August 2020

# Effects of Differential Reinforcer Magnitude for an Alternative Response on the Resurgence of Academic Responding

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Abstract

Several studies have looked at ways to mitigate resurgence of challenging behavior by manipulating dimensions of reinforcement for an alternative behavior. To date, only one study has examined differences in resurgence following different magnitudes of reinforcement for an alternative behavior, and only one study has addressed resurgence in an academic setting. The current study evaluated the magnitude of resurgence of a target academic response when large- or small-magnitude reinforcement for an alternative behavior was provided and then all responses were placed on extinction in a subsequent phase. Four students, not receiving academic or behavioral services, were recruited from a suburban elementary school in Central New York. Students earned tokens for working on math problems, and the rate of problem completion was measured across sessions. In Phase 1, completing addition problems was reinforced. In Phase 2, completing subtraction problems was reinforced, but not addition problems. Finally, in Phase 3A/3B, reinforcement was not provided for any response (i.e., extinction). In Phase 3A, extinction was not signaled and resurgence was only observed in 3 of the 4 students. In Phase 3B, extinction was signaled and resurgence of the target response occurred for all four participants, with variable levels across the large- and small-magnitude conditions. Implications and directions for future research will be discussed.

# EFFECTS OF DIFFERENTIAL REINFORCER MAGNITUDE FOR AN ALTERNATIVE RESPONSE ON THE RESURGENCE OF ACADEMIC RESPONDING

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B.A., University of Minnesota, 2009
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Dissertation
Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy (Ph.D.) in School Psychology.

Syracuse University
August 2020

ACKNOWLEDGEMENTS

The last five years have been life's greatest journey thus far, and my success and completion of this project would not have been possible without several people supporting me along the way. First and foremost, I want to thank my advisor, Dr. Brian K. Martens. Your ability to so skillfully implement DRAs (with extinction) really got me through this time and shaped me into the person, researcher, and clinician I am today. Thank you for your time and guidance. I'm so grateful to be a part of your academic family!

To Deborah, Bruce, Mickey, and Margie. Thank you for being the best parents a girl could ever dream to have. Your unwavering support, encouragement, and love is felt every day. Thank you! And to my grandmother, Marilyn Unangst, who saw me through to the end of this. I'm forever grateful for being able to hold your hand during the toughest and roughest parts of the last five years.

Finally, this project is dedicated to Talitha and Ella. The two strongest ladies I know, who were by my side *every single day* over the last five years. Words cannot express my love and gratitude for you both. I love you to the moon and back, and I thank you for your unconditional love and support!

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Differential reinforcement of alternative behavior (DRA) is a commonly used procedure for decreasing challenging behavior and increasing desired behavior (Cooper, Heron, & Heward, 2007). DRA schedules can be implemented by providing reinforcement for Behavior A and either not providing reinforcement for Behavior B (i.e., DRA with extinction; e.g., Carr & Durand, 1985; Durand & Carr, 1992) or by providing reinforcement of a different quality, delay, magnitude, or rate for Behavior B (i.e., DRA without extinction; e.g., Athens & Vollmer, 2010).

A specific treatment that utilizes DRA is functional communication training (FCT). FCT is a treatment that is often used with individuals who are diagnosed with cognitive or developmental disabilities. Individuals with these diagnoses often have limited functional communication skills and may resort to engaging in challenging behaviors (e.g., aggression or self-injury) to communicate their wants and needs. For example, a child may hit their sibling to access a preferred toy. Teaching individuals who engage in these challenging behaviors an alternative way to express their wants and needs while placing the challenging behavior on extinction is an effective way to decrease the occurrence of challenging behaviors and increase appropriate communication. FCT is typically implemented by conducting an experimental functional analysis to determine the reinforcers maintaining challenging behavior, choosing a functionally equivalent and socially valid replacement behavior and teaching an individual to engage in that behavior to gain access to reinforcement, and placing challenging behavior on extinction.

Carr and Durand (1985) were the first to describe the use of FCT with individuals who engaged in challenging behaviors. They conducted their study with four children ranging in age

from 7-14 years who attended a day program and were diagnosed with either autism, traumatic brain injury, and/or a developmental delay. All children engaged in some combination of challenging behavior that included self-injury, aggression, and/or property destruction. The authors hypothesized that the participants' challenging behavior was maintained by either escape or attention from the teachers at the day program. In a two-part experiment, the authors first tested the function of problem behavior, followed by implementation of FCT to determine if this procedure would reduce challenging behaviors.

In Experiment 1, they conducted an assessment that involved manipulating motivating operations that were likely to evoke problem behavior (e.g., issuing demands or withholding adult attention), and recorded the level of behavior during each context. If challenging behaviors occurred at higher rates or levels during a particular manipulation, hypotheses were made about what was maintaining challenging behavior (e.g., escape from demands or adult attention). Carr and Durand manipulated two levels of variables including task difficulty (i.e., Easy or Hard) and the percentage of intervals adult attention was given during a session (i.e., 33% or 100%). This resulted in three conditions being tested: Easy 100, Easy 33, and Hard 100. When participants engaged in elevated rates of challenging behaviors during the Easy 33 condition but not Easy 100 or Difficult 100, it was hypothesized that their challenging behavior was maintained by attention from teachers. If participants engaged in elevated rates of challenging behaviors during the Difficult 100 and not the other two conditions, it was hypothesized that their challenging behavior was maintained by escape from work.

In Experiment 2, participants were taught a functional communication response (FCR) that matched the outcome of the functional assessment. That is, if during the functional assessment a participant engaged in challenging behavior when the teacher was providing low

levels of attention, they were taught to ask, “Am I doing a good work?” as an FCR. If a participant engaged in challenging behavior when the task difficulty was high, they were taught to tell the teacher “I don’t understand.” Baseline sessions were conducted first and were like the sessions in Experiment 1 except the experimenter now would occasionally prompt the student by asking them if they had any questions. Following baseline sessions, each participant was trained to emit their FCR. Participants were required to independently emit the FCR across 10 consecutive trials prior to moving on to test phases. Across all participants, percentages of intervals with disruptive behavior were high during baseline sessions (i.e., the FCR was not reinforced), and the percentage of intervals with disruptive behaviors during the relevant response phases (i.e., the FCR was reinforced) were at zero or near zero levels. These results indicated that teaching an FCR can be an effective treatment for decreasing challenging behaviors.

Tiger, Hanley, and Bruzek (2008) conducted a literature review of research on FCT since Carr and Durand published their study in 1985. Their review indicated that FCT has become the most frequently published clinical treatment package for addressing and decreasing challenging behaviors. Based on the 20 plus years of research supporting FCT, Tiger et al. provided recommendations to clinicians on how to best initiate and conduct FCT with clients. Implementing pre-treatment functional analyses was strongly advised, as it is important to identify an FCR based on the function of problem behavior. Once the function(s) of problem behavior is determined, then the clinician can decide on the most appropriate FCR. The authors recommended considering several dimensions of the FCR prior to teaching the response to a client, including choosing a response that requires low effort, is easily recognized by others in the client’s environment, and can be taught relatively quickly.

In addition to a pre-treatment functional analysis, and consideration of a low effort, easily recognized and teachable FCR, FCT also includes promoting generalization via multiple trainers, common, or self-mediated stimuli, and promoting persistent use of the FCR through thinning the reinforcement schedule, introducing delay to reinforcement, increasing the duration of extinction periods, or training varied mands (Tiger et al., 2008). For example, Betz and colleagues (2013) conducted a component analysis to study the most effective way to thin reinforcement schedules during FCT to decrease excessively high rates of the FCR and maintain low levels of problem behavior. This was completed in a three-part study in which during Experiment 1 the authors replicated previous research by conducting a functional analysis and implementing traditional FCT. During Experiment 2, they replicated previous research that demonstrated differences in rates of FCR when there were periods of reinforcement and extinction for engaging in the FCR. Specifically, they compared rates of FCRs when a mixed schedule versus a multiple schedule of periods of reinforcement and extinction were implemented.

During the mixed-schedule condition, no discriminative stimuli were present to indicate when there was a change from reinforcement to extinction for engaging in the FCR. That is, apart from contacting the reinforcement or extinction contingencies by engaging in the FCR, the participant was not provided additional signals to indicate whether they would be reinforced or not for engaging in the FCR. During the multiple schedule condition, there were discriminative stimuli used to indicate when reinforcement and extinction periods were in place for engaging in the FCR. The discriminative stimulus used in this study was a bracelet worn by the participant. If the participant was wearing the bracelet FCRs were reinforced, and if they were not wearing the bracelet FCRs were not reinforced.

Their results indicated that the rate of FCRs were suppressed to low or zero levels during extinction phases when the extinction period was signaled using a multiple schedule versus a mixed schedule in which the periods of extinction were not signaled. In Experimental 3, Betz and colleagues tested the necessity for gradually thinning the reinforcement schedule. Their results indicated that when a multiple schedule is implemented, and participants can discriminate when FCRs will be reinforced or not (i.e., between periods of reinforcement and extinction), FCR responses will be suppressed during extinction periods and problem behaviors will be maintained at low levels. The participants in this study successfully transitioned from a dense schedule of reinforcement (i.e., 60-s reinforcement/60-s extinction) to a lean schedule of reinforcement (i.e., 60-s reinforcement/240-s extinction) without an increase in problem behaviors and did so without gradually leaning out the schedule.

FCT has been used in a variety of settings including clinics (e.g., Betz et al., 2013), home and community environments (e.g., Harding, Wacker, Berg, Lee, & Dolezal, 2009), schools (e.g., Walker, Lyon, Loman, & Sennott, 2018), and using a telehealth system (e.g., Benson et al., 2017). For example, Benson and colleagues (2017) implemented a function-based FCT treatment package with two participants who engaged in self-injurious behavior using a telehealth system. Throughout the entire study, caregivers implemented the functional analysis conditions and the FCT treatment packages, while researchers remotely coached them using telehealth on how to conduct each component. The function of each participant's challenging behavior was identified, and an FCR was chosen to be used during the FCT portion of the study. Compared to baseline, both participants engaged in elevated rates of FCR and challenging behaviors were reduced to zero or near zero levels during FCT phases.

Functional communication training is a robust treatment for increasing FCRs and decreasing challenging behaviors as evidenced by studies such as Carr and Durand (1985) and Betz and colleagues (2013). When transitioning FCT from a clinical setting to a more naturalistic setting, however, challenging behaviors may begin to occur again when the responsibility of FCT implementation is transferred to caregivers or teachers. Relapse of challenging behaviors can occur when there is simply a change in the context in which treatment is received or if there are lapses in treatment integrity by caregivers or teachers. Relapse of challenging behaviors following FCT is discussed in further detail in the following section.

**Relapse of Problem Behavior Following FCT**

A significant problem during FCT can occur when previously extinguished challenging behavior returns following effective treatment when there is some sort of challenge to the reinforcement received for the FCR. Some examples include when a parent discontinues or provides a lean schedule of reinforcement for the FCR or the context in which treatment was initially presented changes (e.g., from clinic to home). Relapse of challenging behavior following FCT has been empirically studied and has been shown to occur in the forms of reinstatement, spontaneous recovery, *renewal* or *resurgence.* Reinstatement can be described as when a target behavior that was previously reinforced, most recently was extinguished, but reoccurs when reinforcement is provided noncontingent on the target behavior. Spontaneous recovery of behavior occurs when a target behavior that was previously reinforced, most recently was extinguished, reoccurs after a certain amount of time has passed in extinction. The phenomena of renewal and resurgence will be described in further detail below.

Renewal of challenging behavior following FCT occurs when the treatment context is different from the baseline and post-treatment context (i.e., A-B-A renewal) or the post-treatment

context is different from the baseline and treatment contexts (i.e., A-A-B renewal). Saini and colleagues (2018) studied renewal of challenging behaviors when the treatment phase (FCT) was completed at a clinic and the baseline and post-treatment phases were completed at participants' homes (A-B-A renewal). During the first phase, baseline levels of challenging behavior were recorded at the participants' homes with their caregivers acting as therapists. That is, parents would reinforce instances of problem behavior on a fixed-ratio (FR) 1 schedule of reinforcement. In the second phase, therapists at a behavior clinic implemented FCT, and in the third and final phase, caregivers implemented the FCT procedures at home with 100% treatment fidelity. For three of the four participants, challenging behaviors reoccurred when the treatment context changed (i.e., renewal) even though caregivers implemented the procedures with 100% treatment fidelity. For participants who did exhibit a renewal of challenging behaviors during the third phase, two participants initially engaged in baseline levels of challenging behaviors for the first three or four sessions, but the challenging behaviors decreased to below baseline levels by the fourth or fifth sessions. For one participant, the initial session in the third phase was above baseline levels of challenging behaviors, decreased to baseline levels of responding in the second session, and maintained at baseline levels of challenging behavior for the remainder of the phase. This pattern of renewal following successful treatment in a different context has been hypothesized to occur due to the history of reinforcement that is associated with engaging in challenge behaviors in the original context prior to treatment.

FCT has been shown to be a robust treatment in decreasing challenging behaviors, while increasing prosocial communication behavior. This is typically done by placing the challenging behavior on extinction and teaching an appropriate replacement behavior such as a functional communication response. Once challenging behaviors occur at low or zero levels and FCRs

occur at relatively high levels, treatments are typically transitioned into a more naturalistic setting. During this transition, it is not uncommon to experience relapse of problem behavior due to changes in the context or when there is some type of lapse in treatment integrity. Reinstatement, spontaneous recovery, and renewal were all briefly discussed as possible phenomena that lead to a relapse of challenging behavior. Resurgence is another form of relapse of challenging behavior following successful implementation of FCT. This occurs when there is a challenge to the reinforcement received for the FCR such as extinction (Leitenburg, Rawson, & Bath, 1970; Epstein 1985; Lieving & Lattal, 2003; Volkert et al., 2009). In the following section, basic, translational, and applied research on the resurgence of challenging behavior and its applied implications will be discussed.

## Resurgence of Target Behavior

Resurgence of target behavior is studied using a 3-phase procedure that consists of 1) baseline or the reinforcement of a target behavior (Behavior A), 2) differential reinforcement of an alternative behavior (Behavior B) and/or treatment in applied studies in which Behavior A is placed on extinction, and finally 3) an extinction challenge in which Behavior B is also placed on extinction. In applied research, the parallel of Phase 1 is caregivers reinforcing problem behavior in the natural environment or clinicians reinforcing problem behavior in a clinical setting. The Phase 2 parallel is when treatment (e.g., FCT) is implemented in a clinical setting along with extinction of problem behavior, and Phase 3 parallels caregivers implementing the treatment in the natural environment (e.g., home or school) but engaging in treatment fidelity errors in which the alternative behavior receives no reinforcement for a period or less than the prescribed amount

of reinforcement (e.g., lean schedule of reinforcement). Following is a review of research on resurgence of previously reinforced target behavior.

**Basic Research**

Leitenburg, Rawson, and Bath (1970) were among the first to look at resurgence of a target behavior when reinforcement for alternative behavior was placed on extinction. Their subjects were 24 male hooded rats assigned to either experimental or control groups. During Phase 1, both the experimental and control rats were provided reinforcement for responding on Lever A. During Phase 2, the responses on Lever A were placed on extinction for both groups, but for the experimental group responses on Lever B were reinforced while responses on Lever B for the control group were not reinforced. The pattern of responding across both groups indicated a steeper extinction curve for the experimental group versus the control group during this phase. That is, responses to Lever A decreased at a more rapid rate for the experimental group receiving reinforcement for an alternative behavior than for the control group who did not receive reinforcement for engaging in an alternative behavior. During Phase 3, responses to both levers were placed on extinction for both groups. This did not change the contingencies for the control group, and therefore there was little to no change in their responses compared to the final session of Phase 2. For the experimental group, however, there was a resurgence in responses to Lever A compared to the final session of Phase 2. That is, the average number of responses across the experimental group rats went from near zero responses on Lever A during the last session of Phase 2 to about 200 responses per session during the first session of the Phase 3 extinction challenge. Responses decreased steadily over the next four sessions until they were at near zero levels again by the fifth session of the Phase 3 extinction challenge. This demonstrated that although the experimental group received reinforcement for an alternative behavior (i.e.,

Lever B) in Phase 2 and responding on Lever A rapidly decreased in that phase, reinforcement for that alternative behavior resulted in higher levels of resurgence in Phase 3 when there was an extinction challenge in place.

In another basic research procedure of resurgence, Lieving and Lattal (2003) investigated effects on the magnitude of resurgence in Phase 3 when there were (a) differing lengths of Phase 2 (i.e., 5 sessions versus 30 sessions) in which an alternative response was reinforced, (b) multiple exposures to Phase 3 extinction challenges, (c) variable-time schedules of reinforcers delivery independent of target or alternative responses during the Phase 3 extinction challenge, and (d) shifts to lean schedules of reinforcement during the Phase 3 extinction challenge. Across the four experiments, subjects were naïve White Carneau pigeons, and the number of responses on a target lever press were measured across all sessions.

In Experiment 1, the length of Phase 2 was manipulated to see if longer exposures to reinforcement for the alternative behavior would decrease the magnitude of resurgence of responses on a target lever when an extinction challenge was introduced in Phase 3. The results indicated that there was not a difference in resurgence magnitude of the target behavior between short and long exposures to Phase 2 reinforcement. That is, the proportion of baseline responding during the first session of the Phase 3 extinction challenge fell within the range of .25-.50, and then steady decreased to near zero levels by the seventh session for all subjects regardless of the length of Phase 2 exposure. In Experiment 2, the authors replicated the extinction phase by exposing the subjects to two Phase 3 extinction challenges following reinforcement of the alternative behavior (i.e., an ABCABC design). The results indicated that resurgence of the target behavior occurred at relatively similar rates during the first and second Phase 3 extinction challenges for three of the four subjects. Although the magnitude of resurgence compared to the

final session of Phase 2 differed across pigeons, within-subject comparisons indicated the magnitude of resurgence between the first and second exposure to the Phase 3 extinction challenge fell within the same range. By the seventh session of the extinction challenge, most subjects were responding on the target lever at near zero levels.

In Experiment 3, the authors tested if providing reinforcement on a variable-time schedule during the Phase 3 extinction challenge could produce resurgence of the target behavior similarly to conventional extinction (i.e., zero reinforcement provided for all responses). When a variable-time schedule of reinforcement was in place during the Phase 3 extinction challenge, responses on the target lever remained at near zero levels, while responses to the alternative lever maintained at Phase 2 levels of responding. The data indicated that when some form of reinforcement is provided during a Phase 3 extinction challenge, the alternative response can be maintained at some level, and therefore resurgence of the target behavior did not occur. Target behavior only reliably resurged when conventional extinction was in place for both responses. In Experiment 4, the reinforcement provided for the alternative response during the Phase 3 extinction challenge was abruptly changed from a variable interval (VI) 30-s schedule to a VI 360-s schedule. For two of the three subjects, resurgence occurred at similar levels across the VI 30-s schedule and VI 360-s schedule conditions, but the magnitude of resurgence was relatively lower for both conditions compared to the extinction condition. Responding on the target lever during the extinction challenge steadily decreased across sessions across all subjects. These results indicated that there were local bursts of resurgence when such an abrupt change was made, particularly during longer interreinforcement intervals of the VI 360-s schedule.

Animal models of behavior provide researchers with an understanding of the basic mechanisms underlying resurgence. This can be useful for applying these same mechanisms to

how we analyze and predict situations in which resurgence may occur in humans. In the following section, I will discuss translational and applied research that extend the basic laboratory literature on resurgence by way of studying human participants. It should be noted, however, that there are certain challenges that come with evaluating cross-species generalization in these studies of resurgence. For example, in basic-laboratory settings, the reinforcement history of a particular behavior (e.g., lever pressing) is controlled within the laboratory setting throughout the organisms' entire life. For human participants, it is more difficult (if not impossible), to control for the reinforcement history of a given behavior. Other issues that should be considered when evaluating cross-species generalization include the more the complex stimulus preferences (e.g., preference hierarchy of reinforcers) of humans and the more complex tasks humans are given to complete. Nonetheless, animal models of behavior continue to provide a sound platform upon which to study the mechanisms of resurgence.

**Translational and Applied Research**

Early research on resurgence was primarily conducted in basic laboratories using animal models of behavior. In the last decade, translational and applied researchers have started to study the resurgence of challenging behaviors following treatment of these behaviors. In one of the first applied studies on resurgence, Volkert and colleagues (2009) conducted a two-experiment applied replication of Lieving and Lattal (2003) to examine if the same resurgence effects following FCT would be observed with children who engaged in challenging behavior. Five children diagnosed with autism or another developmental disability who engaged in behaviors such as self-injury, aggression, or disruption were participants in the study. In Experiment 1, the authors replicated the typical resurgence procedure using an ABCABC reversal design with three of the participants. Following a functional analysis to determine the reinforcer maintaining

problem behavior, Phase 1 was completed in which problem behavior was reinforced on an FR1 schedule. In Phase 2, the participant was taught an FCR that was reinforced on an FR 1 schedule and problem behavior was placed on extinction. Included in this phase was an FCT maintenance portion in which all FCR responses were completed without any prompting from the therapist. In the Phase 3 extinction challenge, both the problem behavior and FCR were placed on extinction and resurgence of problem behavior was measured. This sequence of ABC phases was replicated (ABCABC) to determine if resurgence would occur following a second exposure to an extinction challenge after FCT.

During Phase 2, problem behavior of all participants decreased to near zero levels while FCRs occurred at relatively high levels. During the Phase 3 extinction challenge, the problem behavior displayed by two out of the three participants did resurge in both extinction challenges to baseline levels of responding following FCT. In fact, for one of the participants, problem behavior resurged to higher levels than were displayed in baseline during the first session of the second exposure to the Phase 3 extinction challenge. Problem behavior for this participant decreased to near zero levels in subsequent sessions following the initial session of resurgence. This experiment demonstrated that resurgence patterns following an extinction challenge can occur in a human population following the implementation of FCT.

Volkert and colleagues (2009) were also interested in determining if shifts in the density of reinforcement (i.e., rich to lean density) could evoke resurgence like extinction during the Phase 3 extinction challenge phase. In a replication of Experiment 4 of Lieving and Lattal's (2003) study, Volkert and colleagues conducted Experiment 2 in which the schedule of reinforcement for the FCR was changed from an FR 1 to an FR 12 during the third phase of the resurgence procedure. There were three participants in this portion of the study. All phases were

conducted identical to Experiment 1, except for Phase 3 in which intermittent reinforcement (FR 12) was used instead of extinction. During the FCT phase, all three participants engaged in near zero levels of problem behavior and relatively high levels of FCRs. During the intermittent reinforcement/extinction challenge phase, resurgence occurred in the first session for two out of the three participants and eventually decreased to near zero levels following several sessions. For the third participant, problem behavior initially remained at near zero levels, but across sessions increased to baseline level responding. This experiment demonstrated that a behavior does not have to be placed on complete extinction following FCT for problem behavior to resurge. Resurgence can occur even when there is a change in the density of reinforcement for the alternative behavior.

Volkert and colleagues (2009) demonstrated that resurgence of challenging behaviors can occur with human participants during an extinction challenge that follows successful treatment. This study also demonstrated that manipulations to the Phase 3 extinction challenge, such as decreasing the density of reinforcement for the alternative behavior from Phase 2 rates of reinforcement, can produce similar levels of resurgence compared to extinction.

Resurgence is a relapse phenomenon in which a behavior that was previously reinforced, most recently was extinguished, but reoccurs when there is a worsening of reinforcement for an alternative behavior. Resurgence has been studied in basic laboratory, translational, and applied settings using the 3-phase procedure described above. The studies described in this section illustrate that resurgence occurs in these arrangements, but they do not necessarily explain why resurgence occurs. In the next section, explanations that have been offered in the literature for why resurgence occurs will be discussed.

## Theories of Resurgence

### Behavioral Momentum Theory

The general law of momentum in the field of physics has taught us that when objects are propelled into space, an object with relatively more mass will persist for a longer time than an object with relatively less mass. For example, if there is a disruption to the forward motion of two objects (e.g., gravity), the object with more mass will move farther in space despite this disruption compared to the object with relatively less mass. When applied to resurgence, Behavioral Momentum Theory (BMT) posits that the more reinforcement (i.e., mass) a response receives in a given context, the more likely it is to persist when there is some sort of reinforcement challenge (e.g., extinction). Many researchers have used BMT to make quantitative predictions about changes in behavior following a successful DRA or FCT treatment. Thus far, researchers have been successful in providing some explanation for how reinforcement for target behavior and the alternative behavior affects the resurgence of target behavior in the extinction challenge during the resurgence procedure (Fuhrman, Fisher, & Greer, 2016; Fisher et al. 2018) using BMT.

Nevin and Shahan (2011) described several BMT equations to quantify the expected effect on the rate of a target behavior during extinction following manipulations such as baseline reinforcement rate of that behavior, reinforcement rate for an alternative behavior, the length of treatment, or the length of extinction. The rate of target responding during extinction ($B_t$) is expressed as a proportion of target responding during baseline ($B_o$). Higher values of Bt/Bo indicate greater resurgence of target responding. Using BMT to describe why resurgence occurs, the following parameters are considered: baseline reinforcement provided for the target behavior ($r$); reinforcement for the alternative behavior ($R_a$); time or sessions spent in extinction ($t$);

suspension of the contingency between reinforcement and the target behavior (*c*); the effect of removing reinforcers from the environment (i.e., the ability to discriminate periods of reinforcement from extinction; *dr*); and the disruptive effect of reinforcement for the alternative behavior on the target behavior ($pR_a$). The manipulation of several of these variables would predict an *increase* in the resurgence of a target behavior. These manipulations include: 1) A decrease in or elimination of reinforcement for an alternative behavior (i.e., $pR_a$ is a decreased or zero value); 2) relatively short lengths of time or sessions in treatment in which the target behavior is on extinction and the alternative behavior is receiving reinforcement (i.e, small *t* value); 3) relatively high rates of reinforcement for the target behavior during baseline sessions (i.e., high *r* value); 4) relatively high rates of reinforcement for the alternative behavior during treatment (i.e, high $R_a$ value); and 5) the addition of time-based schedules of reinforcement during the extinction challenge, effectively making it more difficult for the individual to discriminate between treatment contingencies and extinction (i.e., low *dr)*. Recently, applied researchers have tested the applicability of this equation to resurgence of problem behaviors following an FCT treatment package.

Fisher and colleagues (2018) investigated the effects of two different parameters on the resurgence of problem behavior during an extinction challenge. Four children participated in this study conducted at a clinic that treated challenging behaviors associated with severe behavior disorders. All participants engaged in property destruction, and three of the participants also engaged in self-injurious behaviors. The authors compared the magnitude of resurgence of challenging behavior when the reinforcement schedule for challenging behavior in baseline was on a dense schedule (high *r*) and the treatment phase (FCT) was relatively short (low *t*) versus the resurgence of problem behavior when the reinforcement schedule for problem behavior in

baseline was on a lean schedule (low *r*) and the treatment (FCT) phase was relatively long (high *t*). BMT, in regard to resurgence, would predict that the high density baseline schedule of reinforcement for the target behavior and the relatively shorter exposure to FCT (i.e., Dense-Short condition) would result in relatively higher magnitudes of resurgence during the extinction challenge compared to a low density baseline schedule of reinforcement of target behavior and relatively longer exposure to FCT (i.e., Lean-Long condition). As predicted, for most sessions during the extinction challenge across all participants, the higher proportions of target behavior during the extinction challenge were observed in the Dense-Short condition. That is, resurgence occurred at a higher magnitude when there were dense schedules of reinforcement for problem behavior in baseline and relatively fewer FCT treatment sessions conducted.

Fuhrman, Fisher, and Greer (2016) utilized the BMT equation for resurgence to create conditions that they predicted would lead to the greatest amount of resurgence during an extinction challenge following FCT. Two children participated in this study conducted at a regional behavior clinic. One participant's target behavior was aggression, while the second participant's target behaviors were self-injurious behavior, aggression, property destruction, and pica. The following manipulations were done to create the ideal conditions for resurgence: 1) high rates of reinforcement for problem behavior were delivered during baseline (high *r*) and high rates of reinforcement for the FCR during treatment (high $R_a$); 2) relatively short phases of treatment prior to the extinction challenge (low *t*); 3) the FCR was placed on extinction during the extinction challenge (low $pR_a$); and 4) reinforcement was provided on a timed schedule during the reinforcement challenge (low *dr*). Using these conditions to maximize the magnitude of resurgence, Fuhrman and colleagues compared the magnitude of resurgence following traditional FCT versus FCT using a multiple schedule. The multiple schedule condition consisted

of the therapist wearing a colored index card on a lanyard as a discriminative stimulus or cue to indicate periods in which engaging in the FCR would be reinforced. Not wearing the colored index card ($S^{\Delta}$) signaled periods in which the FCR would not be reinforced (i.e., extinction) during the treatment phase. During the extinction phase of the FCT with multiple schedule, the $S^{\Delta}$ remained as a cue that the FCR would not be reinforced. The results indicated that using a multiple schedule during treatments to signal periods of extinction as well as keeping the $S^{\Delta}$ present during the extinction challenge (high *dr*) resulted in lower magnitudes of resurgence across participants compared to traditional FCT.

Craig and Shahan (2016) manipulated the rate of baseline reinforcement for target behavior (i.e., high or low) and the rate of reinforcement for the alternative behavior (i.e., high, low, or extinction) during the second phase of a resurgence procedure. Although there were some results from this study that corroborated the predictions of BMT, there were several key findings that led the authors to posit that BMT may not fully explain why resurgence occurs. One finding that was not consistent with BMT is that resurgence of target behavior in the third phase occurred exclusively in the groups that received high rates of reinforcement for the alternative behavior (i.e., high $R_a$), regardless of rates of reinforcement for the target behavior during baseline (high or low *r*). That is, for both high- and low-rates of reinforcement for target behavior, resurgence only occurred when there were high rates of reinforcement for the alternative behavior during Phase 2. In the section that follows, an alternative account of resurgence that addresses these inconsistencies in the BMT explanation of resurgence will be discussed.

**Resurgence as a Choice**

Herrnstein's (1961) matching law posited that an organism's allocation of responding between two mutually exclusive behaviors ($B_1$ *or* $B_2$) is equivalent to the relative rate of reinforcement received for engaging in one response or the other ($R_1$ *or* $R_2$). That is, an organism's choice to engage in one behavior over another is controlled by or "matches" the relative rate of reinforcement they receive for engaging in that behavior. Since the matching law was proposed, there have been advances in the formula to predict response allocation by quantifying choice as time allocation between two responses and by considering additional reinforcer dimensions such as quality, magnitude, or reinforcement delay (Baum & Rachlin, 1969). This idea changed the reinforcement parameters of the matching law from *R to V* (i.e., the value of two options; $V_1$ *or* $V_2$).

Using these tenets of the matching law, Shahan and Craig (2017) developed the resurgence as choice (*RaC*) model as an explanation for why resurgence occurs during an extinction challenge. They posited that a response that has received reinforcement in the past (e.g., a target behavior) maintains some value ($V_t$) even after it has been on extinction and an alternative behavior has been reinforced. The parameters of this model include: 1) the time allocated to a historically productive target behavior (*pT*); 2) the value of outcomes produced by the historically reinforced target behavior ($V_t$); and 3) the value of outcomes produced by an alternative behavior ($V_{alt}$). If there is a decrease in value of the alternative behavior ($V_{alt;}$ e.g., rate, magnitude, or quality of reinforcement for the alternative decreases), that will increase the time allocated to the historically reinforced behavior (*pT;*). That is, this model would predict resurgence of a target behavior when any reinforcer dimension of the alternative behavior decreases in value.

**Context Theory**

Recall from above the discussion about different phenomena of behavior relapse. Specifically, the discussion on A-B-A renewal, in which a target behavior that was reinforced in context "A", treated and extinguished in context "B", reoccurs when the subject is returned to context "A", even though extinction is still in place. Related to this is the theory that resurgence of a target behavior can occur due to changes in the reinforcement context (e.g., Winterbauer & Bouton, 2012; Trask, Schepers, & Bouton, 2016).

Winterbauer and Bouton (2012), conducted a study in which they compared a traditional resurgence procedure to a procedure in which the reinforcement schedule for the alternative response was thinned prior to the Phase 3 extinction test. Resurgence occurred as predicted during the traditional resurgence procedure, and the authors hypothesized that the Phase 2 scheduling-thinning procedure for the alternative response would mitigate the level of resurgence of the target response during the extinction challenge. Resurgence of the target response, however, occurred during the Phase 2 scheduling-thinning procedure. The authors proposed a possible explanation for this by categorizing resurgence as A-B-C renewal, such that context "A" is reinforcement of the target behavior, context "B" is reinforcement of the alternative behavior and extinction of the target behavior, and context "C" is the subsequent extinction of both responses. Their argument that resurgence is actually renewal of target behavior is rooted in the idea that change in reinforcement context actually signals a change in context, thus eliciting resurgence of the target behavior in context "C", similar to how a target behavior reoccurs in A-B-A renewal when the context changes.

BMT, resurgence as choice, and context theory have all been used to describe why resurgence occurs following successful extinction of a target behavior and reinforcement of an alternative behavior. Using BMT as an explanation for why resurgence occurs has a rich history

that includes several studies that support use of its equations (Nevin and Shahan, 2011; Fuhrman, Fisher, & Greer, 2016; Fisher et al., 2018). There is evidence, however, that BMT is not the only and/or the best explanation for why resurgence occurs (Craig and Shahan, 2016). Shahan and Craig (2017) provided a potential explanation for why resurgence occurs with the notion of resurgence as choice when there is a reinforcement challenge for the alternative behavior. Winterbauer and Bouton (2012) provided a theory that resurgence occurs due to the change in reinforcement context across phases in the resurgence procedure (i.e., A-B-C renewal). Although these theories differ in their explanation of resurgence, there are some common themes. One common theme is that there is a reinforcement history established with a target response. A second common theme is that resurgence of that target response occurs when there is some sort of disruption or change in the reinforcement of the alternative response. Further research is needed to better understand these mechanisms in order to help researchers and clinicians determine best practices to decrease or mitigate resurgence of challenging behaviors following treatment.

## Mitigating the Magnitude of Resurgence

Research on resurgence since Volkert and colleagues (2009), has focused on how to reduce or mitigate the magnitude of resurgence following the use of DRA and FCT procedures. This has been studied in both basic laboratories using animal models of behavior (e.g., Craig et al., 2017), as well as translational (e.g., Marstellar & St. Peter, Experiment 1, 2012; Smith et al., 2017) and applied research (e.g., Wacker et al., 2013; Marstellar & St. Peter, Experiment 2, 2012) with humans. Generally, studies that look at methods to decrease resurgence during extinction challenges following DRA have manipulated dimensions of reinforcement (i.e., rate, response effort, or magnitude) for the alternative behavior during Phase 2 (DRA) of the

resurgence procedure. These manipulations to the dimensions of reinforcement of the alternative behavior in Phase 2 to decrease resurgence of the target behavior in Phase 3 can be conceptualized using both BMT and *RaC*. Using BMT, lower rates or magnitude of reinforcement for the alternative behavior (i.e., low $pR_a$) would predict a lower magnitude of resurgence during the Phase 3 extinction challenge. Alternatively, when considering *RaC,* a relatively low rate or magnitude of reinforcement for the alternative behavior ($V_{alt}$) would predict a lower response allocation to the target behavior (*pT)* when reinforcement for the alternative behavior is discontinued. The following sections review basic, translational, and applied research findings on how to mitigate resurgence by manipulating these dimensions.

**Rate and Response Effort.** Research using the resurgence procedure has manipulated the rate of reinforcement for an alternative behavior during the second phase of the procedure (Craig & Shahan, 2016; Smith et al, 2017). This research has indicated that high rates of reinforcement lead to the quickest extinction of a target/challenging behavior during the second (DRA) phase. These studies also indicated, however, that there is a higher magnitude of resurgence during the Phase 3 extinction challenge phase when an alternative behavior receives a higher rate of reinforcement. This has important implications for treatment of challenging behaviors, as clinicians want to decrease these behaviors as rapidly as possible usually through treatments that use high rates of reinforcement for an alternative behavior. The resurgence literature, however, should steer clinicians away from that decision as high rates of reinforcement for the alternative behavior lead to a higher magnitude of resurgence when that reinforcement is challenged.

Manipulating response effort for target behaviors can also successfully mitigate resurgence (Wilson, Glassford, & Koerkenmeier, 2016). Specifically, when a target behavior is a

high effort behavior, it is less likely to resurge during an extinction challenge. This is important for clinicians to consider when deciding what alternative behavior will be taught as a replacement behavior. That is, the alternative behavior should be an easier-effort behavior compared to the target behavior that is placed on extinction.

**Magnitude.** Manipulating the magnitude of reinforcement provided for an alternative behavior has also been shown to lead to differential levels of resurgence during an extinction challenge. Craig and colleagues (2017) conducted a two-experiment study using an animal model (i.e., rats) of behavior to demonstrate the effects of the magnitude of reinforcement for an alternative response on resurgence of a target behavior. In both experiments, the three-phase resurgence procedure was used in which a target lever press was reinforced during the first phase, an alternative lever press was reinforced and the target lever press was placed on extinction in the second phase, and finally in the third phase both the target and alternative lever presses were placed on extinction (i.e., Experiment 1) or there was a decrease in the amount of reinforcement received (i.e., Experiment 2). In Experiment 1, the authors tested differences in resurgence of a target lever press by manipulating the magnitude of reinforcement received (i.e., 1 pellet, 5 pellets, or no pellets) for an alternative lever press during the second phase of the resurgence procedure. The results indicated that a relatively larger magnitude of reinforcement (i.e., 5 pellets) for the alternative behavior during the second phase succeeded in extinguishing responding on the target level at a faster rate than when 1 pellet or no pellets were received for the alternative response. In the Phase 3 extinction challenge, however, resurgence of target lever pressing only occurred with the group who received large-magnitude reinforcement in Phase 2. Across subjects who received large-magnitude reinforcement for the alternative response in Phase 2, the average level of responding on the target lever increased from the last session of

Phase 2 to the first session of Phase 3. In the subsequent four sessions, responses on the target lever steadily decreased, but responses remained above the average rate the subjects engaged in during the final session of Phase 2. These results indicate that although large-magnitude reinforcement of an alternative behavior is useful in quickly decreasing target behavior when target behavior is placed on extinction, receiving large-magnitude reinforcement for an alternative behavior may lead to relatively high levels of resurgence when there is some sort of extinction challenge.

In Experiment 2, Craig and colleagues (2017) extended Lieving and Lattal's (2003) experiment in which the rate of reinforcement for the alternative behavior during the extinction challenge phase was manipulated to test for the effects of shifts in reinforcement. Craig and colleagues instead measured resurgence when there were shifts in magnitude rather than rate of reinforcement received. During Phase 2 in which the alternative lever pressing was reinforced, all rats received 6 pellets for responding on the alternative lever. During the Phase 3 extinction challenge, there were reductions in the magnitude of reinforcement for the alternative behavior across all groups. There were three groups in which reinforcement decreased from the second phase (i.e., 6 pellets) to either 1 pellet (6-1), 3 pellets (6-3), or no pellets (6-0). Responding on the alternative and target levers were similar across all groups during the second phase. Resurgence in target lever pressing during the third phase for the group who received the 6-3 manipulation, however, was relatively lower than the levels of resurgence for the 6-1 and 6-0 groups. The average rate of responding for the 6-3 group during all Phase 3 extinction challenge sessions was only slightly elevated compared to the final session of Phase 2, and the level of responding remained relatively stable across all Phase 3 sessions. The average rate of responding for the 6-0 group during the first Phase 3 extinction challenge session was relatively higher

compared to the final session of Phase 2, but levels of responding steadily decreased to lower over the subsequent four sessions. Finally, the 6-1 group on average engaged in elevated responding during the first session of the Phase 3 extinction challenge compared to the final session of Phase 2, and these levels remained relatively stable across all Phase 3 sessions. These results indicate that resurgence will not occur exclusively when responses are placed on extinction. Shifts in the magnitude of reinforcement received for an alternative response can also result in resurgence of a target behavior.

In summary, there have been several studies looking at the dimensions of reinforcement for an alternative behavior and how that affects resurgence during Phase 3 of a resurgence procedure. Relatively low rates of reinforcement for an alternative behavior, high effort target responses, and small magnitude of reinforcement for an alternative behavior are all manipulations of the dimensions of reinforcement that have been shown to reduce the magnitude of resurgence during an extinction challenge. Most of these studies, however, were completed using an animal model of behavior or they were conducted with humans strictly in a clinic setting. In fact, there has only been one study published on the effects of reinforcer magnitude on resurgence, and it was completed using an animal model of behavior (Craig et al., 2017). Additional research is required to study patterns of resurgence in different settings (e.g., group homes, community centers, or schools). Specifically, the importance of studying resurgence within a school setting, with school age school-aged students, will be discussed in greater detail below.

## Importance of Studying Resurgence in Schools

To date, only one study has been conducted examining resurgence in the schools (Garner, Neef, & Gardner, 2018). This is concerning, as challenging behaviors occur frequently in

classroom settings, school staff are required to conduct functional behavior assessments and/or analyses by law to identify the functions of problem behavior, and DRA interventions are being recommended based on the results of these functional analyses (Mueller, Nkosi, & Hine, 2011). The research discussed above makes it evident that resurgence needs to be addressed when planning school-based reinforcement programs as it is a common problem in clinical settings. Behavioral consultants often make suggestions for providing reinforcement for alternative behavior and placing challenging classroom behaviors on extinction. If behavioral consultants do not consider, however, how different dimensions of reinforcement for the target and alternative behavior across baseline and treatment phases may affect resurgence once they transfer treatment implementation to teachers, challenging classroom behaviors may resurge. More research is needed in this context to understand how to mitigate resurgence of problem behavior in the classroom setting.

Garner, Neef, and Gardner (2018) conducted the only translational study to date within an academic setting. Unlike previous studies involving resurgence of problem behavior following FCT, Garner and colleagues looked at the resurgence of academic responding. The authors trained three students to identify a subset of Greek letters and provided reinforcement for correct responses during baseline (i.e., Phase 1). Just prior to Phase 2, the authors trained students to identify a new subset of Greek letters, and during Phase 2, these responses were reinforced while the original subset was placed on extinction. For both Phases 1 and 2, the authors implemented a multiple schedule in which the rate of reinforcement was manipulated across two components. During baseline, the schedules were identical for both components (i.e., VI 11-s). During Phase 2, however, the rate of reinforcement for the alternative behavior (DRA schedule) varied across components (i.e., VI 5-s or VI 20-s). During Phase 3, all responses were

placed on extinction and the magnitude of resurgence was measured. The target response from baseline did resurge during the final phase across both DRA conditions, but at relatively higher levels following the richer DRA schedule. These results were consistent with the outcomes of previous studies discussed on resurgence of target behavior (e.g., Craig & Shahan, 2016). In this study, however, resurgence was considered a positive outcome and the results indicated that there may be potential in looking at ways to increase resurgence when positive academic skills are involved.

Although the studies by Garner and colleagues (2018) is a start in bridging the gap between research on resurgence completed in a clinical setting and in an academic setting, their study only focused on differences in the rate of reinforcement for the alternative behavior on resurgence of a target behavior. Additional research is needed to determine the effects of different dimensions of reinforcement, such as reinforcement magnitude, on resurgence of both adaptive and problematic responding in an academic setting. We know from basic researchers who have studied effects of the magnitude of reinforcement for an alternative behavior that large-magnitude reinforcement results in higher levels of resurgence compared to providing small-magnitude reinforcement for an alternative behavior (Craig et al., 2017).

Future research should investigate the effects of differential magnitude of reinforcement on academic responding. Studying resurgence of academic responding provides us with an opportunity to conduct clean translational studies that replicate and extend previous work completed in basic laboratories and clinical settings. Extending the current literature base of resurgence of academic responses will be an initial step in building the translational research base that will eventually lead to studying the resurgence of problematic classroom behaviors following successful interventions in the academic setting.

## Purpose of the Current Study

Research on mitigating resurgence in a clinical setting following successful treatment of challenging behaviors is relatively new in the field of applied behavior analysis. That is, these investigations have all been conducted within the last decade (e.g., Volkert et al, 2009; Fuhrman et al., 2016; Fisher et al., 2018), and behavior analysts are still in the early stages of determining best practices when it comes to implementing DRA or FCT in ways that mitigate resurgence of challenging behaviors. It is important to continue studying ways to mitigate resurgence by manipulating different dimensions of reinforcement for an alternative behavior and extending the literature to different settings and different behaviors.

Craig and colleagues (2017) expanded the current resurgence literature by determining the effects of reinforcer magnitude for an alternative behavior on the resurgence of a target behavior. Although many applied resurgence studies have manipulated dimensions of reinforcement such as rate (e.g., Fuhrman et al., 2016) or response effort (Wilson, Glassford, & Koerkenmeier, 2016), there are no known applied studies looking at the effects of differential magnitude of reinforcement for an alternative behavior on resurgence of a target behavior.

To date, there has only been one published study looking at resurgence of behavior in an academic setting (Garner, Neef, & Gardner, 2018). Additional translational and applied studies are needed to increase the field's knowledge about the resurgence of target responding. This is important as the more we know about how the different dimensions of reinforcement affect resurgence, the better informed we will be when we make recommendations to school administration and staff.

There were two primary goals of the current study. First, replicate Craig and colleagues' (2017) Experiment 1 and extend it by using human participants to answer the question of how

differential magnitude of alternative behavior affects the resurgence of target behavior during an extinction challenge. To do this we completed a resurgence procedure in which a target behavior was reinforced in Phase 1, an alternative behavior was reinforced in Phase 2, and both behaviors were placed on extinction during Phase 3. The magnitude of resurgence of target behavior responding was measured during the extinction challenge following relatively large magnitudes of reinforcement for an alternative behavior and relatively small magnitudes of reinforcement for an alternative behavior in Phase 2. Second, this study aimed to increase the literature on resurgence in an academic setting by looking at resurgence of academic responding (i.e., completing math problems) while the magnitude of reinforcement for the alternative behavior (i.e., large magnitude or small magnitude) was manipulated.

**Hypotheses.** Based on previous research examining the magnitude of reinforcement for an alternative behavior on resurgence of a target behavior using lever pressing in rats (Craig et. al, 2017), it was hypothesized that 1) large-magnitude reinforcement of the alternative behavior (i.e., Condition A) in Phase 2 would result in faster suppression of the target response compared to small-magnitude reinforcement of the alternative behavior (i.e., Condition B) in Phase 2; and 2) large-magnitude reinforcement of the alternative behavior would result in a higher magnitude of resurgence in Phase 3 compared to small-magnitude reinforcement of the alternative behavior in Phase 3.

## Method

### Participants and Setting

Four participants were recruited from a local school in a suburban school district in the Northeast region of the United States. All participants were in the 4$^{th}$ grade. The four participants were Ted, a 10-year-old white male; Eleanor, a 10-year-old white female; Jamila, a 9-year-old

Asian-American female; and Janet, a 9-year-old white female. All students' names are pseudonyms to maintain confidentiality. Criteria for student inclusion in the current study were female and male students who were: 1) in the 4th or 5th grade, 2) neurotypically developing; and 3) performing at grade-level in mathematics as reported by their teacher. Students who were English language learners, currently receiving tier 2 or tier 3 services for academic or behavioral concerns, and/or are identified with a disability were not recruited for participation in this study. All students, with the exception of Janet, were performing on the "Mid-4" level of iReady Math curriculum at the time of the study. Janet was performing on the "Late-4" level of iReady Math curriculum at the time of the study.

Approval by the Institutional Review Boards (IRB) of Syracuse University (SU) and a Central New York suburban school district was obtained prior to the start of the study. A meeting was conducted with the district's superintendent and the principal of the target local school to discuss the parameters of the study and to seek permission to conduct the study at their school. Once approval was granted from the SU IRB and the school district and permission was granted by the principal, the primary researcher met with the fourth-grade teachers at the school to discuss the study. The teachers were asked to nominate all students who were currently performing at grade-level in mathematics. Consent forms were sent home with those who were nominated to be signed by a parent/guardian. A meeting with the primary researcher was offered to prospective participants' parents/guardians to explain the procedures in place so that the parents/guardians could provide informed consent for their child's participation in the study. The first 4 students who returned consent forms signed by their parent/guardian were recruited for participation in the study. An assent form was signed by each participant at the beginning of the study, and verbal consent was obtained at the start of each day of participation in the study.

Sessions took place in the same context (within a conference room in the main office), except for two days when the conference room was occupied due to administrative meetings or state testing. These two days of sessions were conducted in empty classrooms. The experimenter sat at a 90-degree angle next to the participant at a conference table. Three packets of stapled worksheets were 6 inches from the edge of the table and approximately 1 foot of space between the packets. There was a container for the tokens earned centered between the experimenter and the worksheets, and the experimenter held a bag of tokens that were used during each 3-min session.

## Materials

**Curriculum based measurement probes in math (CBM-M).** Single-skill curriculum-based measurement probes in math (CBM-M) were administered to determine mastery-level problems for each participant. The rationale for determining and using mastery-level problems during the current study was twofold: 1.) Mastery-level problems were used as an analogue to lever pressing in Craig and colleagues (2017) in that the participants would be able to fluently complete the math problems similar to how the nonhuman subjects responded on their operandum; and 2.) Using mastery-level problems would avoid an increase in rate of problem completion over time due to maturation effects, as the participants would already be completing the problems fluently (i.e., at a high rate) from the start. During each CBM-M probe, participants were given a pencil and a five-page packet of worksheets. Each page of the packet had 25 single-skill math computation problems in a 5 x 5 format. See Appendix A for an example page of the CBM-M probe.

**Experimental phase single-skill math worksheets.** One five-page packet of mastery level single-skill addition mathematic worksheets (Packets A), one five-page packet of mastery

level single-skill subtraction mathematic worksheets (Packet B), one five-page packet of mastery level single-skill mixed addition and subtraction (Packet C), and a pencil were placed in front of the participant at the start of each experimental session. For Janet, each packet was 6 pages, as it was discovered during the initial baseline that she was able to complete all 5 pages of the subtraction problems prior to the end of the 3-min session. Each page of the packets had 25 single-skill addition or subtraction math computation problems in a 5 x 5 format. Each packet of worksheets was printed on different colored paper (i.e., packet A was blue, packet B was yellow, and Packet C was white).

**Tokens and back-up reinforcers.** An open mason jar was placed between the packets and the experimenter. There was a small "school store" set up on the opposite end of the conference room table. There were 4 clear plastic zip-locked bags with a different type of school supply in each. Each bag was labeled with the number of tokens required to buy one item from the bag. For Ted, a deck of UNO cards was used as the activity for which he could trade his tokens.

**Experimenter and observer materials.** The experimenter was equipped with a gallon-sized zip-locked bag with 40 white poker chips in it, a stopwatch, a pencil, and a clipboard with a variable interval sheet to mark when reinforcer intervals were set up and when reinforcers were to be delivered (See Appendix B for a template of the interval sheet). During Phases 2 and 3, the experimenter also had a colored lanyard around their neck that had a laminated card attached to it. One lanyard and card were black to signal the large-magnitude condition, and the other lanyard and card were yellow to signal the small-magnitude condition. Data collectors were equipped with a computer installed with BDataPro (Bullock, Fisher, & Hagopian, 2017).

**Response Measurements**

**Curriculum based measurement probes in math (CBM-M).** Participants' responses were hand scored by the experimenter after the preliminary CBM-M assessment. The experimenter scored each completed worksheet for digits correct per minute (DCM). A participant earned a digit correct for each correct number written in the correct place in an answer. Therefore, if there was one digit in the answer (e.g., 9) the participant could earn one digit correct, and if there are two digits in an answer (e.g., 13) the participant could earn up to two digits correct.

**Experimental phases.** Prior to the experimental phases, data collectors were trained on how to collect frequency and duration data using BDataPro. They were required to record data from a practice video with 90% or greater accuracy compared to the primary experimenter of the study.

During experimental phases, data collectors recorded frequency of problems completed on Packets A, B, and C during each session. There was a key for each packet, and the frequency was converted into a rate (i.e., responses per minute). The rate of responding was graphed with sessions on the X-axis and the rate of responding on the Y-axis. Duration of response allocation to Packet A, Packet B, and Packet C during sessions was also recorded. That is, when the participant began working on Packet A the data collector turned on the duration key for Packet A and when the participant stopped working on Packet A the data collector turned off the duration key for Packet A, and completed the same process for duration of response allocation to Packet B and C. If the participant was not working on any of the packets, no duration key was on. The primary dependent variable was the rate of responding on Packet A across sessions and phases.

## Preliminary Assessments

**Curriculum-based measurement assessment.** Participants were initially given a packet of grade-level single-skill math problems (i.e., addition and subtraction). The participant was given 2 minutes to complete as many problems as they can. See Appendix C for complete instructions that will be provided to each participant. The digits correct per minute (DCM) were computed. This process was completed two more times. The median DCM from the three administrations was used to determined instructional level for that skill and grade level. If the participant performed at an instructional or frustration level, probes from the grade level below were administered to determine instructional level. This process continued until a mastery level was determined. Performance level criteria for fourth-grade mathematical computation is more than 49 DCM, 24-49 DCM, and less than 24 DCM for mastery, instructional, and frustrational levels, respectively (Burns, VanDerHeyden, & Jiban, 2006). For Ted, Eleanor, and Jamila, single digit addition and subtraction problems were determined to be mastery. For Janet, a mix of single- and double-digit addition problems and single digits subtraction problems were determined to be mastery.

**Preference assessment.** A paired-choice preference assessment (Fisher et al., 1992) was completed to identify an array of moderately preferred school supplies as back-up reinforcers that were available to trade in tokens for at the end of each session. The items included erasers, pencils, small notepads, pencil grips, highlighters, markers, colored pencils, stickers, rulers, and sticky note pads. The top two and bottom two items identified as most and least preferred for each participant were not used in the array of school store items during the experiment. The six moderately preferred items for each participant were rotated across different days so that 4 items were always available at the school store. Items were rotated to avoid satiation effects.

**Experimental Design and Procedures**

Across participants, a 3-phase resurgence procedure was used, with a multielement design embedded within Phases 2 and 3, to evaluate resurgence of a target behavior. All participants initially began the study with the originally proposed baseline phase. In Phase 1, responses to Packet A (target behavior) were reinforced with 3 tokens on a variable interval (VI) 30-s schedule while responses to Packet B (alternative behavior) were not reinforced (i.e., extinction). At the start of each session during this phase, the first response on Packet A was reinforced and the VI 30-s schedule commenced thereafter.

Janet and Ted continued to show variability in their target packet responding across this initial baseline phase, so additional manipulations were made to bring target packet responding under control of the contingencies. Based on a hypothesis that Janet was becoming satiated on the amount of school supplies she was earning each session the initial change made for her was to decrease the number of tokens received during baseline to 2 tokens on a VI 30-s schedule and increasing the number of tokens needed to trade in for an item in the school store to 5 tokens. Therefore, Janet was not accruing as many school store items. This manipulation, however, did not suffice in eliciting more consistent responding. We made a second manipulation (i.e., Baseline 3), in which Janet was required to wait until the very end of all sessions for the day to trade in her tokens for school supplies. This manipulation was successful in bringing about more consistent responding during baseline.

For Ted, the same initial manipulations were completed as were done for Janet, but his responding remained inconsistent. Anecdotally, I asked him why he did not continue to respond to earn tokens and he responded that he "felt bad about taking the items away from other kids." Therefore, I made the decision to change his reinforcement to an activity that could be immediately consumed. He was able to earn 5 s of card play (i.e., UNO) for each token he

earned. During baseline he earned 3 tokens on a VI 30-s schedule for working on the target packet. This manipulation elicited high and consistent responding on the target response.

During Phases 2 and 3, the A and B conditions were randomized in a pair-wise fashion, such that the same condition did not occur for more than two consecutive sessions. It should be noted that there was an experimenter error during Phase 2 for Jamila, in which 3 consecutive sessions occurred in the small-magnitude condition. By the end of the phase, however, an equal number of large- and small-magnitude sessions had been conducted. The experimenter wore a different colored card displayed on a lanyard that signaled each condition. A black card indicated the large-magnitude condition, while a yellow card indicated the small-magnitude condition.

In Phase 2, responses to Packet A were placed on extinction, while responses to Packet B were reinforced with either 5 tokens (i.e., large-magnitude reinforcement [A condition]) or 1 token (i.e., small- magnitude reinforcement [B condition]) on a VI 30-s schedule. At the start of each session during Phase 2, the first response on Packet B was reinforced and the VI 30-s schedule commenced thereafter. For Janet, the small-magnitude reinforcement condition was identical to the other three participants, however, she only received 3 tokens in the large-magnitude reinforcement condition. In Phase 3A and Phase 3B, all responses were placed on extinction (i.e., an extinction challenge).

Packet A consisted of addition problems and Packet B (alternative behavior) consisted of subtraction problems. A third packet (i.e., Packet C) was available during each session throughout all phases, but responses to Packet C were never reinforced. Packet C functioned as an active control and as an alternate response option other than sitting and not completing problems on either Packet A or B during the extinction challenge (Sweeney & Shahan, 2016). Problems in Packet C were mixed mathematic problems (i.e., addition and subtraction).

Each session was 3 min in length. A VI 30-s reinforcement schedule was used, and therefore up to 5 programmed reinforcement deliveries occurred each session, if a participant responded exclusively to the packet that was receiving reinforcement during that phase. During Phase 1, participants earned up to 15 tokens (5 deliveries of 3 tokens each) if they were continuously working on Packet A. During Phase 2, a participant earned up to 25 tokens (5 deliveries of 5 tokens each) during the large-magnitude A condition, whereas a participant earned up to 5 tokens (5 deliveries of 1 token each) during the small-magnitude B condition if they were consistently working on Packet B. For Janet, up to 15 tokens (5 deliveries of 3 tokens each) could be earned during the large-magnitude A condition and up to 5 tokens (5 deliveries of 1 token each) could be earned during the small-magnitude B condition if she was consistently working on Packet B.

During Phase 1, prior to the session beginning, the experimenter said to the participant, "You can work on Packet the Blue, Pink, or White packet or you do not have to work on any of the packets and you can just sit there. You can switch any time until I say stop. If you work on the Blue packet you will sometimes earn 3 tokens. If you earn tokens, you can trade them in for an item from the school store when we're done working. Please begin when I say 'Start working.'" During Phase 2, prior to the session beginning, the experimenter said to the participant, "You can work on Packet the Blue, Pink, or White packet or you do not have to work on any of the packets and you can just sit there. You can switch any time until I say stop. If you work on the Pink packet you will sometimes earn [5 tokens as I am wearing the black necklace (in the large-magnitude condition)] or [1 token as I am wearing the yellow necklack (in the small-magnitude condition]. If you earn tokens, you can trade them in for an item from the school store when we're done working. Please begin when I say 'Start working.'" The

instructions during Phase 2 were faded out across sessions, with the only instruction being "You can start." The location of the packets on the table were counterbalanced following each session.

During Phase 3A, reinforcement for all responses was discontinued (i.e., placed on extinction). As the instructions during both conditions in Phase 2 had been faded out, the only change from the last sessions in Phase 2 to Phase 3A sessions in the perspective of the participants was that reinforcement was no longer provided when they worked on Packet B (i.e., the pink packet). As we did not see resurgence during this phase, Phase 3B was conducted. At the beginning of these sessions the participants were told, "You can work on the Blue, Pink, or White packet or you do not have to work on any of the packets and you can just sit there. You can switch any time until I say stop. If you work on the Pink packet you will NOT earn [5 tokens as I am wearing the black necklace (in the large-magnitude condition)] or you will NOT earn [1 token as I am wearing the yellow necklace (in the small-magnitude condition]. Please begin when I say 'Start working.'" Large- and small-magnitude conditions were conducted in a pairwise fashion across both extinction phases.

Following each session, participants could trade in their tokens for items from the school store. Any tokens that were not used following the session were discarded and unavailable for future use. For Eleanor and Jamila, each item in the school store cost three tokens. This number was calculated by averaging the number of tokens they can earn each session during Phase 1, Phase 2 of Condition A, and phase 2 of Condition B, and dividing that number by the number of items available at the school store. For Janet, each item in the school store cost five tokens. Janet's school store items "cost" more than the other participants, due to satiation effects observed during the initial baseline. The higher exchange rate resulted in Janet receiving less

items each session. For Ted, each token he earned equaled 5 s of game-play time following the session.

**Phase change criteria.** Phase change decisions were based on the rate of responding on the target response (i.e., Packet A). Phase changes were not made until 1) at least 5 sessions occurred, 2) responding on Packet A during Phase 1 was stable defined as the last data point in the phase being within 3 responses/minute of the two previous data points), and 3) responding on Packet A during Phase 2 was sufficiently suppressed in both conditions, defined as the last three data points in the phase for both conditions had an 80% or greater reduction in rate from baseline rates of Packet A. An equal number of sessions was conducted for each condition across Phase 2 and 3. Phase changes were never made during the first session conducted during a day. That is, all phase changes were such that the participants experienced Phase 1 and Phase 2, Phase 2 and Phase 3A, or Phase 3A and Phase 3B within the same day.

## Interobserver Agreement and Procedural Integrity

Interobserver agreement (IOA) was collected in vivo using a second data collector with a computer equipped with BDataPro. BDataPro is equipped with IOA software, in which exact agreement was calculated for the frequency of responding to Packets A, B, and C converting that ratio into a percentage. IOA for frequency of responding on Packets A, B, and C was collected for 52.4% of all sessions. The average IOA across all packets for all participants was 99.04% (range: 66.67-100%). IOA for DCM on the worksheets was collected and recorded. The IOA for the DCM were calculated by dividing the number of agreements by the number of agreements plus disagreements and converting that ratio into a percentage. IOA for DCM was collected for 34.95% of all sessions. The average IOA across all packets for all participants was 98.8% (range: 45.5-100%). Procedural integrity of the experimenter was recorded following 100% of sessions

by one of the data collectors. Procedural checklists for each phase can be found in Appendix D. Procedural integrity across all sessions and participants averaged 97.23% (range: 85.7-100%).

**Data Analysis**

The rate of responding on Packets A, B, and C was recorded and plotted each session, with sessions on the X-axis and rate of responses per minute on the Y-axis. These data were analyzed following each session to determine when phase-change criteria were met. The proportion of baseline responding on Packet A during Phase 3A and Phase 3B across sessions for both the large- and small-magnitude conditions was calculated. To calculate the proportion of baseline responding on Packet A, the rate of responding across each consecutive session during the extinction test phases was divided by the average rate of responding on Packet A across all baseline sessions. Both conditions were plotted on the same graph with their own data paths. Consecutive sessions of the extinction test phase are on the X-axis and the proportion of baseline responding on Packet A are on the Y-axis.

An additional analysis was completed to compare the proportion of problems completed allocated to each type of response (i.e., target, alternative, or control) across all phases and conditions. For Phase 1, the proportion of each response in baseline was calculated by adding the number of problems completed of each response type and dividing that by the total number of problems completed across all sessions. For Phase 2, 3A, and 3B, the proportion of each response for the large-magnitude and the small-magnitude conditions were calculated separately. For each specific phase (i.e., 2, 3A, or 3B) and condition within that phase (i.e., large-or small-magnitude), the number of problems completed for each response type was added and divided by the total number of problems completed across sessions of that specific phase and condition.

Proportions were plotted on a bar graph, with phases and condition across the x-axis, and proportion of problems completed on the y-axis.

## Results

Figure 1 displays graphs for problems completed on the target response for each participant across all phases. Session numbers are displayed on the x-axis and target problems completed per minute are on the y-axis. Baseline data points are indicated with white circles.

During the Phase 1 baseline when target responding was reinforced, both Eleanor and Jamila showed high rates of problems completed per minute, with average problems completed per minute across all baseline sessions of 31.4 (range = 20.33-36.33) and 31.33 (range = 30.33-32.33), respectively. Ted and Janet both required additional manipulations to bring their responding on the target packet under control of the contingencies in place. Janet's rate of target problem completion was 0 during Baseline 1 and variable during Baseline 2, ranging from 0 to 37 problems completed per minute. Janet's average problems completed per minute was high and stable during Baseline 3 with a mean of 35.33 (range = 34.67-37). Ted's rate of problem completion on the target packet across Baselines 1, 2, and 3 was variable, ranging from 0-26.33 problems completed per minute. Ted's rate of problem completion during Baseline 4 was high and stable with a mean of 26.3 (range = 23.33-29.67).

Target responses during Phase 2 when responding on the alternative packet was reinforced are displayed in Figure 1 as a multielement design. The black circles indicate sessions in which large-magnitude reinforcement was provided for responses on the alternative packet and the white squares indicate sessions in which small-magnitude reinforcement was provided for responses on the alternative packet. For Ted and Janet, problems completed per minute on the target packet was 0 across all conditions and sessions of Phase 2. For Eleanor and Jamila,

problems completed per minute on the target packet during all large-magnitude sessions remained at 0 during Phase 2. For both participants, problems completed per minute on the target packet was 0 for most small-magnitude sessions with the exception of sessions one and three for Eleanor (5.67 and 1.67 problems completed per minute) and sessions two and seven for Jamila (29.0 and 30.67 problems completed per minute).

During the first extinction phase for both target and alternative responding, three of the four participants did not demonstrate resurgence of the target response in either the large- or small-magnitude conditions as displayed in Figure 1. That is, for Ted, Eleanor, and Jamila, problems completed per minute for the both conditions were 0 across all sessions during the first extinction phase. Janet demonstrated resurgence of the target response during the second session of the small-magnitude condition but did not demonstrate resurgence of the target response during the large-magnitude condition.

During the second extinction phase, resurgence of the target response in both the large- and small-magnitude conditions was observed for three of the four participants. Jamila only demonstrated resurgence during the large-magnitude condition of the second extinction phase. Ted demonstrated resurgence of the target response immediately and responding consistently increased across all small-magnitude condition sessions. Conversely, Ted demonstrated resurgence only during the second session of the large-magnitude condition during the second extinction phase. Ted's initial resurgence in the large-magnitude condition was relatively higher (26 problems completed per minute) than in the small-magnitude condition (21.33 problems completed per minute). Responding during the large-magnitude condition, however, decreased to 0 during the subsequent session in that condition, while problems completed per minute in the small-magnitude condition increased across sessions for that condition.

For Janet, resurgence of the target response occurred at a relatively greater magnitude during the first session of the small-magnitude condition (rate of problem completion = 30.33,) compared to the first session in which resurgence occurred during the large-magnitude condition (rate of problem completion= 21.33). Responding on the target packet during subsequent sessions of the small-magnitude condition, however, decreased to 0 problems completed per minute, whereas responding on the target packet during the large-magnitude condition continued to occur in the final two sessions of that condition.

A single session of both the large- and small-magnitude conditions were completed for Eleanor and Jamila with similar patterns of responding for both participants. That is, resurgence occurred at a higher level in the large-magnitude condition compared to the small-magnitude condition. For Eleanor, responding on the target packet during the large-magnitude condition resulted in 4 problems completed per minute, compared to the small-magnitude condition in which responding on the target packet resulted in 1.33 problems completed per minute, For Jamila, responding on the target packet during the large-magnitude condition resulted in 28 problems completed per minute, compared to the small-magnitude condition in which there was no responding on the target packet.

Figure 2 displays the total proportion of problems completed allocated to the target (black bar), alternative (white bar), and control (checkered-gray bar) packets stacked in the same bar across all sessions of each phase for each participant. Proportions ranged from 0.0, meaning there were no problems completed per minute allocated to a response, to 1.0, meaning all problems completed per minute were allocated to a particular response. This additional analysis was completed to provide a visual for how each participants' response allocation changed across each condition and phase of the study. Using Figure 2, the reader can track how the response

allocation on the target response, compared to the other two responses (i.e., the alternative and control responses), changed from Phase 1 (baseline), to Phase 2, to Phase 3A, and finally Phase 3B. For example, the reader can see in the Phase 3B panel of Figure 2 which condition resulted in a higher allocation of target responses (i.e., resurgence) for each participant, by visually inspecting in which condition the black bar was highest. For three of the four participants, the proportion of target problems completed per minute during Phase 1 (Baseline) was 1.0. Eleanor allocated .96 of her responding to the target response and .04 to the alternative response during Baseline 1. During Phase 2, both Ted and Janet allocated 1.0 of their responding to the alternative packet for both large- and small-magnitude condition sessions. For Eleanor and Jamila, the proportion of problems completed per minute allocated to the alternative packet during the large-magnitude Phase 2 condition was 1.0. During the small-magnitude condition, Eleanor's proportion of problems completed per minute was .05 for the target packet, .93 for the alternative packet, and .02 for the control packet, and Jamila's proportion of problems completed per minute was .25 for the target packet and .75 for the alternative packet.

During the first extinction phase (Phase 3A), the proportion of problems completed per minute allocated to the alternative packet was 1.0 for both the large- and small-magnitude conditions for Eleanor, Jamila, and Ted. For Janet, the proportion of problems completed per minute allocated to the alternative packet during the large-magnitude condition was 1.0. During the small-magnitude condition, Janet's proportion of problems completed per minute was .05 for the target packet, .81 for the alternative packet, and .12 for the control packet.

During the second extinction phase (Phase 3B), Eleanor demonstrated a higher level of resurgence of the target response during the large-magnitude condition of Phase 3B as evidenced by the taller black bar in the large-magnitude condition (proportion of .09), compared to the

black bar in the small-magnitude condition (proportion of .03). Responses were also allocated to the alternative packet during both the large- (proportion of .91) and small-magnitude (proportion of .97) conditions. Eleanor did not engage in the control packet (checkered-gray bar) during the second extinction phase. Jamila allocated all of her responding to the target packet during the large-magnitude condition (proportion of 1.0) and allocated all of her responding to the control packet during the small-magnitude condition (proportion of 1.0). She did not engage in the control packet during the second extinction phase.

For Janet, a higher level of resurgence of the target response is evidenced by the taller black bar in the small-magnitude condition (proportion of .26), compared to the black bar in the large-magnitude condition (proportion of .21). Responses were also allocated to the alternative packet during the small-magnitude condition (proportion of .74). During the large-magnitude condition, responses were also allocated to the alternative packet (proportion of .47), and the control packet (proportion of .32). For Ted, a higher level of resurgence is evidenced by the taller black bar in the small-magnitude condition (proportion of 1.0), compared to the black bar in the large-magnitude condition (proportion of .33). During the large-magnitude condition, responses were also allocated to the alternative packet (proportion of .41), and the control packet (proportion of .26).

## Discussion

The goal of this study was to examine how differential magnitude of reinforcement for an alternative behavior affects the resurgence of a previously reinforced target behavior when both behaviors are subsequently placed on extinction (i.e., no reinforcement is provided). I accomplished this by using a 3-phase resurgence procedure in which a target behavior was reinforced during Phase 1, an alternative behavior was reinforced in Phase 2 with either large- or

small-magnitude reinforcers (i.e., tokens that could be traded in for school supplies), and both target and alternative responses were placed on extinction in Phase 3.

**Requirements for Demonstrating Experimental Control**

To demonstrate experimental control using this procedure, there are patterns of behavior that we would expect to observe based on previous literature (e.g., Epstein, R., 1985; Fuhrman, Fisher, & Greer, 2018; Craig et al., 2017). These patterns of responding would be prerequisite to evaluating the research hypotheses in my study. Specifically, there should be near exclusive responding to the reinforced target response in Phase 1, near exclusive responding to the reinforced alternative response in Phase 2, and an initial increase in responding to the target response that decreases to near zero levels across subsequent extinction sessions in Phase 3.

For Eleanor and Jamila, rate of responding on the target response during Phase 1 was high across all baseline sessions. For Janet and Ted, responding during the initial baseline (i.e., VI 30-s schedule of 3 tokens for the target response) in Phase 1 did not increase (i.e., did not come under control of the original contingency) and responding was variable across sessions. Therefore, changes were made to the baseline contingencies for these two participants to occasion consistently high responding on the target response. For Janet, the number of tokens received on a VI 30-s schedule was decreased to 2, and she exchanged her tokens for items in the school store at the end of all sessions in a day. The ratio of tokens Janet received during Phase 2 was adjusted to 1 token as the small-magnitude reinforcement and 3 tokens as the large-magnitude reinforcement. These changes were made based on a hypothesis that Janet may have been satiated with the amount of school supplies she was earning and with the number of times she was able to access the school store throughout each day. The satiation may have been having an abolishing effect on the value of the reinforcers, therefore I made these changes to increase

the value of the reinforcers in the school store. For Ted, items in the school store were not functioning as effective reinforcers, therefore a new reinforcer was identified (i.e., playing UNO), and each token was worth 30-s of playing time. The ratio of tokens Ted received during Phase 1 baseline (i.e., 3 tokens) sessions, small-magnitude condition (i.e., 1 token) sessions, and large-magnitude condition (i.e., 5 tokens) sessions remained the same as the original token ratio. Once these changes were made for Janet and Ted, target responding occurred at high and consistent rates across Phase 1 sessions.

During Phase 2, alternative responding occurred at high rates and target responding occurred at near zero or zero during most sessions for Eleanor and Jamila. For Janet and Ted, alternative responding occurred at high rates and target responding occurred at a rate of 0 across all Phase 2 sessions.

When reinforcement was suspended for the alternative and target responses in Phase 3, Ted, Jamila, and Eleanor all persisted on the alternative response across all sessions in both conditions. Janet persisted on the alternative response for five of the six sessions of Phase 3, but responded on the target and control packets in addition to the alternative packet for one session in the small-magnitude condition.

As the participants persisted on the alternative response across this extinction phase (i.e., Phase 3A), I decided to implement a second extinction phase (i.e., Phase 3B) in which an explicit rule was given to the participants about the reinforcement contingencies. That is, I provided the instruction "You can work on the pink, blue, or white packet. You can switch anytime or take a break. As I'm wearing the [yellow or black] necklace, you will *NOT* get [1 or 5] tokens for working on the pink packet." During Phase 3B, the target response did reoccur during one or both conditions for each participant. For Eleanor and Jamila, only one session of each condition

was completed due to time constraints to their participation. For Janet and Ted, three sessions of each condition were run during Phase 3B.

**Evaluation of Research Hypotheses**

I made two hypotheses based on previous literature concerning the effects of magnitude of reinforcement for an alternative response on the resurgence of a target response when both responses are placed on extinction (Craig et al., 2017). The first hypothesis was that large magnitude reinforcement for the alternative response condition would suppress the target behavior more quickly during Phase 2 compared to small-magnitude reinforcement for the alternative response condition. For Janet and Ted, responding on the target response immediately dropped to 0 responses/minute in the first session of both conditions, and remained at this level across all sessions of Phase 2. Therefore, their responding did not support this first hypothesis, as both conditions equally suppressed target responding. For Eleanor and Jamila, responding on the target response during the large-magnitude condition was suppressed to 0 responses/minute across all sessions, while there were two sessions of the small-magnitude condition in which responding on the target response was above 0 responses/minute. Therefore, the response pattern of these two participants did support this first hypothesis, in that large-magnitude reinforcement for the alternative suppressed target responding consistently to 0 responses/minute, while small-magnitude reinforcement for the alternative did not suppress target responding consistently across all sessions of that condition.

My second hypothesis was that during the Phase 3 extinction challenge the large-magnitude reinforcement condition would result in a greater level of resurgence compared to the small-magnitude reinforcement condition. As all four participants persisted on the alternative response during Phase 3A, a second extinction phase was completed that included the

explanation of the contingency. During Phase 3B, Eleanor and Jamila's pattern of responding supported this hypothesis in that target responding resurged to a greater degree during the large-magnitude condition compared to the small-magnitude condition. For Janet, target responding resurged to a higher degree during the initial session of the small-magnitude condition, but decreased to a rate of 0 responses/minute in subsequent sessions while responding on the target responding in the large-magnitude condition remained elevated above 0 responses/minute across all sessions. Ted's pattern of responding also did not support this hypothesis, as responding to the target response during the small-magnitude condition resurged and persisted across all sessions, while responding on the target response during the large-magnitude condition occurred at 0 responses/minute for 2 of the 3 sessions.

**Persistence and Resurgence across Extinction Phases**

There are several possible explanations for why responding on the alternative persisted during Phase 3A. The first explanation may have involved the demand characteristics of the study. I had instructed the participants previously that working on the alternative (pink) packet would be reinforced. They may have continued to work on that packet because they did not receive any other instructions from me (the experimenter) that indicated their response allocation should switch to any of the other packets. It may also be that their behavior of responding on the alternative persisted because it was rule-governed. That is, the most recent verbal "rule" that the participants had received was that they would receive reinforcement for working on the alternative packet. Therefore, their behavior may have been under the control of the most recent verbal rule. A related second explanation involves the children's reinforcement history of completing work in an academic or classroom setting. As these participants were relatively high performing students, their academic behavior most likely contacted reinforcement. Additionally,

reinforcement for on-task behavior in the classroom typically occurs intermittently, and students are required to work for periods of time in which they do not receive reinforcement. It may be that when reinforcement was no longer provided for working on the alternative task this mirrored the intermittent period of no reinforcement for on-task behavior in the classroom. Therefore, instead of stopping or switching to a different packet the participants have continued to work on the most recently reinforced packet.

Third, the persistence, or resistance to extinction, of the alternative response may also be explained by behavioral momentum. That is, when a behavior is given mass (i.e., reinforcement), that behavior will persist even when there is some sort of disruption (e.g., extinction; Nevin & Shahan, 2011). During Phase 2, participants had received reinforcement across a minimum of 8 sessions for responding on the alternative response (i.e., completing problems on the pink packet). Regardless of the magnitude of reinforcement across sessions, at least 8 sessions of reinforced responding would be expected to increase mass of the alternative response. When a disruption in reinforcement for the alternative response occurred during Phase 3A, the participants' responding on the alternative response may have been resistant to that change due to the behavioral mass that had accumulated across Phase 2. Thus, responding on the alternative response persisted across the first iteration of the extinction phase.

A forth alternative explanation for persistence on the alternative response during Phase 3A is that the change in reinforcer context was not salient enough for the participants. Trask, Schepers, and Bouton (2015) describe how resurgence occurs when there is a change in the reinforcer context. When an organism no longer receives reinforcement for engaging in the previously reinforced alternative response during the extinction phase, that signals a context change and the organism will reengage with the previously reinforced target response. The

reinforcer context change alone in the present study may not have been salient enough to occasion a reoccurrence of the target response given the previous explanations of resistance to extinction of the alternative response during Phase 3A. That is, simply eliminating reinforcement for the alternative response may not have been a strong enough signal that there was a change in the reinforcer context, and therefore alternative responding was not disrupted.

I provided an additional rule explaining that reinforcement was no longer available for the alternative response during the second iteration of the extinction phase (i.e., Phase 3B). Once this verbal rule was given, resurgence of the target behavior occurred across all participants. There a few potential explanations for why this occurred. First, the participants' behavior may have been rule governed. That is, once they were given the "rule" that reinforcement was no longer available, they may have created their own rule for what would receive reinforcement. Given that the target response had previously been reinforced in Phase 1, it makes sense that initial responding during Phase 3B was primarily allocated to the target response. The rule I provided may have also made the change in reinforcer context more salient to the participants (Trask, Schepers, & Bouton, 2015), therefore shifting their response allocation to the previously reinforced target response.

This shift in response allocation during Phase 3B can also be explained using Resurgence as Choice Theory (Craig et al., 2017). That is, the target response retained some value over time due to the reinforcement history from Phase 1, even though responding on the target had been on extinction for several sessions. When there was a disruption in reinforcement for the alternative (i.e., extinction for alternative responses) and this change in the contingency was explained to the participants in Phase 3B, the participants discontinued allocating responses to the alternative

response (e.g., the most recently reinforced response) and began allocating responses to the target response which had been reinforced in the past.

**Inconsistent Effects of Reinforcer Magnitude on Resurgence**

Overall, there were inconsistent results regarding the effect of reinforcer magnitude on the resurgence of a targeted academic response during the extinction phase of the resurgence procedure. Three major points stand out that may help explain this inconsistency with Craig et al.'s (2017) outcome suggesting that large-magnitude reinforcement would lead to higher levels of resurgence. One, it may be that the difference between large- and small-magnitude reinforcement was not great enough. That is, perhaps from the perspective of a student, 5 tokens is not sufficiently larger than 1 token to create meaningful differences in response allocation across conditions during extinction.

Two, there is currently little if any research on the effect of conditioned reinforcers (i.e., tokens) on the resurgence of target responding. Vargo and Ringdahl (2015) studied differences in conditioned and unconditioned reinforcers on the resistance to change of a target behavior when that behavior was placed on extinction. They found that conditioned reinforcers were more resistant to change when extinction was implemented. This may have implications for the current study in that using conditioned reinforcers may have affected the persistence of the alternative response during extinction across both conditions.

For the third point, I direct the reader to Figure 2 (i.e., the proportion of response type across all phases). Jamila, Janet, and Ted all responded on the inactive control packet (i.e., 3 of the 4 participants) during Phase 3B. This may indicate that responding on the target packet during this phase was due to extinction-induced variability as opposed to resurgence if responding on the inactive control occurred more frequently than the target response (Sweeney

& Shahan, 2016). For these participants, there are inconsistencies in how their responding was allocated across the three packets during Phase 3B. Jamila, who only completed one session of each condition in Phase 3B, initially allocated all of her responding to the target response during the first session of the phase. She then allocated all of her responding to the control response during the second and final session of the phase. Anecdotally, these response patterns resemble a "process of elimination" to determine completion of which packet would lead to reinforcement. Janet and Ted showed similar response patterns to each other in that the control response only occurred during the large-magnitude condition during Phase 3B. The large-magnitude condition elicited more response variability for these two participants compared to the small-magnitude condition. It would be interesting to replicate this finding to determine if high-magnitude reinforcement not only leads to resurgence of the target behavior, but also elicits more response variability compared to small-magnitude reinforcement.

**Limitations**

There are several limitations to the current study that warrant discussion. First, I was unable to extend Phase 3B for all four participants to observe if target responding would eventually extinguish across both conditions. This is particularly true for Eleanor and Jamila, for whom we were able to conduct only one session of each condition during Phase 3B. It is difficult to make conclusions about the resurgence of the target response for these participants, as we have no additional data points to indicate what direction responding would have gone for both conditions. Although we were able to run two additional sessions in each condition of Phase 3B for Janet and Ted, we never saw target responding completely extinguish, which is the pattern one would typically expect in a resurgence procedure. Additional sessions in each condition could have helped make more definitive statements about the mechanisms at play for responding

on the target and alternative responses during this phase. Due to time constraints, I was also unable to replicate the effects of an unsignaled versus signaled (i.e., verbal rule provided) reinforcer context change on the resurgence of the target behavior.

Another potential limitation in the design of the current study is the "inactive control" response that was included. I included a third packet of mixed addition and subtraction problems (i.e., Packet C) to help determine if responding during the Phase 3 extinction phase was extinction induced variability or resurgence (e.g., responding on the inactive control represented extinction induced variability). Due to the similarity in response topography across all responses, however, Packet C could be considered to be in the same response class as the other two responses (Shahan & Chase, 2002). Therefore, Packet C may not have been an appropriate inactive control response. That is, providing an inactive control response that was not within the same response class may have been more appropriate.

**Clinical Implications and Future Research Directions**

This study extended the current literature on resurgence in two areas; (a) how manipulating the magnitude of reinforcement for an alternative response effects the resurgence of a target response (Craig et al., 2017), and (b) the resurgence of prosocial or desirable behaviors (e.g., Bruzek, Thompson, & Peters, 2009; Williams & St. Peter, 2019). Although the majority of applied resurgence studies focus on problematic or challenging behaviors (e.g., Fuhrman, Fisher, & Greer, 2016; Volkert, Lerman, Call, & Trosclair-Lasserre, 2013), there is evidence provided by this study that the way we provide reinforcement for an alternative behavior effects how and when a target behavior will return that we *want* to occur when reinforcement is no longer provided. This may have implications for teachers in the classroom who want to maximize the way they provide reinforcement to increase certain academic

behaviors. Recently, Williams and St. Peter (2019), published a translational study looking at the resurgence of strategies used to solve complex math equations in a college student population. The results indicated that previously reinforced target academic responses can resurge when reinforcement for the target and an alternative response are placed on extinction.

To date, only rate (Gardner et al, 2018) and magnitude of reinforcement (i.e., this study) have been manipulated for the alternative response to see the effect on resurgence of a target behavior when reinforcement for both responses is placed on extinction. Both of these studies were done in a translational setting. It would be helpful to study the effects of alternative reinforcement on resurgence of academic behavior in a naturalistic setting, with teachers implementing the procedures to see if this phenomena occurs in that setting. There are several other factors that would need to be considered in that type of setting that are not necessarily addressed in the current study (e.g., extraneous reinforcers such as peer attention).

To my knowledge, rate and magnitude of reinforcement of the alternative response are the only two dimensions of reinforcement that have been manipulated to study their effects on resurgence of a target response in an educational setting. Future lines of research should consider manipulating additional dimensions of reinforcement (e.g., quality or effort). For example, future studies could manipulate the difficulty of the alternative problems to compare resurgence when there are varied levels of effort required in completing problems. That is, during Phase 2 of the resurgence procedure, alternative math problems presented could be mastery, instructional, or even frustrational level, and the magnitude of resurgence of a target response could be measured during the subsequent extinction phase.

There is still much to consider for future translational and applied studies of the resurgence of both desired and undesired classroom behaviors. First and foremost, replications of

resurgence procedures in an academic setting for both academic and challenging behaviors in the classroom are needed. Although there have been no applied studies to date on resurgence of desired and undesired behaviors in the classroom, it would certainly be important in providing direction for teachers who are trying to increase particular academic responses and decrease problem behavior. If dimensions of reinforcement such as rate and magnitude (e.g., Garner, Neef, & Gardner, 2018; Craig et al., 2017) affect the way behavior reoccurs when reinforcement for the alternative response worsens, they should be studied in the classroom where treatment integrity errors (i.e., reinforcement for the alternative response worsens) are likely to occur. Additionally, if we could use resurgence procedures to increase the amount of response variability seen during extinction, this could assist teachers in expanding their instructional reach. In a procedure looking at the occurrence of nontargeted problem behaviors during the extinction phase of resurgence, Sullivan et al. (2019) assessed how functionally related behaviors that had not previously received reinforcement occur. A replication and extension of this study in the classroom setting could provide information about how best to teach and reinforce academic behaviors to potentially elicit nontargeted responses when reinforcement is not available in the classroom.

Additional research on the effects of conditioned reinforcers versus unconditioned reinforcers on the resurgence of target behavior during the extinction phase of the resurgence procedure is also needed. Conditioned reinforcers such as token systems are commonly used in classroom settings. Vargos and Ringdahl (2015) indicated that conditioned reinforcers are more resistant to change, particularly during extinction challenges. This may indicate that in a treatment for problem behavior, conditioned reinforcers could be more effective in mitigating resurgence of target problem behavior. This would be interesting for researchers to look at across

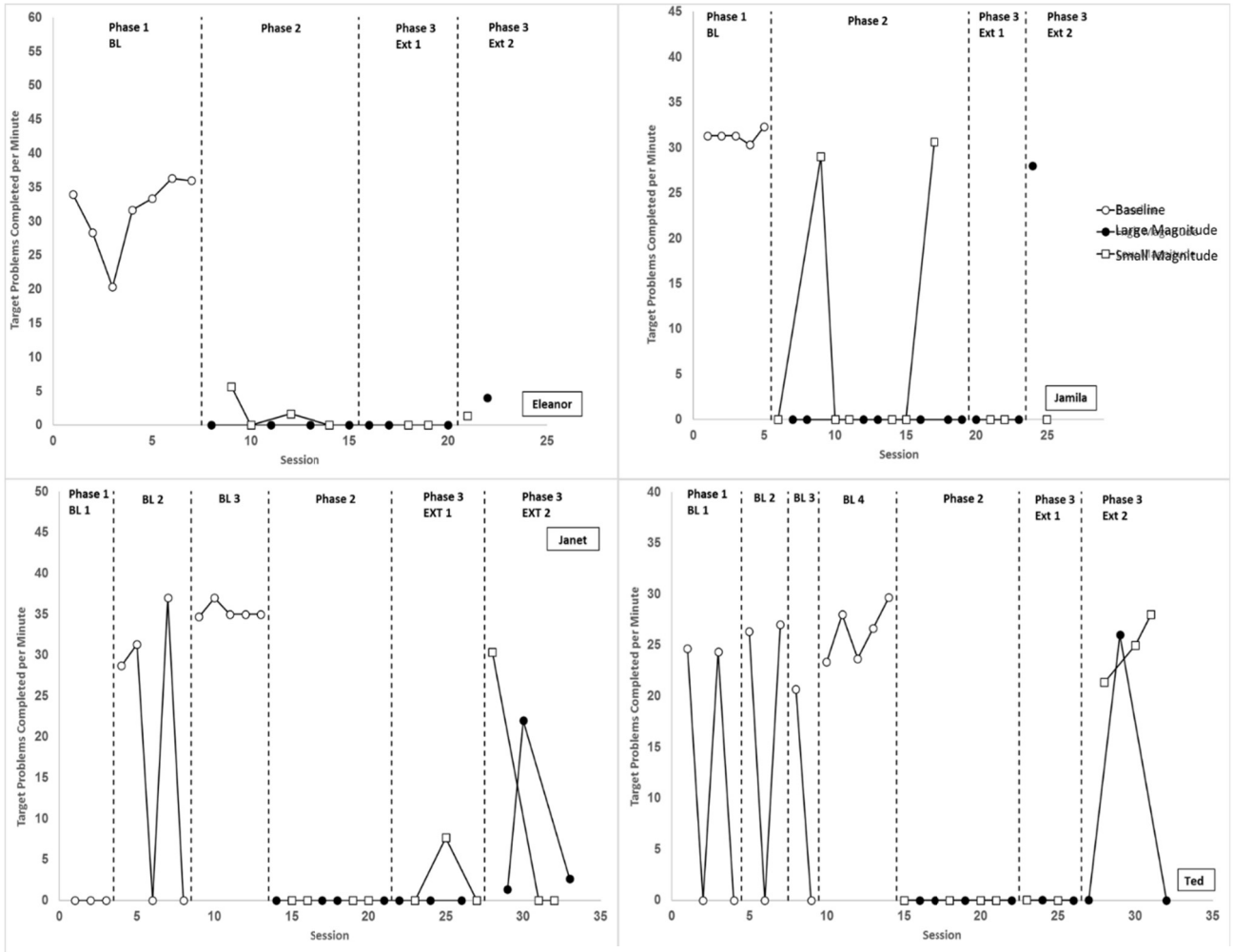
translational and applied settings. Finally, future research could replicate and address the differences observed in the current study in resurgence when the change in the reinforcer context was not explicitly signaled and when it was explicitly signaled.

Overall, resurgence of a target academic response occurred in the current study when there was signaled worsening reinforcement for an alternative behavior. I did not observe systematic differences in resurgence of the target response and response allocation to the alternative and control responses between the large- and small-magnitude conditions across participants. This may have been due, however, to the ratio of the large- and small-magnitude reinforcement received across conditions. It may be that the large- and small-magnitude amounts were not sufficiently different from each other to elicit differential resurgence levels, and therefore additional research should be done to determine what magnitude ratios will elicit consistent resurgence across conditions.

In conclusion, the current study extended the literature on the effect of reinforcer magnitude for an alternative response on the resurgence of target behavior (Craig et al., 2017) and the resurgence of academic responding (Garner, Neef, & Gardner, 2018; Williams & St. Peter, 2019). I did this by applying the resurgence procedure with an embedded comparison of large- and small-magnitude reinforcement for an alternative academic response, and then measuring the resurgence of a target academic response when both behaviors were placed on extinction. This study adds to the small literature base looking at resurgence of prosocial and desirable behavior, particularly in an academic setting, and will hopefully encourage more study of the resurgence of prosocial behavior.

**Figure 1**

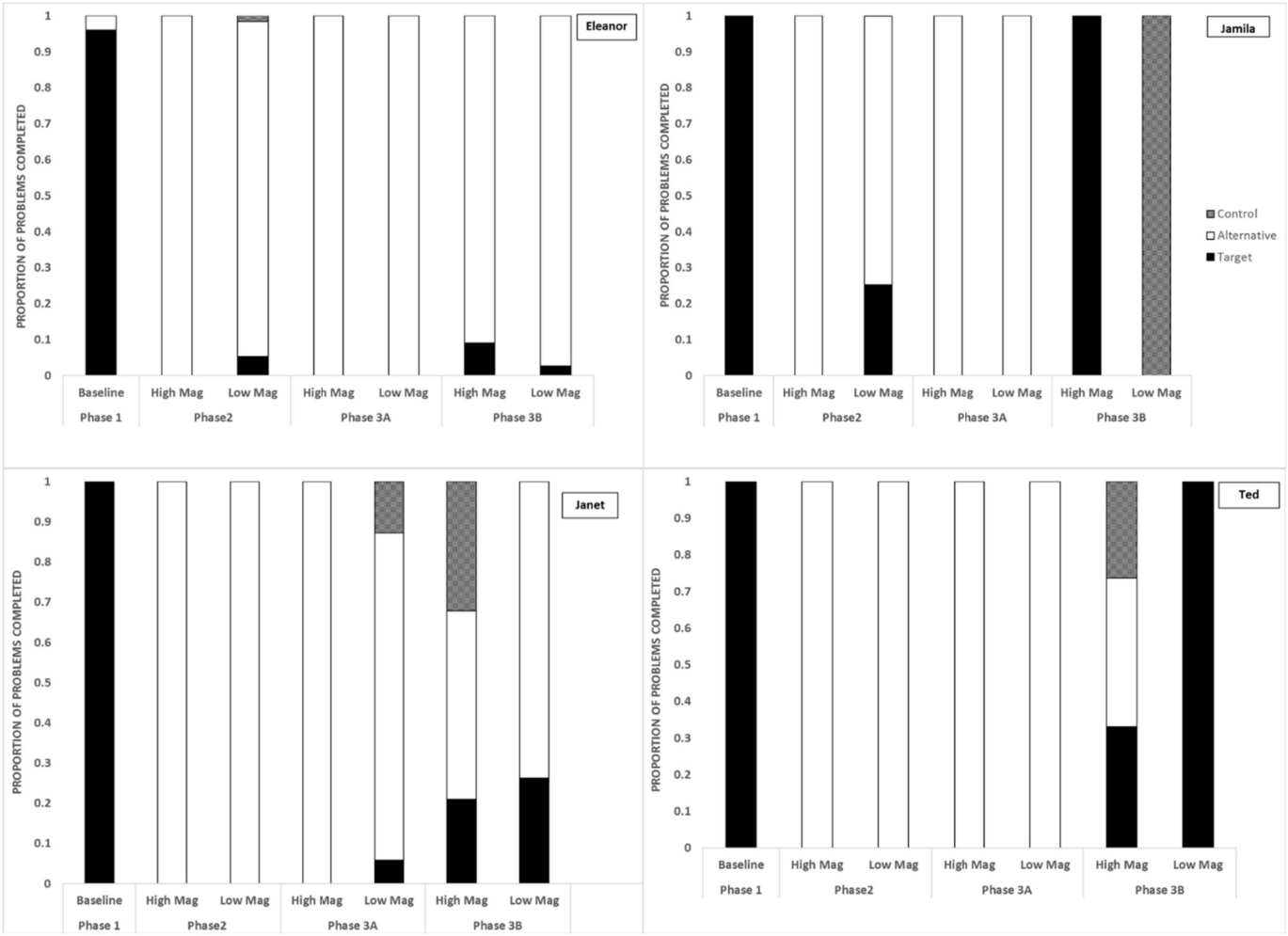
*Rate of Target Problems across Conditions*




*Note.* Represented are target problems completed per minute for each participant across sessions in all phases. The white circles represent the baseline rate of the target response, the black circles represent the rate of the target response during the large-magnitude condition, and the white squares represent the rate of the target response during the small-magnitude condition.

**Figure 2**

*Proportion of All Responses across each Condition*




*Note.* The proportion of all responses (i.e., target, alternative, and control) across each phase and condition are represented. The black bar represents the proportion of target responses, the white bar represents the proportion of alternative responses, and the checkered-gray bar represents the proportion of control responses.

## Appendix A

Name _____ Date _____

| | | | | |
|---|---|---|---|---|
| 1 + 5 | 7 + 5 | 1 + 3 | 3 + 5 | 8 + 7 |
| 3 + 6 | 5 + 6 | 9 + 6 | 2 + 1 | 3 + 4 |
| 4 + 4 | 3 + 8 | 3 + 1 | 7 + 8 | 2 + 6 |
| 6 + 1 | 9 + 1 | 7 + 1 | 6 + 3 | 2 + 8 |
| 6 + 2 | 5 + 4 | 3 + 3 | 7 + 9 | 7 + 6 |

TheMathWorksheetSite.com

# Appendix B

Date: Condition:

Session: Participant Initials:

| Partial Interval Recording Sheet (5-s Intervals) | | | | | |
|---|---|---|---|---|---|
| 0:00-0:05 | 0:05-0:10 | 0:10-0:15 | 0:15-0:20 | 0:20-0:25 | 0:25-0:30 |
| | | | | | |
| 0:30-0:35 | 0:35-0:40 | 0:40-0:45 | 0:45-0:50 | 0:50-0:55 | 0:55-1:00 |
| | | | | | |
| 1:00-1:05 | 1:05-1:10 | 1:10-1:15 | 1:15-1:20 | 1:20-1:25 | 1:25-1:30 |
| | | | | | |
| 1:30-1:35 | 1:35-1:40 | 1:40-1:45 | 1:45-1:50 | 1:50-1:55 | 1:55-2:00 |
| | | | | | |
| 2:00-2:05 | 2:05-2:10 | 2:10-2:15 | 2:15-2:20 | 2:20-2:25 | 2:25-2:30 |
| | | | | | |
| 2:30-2:35 | 2:35-2:40 | 2:40-2:45 | 2:45-2:50 | 2:50-2:55 | 2:55-3:00 |
| | | | | | |

| VI 30-s Schedule (15, 30, 45) | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |

## Appendix C

### Curriculum-Based Measurement Probe Integrity Checklist

| Steps: | Completed | Not Completed |
|---|---|---|
| Therapist placed a copy of the math probe face down in front of the student | | |
| The therapist said **"All of these problems are [addition or subtraction] facts. When I say 'Begin', turn the worksheet over and begin answering the problems. Start on the first problem on the left on the top row [point]. Work across and then go to the next row. If you can't answer a problem, make an 'X' on it and go to the next one. If you finish one side, go to the back. Any questions?"** | | |
| The therapist then said **"Start"** and started a stopwatch | | |
| The therapist ensured the student went in the correct order, and prompted them to work left to right and top to bottom if they were not working in the correct order | | |
| After two minutes elapsed, the therapist said **"Stop"** and marked the last problem the student successfully completed when the time elapsed. | | |
| The therapist scored the worksheet and recorded the digits correct per minute | | |
| **% of Steps Completed:** | | |

## Appendix D

### Experimental Session Procedural Integrity Checklists

***Phase 1 (Baseline)***

| Steps: | Completed | Not Completed | N/A |
|---|---|---|---|
| The therapist sat next to the student | | | |
| Three packets of math problems were placed equidistance from each other in front of the student. The therapist had a bag of tokens and a jar was placed next to the worksheets. | | | |
| The packets of math problems were counterbalanced from the previous session (if applicable) | | | |
| On a second table adjacent to the worktable, 4-6 baggies of reinforcers were on display with *"3 Tokens for Each Item"* labeled on each baggie. | | | |
| Therapist began the session by telling the student **"You can work on the white, pink, or blue packets, or take a break and not work on any of the packets. You can switch any time between packets or taking breaks until I say stop. If you work on the blue packet you will earn tokens. If you earn tokens, you can trade them in for items from the school store when we're done working. Please begin when I say 'Start.'"** The therapist then said **"Start."** to initiate the session.<br>**Note:** These instructions can be shortened after 2-3 sessions | | | |
| The researcher used the partial-interval recording data sheet to determine when reinforcement should be provided (VI-30s schedule) | | | |
| The therapist placed **THREE** tokens in the jar following the student's first response on Packet A | | | |
| Following the initial response to Packet A, the therapist provided **THREE** tokens contingent on the student providing a response on Packet A following the reinforcement interval elapsing. | | | |
| The therapist did not provide tokens for responses on Packet B or Packet C | | | |
| No attention was provided to the student during the session. | | | |
| Once the 3-minute session was complete, the therapist brought out the school store items and allowed the student to trade in their tokens for items. | | | |
| **% of Steps Completed:** | | | |

***Phase 2 (Large-Magnitude Reinforcement for Alternative Response)***

| Steps: | Completed | Not Completed | N/A |
|---|---|---|---|
| The therapist sat next to the student wearing a lanyard with a black card attached. A black card was velcroed to the back to the primary data collectors computer | | | |
| Three packets of math problems were placed equidistance from each other in front of the student. The therapist had a bag of tokens and a jar was placed next to the worksheets. | | | |
| The packets of math problems were counterbalanced from the previous session (if applicable) | | | |
| On a second table adjacent to the work table, 4-6 baggies of reinforcers were on display with *"3 Tokens for Each Item"* labeled on each baggie | | | |
| Therapist began the session by telling the student **"You can work on the white, pink, or blue packets, or take a break and not work on any of the packets. You can switch any time between packets or taking breaks until I say stop. If you work on the pink packet you will earn tokens. When I'm wearing the black necklace you will earn 5 tokens at a time. If you earn tokens, you can trade them in for items from the school store when we're done working. Please begin when I say 'Start.'"** The therapist then said **"Start."** to initiate the session.<br>**Note:** These instructions can be shortened after 2-3 sessions | | | |
| The researcher used the partial-interval recording data sheet to determine when reinforcement should be provided (VI-30s schedule) | | | |
| The therapist placed **FIVE** tokens in the jar following the student's first response on Packet B | | | |
| Following the initial response to Packet B, the therapist provided **FIVE** tokens contingent on the student providing a response on Packet A following the reinforcement interval elapsing | | | |
| The therapist did not provide tokens for responses on Packet A or Packet C | | | |
| No attention was provided to the student during the session | | | |
| After the session, the therapist brought out the school store items and allowed the student to trade in their tokens for items. | | | |
| **% of Steps Completed:** | | | |

## *Phase 2 (Small-Magnitude Reinforcement for Alternative Response)*

| Steps: | Completed | Not Completed | N/A |
|---|---|---|---|
| The therapist sat next to the student wearing a lanyard with a yellow card attached. A yellow card was velcroed to the back to the primary data collectors computer | | | |
| Three packets of math problems were placed equidistance from each other in front of the student. The therapist had a bag of tokens and a jar was placed next to the worksheets. | | | |
| The packets of math problems were counterbalanced from the previous session (if applicable) | | | |
| On a second table adjacent to the work table, 4-6 baggies of reinforcers were on display with *"3 Tokens for Each Item"* labeled on each baggie. | | | |
| Therapist began the session by telling the student **"You can work on the white, pink, or blue packets, or take a break and not work on any of the packets. You can switch any time between packets or taking breaks until I say stop. If you work on the pink packet you will earn tokens. When I'm wearing the yellow necklace you will earn 1 token at a time. If you earn tokens, you can trade them in for items from the school store when we're done working. Please begin when I say 'Start.'"** The therapist then said **"Start."** to initiate the session. **Note:** These instructions can be shortened after 2-3 sessions | | | |
| The researcher used the partial-interval recording data sheet to determine when reinforcement should be provided (VI-30s schedule) | | | |
| The therapist placed **ONE** token in the jar following the student's first response on Packet B | | | |
| Following the initial response to Packet B, the therapist provided **ONE** token contingent on the student providing a response on Packet A following the reinforcement interval elapsing. | | | |
| The therapist did not provide tokens for responses on Packet A or Packet C | | | |
| No attention was provided to the student during the session. | | | |
| Once the 3-minute session was complete allowed the student to trade in their tokens for items. | | | |
| **% of Steps Completed:** | | | |
| | | | |

## *Phase 3 (Extinction Challenge- Large Magnitude)*

| Steps: | Completed | Not Completed | N/A |
|---|---|---|---|
| The therapist sat next to the student wearing a lanyard with a black card attached. A black card was velcroed to the back to the primary data collectors computer | | | |
| Three packets of math problems were placed equidistance from each other in front of the student. The therapist had a bag of tokens and a jar was placed next to the worksheets. | | | |
| The packets of math problems were counterbalanced from the previous session (if applicable) | | | |
| On a second table adjacent to the work table, 4-6 baggies of reinforcers were on display with *"3 Tokens for Each Item"* labeled on each baggie. | | | |
| Therapist began the session by telling the student **"You can work on the white, pink, or blue packets, or take a break and not work on any of the packets. Please begin when I say 'Start.'"** The therapist then said **"Start"** to initiate the session<br>**Note:** These instructions can be shortened after 2-3 sessions | | | |
| The therapist did not provide tokens for responses on Packet A, B, or C | | | |
| No attention was provided to the student during the session. | | | |
| **% of Steps Completed:** | | | |

## *Phase 3 (Extinction Challenge- Small Magnitude)*

| Steps: | Completed | Not Completed | N/A |
|---|---|---|---|
| The therapist sat next to the student wearing a lanyard with a yellow card attached. A yellow card was velcroed to the back to the primary data collectors computer | | | |
| Three packets of math problems were placed equidistance from each other in front of the student. The therapist had a bag of tokens and a jar was placed next to the worksheets. | | | |
| The packets of math problems were counterbalanced from the previous session (if applicable) | | | |
| On a second table adjacent to the work table, 4-6 baggies of reinforcers were on display with *"3 Tokens for Each Item"* labeled on each baggie. | | | |
| Therapist began the session by telling the student **"You can work on the white, pink, or blue packets, or take a break and not work on any of the packets. Please begin when I say 'Start.'"** The therapist then said **"Start"** to initiate the session<br>**Note:** These instructions can be shortened after 2-3 sessions | | | |
| The therapist did not provide tokens for responses on Packet A, B, or C | | | |
| No attention was provided to the student during the session. | | | |
| **% of Steps Completed:** | | | |

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# CURRICULUM VITAE
# EMILY L. BAXTER, M.A., BCBA

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**EDUCATION**

| | | |
|---|---|---|
| Ph.D. | In Progress<br>2015-Present | Syracuse University<br>Syracuse, NY<br>School Psychology<br>Advisor: Brian K. Martens, Ph.D. |
| M.A. | 2009-2012 | University of North Carolina Wilmington<br>Wilmington, NC<br>Psychology with an emphasis in Applied Behavior Analysis<br>Advisor: Christine Hughes, Ph.D. |
| B.A. | 2005-2009 | University of Minnesota<br>Minneapolis, MN<br>Psychology |

**CLINICAL EXPERIENCE**

*Pre-doctoral Internship*

SUNY Upstate Medical University Family Behavior Analysis Clinic
Syracuse, NY (August 2019-Present)
Supervisor: Henry S. Roane, Ph.D., LP, BCBA-D

Required 12-month internship to complete doctoral program. Responsibilities include behavioral assessment and treatment, diagnostic assessment, case management, report writing applied research, behavioral consultation, and administrative duties.

*Consultation Practicum*

Syracuse City School District, Roberts K8 School,
Syracuse, NY (Spring 2018)
PSY 862

Consulted with teachers about students who had both behavior and academic needs within the classroom. Directly provided academic interventions to students, collected progress data weekly, and presented information to classroom teachers.

*School Psychology Practicum*

Syracuse City School District, Roberts K8 School,
Syracuse, NY (Fall 2017-Spring 2018)
PSY 880

Conducted cognitive and achievement assessment batteries, functional behavior assessments, evaluations of students receiving special education services, participated in Individualized Education Plan meetings, consulted with classroom teachers and staff, wrote psychoeducational reports, and conducted social skills groups.

*Parent Training Group Co-Facilitator* — Research Project through SUNY Upstate University and Syracuse University (Fall 2017-Spring 2018)

Co-facilitated a two group of parents for the NAPPI research project conducted by Dr. Kevin Antshel and Dr. Henry Roane. Over 6 weeks, parents were trainined on a variety of applied behavior analysis techniques used to improve problem behaviors at home.

*Patient Care Specialist* — SUNY Upstate Family Behavior Analysis Clinic, Syracuse, NY (2016-2017)

Conducted both behavioral assessments and interventions using applied behavior analytic strategies for children diagnosed with severe behavior disorders. Conducted parent training to help transfer treatments from the clinical setting to the home setting.

*Senior Consultant (BCBA)* — Butterfly Effects, Inc., Fayetteville, NC (2013-2015)

In-home applied behavior analysis services provided to children on the autism spectrum, and caregiver training to increase generalization of skills across settings

*Program Coordinator (BCBA)* — Potential, Inc. and the Springtime School, Newtown, PA (2013)

Developed and wrote comprehensive treatment plans based on the functional behavior assessment that included behavior intervention, skill acquisition, and parent-training plans for clients in clinic, school, and home settings

*Master's Internship* — Munroe-Meyer Institute: Center for Autism Spectrum Disorders and Pediatric Feeding Disorders, Omaha, NE (2012)

Behavior Analyst Specialist I in the Pediatric Feeding Disorders Clinic. Routinely managed clients' eight-week admissions. Engaged in therapy with children who were learning skills needed for oral intake.

*Master's Practicum* — Roger Bacon Academy Charter School, Leland, NC (Spring 2011)

Prepared and presented weekly tutorials to teachers. Taught basic principles of applied behavior analysis and how to use applied behavior analysis principles in the classroom. In addition, worked with student identified by teachers as engaging in problem behaviors in the classroom.

*Undergraduate Internship* Lovaas Institute, Minneapolis, MN (2009)

Shadowed and assisted a behavior therapist three to four times a week using applied behavior analysis techniques in intensive early intervention. Met weekly to discuss methodology of behavior analysis.

**TEACHING EXPERIENCE**

Instructor/Co-Instructor
*State University of New York Upstate Medical University*
ABAS 644: Practicum in School-based Consultation; Summer 2020
ABAS 623: School-based Consultation in Autism; Summer 2020
ABAS 622: Advanced Issues in ABA; Spring 2020
ABAS 603: Evidence Based Treatments for Autism; Spring 2020
ABAS 641: Practicum in Autism Spectrum Disorders; Fall 2019

Teaching Assistant
*Syracuse University*
PSY 756: Experimental Design and Statistical Methods II; Spring 2018
PSY 655: Experimental Design and Statistical Methods I; Fall 2017
PSY 445: Behavior Disorders in Children; Summer 2018
PSY 205: Foundations of Human Behavior; Fall 2015; Spring 2016; Summer 2016; Spring 2018; Fall 2018; Spring 2019

Guest Lecturer
*State University of New York Cortland*
PST 360: Applied Behavior Analysis I; Functional Behavior Assessment, March 2020

*University of Nebraska Medical Center*
HPSY 920: Assessment and Treatment of Severe Behavior Disorders; Multiple Control, November 2019

*LeMoyne College*
PSY 215: Child and Adolescent Development; Language Development, October 2017

*Syracuse University*
PSY 432: Behavior Analysis in Children; Feeding Disorders in Children, April 2016

**PUBLICATIONS**

1. Martens, B.K., and **Baxter, E.L.** (2020). Pediatric prevention: academic behavior. *Pediatric Clinics of North America, 67(3),* 469-479. http://doi.org/10.1016/j.pcl.2020.02.002

2. Martens, B.K., Young, N.D., Mullane, M.P., **Baxter, E.L.**, Sallade, S.J., Long, S.J., Sullivan, W.E., Womack, A.J., & Underberg, J. (2019). Effects of word overlap on generalized gains from a repeated readings intervention. *Journal of School Psychology, 74,* 1-9.
3. Martens, B.K., **Baxter, E.L.**, McComas, J.J., Kester, J.S., Sallade, S.J., Caamano, M., Dimian, A., Simacek, J., and Pennington, B. (2019). Agreement between descriptive assessments and functional analyses conducted over a telehealth system. *Behavior Analysis: Research and Practice.* Advance online publication. http://dx.doi.org/10.1037/bar0000153.
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5. Mullane, M.P., Martens, B.K., **Baxter, E.L.**, and Steeg, D.V. (2017). Children's preference for mixed- versus fixed-ratio schedules of reinforcement: A translational study of risky choice. *Journal of the Experimental Analysis of Behavior, 107,* 161-175.
6. Martens, B.K., Lambert, T.L, Sullivan, W.E., Magnuson, J.D., Morley, A.J., Sallade, S.J., & **Baxter, E.L.** (2016). Choice in transition: Replication and extension to preschool children in a naturalistic setting. *Journal of the Experimental Analysis of Behavior, 105,* 307-321.

## CONFERENCE PRESENTATIONS

1. **Baxter, E.L.,** Martens, B.K., Cerisier, T., Sallade, S.J., and Circe, J. (2020). Effects of differential reinforcer magnitude on resurgence of academic responding. Virtual paper presentation at the Winter Conference on Learning and Behavior, Logan, UT.
2. **Baxter, E.L.,** Martens, B.K., Cerisier, T., Sallade, S.J., and Circe, J. (2019). Effects of differential reinforcer magnitude of an alternative response on the resurgence of academic responding. Paper presentation in a symposium at the New York State Association for Behavior Analysis Conference, Albany, NY.
3. **Baxter, E.L.**, Martens, B.K., McComas, J.J., Kester, J.S., Sallade, S.J., Caamano, M., Dimian, A., Simacek, J., and Pennington, B. (2019, September). Agreement between structured descriptive assessments and functional analyses conducted over a telehealth system. Poster presentation at the Association for Behavior Analysis International (ABAI) International Conference, Stockholm, Sweden.
4. Martens, B.K., **Baxter, E.L.**, McComas, J.J., Kester, J.S., Sallade, S.J., Caamano, M., Dimian, A., Simacek, J., and Pennington, B. (2018). Agreement between structured descriptive assessments and functional analyses conducted over a telehealth system. Poster presentation at the New York Association for Behavior Analysis Conference, Albany, NY.
5. **Baxter, E.L.**, Sullivan, W.E., DeRosa, N.M., & Roane, H.S. (2017) *Mitigating the effects of treatment integrity errors during functional communication training.* Poster presentation at the SUNY Upstate Autism Symposium 2017: Where We Are, Where We Are Going, Syracuse, NY.
6. Sullivan, W.E., Bishop, J., Silkowski, **E., Baxter**, E.L., Saini, V., DeRosa, N.M., Kadey, H.J., & Roane, H.E. (2016). Identification and modification of client preferences to enhance treatments of problem behavior displayed by children with autism spectrum disorder. Presentation given in a symposium at the New York Association for Behavior Analysis Conference, Albany, NY.

7. **Baxter, E.L.**, Sullivan, W.E., DeRosa, N.M., & Roane, H.S. (2016). Use of probabilistic reinforcement to increase compliance during activity transitions. Poster presentation at the New York Association for Behavior Analysis Conference, Albany, NY.
8. **Baxter, E.L.**, Knight, K.G., & Hughes, C.E. (2012). *Use of timeout to decrease pausing during rich-to-lean transitions.* Poster presentation at the Association of Behavior Analysis International Annual Conference, Seattle, WA.
9. **Baxter, E.L.**, & Hughes, C.E. (2011). *Rich-to-lean transitions and their punishing effects on key pecking in pigeons.* Poster presentation at the Association of Behavior Analysis International Annual Conference, Denver, CO.
10. **Baxter, E.L.**, & Hurst, R. (2010). *Restraint versus Reese's: Strengthening reinforcer assessment by assessing response strength.* Presentation given in a symposium at the Association of Behavior Analysis International Annual Conference, San Antonio, TX.

**CLINICAL CERTIFICATIONS AND LICENSURES**
Board Certified Behavior Analyst (BCBA), certification #1-13-13110

**CURRENT PROFESSIONAL MEMBERSHIP**
Association for Behavior Analysis International (2010-2013; 2017-Present)
New York Association for Behavior Analysis (2017-Present)

**AWARDS**
NYSABA Research Award: First Prize for "Agreement between Structured Descriptive Assessments and Functional Analyses Conducted over a Telehealth System." (September 2018)

**FELLOWSHIPS/GRANTS**
*Society for the Advancement of Behavior Analysis* December 2019
*Senior Student Presenter Grant*
Covered the cost of registration for the 2020 Annual Association for Behavior Analysis International Conference in Washington, D.C.

*Syracuse University Graduate Student Organization Travel Grant* October 2019
$400 provided for reimbursement for travel to the Association of Behavior Analysis International's international conference in Stockholm, Sweden.

*Syracuse University Summer Dissertation Fellowship* Summer 2019
$4,000 stipend towards making significant progress on dissertation

**COMMUNITY INVOLVEMENT/VOLUNTEERING**
*Syracuse Chargers Rowing Club* December 2018-Present
Board member (Secretary)

*Superintendent Parent Council* January 2018-Present
*Syracuse City School District*
Parent member

*Roberts K-8 School Family Teacher Organization* September 2017-Present

*Syracuse City School District*
Parent member (Secretary)