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Comparing extinction and noncontingent reinforcement under challenging conditions: the discriminative effects of reinforcement delivery

Jessica Pearl Alvarez
Louisiana State University and Agricultural and Mechanical College

COMPARING EXTINCTION AND NONCONTINGENT REINFORCEMENT UNDER CHALLENGING CONDITIONS: THE DISCRIMINATIVE EFFECTS OF REINFORCEMENT DELIVERY

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Jessica Pearl Alvarez
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Abstract

Extinction (EXT) and noncontingent reinforcement (NCR) procedures are commonly used to reduce problem behavior maintained by operant reinforcement. Both procedures reduce behavior by eliminating the contingency between that behavior and reinforcement; however, EXT procedures may leave the discriminative effects of the reinforcer intact. The discriminative effects of reinforcement following EXT compared to NCR were investigated using an arbitrary response within three participants. Results indicate that following EXT, re-emergent responding is not more likely to occur in the presence of reinforcement compared to control trials. Moreover, re-emergent responding was overall unlikely to occur following EXT and NCR procedures.

Introduction

Extinction (EXT) and noncontingent reinforcement (NCR) are function-based interventions to reduce problem behavior maintained by operant reinforcement. Typically a therapist will conduct a functional analysis to identify the source of reinforcement maintaining problem behavior and then will disrupt that reinforcement contingency to reduce problem behavior (Iwata, Vollmer, & Zarcone, 1990). EXT involves terminating reinforcement delivery following problem behavior (Catania, 1992). For example, a therapist implementing EXT with an individual who engages in attention maintained aggression would no longer deliver attention following an instance of aggression (e.g., Iwata, Pace, Cowdery, & Miltenberger, 1994). NCR involves delivering the reinforcer that was found to maintain problem behavior *independent* of the occurrence of problem behavior. Reinforcement can be delivered continuously or on a fixed-time (FT) schedule, but similar to extinction the occurrence of problem behavior would no longer produce reinforcement (Kahng, Iwata, Thompson, & Hanley, 2000). For example, a therapist implementing NCR for an individual engaging in aggression to gain access to attention would provide continuous attention to the individual regardless of their behavior.

Both EXT and NCR have been demonstrated to be highly efficacious approaches for treating problem behaviors such as aggression (Fisher, Thompson, DeLeon, Piazza, Kuhn, Rodriguez-Catter, & Adelinis, 1999; Fisher, DeLeon, Rodreiguez-Catter, & Keeny, 2004; Hanley, Piazza, & Fisher, 1997a), self-injurious behaviors (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993; Iwata, Pace, Cowdery, & Miltenberger, 1994; Vollmer, Marcus, & Ringdahl, 1995; Hagopian, Fisher, & Legacy, 1994; Mace, Shapiro, & Mace, 1998; Kahng, Iwata, DeLeon, & Wallace, 2000), and disruption (Britton, Carr, Kellum, Dozier, & Weil, 2000; Fisher, Ninness, Piazza, & Owen-DeSchryver, 1996; Hanley et. al, 1997a; Vollmer, Progar, Lalli, Van

Camp, Sierp, Right, Nastasi, & Eisenschink, 1998). In addition to research investigating the effectiveness of each procedure alone, research has also experimentally compared EXT and NCR.

Thompson, Iwata, Hanley, Dozier, and Samaha (2003) compared the effectiveness of EXT and NCR at reducing responding previously maintained by positive reinforcement for nine adults with developmental disabilities. During the first phase experimenters reinforced a simple operant response (e.g. microswitch pressing, toe-touching, stair stepping) on an fixed-ratio (FR)1 schedule. Experimenters then exposed participants to conditions of EXT, NCR, and differential reinforcement of other behavior (DRO) in a combination of multi-element and reversal designs to compare the efficacy of each procedure as a control condition for the effects of positive reinforcement. Results indicated that EXT resulted in the fastest reduction in responding across participants. These findings have potentially important implications for the use of these same procedures as behavior reduction strategies; specifically EXT procedures may yield the fastest reduction of severe problem behaviors (i.e. aggression, destruction, self-injurious behaviors) maintained by social reinforcement. The authors posed that responding may have persisted for longer durations under NCR and DRO conditions due to the discriminative effects of reinforcement delivery.

There are many features of the contingency between problem behavior and its reinforcer that may be disrupted during behavioral interventions. Both EXT and NCR reduce problem behavior by eliminating the contingency between the behavior and its reinforcing consequence. However, not all elements of that previous reinforcement contingency may be eliminated. For instance, the delivery of reinforcement has not only historically served to reinforce problem behavior, but it also has likely served as a discriminative stimulus for the continued availability

of reinforcement. That is, when a reinforcer has been delivered following the occurrence of problem behavior, it may well also serve as a discriminative stimulus for the continued availability of reinforcement for problem behavior. Thus, when reinforcement is then delivered on an FT schedule or contingent upon the absence of responding, it may then occasion the problem behavior which had historically produced it. For example, take an individual whose aggressive behavior has historically resulted in access to adult attention. When adult attention is delivered on a fixed time schedule (e.g. every 1 min), the delivery of attention may serve as a signal to the individual that attention is now available for engaging in aggressive behaviors. As a result, the individual may begin to engage in aggression following the delivery of reinforcement (i.e. attention), even when the contingency between aggression and adult attention has been eliminated.

Spradlin, Girardeau, and Hom (1966) investigated this hypothesis with six adolescent girls with developmental disabilities. The experimenters established a lever pressing response on an FR schedule of reinforcement. Once participants exhibited high rates of responding, experimenters placed all participants' behavior on extinction. Once participants ceased responding for 2 consecutive min, the authors then initiated a series of test and control trials. The experimenters delivered a single reinforcer non-contingently during test trials and did not deliver a reinforcer during control trials. The authors measured the resumption of lever pressing for the 1 min period immediately following the initiation of each trial. Participants were more likely to engage in lever pressing during test trials in which a non-contingent reinforcer was delivered than control trials in which no reinforcement was delivered (i.e., the delivery of NCR occasioned additional responding).

Spradlin, Fixsen, and Girarbeau (1969) conducted a follow-up study in which they taught 12 children with mental retardation to press a key on a FR schedule to establish high rates of responding. Once participants exhibited high rates of responding, experimenters placed all participants' responding on extinction. Once participants met the extinction criterion, the experimenters then initiated a series of test and control conditions similar to those described above except that they included an additional control condition in which a buzzer initiated trials to test for the effects of sensitization to any stimulus change during extinction. Responding again emerged following NCR delivery of reinforcement and not during either of the two control conditions.

These findings may influence a therapist's decision to implement EXT vs. NCR as treatment for problem behavior. In theory, delivering reinforcement on an FT schedule would disrupt not only the contingency between problem behavior and its consequence, but also the discriminative features of reinforcement delivery (i.e., the frequent non-contingent delivery of reinforcement without the associated continued availability would weaken the discriminative effects of reinforcement delivery). In contrast, when EXT is implemented in isolation, the contingency between problem behavior and its consequence is broken, but the discriminative effects of reinforcement delivery remain intact. So for instance, when a novel caregiver delivers reinforcement (e.g. greeting an individual in the hallway who had received EXT as a treatment for attention maintained problem behavior) the discriminative effects of this event may continue to occasion problem behavior. These implications illustrate the importance of determining if and when problem behavior might reemerge following its successful reduction through EXT and NCR procedures. To begin to answer this question it would be valuable to develop and evaluate procedures using an arbitrary response in lieu of problem behavior in a translational study. A

translational study offers the advantage of manipulating potential treatment challenges and their effects before exposing them to clinical populations. The purpose of this study is to evaluate the re-emergence of a response given the delivery of reinforcement following exposure to EXT and NCR using procedures similar to Spradlin et al. (1969).

Method

Participants, Setting, and Apparatus. Three participants were recruited from a small private school serving children with special needs based upon mutual availability with the experimenters and characteristic absence of problem behavior. Brandon was an eight-year-old boy diagnosed with autism who presented no vocal verbal behavior and whose current academic tasks in school were matching, verbal discrimination of instructions, and fine motor skills. Peter was a four-year-old boy diagnosed with pervasive developmental disorder- not otherwise specified who presented with a limited vocal verbal repertoire and whose academic tasks in school were matching, sorting, and pattern recognition. Vincent was a seven-year-old boy diagnosed with developmental delays who presented with a limited vocal verbal repertoire and whose academic tasks in school were basic addition, handwriting, and pattern recognition. We conducted this experiment in an unoccupied room at the school that contained a table and two chairs.

Materials. We individually identified a simple-operant task based upon a consultation with the participant's classroom teacher. Brandon's task was stringing wooden beads onto a yarn string. During all sessions Brandon was presented with a wooden bead and yarn at all times. Peter's task was to repeat a two-color block pattern using connecting plastic blocks. Vincent's task was to repeat a three-color block pattern using connecting plastic blocks. Peter and Vincent were presented with a sample of the block pattern and had continuous access to a container containing multi-colored blocks. We also delivered small edible items during some sessions that we identified as highly preferred via a paired item preference assessment (Fisher, Piazza, Bowman, Hagopian, Owens, & Slevin, 1992).

Measurement and Interobserver Agreement. We collected data on participant responding on HP mini laptops using a computerized data collection system (Instant Data v 1.4), and graduate student observers collected frequency counts of the target behavior and reinforcer delivery during each session. We converted both measures to rates. For the first participant Brandon, we defined an independent response as the placement of a string through a wooden bead until the string was observable on the other side of the bead. For participants Peter and Vincent, we defined an independent response as the placement of a plastic connecting block in the correct position so that it continued the sample two- or three- color pattern. Reinforcer delivery was defined as the experimenter placing the edible item in the participant's hand.

To obtain interobserver agreement for all phases, two observers collected data simultaneously but independently for a total of 63% of sessions for Brandon, 50% of sessions for Peter, and 63% of sessions for Vincent. Interobserver agreement percentages were calculated by partitioning each session into 10-s intervals. Observers' records were compared on an interval-by-interval basis using the proportional agreement method. The mean agreement for independent responses was 95.9% (range 80.0% to 100%) across all conditions for Brandon, 96.0% (range 80.0% to 100%) across all conditions for Peter, and 92.5% (range 76.7% to 100%) across all phases for Vincent. The mean agreement for reinforcer delivery was 91.3% (range 68.3%-100%) across all conditions for Brandon, 94.6% (range 80.7%-100%) across all conditions for Peter, and 94.1% (range 75.5%-100%) across all conditions for Vincent.

Procedures

Preference Assessment. We conducted a paired-item preference assessment (Fisher et al., 1992) with each participant prior to inclusion in the study in order to identify a highly preferred edible item from an array of eight to 10 items. We presented each item individually to the participant and allowed item consumption in order to ensure exposure to each item; we then initiated the formal assessment. The therapist presented a pair of edible items in front of the participant on a table during each trial. Following a participant approach to a single item the therapist allowed consumption of that item and removed the unselected item; simultaneous approaches to both items were blocked. If the participant did not approach either item, the experimenter vocally prompted the participant to select one of the items. If the participant did not approach either item within 10 s of the vocal prompt, then the experimenter removed both items, scoring that trial as no selection, and beginning the next trial. We presented each item in a paired-array with each other item one time, and then calculated a selection percentage by dividing the number of trials each item was approached by the number of times presented. The edible item with the highest selection percentage was used as the reinforcer throughout the remainder of the experiment. For Brandon, we identified Lays® sour cream and onion chips as the most-preferred item. For Peter, we identified Walmart® fruit snacks as the most-preferred item. For Vincent, we identified Skittles® as the most-preferred item.

Baseline. During 5-min baseline sessions, the participant was seated at the table across from the experimenter with all task materials (e.g., wooden beads and string). The therapist did not interact with the participant during baseline sessions. Once stable levels of task completion were observed across sessions, the participant then experienced the fixed ratio FR schedule. Stable levels of responding were defined as three consecutive sessions with no increasing or

decreasing data trend determined by visual inspection. The purpose of this phase was to evaluate the level of responding before any reinforcement contingencies are put in place for operant-task completion.

Response Training. We taught each participant to complete an operant task through a three-step prompting and differential reinforcement procedure. Immediately prior to the start of the phase the experimenter conducted two physically guided and reinforced trials to teach the participant the correct response. Sessions were 5 min in duration. The experimenter initiated the prompting sequence with a 5-s delay period during which the participant could engage in the operant response independently. If the participant did not initiate the task independently, the experimenter vocally prompted the participant to initiate the task (e.g., by saying "string the bead"). If the child did not initiate the task within 5 s of the vocal prompt, the experimenter modeled the correct response while repeating the vocal prompt. Finally, if the child did not initiate the task within 5 s following the model prompt, then the experimenter physically guided the participant to complete a response. The experimenter discontinued prompting when the child had completed two consecutive sessions with five or fewer prompts (Lerman, Iwata, Rainville, Adelinis, Crosland, & Kogan, 1997). The experimenter delivered one edible item on an FR-1 schedule for each independent correct response (i.e., those occurring in the absence of a model prompt or physical guidance). Participants remained in the response training phase until stable levels of responding were met. Stable levels of responding were defined as three consecutive sessions with no increasing or decreasing data trend as determined by visual inspection. The purpose of this phase was to strengthen the child's independent responding so that we could evaluate the persistence and re-emergence of the strengthened response.

Following the response training phase, half the participants experienced an extinction (EXT) phase first and half the participants experienced a fixed time reinforcement (FT) phase first. Following either the EXT/FT schedule phase all participants experienced a FT test phase. All participants were then placed back into an identical baseline and yoked-reinforcement phase. During the response training phase the total number of reinforcements delivered per session was recorded. During the yoked-reinforcement phase each session delivered the same number of reinforcements as its yoked response training session. The stop criterion for each session was the point at which the yoked number of reinforcements were earned. A new response rate was calculated for this phase using each individual session duration. The purpose of this phase was to keep the amount of reinforcement history the same before implementing either EXT or FT schedule phases. Each participant then experienced the EXT/FT schedule phase that they had not previously been placed in. Following either the EXT/FT schedule phase all participants experienced another FT test phase.

EXT. The EXT phase lasted the total duration it took for the participant to meet extinction criterion. Extinction criterion was set at two consecutive min of no responding for Brandon and five consecutive min of no responding for Peter and Vincent. During extinction the task materials were present, but all reinforcement delivery and prompting were removed. The purpose of this phase was to extinguish the previously maintained response so that the re-emergence of that response could be tested.

FT Schedule. Each FT schedule phase lasted the total duration it took for the participant to meet the response cessation criterion. Brandon experienced a FT 1 min schedule, a yoked-density FT schedule, and a high-density FT schedule. Due to Brandon's persistent responding under the FT 1 min schedule and the yoked-density FT schedule, both phases were eliminated for

Peter and Vincent. Peter and Vincent only experienced the high-density FT schedule. The response cessation criterion was set at two consecutive min of no responding for Brandon, and again due to Brandon's persistent responding the response cessation criterion was extended to five consecutive min of no responding for Peter and Vincent. During all three FT schedule phases all task materials were present and the experimenter delivered one edible item on the corresponding FT schedule. All prompting was removed. The stop criterion for each phase was 60 consecutive min without meeting the response cessation criterion.

During the yoked-density FT schedule phase we calculated the yoked-density schedule by calculating the inter-response time (IRT) of reinforcement delivery for the last three sessions of the prior response training phase. A mean IRT was calculated for each session and then a grand mean was calculated across the three sessions. Reinforcement was delivered on the yoked-density schedule throughout the phase.

During the high-density FT schedule phase the schedule of reinforcement delivery was calculated as a 50%-denser FT schedule from the same calculation method used during the matched-time schedule phase. The purpose of the FT schedule phase was extinguish the previously maintained response so that the re-emergence of that response could be tested

FT Test. Once the criterion was met to end either EXT/FT schedules all participants were immediately placed into a test phase. During the test phase participants experienced two types of trials that were alternated within participants. Every trial began with a 2-min pause criterion of responding for Brandon and a 5-min pause criterion of responding for Peter and Vincent. The pause criterion of responding was modified for Peter and Vincent to match the extinction and response cessation criteria. During reinforcement trials, once the participant met the pause criterion they were presented with one edible reinforcer. During control trials, once

the participant met the pause criterion no stimulus/reinforcement was presented. A 1-min sample recording of responding was collected immediately following the point at which the participant met the pause criterion. Each participant experienced five reinforcement trials and five control trials during each FT test phase. Responding under reinforcement trials was compared against control trials, and responding following the EXT phase was compared to responding following the 50%- denser FT schedule phase. These comparisons were used to evaluate the reemergence of responding.

Results

We conducted baseline sessions with Brandon during which he engaged in near zero levels of responding (Figure 1). Following the two physically guided trials we arranged the response training (RT) phase. The prompt removal criterion was met following the second session in this phase. Brandon met the stability criterion at session 13 with an average of three responses per min for the last three sessions. Following the RT phase we arranged the EXT phase. Although the EXT phase was one continuous phase we divided the data up into 5-min sessions for graphing purposes. Brandon met extinction criterion during the third 5-min session and we immediately arranged the FT test phase. Following EXT, Brandon responded during two out of five reinforcement trials and zero out of five control trials. Brandon responded three times during the first reinforcement trial and three times during the fourth reinforcement trial. We then arranged the baseline condition in which Brandon engaged in stable near zero levels of responding by the fifth session. We then arranged Brandon into the yoked-reinforcement phase until the stop criterion was met. Brandon first experienced the FT-1 min reinforcement phase in which his responding remained consistent and never met the response cessation criterion. He then experienced the matched-schedule FT phase once he met the stop-criterion for the FT-1 min phase. During the matched-schedule FT phase reinforcement was delivered non-contingently every 17 s. Brandon continued to respond during the matched-schedule FT phase, and again never met extinction criterion. We then arranged the 50%-denser FT schedule phase once he met the stop-criterion for the matched-schedule phase. During the 50%-denser FT schedule phase reinforcement was delivered non-contingently every 9 s. Under the 50%-denser FT schedule condition Brandon met the response cessation criterion during the fourth 5-min session. Brandon immediately experienced the second FT test phase. During the second FT test phase Brandon

responded following two out of five reinforcement trials and one out of five control trials. Brandon responded twice during the first reinforcement trial, once during the third reinforcement trial, and once during the fourth control trial.

We conducted baseline sessions with Peter during which he engaged in zero levels of responding (Figure 2). Following the two physically guided trials we arranged the RT phase. The prompt removal criterion was met following the eighth session in this phase. Peter's responding was variable and met stability criterion at session 26 with an average of 1.4 responses per min for the last three sessions. Following the RT phase we arranged the 50%-denser FT schedule phase. During the 50%-denser FT schedule phase reinforcement was delivered non-contingently every 24 seconds. Under the 50%-denser FT schedule condition Peter met the response cessation criterion during the second 5-min session. Peter immediately experienced the FT test phase. During the FT test phase Peter only responded once during the first control trial and never responded during reinforcement trials. We then arranged the baseline condition in which Peter's responding was low and variable until there was no increasing or decreasing trend following the ninth session. Peter then experienced the yoked-reinforcement phase until the stop criterion was met. Following the yoked-reinforcement phase we arranged the EXT phase. Peter met extinction criterion during the second 5-min session and immediately experienced the second FT test phase. Following EXT Peter never responded during either reinforcement or control trials.

We conducted baseline sessions with Vincent during which he engaged in zero levels of responding (Figure 3). Following the two physically guided trials we arranged the RT phase. The prompt removal criterion was met following the third session in this phase. Vincent met

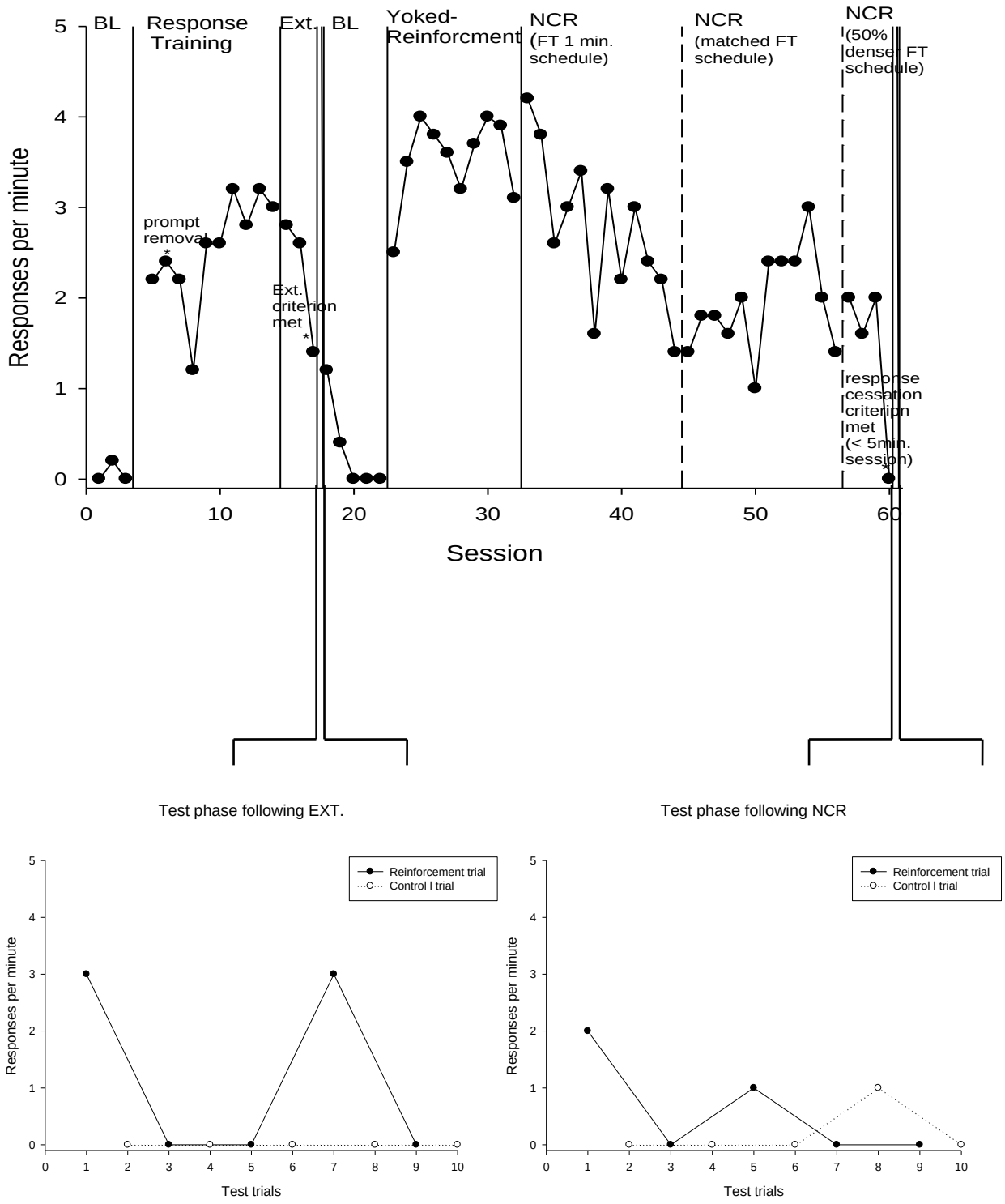

Figure 1. Results for Brandon's independent responding across *baseline, response training, EXT, Yoked-reinforcement, FT NCR,* and *Test* conditions.

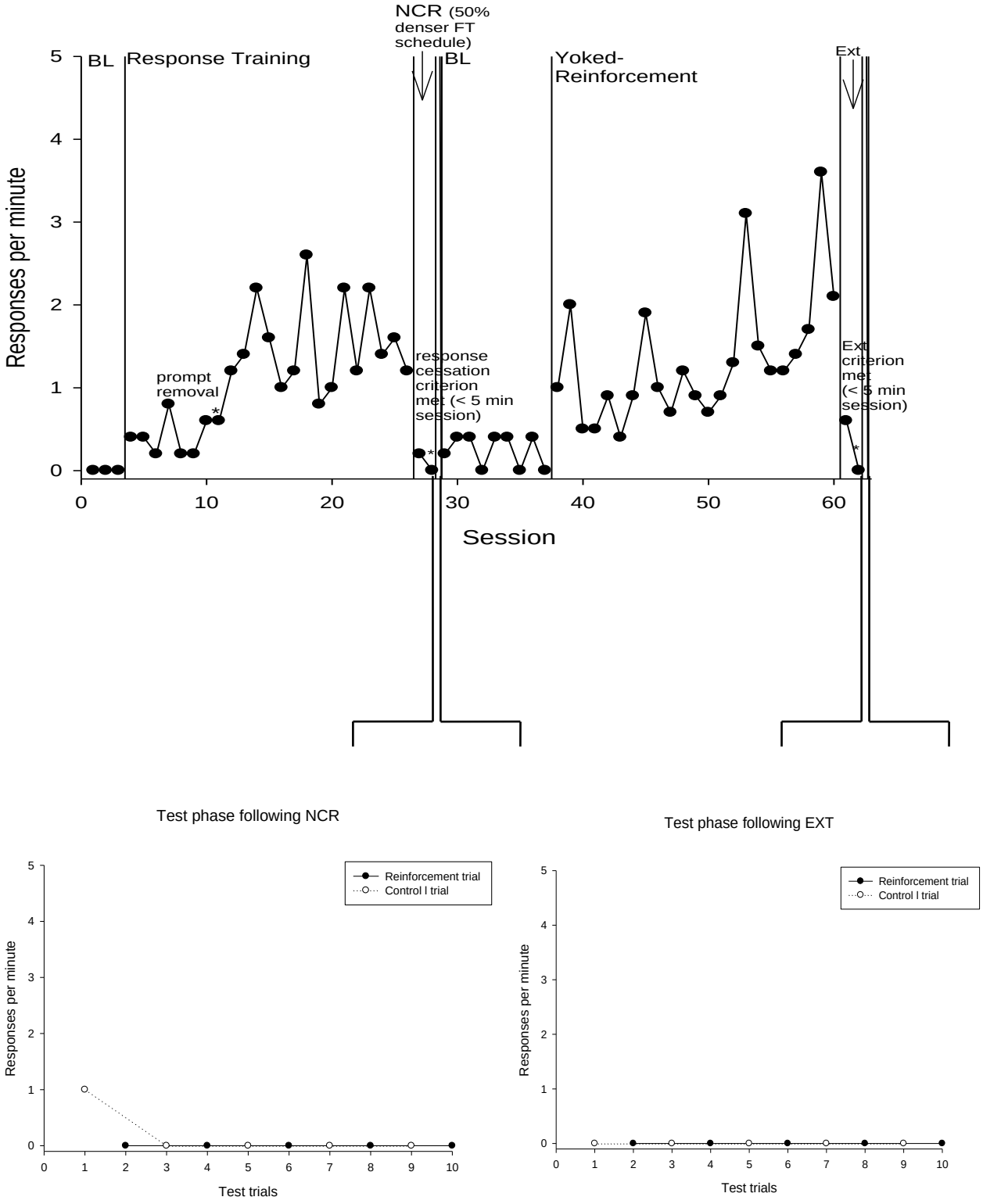

Figure 2. Results for Peter's independent responding across *baseline, response training, EXT, Yoked-reinforcement, FT NCR,* and *Test* conditions.

stability criterion at session 10 with an average of 5.1 responses per min for the last three sessions. Following the RT phase we arranged the EXT phase. Vincent met extinction criterion during the sixth 5-min session and was immediately placed in the FT test phase. Following EXT, Vincent responded once during the first reinforcement trials and never responded during control trials. We arranged baseline conditions in which Vincent's responding was variable until he met stability criterion with near zero levels of responding at session eight. Vincent then experienced the yoked-reinforcement phase until the stop criterion was met. We then arranged the 50%-denser FT schedule phase. During the 50%-denser FT schedule phase reinforcement was delivered non-contingently every 6 s. Under the 50%-denser FT schedule condition Vincent met the response cessation criterion during the fourth 5-min session. Vincent immediately experienced the second FT test phase. During the second FT test phase Vincent never responded during any reinforcement or control trials.

Responding was idiosyncratic with one participant exhibiting undifferentiated responding across test phases, one participant exhibiting a single response during the first reinforcement trial following EXT, and one participant exhibiting a single response during the first control trial following 50%-denser FT schedule. Overall, across participants, responding during reinforcement trials was not consistently higher compared to responding during control trials following EXT compared to following 50%-denser FT schedule. Additionally, responding was not consistently more likely during test phases following EXT compared to following 50%-denser FT schedule.

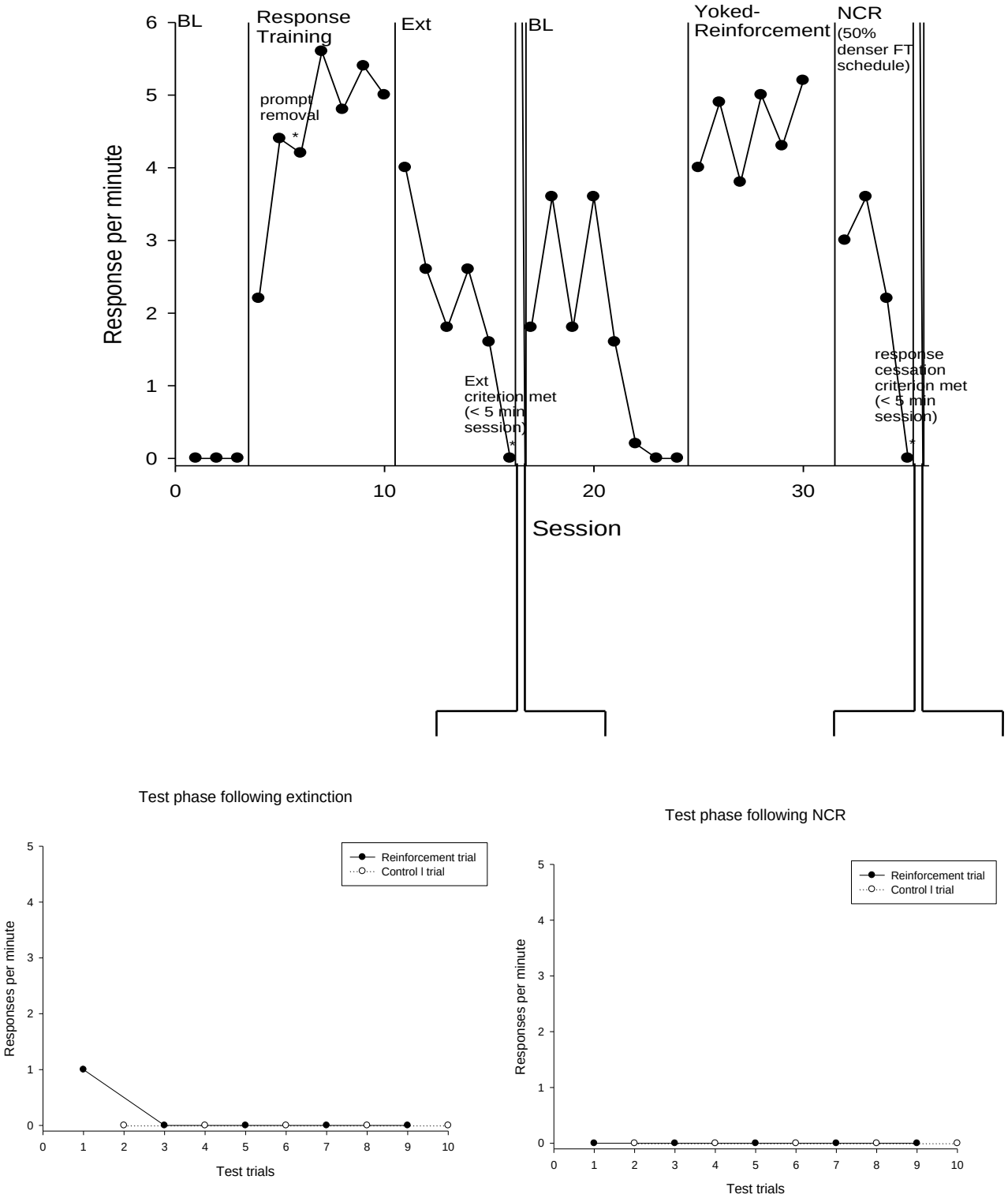

Figure 3. Results for Vincent's independent responding across *baseline*, *response training*, *EXT*, *Yoked-reinforcement*, *FT NCR*, and *Test* conditions

Discussion

In the current study we compared whether a previously reinforced response would re-emerge in the presence of reinforcement following the reduction of that response using EXT compared to NCR procedures. We collected 1-min samples of responding following the presentation of reinforcement compared to control trials following both EXT and NCR procedures within each of the three participants. Overall, results were not consistent across participants. First, EXT resulted in the re-emergence of responding given the FT test in two out of three cases. Second, NCR procedures resulted in the re-emergence of responding given the FT test in two out of three cases. Lastly, NCR only resulted in less re-emergent responding in one out of three cases. Taken together, these results show that the introduction of reinforcement following EXT does not consistently result in the re-emergence of the response previously maintained by that reinforcer. Moreover, these results indicate that re-emergent responding is overall unlikely following EXT or NCR procedures.

The present study differed from the existing research on re-emergent responding in that it examined the effects of reinforcement delivery following both EXT and NCR procedures. Spradlin, Girardeau, and Hom (1966) and Spradlin, Fixen and Girarbeau (1969) presented data on re-emergent responding following only EXT procedures. In both studies, participants were taught a simple motor response under FR schedules of reinforcement and then experienced EXT conditions. Following a 2-min pause criterion for responding, participants experienced either the delivery of reinforcement (i.e. reinforcement trial) or the delivery of no stimulus or arbitrary stimulus (i.e. control trial). All participants experienced five reinforcement trials and five control trials. Results from both studies revealed that participants were more likely to engage in the previously reinforced response following reinforcement trials compared to either type of

control trial. The results from Spradlin, Girardeau, and Hom (1966) and Spradlin, Fixen and Girarbeau (1969) were consistent with the theory that when EXT is implemented in isolation, the contingency between problem behavior and its consequence is broken, but the discriminative effects of reinforcement delivery remain intact. Therefore, when reinforcement is re-presented following EXT it may serve as a signal that reinforcement delivery is now available, and the individual may engage in the response that was previously maintained by that reinforcer. Our results are not fully consistent with this prior research and theory in that only two out of the three participants were more likely to engage in responding during reinforcement trials compared to control trials following EXT procedures. Furthermore, our results are not consistent with the theory that delivering non-contingent reinforcement on an FT schedule would disrupt not only the contingency between problem behavior and its consequence, but also the discriminative features of reinforcement delivery (i.e., the frequent noncontingent delivery of reinforcement without the associated continued availability would weaken the discriminative effects of reinforcement delivery). Only Vincent's results were consistent with both theories of EXT and NCR procedures. Vincent responded only during a reinforcement trial following EXT and never responded during test trials following NCR. Our results are inconsistent with the features of NCR previously mentioned in that one out of three participants engaged in responding during reinforcement trials subsequent to the successful elimination of the response using FT schedules of reinforcement, and two out of three participants engaged in responding during control trials following the successful elimination of responding using FT schedules of reinforcement. There are a number of potential explanations for these discrepancies.

First, Brandon was the only participant to experience the 2-min cessation of responding criterion instead of the lengthier 5-min cessation of responding criterion. This modification was

implemented as a result of Brandon's persistent responding. It was anecdotally observed that during the matched-schedule FT phase and the 50%-denser FT schedule phase his responding came within seconds of meeting the cessation of responding criterion and then increased again. It is likely that his responding was not fully extinguished before entering the second test phase. Therefore, initiating the test phase before the response was fully extinguished could explain why responding was undifferentiated across test trials following NCR procedures.

Additionally, Brandon was also the only participant to go through multiple FT schedule procedures. During all three FT schedule phases there appeared to be adventitious reinforcement for responding. Adventitious reinforcement could have made the FT schedules of reinforcement more similar to a variable-ratio (VR) schedule of reinforcement. Therefore, the reinforcement history prior to the second test phase was substantially longer and different than the reinforcement history prior to the first test phase. A history of reinforcement under VR schedules of reinforcement could explain the inconsistent responding across reinforcement and control trials during the second test phase.

Secondly, the only participant (Peter) who was not more likely to respond during reinforcement trials compared to control trials following EXT procedures was also the only participant to experience EXT procedures as the second condition to extinguish the response. The second baseline phase was essentially the same arrangement as the EXT condition, and therefore Peter had prior experience with EXT followed by the presentation of reinforcement (i.e. yoked-reinforcement phase) before entering the second test phase. In other words, Peter was the only participant to experience EXT followed by reinforcement followed by EXT followed by the test phase. This sequencing of conditions could have diminished the discriminative effect of reinforcement delivery during the second test phase.

Another discrepancy in Peter's results was his responding during the first control trial of the test phase following FT procedures. It is possible that his response was due to the abrupt removal of the dense schedule of reinforcement, and could be a result of the evocative effects of the establishing operations. In other words, abruptly discontinuing reinforcement, that was being delivered on a dense schedule, could increase the likelihood an individual would engage in the behavior that has historically resulted in that reinforcement.

An additional concern regarding Peter's responding was that he began to "play" with the task materials and this activity became increasingly preferred. In particular, Peter engaged in the "play" activity for almost the entirety of the test phases and this may have decreased his sensitivity to the test contingencies. A modification that could prevent this issue in future research would be to restrict access to multiple task items at once or block certain types of "play" behavior with the materials. This modification would make sessions more consistent across participants and eliminate distractions away from the test phase contingencies.

Due to the inconsistent results of the current study, future research should investigate re-emergent responding using the modifications to the current study's procedures with more participants (i.e. removal of second baseline, restriction of materials). In addition, future research could manipulate the length of reinforcement history to see its effects on the discriminative effects of reinforcement following EXT and NCR procedures. The reinforcement history in the current study was very brief and different results might have been obtained had the response under manipulation had a substantially longer history of reinforcement. Future research should examine response re-emergence following lengthier reinforcement periods or use responses or behaviors that participants already have an extensive history of reinforcement for.

At this time we do not recommend either EXT or NCR procedures as being superior against preventing re-emergent responding. Under our manipulation no consistent pattern was observed to indicate an increased likelihood of re-emergent responding following either procedure. Practitioners should continue to use both procedures as behavior reduction strategies in applied settings.

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VITA

Jessica Alvarez is following in her grandfather's footsteps by pursuing a doctorate as a behavioral psychologist. She attended the University of Iowa in her home state where she was first exposed to working with individuals with developmental disabilities and severe problem behavior. She continued to work for 2 years in the Biobehavioral Day Treatment Clinic at the University of Iowa Hospitals and Clinics after she graduated as a direct therapist and researcher. It was here where her passion to help individuals with disabilities and their families flourished. When she moved to Baton Rouge to attend LSU as a doctoral graduate student she knew new experiences and knowledge awaited her, however she did not anticipate meeting the love of her life. Since attending LSU she met Alejandro Alvarez and they married in the summer of 2011 in Switzerland where her parents now reside. She looks forward to completing her degree and continuing her work in the field of behavior analysis and to starting her own family one day.