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## An analysis of the effects of reinforcers arranged in choice contexts

Casey J. Clay  
Northeastern University

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An Analysis of the Effects of Reinforcers Arranged in Choice Contexts

**A Thesis Presented**

**By**

**Casey J. Clay**

The Department of Counseling and Applied Educational Psychology

In partial fulfillment of the requirements

for a degree of

**Master of Science**

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Author: Casey J. Clay

Department: Counseling and Applied Educational Psychology

Approved for Thesis Requirements of Master of Science Degree

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Jason C. Bourret

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Richard B. Graff

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William H. Ahearn

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By

Casey J. Clay

B.S., Utah State University

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## Abstract

Previous studies have shown participants prefer concurrently available sources of reinforcement relative to a solitary source of reinforcement. The effects of arranging concurrently available sources of reinforcement on the rate of a single response, however, are unclear. In Study 1, a concurrent-chains schedule was used to measure preference between concurrent (choice) and simple FR1 (single-alternative) terminal links. Participants were presented with two plates: a plate with multiple edible items and a plate with one edible item, all edibles were the identical. Results determined that both participants preferred the concurrent link to the single-alternative link. In Study 2, concurrent and single-alternative conditions were arranged for both participants in a multi-element design and schedule requirements for both were systematically manipulated. No differences in absolute reinforcing efficacy between single-alternative and concurrent reinforcement arrangements emerged.

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### An Analysis of the Effects of Reinforcers Arranged in Choice Contexts

Numerous basic and applied studies have examined the effects of arranging reinforcers in choice contexts. Choice responding has typically been examined using situations that offer concurrently available options as consequences (Fisher & Mazur, 1997). Research has been conducted using *different* concurrently available consequences (Dyer, Dunlap, and Winterling, 1990; Geckeler, Libby, Graff, and Ahearn, 2000; Hanley, Piazza, Fisher, Contrucci, and Maglieri, 1997) and also, *same* consequences arranged concurrently (Catania & Sagvolden, 1980; Tiger, Hanley, and Hernandez, 2006). It has been found that participants prefer concurrently arranged options over single sources of reinforcement, using both same and different consequences. Although same and different consequences have been examined, responding to one reinforcer over a qualitatively different one might be a result of dynamic motivating operations. It is therefore necessary to use the same consequences when using concurrent arrangements. This may lead to the conclusion that it is the arrangement of a choice context controlling responding as opposed to qualitatively different reinforcers and changing motivating operations.

Research on choice using different reinforcers has been conducted in a variety of applied studies. Geckeler and colleagues (2000) examined choice between a highly preferred edible and an array of moderately preferred edibles and found higher response rates to gain access to a choice context. Hanley and colleagues (1997) examined choice by offering the client choice between the treatment packages of FCT or NCR and found reduced problem behavior in both treatments, but a consistent client preference for one treatment package over another emerged. Dyer and colleagues (1990) offered choice between instructional tasks and reinforcers and found

increased appropriate engagement. These studies all yielded similar results suggesting that there may be benefits when different reinforcers are arranged concurrently.

Graff and Libby (1999) and Geckeler et al., (2000) found that participants responded more towards, or preferred, different reinforcers arranged concurrently. Graff and Libby (1999) used single- and concurrent-operant arrangements to compare the effects of within and pre-session reinforcement choice. In the single-operant arrangement, the pre-session condition consisted of a single highly-preferred reinforcer (which the participant had selected at prior to start of the session) being delivered contingent on responding. The within session condition consisted of an array of three highly-preferred reinforcers, from which the participant could select one, being delivered contingent on responding. Participants showed higher rates of responding in the within session condition. In the concurrent-operants arrangement the participant could select which condition they were exposed to, via their responding on one of two different colored buttons, each correlated with one of the conditions. Results indicated the participants selected the button correlated with the within session condition more frequently than the pre-session condition, or, the participants preferred delivery of concurrently available reinforcers as compared to the delivery of a single reinforcer. Geckeler et al., (2000) found similar results when they compared concurrently available reinforcers to single sources of reinforcement within single- and concurrent-operant arrangements. In the single-operant arrangement, the no-choice condition consisted of the experimenters delivering a single highly-preferred edible contingent on responding. The choice condition consisted of the experimenters presenting an array of three different highly-preferred reinforcers, and allowing the participant to select one, contingent on responding. In the concurrent operant arrangement, responding on one button led to exposure to the no-choice condition, and responding on another led to exposure to

the choice condition. An ABCBC arrangement was used to compare response rates during the conditions within (A) baseline, (B) single-operant, and (C) concurrent-operant schedules. They found results were undifferentiated between conditions within single-operant phases.

Conversely, they found higher levels of responding when presented with concurrently available rather than single-sources of reinforcement within concurrent-operant phases.

Catania and Sagvolden (1980) found that pigeons preferred consequences be arranged concurrently, even though consequences were the same (3 s access to grain). They did this using a concurrent chains procedure in a six key operant chamber. During initial links four upper keys were dark and two lower keys to the left and right were white. Pecks to the white keys led to mutually exclusive terminal links based on a variable interval schedule. One terminal link contained three red lights and one green light, and the other terminal link contained three green lights and one red light. Pecks to the green lights produced food based on a fixed-interval schedule and pecks to the red keys produced no programmed consequences. They found pigeons responded more frequently to the initial link correlated with the terminal link in which there were concurrently arranged sources of reinforcement (i.e., three green keys) versus single sources of reinforcement (i.e., one green key).

Tiger et al. (2006) also used the same consequences when examining choice contexts. This study evaluated preschool aged children's preference for concurrently available sources of reinforcement through four studies. The first study was to evaluate the preference for choice; the second, to enhance the value of choice; the third, to establish the value of choice; and, the fourth, to quantify a preference for choice.

Participants included six preschool children ages 2.5-5.5 years-old. Preference for choice was evaluated using a concurrent chain schedule. Five of the six participants were typically

developing and one of the participants was diagnosed with an autism spectrum disorder. A concurrent-chains arrangement was used in each of studies. In the initial link of each study three different colored worksheets (orange, blue, yellow) were present in front of the participant. The participant was instructed to select a worksheet. On each worksheet were written letters the experimenters would prompt the child to say following their selection of a worksheet.

In Study 1, selection and correct responding on the orange worksheet led to the experimenter delivering a plate of five identical edible items from which the participant could select one. If the participant selected and correctly responded on the blue worksheet the experimenter delivered a plate with one edible item, and if the participant selected and correctly responded to the yellow plate, praise alone was delivered. Selection responses of each of the worksheets were recorded and it was found that 5 of the 6 participants preferred selecting the blue worksheet that led to the option of selecting an edible from a concurrent arrangement.

Study 2 was conducted to enhance the value of choice. The same initial link stimuli were used in Study 1, but in this study the experimenters manipulated the number of edibles from which to choose in both of the terminal links that contained concurrently arranged edibles. The number of edibles was increased from 4 to 8 then to 12, and finally to 16 in the terminal link which followed selection and responding on the blue and orange worksheet. Results from this study showed that all three participants responded more toward the worksheet correlated with the terminal link containing largest number of edibles arranged concurrently. In Study 3, the number of options on the choice link was manipulated. The same initial link stimuli were used in Study 1. The experimenters increased the number of edibles from which to choose in one terminal link from 5 to 10 and 15, while a single available edible remained in the other. All three participants who initially didn't show a preference for a concurrent arrangement of edibles participated.

Results indicated that as the number of edibles was increased in one terminal link responding toward that link also increased for two of the three participants. For one of the participants, experimental control was demonstrated when the number of edibles was reduced back down to 5 and his responding became undifferentiated.

In Study 4 the experimenters quantified a preference for choice by increasing the number of tasks from 2, 3, 4, 8, 12, 16, and 32 that led to a concurrent arrangement of edibles, while one task remained to access the terminal links that led to a single edible or praise. The authors found that as they increased the number of tasks on the link that led to concurrently arranged edibles responding decreased and responding increased toward the link that led to a single edible. This happened at different schedule values for each participant, thus quantifying a preference for choice.

The purpose of the current research is three fold. The first purpose is to replicate the outcomes of Study 1 of Tiger et al. (2006) and determine if preference will be observed for concurrent terminal links (choice context) over a single-alternative (forced choice) terminal link. Second, if no preference was observed between these two links, to increase the reinforcing potency of the concurrent terminal link by increasing the amount of edibles from which to choose replicating Study 3 of Tiger et al. (2006). Thirdly, to evaluate the response rates maintained by concurrent and single-alternative terminal links across a range of initial link schedule values.

## **Method**

### **Participants, Setting, and Materials**

The participants were two males who attended a school for individuals diagnosed with autism or related developmental disabilities. Jim was a 20-year-old male diagnosed with

pervasive developmental disorder. Jim communicated with a picture exchange communication system and limited vocals. Jim could follow multi-step directions, accept, reject, imitate, and request. Marcus was a 16-year-old boy diagnosed with autism. Marcus communicated vocally for the purposes of requesting, accepting, rejecting, labeling, and answering familiar questions.

Sessions were conducted at the participant's desk in the participant's classroom. The space contained two chairs, a table, video recording equipment, and the other necessary materials. Sessions were also conducted in a leisure area at the student's residence that contained the same materials. Sessions were conducted 3 to 6 times a day, 5 times per week. Materials included a Tupperware container, pennies, poker chips, Cheeze-its®, Gripz®, Hot Tamales®, a small plate, and a timer.

### **Response Measurement and Interobserver Agreement (IOA)**

**Preference Assessments.** During preference assessments, the dependent variable was a selection response, which was defined as the participant picking up one of the items and consuming it. The participant had 30 s to select an item. If no item was selected within the 30 s interval, the trial was ended. A trained observer recorded whether the participant selected each item presented on a trial-by-trial basis. A second observer collected interobserver agreement data during 33% of the preference assessment. Agreement for approach and consumption was 100% across all participants.

**Study 1.** During the concurrent schedule the dependent variable was a selection response, which was defined as the participant taking one edible off a plate. Data were collected by a trained experimenter on a trial-by-trial basis. Percent selection of each link was calculated by dividing the number of selections by the total number of trials. Interobserver agreement data were collected during 50% of the sessions. Agreement was calculated on a trial-by-trial basis by

dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100%. Across all participants, agreement was 100%.

**Study 2.** During the concurrent (CS) and single-alternative (S-A) terminal link chain sessions, the dependent variable was putting pennies into a container for Marcus, and putting poker chips in a container for Jim. This was defined as the participant picking up a penny/poker chip and putting it past the entry point on the slot on top of the container. Data were collected using data collection software on a palm top or laptop computer. Initial link responding was recorded on a frequency key and responses were recorded in 10-s intervals. The total duration of the availability to respond was recorded on a duration key. Responses per min were calculated by dividing the number of responses by the duration of session time with consumption time taken out. Sessions were 5 min in duration. Interobserver agreement was collected by having one independent observer record data for 33% of sessions. Agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100%. Agreement was 89% for Jim, and 91% for Marcus.

## **Procedure**

**Preference Assessment.** Prior to the study, a collection of potential reinforcers was generated based on staff interviews and informal observation of the participants. A total of eight edible stimuli were assessed for each participant using a paired-stimulus preference assessment (Fisher et al., 1992). On each trial, the stimulus chosen by the participant was scored as approached, and the individual was allowed to consume the item. For Jim, the most highly preferred stimulus was Cheeze-its®; for Marcus, Hot Tamales®.

**Study 1.** During the concurrent schedule, the participant was presented with two plates with identical edible items on each plate. One plate contained five of the same edible item, and

the other plate contained one edible item. The two plates were presented at the same time and the participant was instructed to choose one. The participant then selected one of the edible items off either plate, the plates were removed, and the trial was ended. If no selection was made within 5 s of plate presentation, the trial was ended and a “no response” was scored. Attempts to take more than one edible off the plate were blocked. Sessions were composed of 15 trials.

**Study 2.** Concurrent (choice context) and single-alternative (S-A) terminal links were arranged in a concurrent schedule. During a concurrent session, the initial link was responding on the container and the terminal link was a plate of 5 edibles from which the participant could choose one. During an S-A session, the initial link responding was the same; however, the terminal link was a plate of 1 edible from which to choose. Initial link fixed-ratio (FR) values were manipulated, including, FR 1, FR 2, FR 4, FR 8, FR 16, and FR 32.

### Results

Data from Study 1 are shown in Figure 1. Jim exclusively selected the concurrent link. Marcus’s selections were undifferentiated between the concurrent and single-alternative terminal links. Therefore, in order to establish a value for the concurrent link we increased the number from which to select to 10. Following this manipulation, increased selection on the concurrent link began to emerge. Marcus continued to select the concurrent link when the number of edible items present was reduced to 5.

Results from the Study 1 suggest that for all of the participants, the concurrent link was preferred over the single-alternative link. Results also showed that for one participant the concurrent link was preferred over the single-alternative link, but only within a specific context in which the value of the consequence had been enhanced.

Data from Study 2 are shown in Figure 2. Jim's responding was undifferentiated at all schedule values. We also generally observed increased responding particularly when the response requirement was increased to 8, 16, and 32 ( $M = 17.37, 18.71, 21.5$  respectively). Approximately halfway through the second FR2 phase we were beginning to see a satiation effect across blocks of sessions, so the size of the reinforcer was reduced at Session 60. Marcus's responding was undifferentiated across both the FR1 and FR2 phases.

### **Discussion**

During the concurrent schedule, when the response requirement was a selection response, both participants demonstrated a preference for the concurrent (choice context) link replicating Study 1 of Tiger et al. (2006) findings. One participant's preference emerged for the concurrent link only when the number of edible items from which to choose increased to 10 items, also partially replicating the results Study 3 in Tiger et al. This finding replicates past literature that participants prefer to choose their reinforcer from concurrently available reinforcers over being presented a single source of reinforcement (Geckeler et al., 2000; Graff & Libby, 1999; Graff, Green, & Libby., 1998). A potential explanation for these results may be a history of reinforcement associated with choosing. Catania (1980), proposed that choice might emerge as a reinforcer through phylogenic or ontogenic selection. Phylogenic selection of this behavior would come about due to probability of survival being higher for organisms that prefer choice contexts in which they find nourishment rather than a context with a single source of nourishment. Specific preference for the option to choose may have also emerged at the ontogenic level of selection, and persisted, due the history of reinforcement in that organism's lifetime.

Concurrent-operant arrangements produce relative response rates for one reinforcer over another, and as such, are more sensitive measures of reinforcement than absolute response rates (Fisher & Mazur, 1997). In a concurrent arrangement, relative response rates shift toward the option with the more valuable consequence (Fisher & Mazur, 1997). When both schedules were implemented in a multiple schedule design and response requirements were manipulated, response rates were identical in all lower FR schedule values. However, when the response requirement was increased to FR 8, 16, and 32 access to the concurrent schedule (choice context) maintained higher rates of responding respectively. If only lower FR values were used, no differences would have been observed.

This study's practical implications could be translated in applied settings in which therapists are arranging reinforcement for clients. The results of the study suggest that presenting choice contexts alone may not increase the number of activities or tasks a client completes. Therefore, it may be beneficial for the client, and more efficient for the therapist, to first identify a client's most preferred reinforcer and then for that reinforcer to be presented contingently on the client's behavior, while also paying attention to the fact that the client's preference may change over time.

It seems that the choice context is not the determining factor increasing productivity, but rather the variety of different reinforcers from which to choose as was seen in Graff and Libby (1999). However, results from Study 1 indicated that the participants preferred a choice context over single-alternative when all edible items were identical. Consequently, it follows that honoring a client's preference would imply the increased use of choice contexts if that client so prefers.

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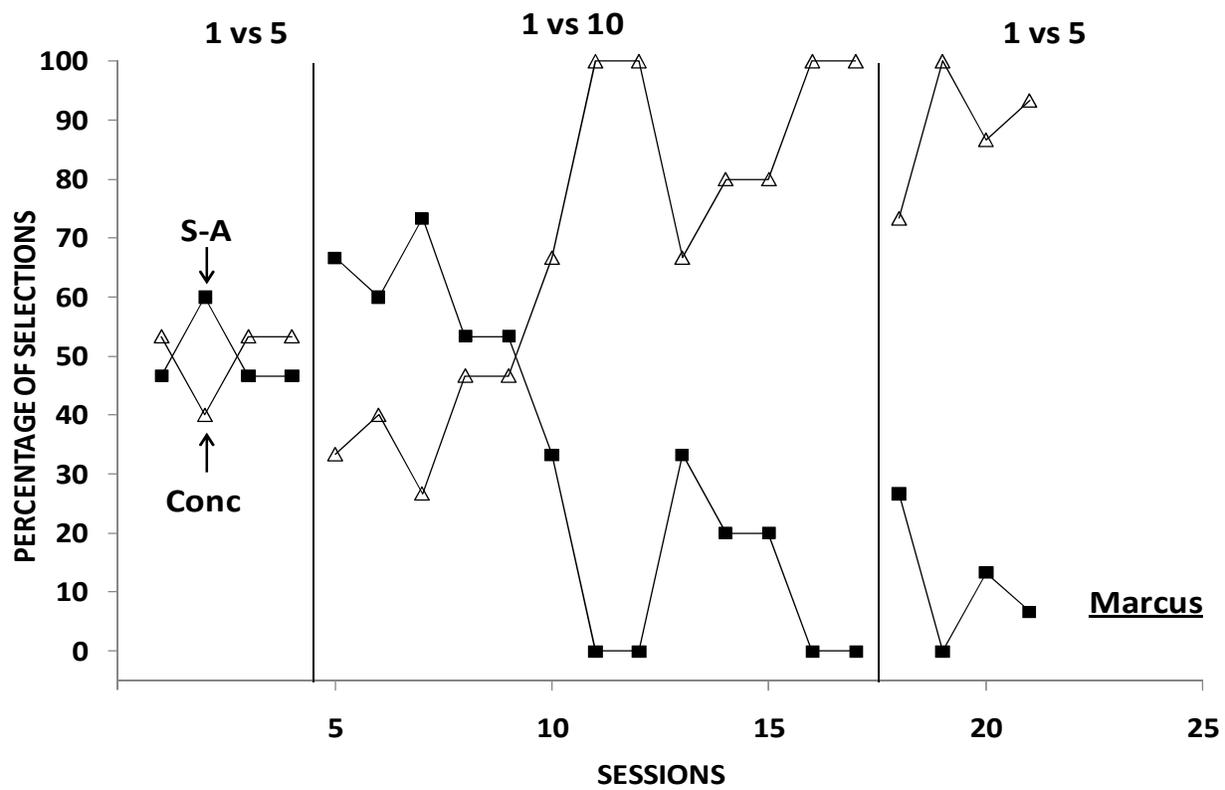
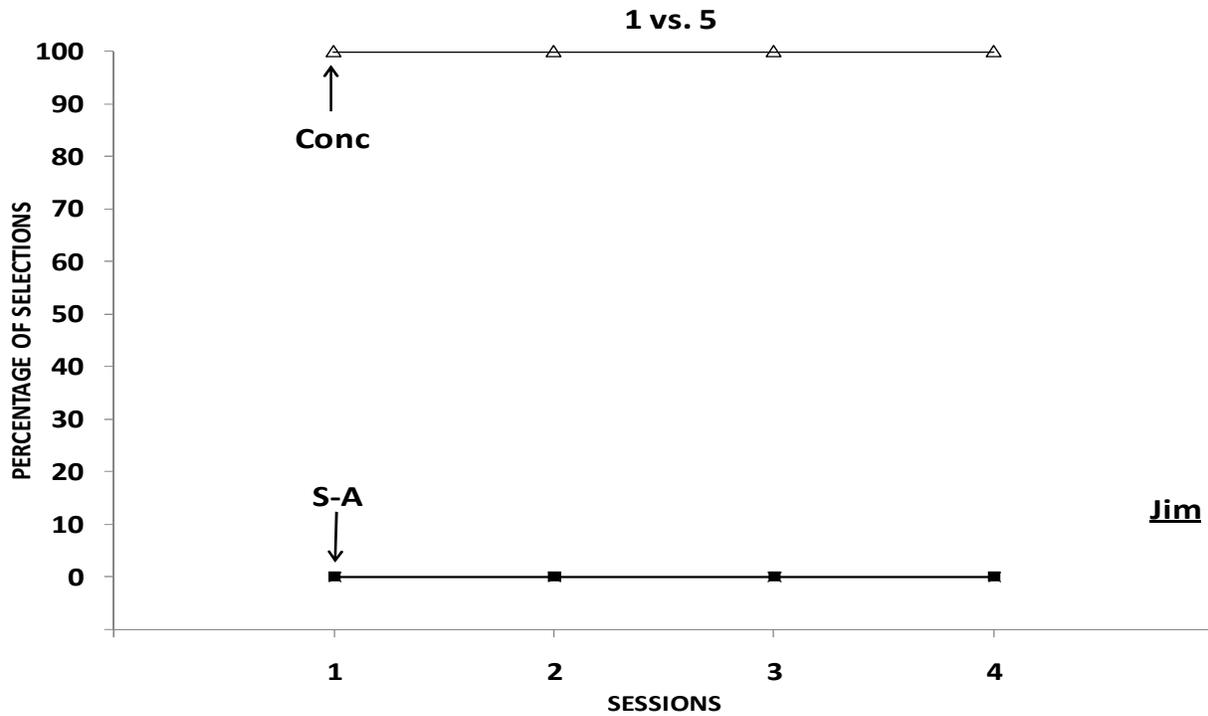


Figure 1. Jim and Marcus's percent selection of concurrent (Conc) and single-alternative (S-A) terminal links

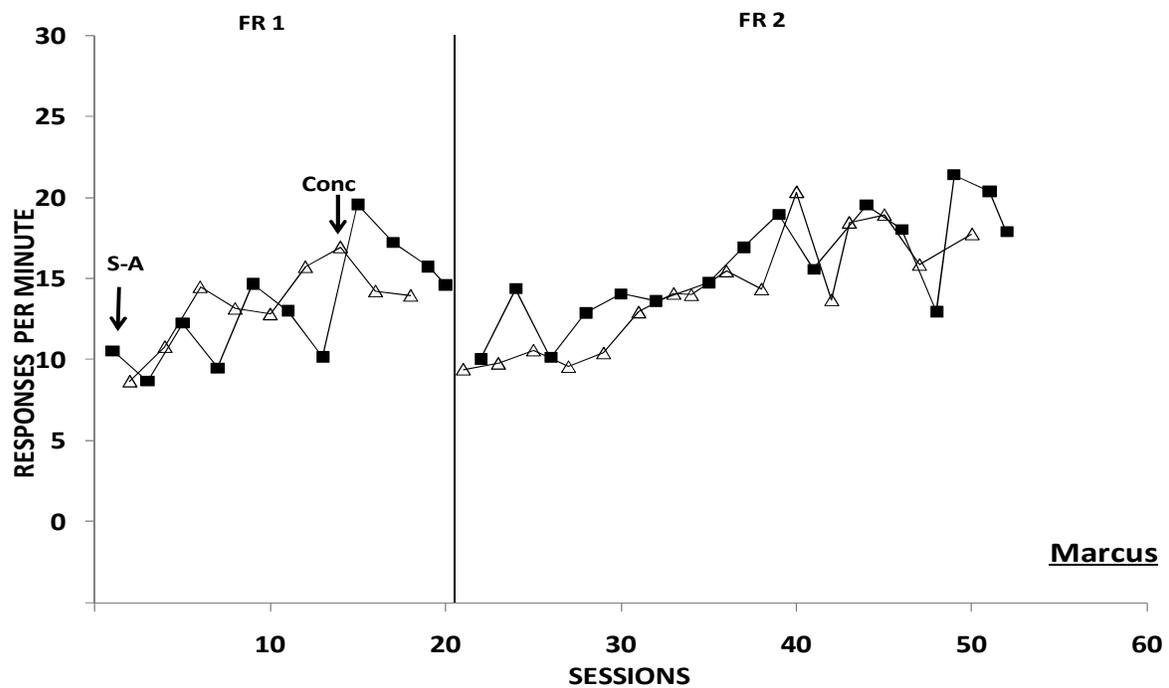
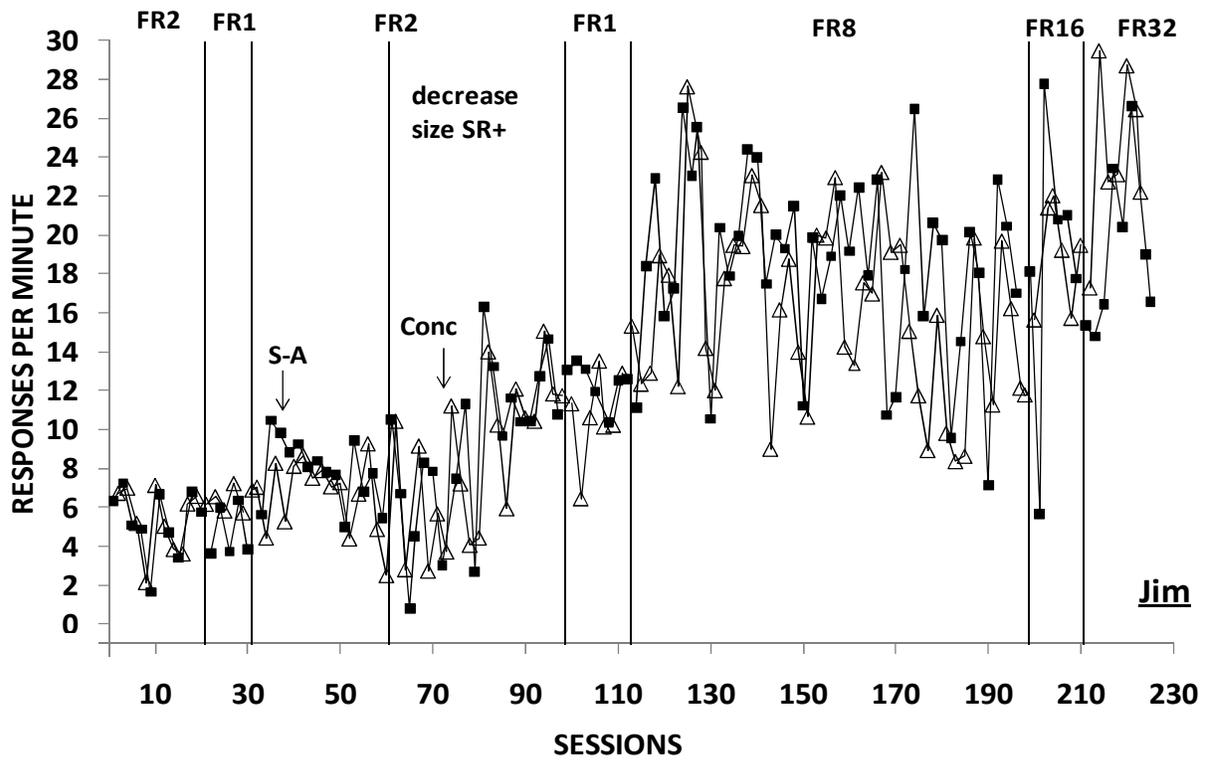


Figure 2. Jim and Marcus's response rates across increasing FR values.