement

Primary reinforcement sessions began with the following instruction: “We are going to play a game! Remember, this is how you play this game. [Experimenter moved a marble from one bowl to the other with the spoon]. Today you’ll earn [the three most preferred snacks in rotation]. For each marble you move, I’ll put one piece on this plate. When the game ends, you can eat all the pieces you earned. I’ll let you know when the game is over.” For Kyle, Ryan, and Burt, the experimenter presented the alternative task and delivered the following instruction, “If you do not want to play the game and earn snacks, you can [play with blocks or color].” Following a single primary reinforcement session in which Kyle engaged in the alternative task for the entirety of the session, the experimenter prompted Kyle to engage in one correct response, delivered one piece of edible, and allowed Kyle to consume the edible immediately. For Ezra, the experimenter presented the “ALL DONE” card and delivered the following instruction, “If you want the game to end before I say it is over, you can hand me this card.” The experimenter recorded correct responses to the target task for 2 min or 20

responses (or until Ezra handed over the “ALL DONE” card), whichever came first. The experimenter provided a piece of snack for correct responses, rotating through the top three most preferred snacks (Egel, 1981), and no response for incorrect responses. The experimenter informed the participant that the game was over when the participant met one of the termination criteria and allowed the participant to consume the accumulated reinforcers after the session ended.

Control

Control sessions began with the following instruction: “We are going to play a game! Today you’ll earn [most preferred color] tokens. For each marble you move, I’ll put 1 [most preferred color] token on your board. When the game ends, I’ll take all your tokens. I’ll let you know when the game is over.” For Kyle, Ryan, and Burt, the experimenter presented the alternative task and delivered the following instruction, “If you do not want to play the game, you can [play with blocks or color].” For Ezra, the experimenter presented the “ALL DONE” card and delivered the following instruction, “If you want the game to end before I say it is over, you can hand me this card.” The session ended after the participant reached the criterion number, which was set at the median number of responses completed by the participant during the primary reinforcement phase or after 2 min.

Exchange-production schedules

During all exchange-production schedule sessions, a menu with a picture of each back-up reinforcer was visible in the session area. Back-up reinforcers were the top three edible items from the MSWO in the pre-assessment. Following each exchange-production schedule session, the experimenter counted the tokens earned, and the

participant traded in all tokens. The price of all back-up reinforcers was one token per piece of edible (i.e., FR 1 token-exchange schedule).

Fixed ratio. FR exchange-production schedule sessions began with the following instruction: “We are going to play a game! Today you’ll earn [second or third preferred color] tokens. For each marble you move, I’ll put 1 [second or third preferred color] token on your token board. At the end of the game, you can trade each token in for one of these snacks [show menu and review two examples of possible spending]. The game ends when you earn [criterion number] tokens.” For Kyle, Ryan, and Burt, the experimenter presented the alternative task and delivered the following instruction, “If you do not want to play the game, you can [play with blocks or color]. However, if you don’t earn [criterion number] tokens, you cannot trade any of your tokens in for snacks.” For Ezra, the experimenter presented the “ALL DONE” card and delivered the following instruction, “If you want the game to end before I say it is over, you can hand me this card, but if you don’t earn [criterion number] tokens, you cannot trade them in for snacks.” The experimenter set the criterion number of responses at the median number of responses completed by the participant during the primary reinforcement phase (same as the control condition). The experimenter started a timer immediately after delivering the instructions and stopped the timer when the participant completed the last response to fill their token board.

Yoked time. Yoked time (YT) exchange-production schedule sessions began with the following instruction: “We are going to play a game! Today you’ll earn [second or third preferred color] tokens. For each marble you move, I’ll put 1 [second or third preferred color] token on your token board. At the end of the game, you can trade each

token in for one of these snacks [show menu and review two examples of possible spending]. You'll have [X] min to earn as many tokens as you can." For Kyle, Ryan, and Burt, the experimenter presented the alternative task and delivered the following instruction, "If you do not want to play the game, you can [play with blocks or color]." For Ezra, the experimenter presented the "ALL DONE" card and delivered the following instruction, "If you want the game to end before I say it is over, you can hand me this card." Session duration was equivalent to the previous FR exchange-production condition session.

Choice. Prior to the start of each choice session, the experimenter reviewed the contingencies associated with each token type in the following way: "The [FR token color] tokens mean you have to earn [criterion number] tokens for the game to end. At the end of the game, you can trade in your tokens for one of these snacks [show menu and review two examples of possible spending]. The [YT token color] tokens mean you have [X] min to earn as many tokens as you can before the game ends. At the end of the game, you can trade in your tokens for one of these snacks [show menu and review two examples of possible spending]. The [control token color] tokens means you get to earn tokens and when the game ends, I'll take your tokens." The duration of all YT sessions in the choice phase was the median duration of YT sessions during the multielement comparison for each participant respectively. The order in which the tokens were presented and introduced varied across choice sessions. The experimenter reviewed the contingencies with the participants until they could correctly answer comprehension questions about the contingencies associated with each board and token color (e.g., When you earn this color token, do you get to trade them in for

snacks?; Do you have to fill this board up with tokens to earn snacks?). Then, the experimenter delivered the following instructions: "We are going to play a game! Today you get to choose what kind of token you want to earn. For each marble you move, I'll put 1 [chosen token] on your token board. Pick which token you'd like to earn." Following a selection response, the experimenter immediately began a session of the selected type.

Treatment Integrity

Experimenters evaluated treatment integrity using an eight-item procedural checklist: displaying the participant's menu with their top three edibles, noting which color token was available to earn during the current session, explaining the FR 1 token-production schedule, providing two examples of possible spending, explaining the termination criterion, delivering tokens for each correct response, terminating session when termination criteria were met, and providing an exchange opportunity following session. An observer scored whether therapist performed each of the eight steps during 49.16% (range, 42.11-61.11%) of sessions across all participants. An experimenter calculated treatment integrity for the procedural checklist by dividing the number of items performed over the total number of items and multiplying by 100. Therapists performed 100% of steps across all sessions across all participants. A secondary observer collected data using the procedural checklist on an average of 61.15% (range, 57.14-66.67%) of sessions in which treatment integrity data were collected across participants. An experimenter calculated item-by-item IOA by comparing the observers' responses to each item, dividing the number of agreements by the total number of items and multiplying by 100. Mean IOA was 99.40% (range, 97.62-100%).

Results

The top panel of Figure 1 displays the rate of responses per min across experimental phases for Ezra. Ezra's rate of responding during the primary reinforcement phase and the exchange-production schedule multielement comparison was higher on average than in baseline phases, though in the reversal to baseline, Ezra's rate of responding did not return to his original baseline levels of responding.

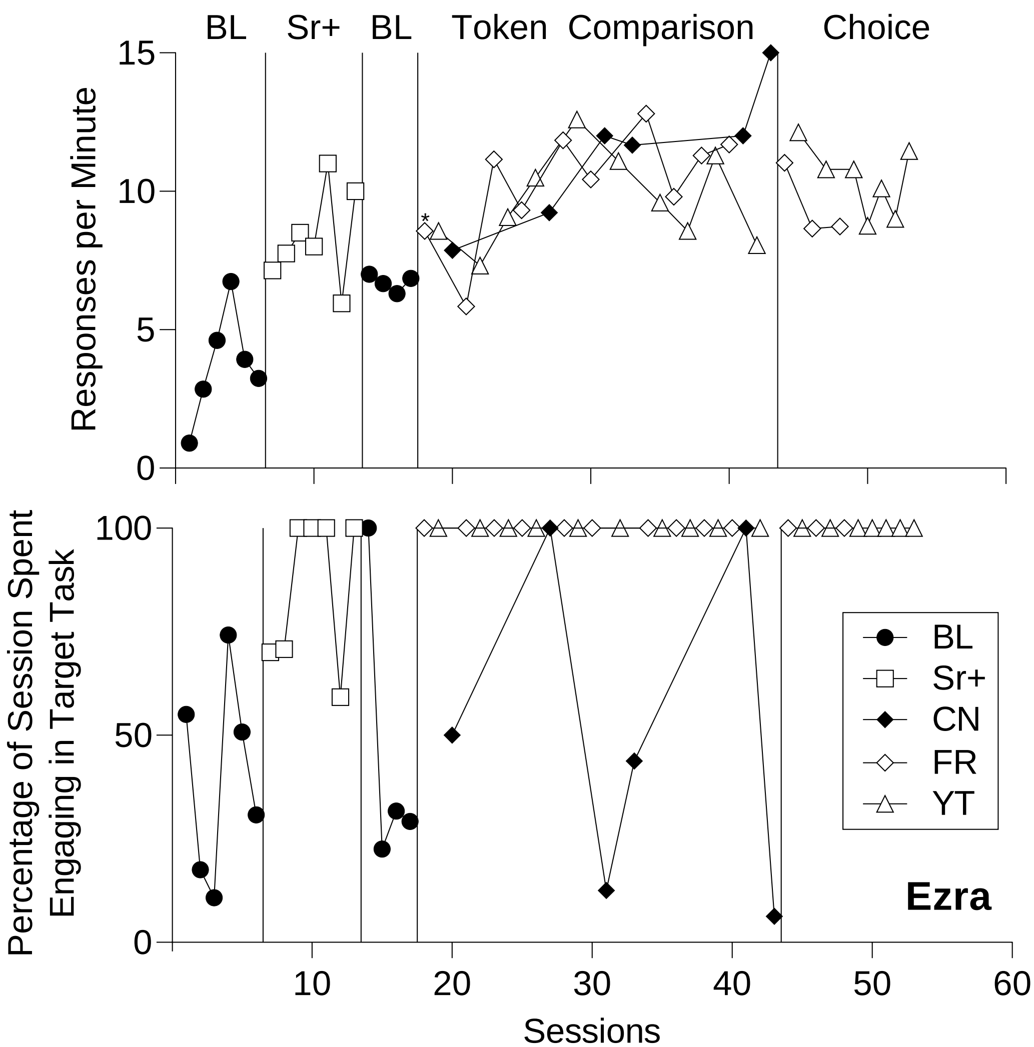

Figure 1. Rate of Responding and Percentage of Session Engaging in the Target Task for Ezra.
Note. BL= Baseline, Sr+ = Primary reinforcement, CN = Control, FR = Fixed ratio, YT = Yoked time
[a] The * on Session 18 in the top panel indicates that the YT token board was used in error (20 v. 16 slots).

No differentiation in rate of responding was observed between the exchange-production schedule conditions and the control condition. The bottom panel of Figure 1 displays the percentage of session Ezra spent engaging in the target task across experimental phases. In baseline and in the control condition during the multielement comparison, Ezra spent less of the session engaging in the target task than during primary reinforcement, FR, or YT sessions, demonstrating that Ezra's preferred edibles functioned as primary reinforcers and that tokens in the FR and YT conditions (i.e., tokens exchangeable for preferred edibles) functioned as conditioned reinforcers, whereas the tokens in the control condition did not. No differentiation in percentage of session engaged in the target task emerged between the FR and YT conditions for Ezra.

Figure 2 displays responses per min across experimental phases for Kyle, Ryan, and Burt. For all three participants, rates of responding in baseline were considerably lower than their rates of responding in the primary reinforcement phase, suggesting that their respective preferred edibles functioned as primary reinforcers. In addition, Kyle and Ryan's rates of responding were similar in FR and YT token conditions to the primary reinforcement condition, suggesting that the tokens in the FR and YT token conditions functioned as conditioned reinforcers. Kyle and Ryan engaged in little to no responding in the control condition, indicating that the tokens in this condition (which were not exchangeable for edibles) did not function as conditioned reinforcers. For Burt, responding persisted in the control condition in the multielement comparison; however, during the control-only phase, Burt's rate of responding decreased, and in several sessions, he engaged in no responding. No differentiation in rates of responding

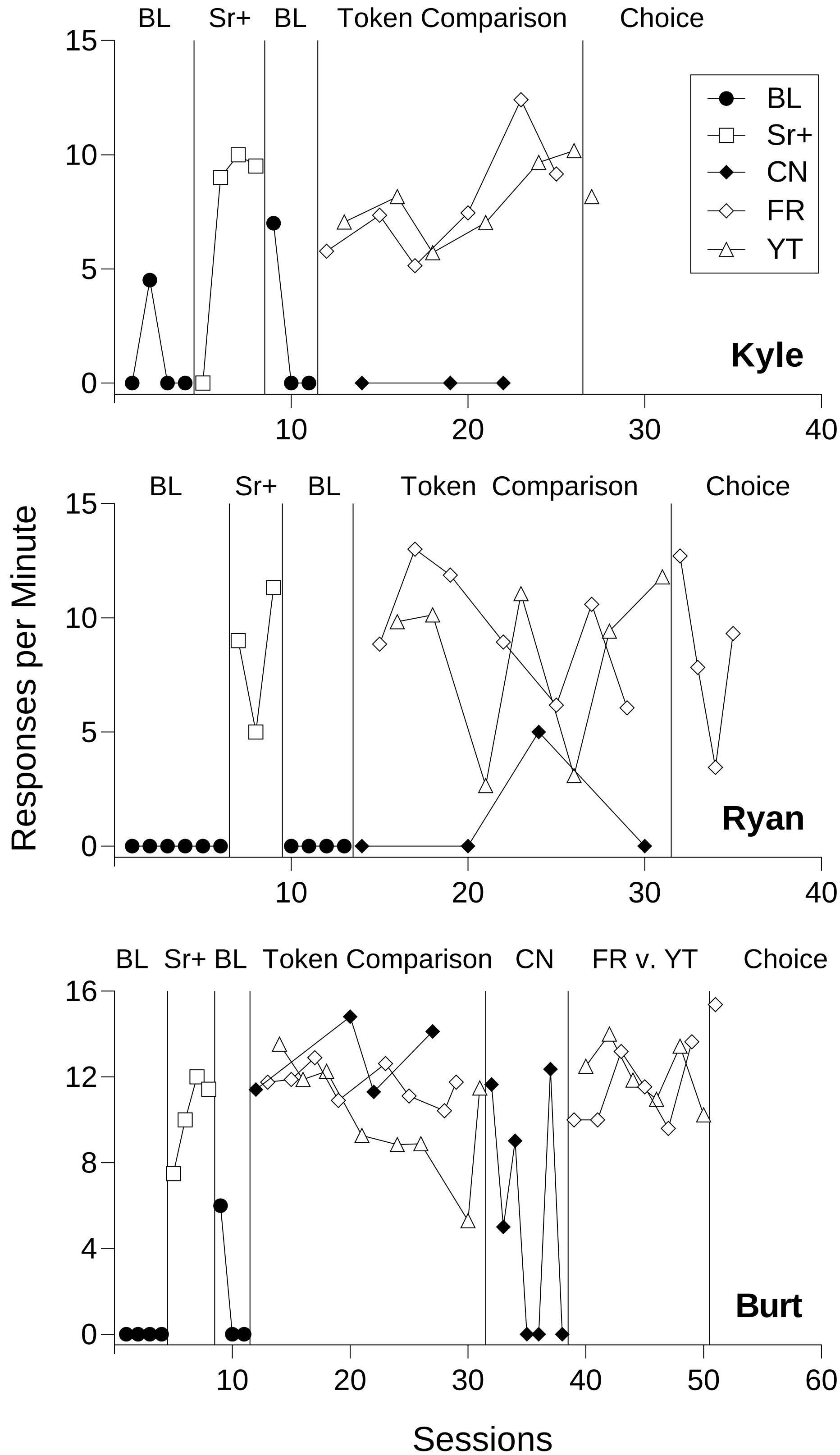

Figure 2. Rate of Responding for Kyle, Ryan, and Burt.
Note. BL= Baseline, Sr+ = Primary reinforcement, CN = Control, FR = Fixed ratio, YT = Yoked time

between the FR and YT conditions emerged for Kyle or Ryan. Differentiation between the FR and YT conditions initially appeared to occur in the first multielement comparison phase for Burt; however, this is likely an artifact of Burt's responding always being higher in the first session of the day. Unlike with the other participants whose first session type of the day was counterbalanced across days, the only YT session that came first in the day for Burt was session 31. Taken together, Burt's pattern of responding observed in the first multielement comparison phase and his pattern of responding in the FR versus YT only comparison phase, no considerable differentiation between FR and YT was observed for Burt.

Figure 3 displays the mean pause duration following reinforcer delivery by experimental condition for all participants. Ezra does not have a bar for the primary reinforcement condition, because edible reinforcer delivery was not recorded for Ezra. For Ezra, Kyle, and Burt, mean pause duration by session did not differ substantially across conditions. For Ryan, mean pause duration was the shortest in the primary reinforcement condition followed by the YT condition. However, upon examining records of cumulative within session responding in each yoked pair of exchange-production schedule conditions, no consistent patterns emerged between or within conditions (e.g., the FR session was not consistently lower than the corresponding YT session). For Ezra and Burt, the individual sessions with the shortest mean pause duration were control sessions.

Figure 4 displays the cumulative selections of Ezra and Ryan during the choice phase. Ezra demonstrated a clear preference for the YT condition. Ryan displayed an exclusive preference for the FR condition. Due to time constraints, experimenters were

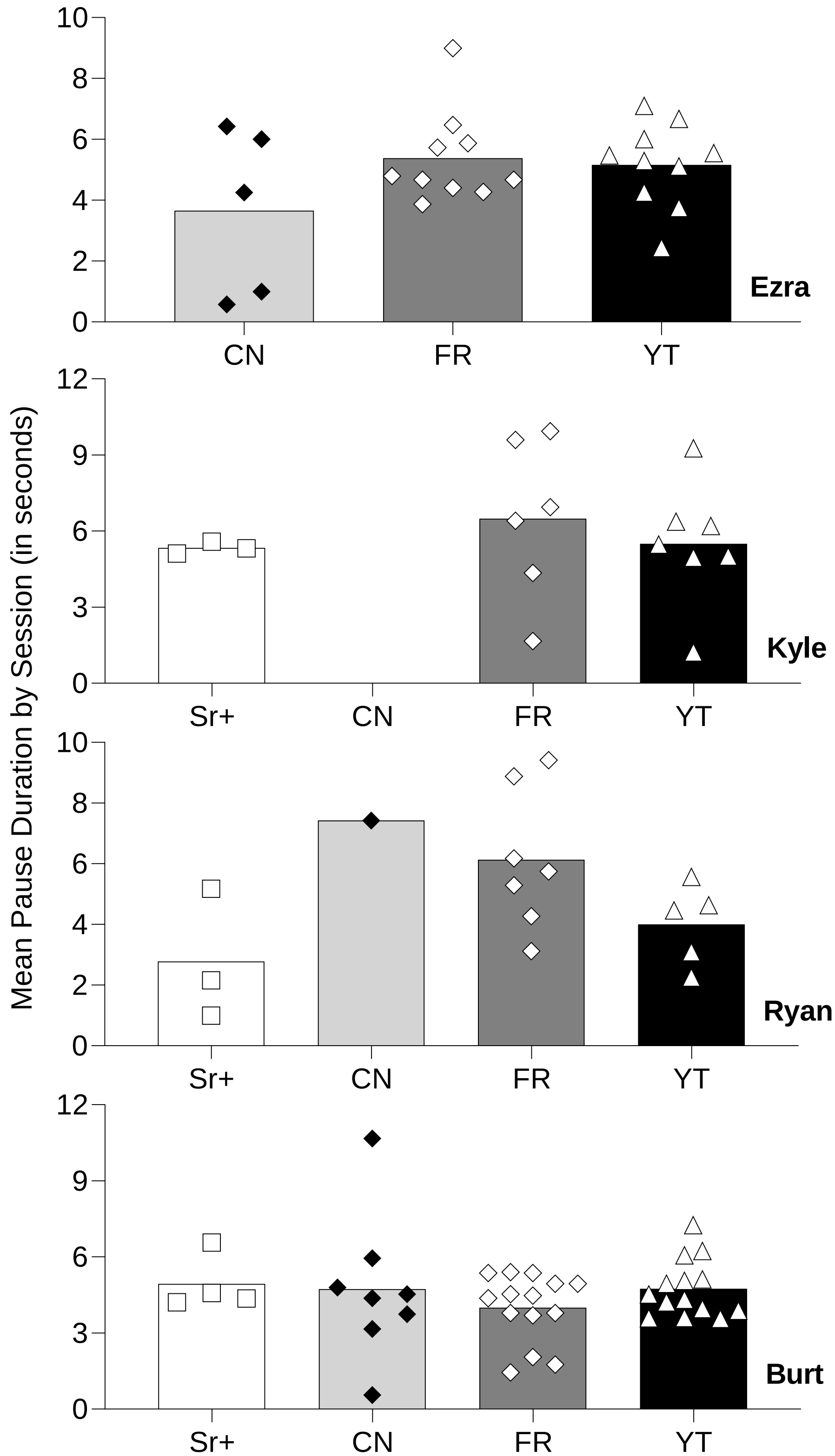

Figure 3. Mean Pause Duration by Session by Condition for Ezra, Kyle, Ryan, and Burt.
Note. BL= Baseline, Sr+ = Primary reinforcement, CN = Control, FR = Fixed ratio, YT = Yoked time

only able to run one choice session each with Kyle and Burt. In Kyle's choice session, he chose the YT condition, and in Burt's choice session, he chose the FR condition. No definitive statements can be made regarding Burt and Kyle's preference due to the lack of repeated measurement of their preferences over time. However, no participant selected the control condition during any choice session, suggesting participant selections were under discriminative control.

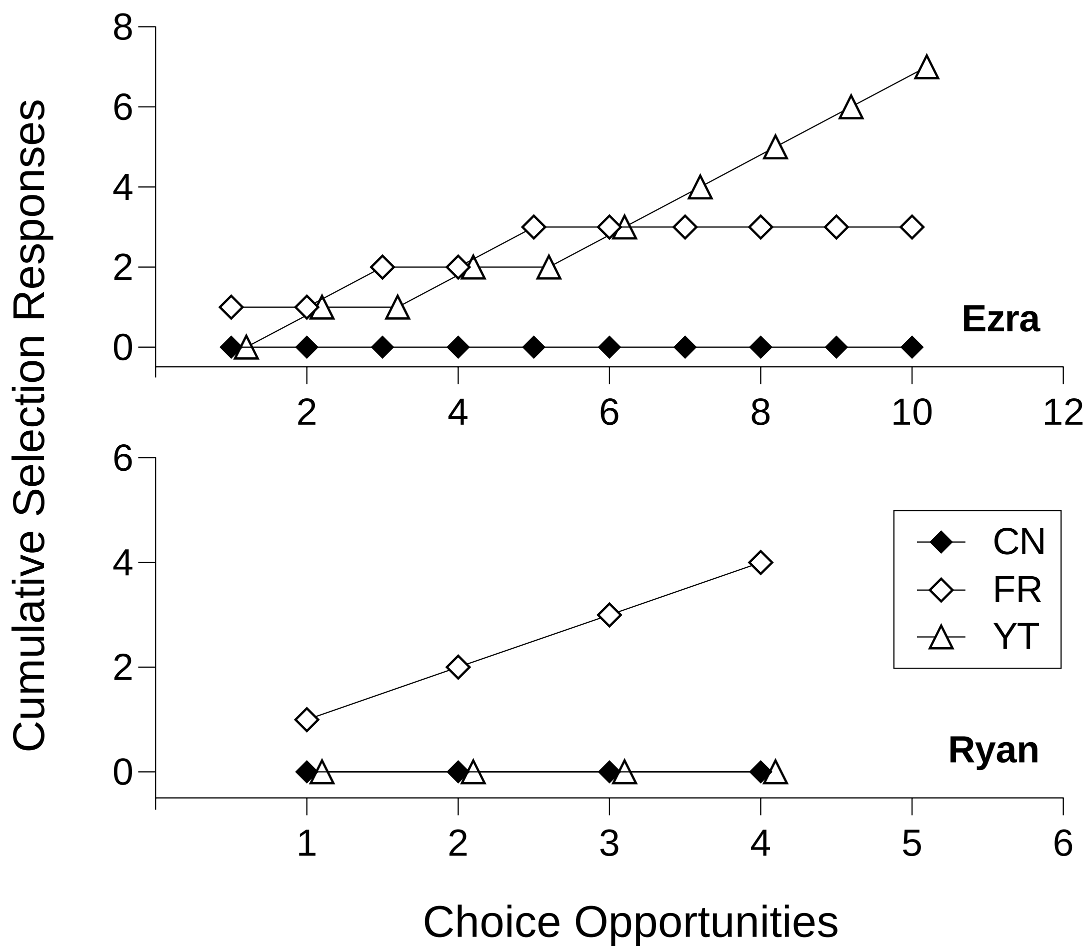

Figure 4. Cumulative selections for Ezra and Ryan.
Note. CN = Control, FR = Fixed ratio, YT = Yoked time-based

Discussion

All participants responded differentially higher in the exchange-production conditions (FR and YT) compared to the control condition in which tokens were not exchangeable for backup reinforcers. However, the FR and YT exchange-production conditions did not produce differential rates of responding during token production for any participants. Despite no differences in responding between FR and YT conditions, participants showed clear preferences for one condition, but those preferences varied across participants.

For all participants, clear differentiation between baseline and the primary reinforcement condition were also observed, indicating clearly that their three most highly preferred edibles identified in the edibles preference assessment at the beginning of the study functioned as reinforcers. Ezra's rate of responding persisting during the return to baseline, albeit at a generally lower level than during primary reinforcement, and increasing across the multielement phase, including during the control condition, was likely an artifact of providing Ezra with an "ALL DONE" card to terminate sessions rather than a programmed alternative task. That is, Ezra generally performed a small number of responses in the baseline and control conditions before submitting the "ALL DONE" card, which made his session time very short; whereas, he never used the "ALL DONE" card in the FR and YT sessions. Anecdotally, it appeared as though Ezra created a rule that he needed to do some work before turning in the "ALL DONE" card. For example, he made statements like, "I'm only going to move four marbles because I am four years old!" Analyzing the data as percentage of session engaged in the target

task provides a more accurate picture of the differential value of the consequences delivered in each condition for Ezra.

Subsequently, we provided an alternative task for the remaining participants, which produced differential response rates between sessions in which edibles could be earned and sessions in which edibles could not be earned. This preparation is consistent with some previous token research (e.g., Jowett Hirst et al., 2016) but inconsistent with Argueta et al. (2019). Argueta et al. did not arrange an alternative task but conceptualized their participant's stereotypy as an unprogrammed alternative task concurrently available with the target task. Typically developing preschoolers are likely to have relatively long histories of reinforcement for completing tasks adults present to them (or prompting contingent on failing to comply). Therefore, providing an explicitly available alternative task or training a specific response to terminate the task, as in Ezra's "ALL DONE" card, are viable approaches for translational studies examining reinforcement procedures with preschoolers.

Responding to the target task persisting in experimental conditions in which tokens were exchangeable for backup reinforcers across participants suggests that the tokens paired with backup reinforcers functioned as conditioned reinforcers in the current study, consistent with previous research evaluating token systems across species (Cowles, 1937; DeFulio et al., 2014; Fiske et al., 2015; Wolfe, 1936). In contrast, in the control condition in which tokens earned were not exchangeable, rate of responding or time spent engaging in the target task eventually decreased drastically or abated entirely for all participants. For Ezra and Burt, whose responding persisted in the control condition more than Kyle and Ryan, the individual sessions with the shortest

mean pause duration were control sessions, suggesting that their responding in control sessions was reinforced by moving on to the next session in which exchange for backups was available, similar to a chain schedule. Taken together, these findings suggest that tokens in the control condition did not function as conditioned reinforcers for any participant. Additionally, all participants exchanged their tokens for all available terminal reinforcers in varying amounts throughout the study, indicating that the tokens exchangeable for backup reinforcers functioned as generalized conditioned reinforcers.

In the current study, experimenters initially facilitated the pairing of tokens and terminal reinforcers via vocal instructions explaining session conditions as opposed to a pre-session training involving direct contact with token system contingencies as in Argueta et al. (2019). Ezra's percentage of session spent engaging in the target task in initial exchange-production condition sessions and Kyle, Ryan, and Burt's rates of responding indicate that the use of instructions did not impede the conditioning of tokens in the FR and YT conditions as reinforcers, though the relative effect of the instructions is unknown. In contrast to the participant in Argueta et al. (2019), the participants in the current study had more advanced vocal-verbal repertoires (i.e., complex, full sentence speech), which is one factor that could affect how vocal instructions impact conditioning tokens as reinforcers. Future research should determine the prerequisite skills necessary for vocal instructions to serve as sufficient token training, as previous research has shown varied effects of vocal-verbal instructions on the conditioning of tokens as reinforcers (Hackenburg, 2018).

Differences in responding during token production between the FR and YT conditions were not observed for any participant in terms of rate of responding, mean

pause duration, or percentage of session engaged in the target task. One potential reason for the lack of differential responding across FR and YT conditions was that the token-production (FR 1) and token-exchange schedules (FR 1) were held constant and dense across the conditions. This finding is consistent with previous basic and applied research examining the exchange-production schedules, which has demonstrated second-order schedule effects (Argueta et al., 2019; Foster et al., 2001; Leon et al., 2016; Waddell et al., 1972). That is, the effects of the exchange-production schedule on responding in token production are not independent of the effects of the token-production schedule or the token-exchange schedule. In the current study, the effects of the token-production and token-exchange schedules were likely more salient than any differential effects of the two exchange-production schedules. These findings support arranging the exchange-production schedule in applied settings based on convenience, because responding during token production appears to be relatively insensitive to differences in the exchange-production schedule alone. Another contributing factor to the lack of differences in responding observed between the FR and YT conditions could be a ceiling effect. FR schedules of reinforcement typically produce rapid responding with minimal pausing, and the time-based, “beat the buzzer” style arrangement can promote a similar pattern of responding. Consequently, it is possible that the participants reached their maximum rate of responding in both conditions. Anecdotally, participants generally appeared to be working as quickly as they could during FR and YT sessions; occasional dropped marbles that rolled across the table or onto the floor likely contributed to differences in pausing and small between-session differences.

Although no differences in responding were observed during token production between the FR and YT conditions, differences in terms of learner preference were observed. Repeated measurement of preference via the concurrent chains preference assessment indicated a clear preference for the time-based exchange production schedule arrangement for Ezra and an exclusive preference for the FR arrangement for Ryan. Kyle and Burt's single choice sessions indicated that they both preferred an exchange-production schedule condition versus the control condition, though whether their preference over time would have remained consistent for the exchange-production schedule condition they chose initially (i.e., FR for Burt and time based for Kyle) is unknown. These results are consistent with the previous research demonstrating that learners can exhibit clear preferences for procedures even when other behavioral metrics do not indicate any differences between the procedures (Hanley et al., 1997; Lozy et al., 2020). One reason some learners might prefer the FR exchange-production schedule is that there may be reinforcers associated with filling every slot on their token board. Several of the participants (especially Ryan) made statements during time-based sessions suggesting that they disliked not being able to fill every slot on their board before meeting the time-based termination criterion (e.g., "But I need five more tokens to finish my board!"). There may also be reinforcers associated with the "beat the buzzer" contingency in the time-based exchange-production schedule condition that resulted in some participants preferring that arrangement. Previous research indicates that "beat the buzzer" interventions are effective for reducing the duration of transitions as well as decreasing negative parent-child interactions; measures of social validity also

indicate that the intervention is viewed favorably by participants (Embry & Biglan, 2008; McGrath et al., 1987).

There are several limitations that warrant discussion. First, the rapid alternation of conditions may have produced carryover effects leading to the lack of differentiation observed between FR and YT exchange-production conditions. Sessions were typically 2 min or less and often occurred in quick succession on the same day. However, clear differences in responding occurred between the control and exchange-production conditions for Ezra, Kyle, and Ryan, suggesting that the rapid alternation was not preventing discrimination of condition differences. Rapid alternation likely did result in Burt's initially persistent responding in the control condition. However, during the control-only phase, Burt's rate of responding decreased or abated. On the second day of the control-only phase, Burt made statements to the experimenter that indicated that his responding in control sessions was sensitive to the exchange-production schedule in the preceding and following sessions, "But we did those yesterday! At home when I get black tokens [the color of Burt's control condition tokens], my mom gives me snacks!" In the FR versus YT comparison phase (sessions 39 through 50) for Burt, only one session of each exchange-production schedule condition was conducted each day, and rates of responding in the exchange-production condition remained undifferentiated. The consistency of participants' preferences lends further evidence to the suggestion that differences in the contingencies across sessions were discriminable.

Second, preference for conditions could only be assessed once with Burt and Kyle. Therefore, definitive conclusions regarding their preference cannot be made. Nevertheless, none of the participants ever chose the control condition, providing

validity for the preference assessment arrangement. Third, the session duration was very brief, which is atypical for practice settings but relatively commonplace in basic research arrangements. It is possible that differences in rates of responding, mean pause duration, and percentage of time spent engaging in the target task between FR and YT conditions might have emerged if sessions were more comparable in duration and relative response effort to work periods arranged in applied settings. For example, although participants in the current study could typically earn at least 15 tokens and an exchange opportunity in 2 min or less, learners are often expected to respond over a longer period of time (e.g., 10-15 min, an entire school day) with the opportunity to earn fewer tokens. Future applied research should compare exchange-production schedules with session durations and/or response effort requirements (e.g., higher schedule values during token production) more comparable to those found in applied settings.

Despite the current study's limitations, these findings have several practical implications for arranging token systems in applied settings. The lack of differentiation between the FR and time-based exchange-production schedule conditions suggest that selecting the exchange-productions schedule based on which one can be more seamlessly integrated into the learner's daily or weekly routine is warranted to optimize the pace of instruction. Given that no participant selected the control condition during the choice phase and definitive preferences were observed for two participants for one of the exchange-production schedules, learner preference should also be considered, when possible, when arranging the exchange-production schedule in token systems in applied settings.

These data support the implementation of token systems with children as young as preschool with tokens exchangeable for terminal reinforcers. Clear differentiation between conditions in which contingent tangible reinforcers were delivered (e.g., edibles, tokens exchangeable for edibles) versus conditions in which no contingent reinforcers were delivered was observed for all participants. Although no differences in rates of responding, percentage of session spent engaging in the target task, or mean pause duration by session between FR and YT exchange-production schedule conditions emerged, clear preferences for one of the exchange-production schedules versus the control condition were observed for both participants whose preference was assessed over time. In addition, the lack of differentiation between the exchange-production schedule arrangements and participants' clear albeit varying preferences supports the clinical recommendation to arrange the exchange-production schedules in token systems based on practical utility and/or learner preference. The findings of the current study indicate that future research is needed to determine when or if meaningful differences in responding occur under FR versus time-based exchange-production schedules that might inform the arrangement of the exchange-production schedule in token systems in applied settings.

Appendix. IRB Approval

ACTION ON PROTOCOL APPROVAL REQUEST

LSU

Dr. Dennis Landin, Chair
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TO: Jeanne Donaldson
Psychology

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: April 8, 2019

RE: **IRB#** 3905

TITLE: An Evaluation of Procedures to Increase Academic Fluency in Young Children

New Protocol/Modification/Continuation: Modification

Brief Modification Description: Increase participants to 100.

Review type: Full ____ Expedited __X__ **Review date:** 4/8/2019

Risk Factor: Minimal __X__ Uncertain ______ Greater Than Minimal______

Approved __X__ **Disapproved** ________

Approval Date: 4/8/2019 **Approval Expiration Date:** N/A

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 100

LSU Proposal Number (if applicable): 48616

By: Dennis Landin, Chairman DLandin

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: Make sure you use bcc when emailing more than one recipient.**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

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Vita

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