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Comparison of Differential Effects of Interpolated and Intermittent Reinforcement on Extinction Resistance: A Simulated Study

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COMPARISON OF DIFFERENTIAL EFFECTS OF INTERPOLATED AND INTERMITTENT REINFORCEMENT ON EXTINCTION RESISTANCE: A SIMULATED STUDY

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
College of Education
at the University of Kentucky

By

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Lexington, Kentucky

Director: Dr. Sally Shepley, Assistant Professor of Special Education

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2021

ABSTRACT OF THESIS

COMPARISON OF DIFFERENTIAL EFFECTS OF INTERPOLATED AND INTERMITTENT REINFORCEMENT ON EXTINCTION RESISTANCE: A SIMULATED STUDY

Schedules of reinforcement explain when a reinforcer may be delivered. Among the different schedules exists continuous (CRF), intermittent (INT), and extinction (EXT). When employing a CRF, reinforcement is delivered following every occurrence of the target response. An INT schedule includes varying the delivery of reinforcement. While both of these schedules include the delivery of reinforcement, EXT means that reinforcement is no longer delivered for the target response (Lee & Belfiore, 1997). Studies have shown that behaviors may be less resistant to extinction if moved from an INT schedule to a CRF schedule than if EXT followed the INT schedule alone. This effect on behavior has been termed the interpolation of reinforcement effect (IRE; Higbee et al., 2002). The current study seeks to compare the effects of prior exposure to a CRF and INT schedule of reinforcement on responding during subsequent extinction with Sniffy, a simulated virtual laboratory rat.

KEYWORDS: schedules of reinforcement, interpolated reinforcement, intermittent reinforcement, continuous reinforcement, extinction

Cara D. Baxter

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Date

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INTRODUCTION

Originating back to the early 1950-1970s, research demonstrates that manipulating schedules of reinforcement can impact how behaviors maintain over time and how they are extinguished (Cooper et al., 2020). Schedules of reinforcement exist in various forms and densities following all behaviors that humans engage in on a day-to-day basis; these schedules are one of the many principles explained by the science of human behavior, known as applied behavior analysis or ABA. These schedules explain how often a reinforcer will be delivered following a specific behavior. Three broad categories of schedules of reinforcement exist, including continuous (CRF), intermittent (INT), and extinction (EXT). When employing a CRF schedule, reinforcement is delivered following every occurrence of a target response. An INT schedule involves includes varying the delivery of reinforcement so that reinforcement is not delivered following every occurrence of the target response (e.g., a variable ratio three [VR-3], meaning reinforcement is delivered on the average of every third response). While both CRF and INT schedules include the delivery of reinforcement, the use of EXT means that reinforcement is no longer delivered for the target response (Lee & Belfiore, 1997).

Utilizing different schedules of reinforcement can alter patterns of responding. These findings have been especially useful when teaching individuals with disabilities new behaviors. Although ABA as a science is not specific to people with disabilities, the principles are commonly used to develop interventions to promote socially meaningful behaviors. Studies have concluded that delivering reinforcement systematically, especially for people with disabilities, can increase the efficiency of instruction or maintenance of a behavior (see review, Chadwick, 1971). Ultimately, most practitioners

that work with individuals with disabilities want to thin reinforcement for socially significant behaviors to a naturally occurring INT schedule so that the target behavior maintains and accesses reinforcement without supplemental or artificial supports. On the other hand, when treating challenging behaviors for individual with disabilities, practitioners need to remove the maintaining reinforcers in efforts to decrease challenging behavior levels. Therefore, for individuals engaging in challenging behavior, EXT may be a procedure used to decrease a target behavior. An abrupt decision to switch from a CRF or INT to EXT is not as simple as it sounds, as the schedule on which a behavior is reinforced prior to EXT may impact the efficiency of EXT (Mazaleski et al., 1993).

Depending on the function of behavior and the intervention, the use of EXT can look different across behaviors. In a study conducted by Mazaleski et al., (1993), researchers found that treatments that included EXT and those that did not demonstrated that those with the EXT component were more effective in decreasing challenging behaviors. While EXT can be a useful procedure for decreasing challenging behaviors, additional studies show undesirable side effects of EXT (e.g., Lerman et al., 1999; Goh & Iwata, 1994). Extinction bursts, which are momentary increases in the target behavior, and EXT-induced aggression, which include an increase in the individual's aggressive behaviors, are some examples of undesirable effects of using EXT (Lerman et al., 1999). Due to these effects, the use of EXT can sometimes pose an ethical dilemma for practitioners.

Studies have documented a phenomenon known as the partial reinforcement EXT effect (PREE), in which behavior that is reinforced on an INT schedule of reinforcement

is more resistant to EXT than a behavior reinforced on a CRF schedule (Higbee et al., 2002). In contrast, researchers have found that behaviors may be less resistant to EXT if moved from an INT schedule of reinforcement to a CRF schedule of reinforcement than if EXT followed the INT schedule of reinforcement alone (e.g., Carr et al., 2012; Higbee et al., 2002). This effect on behavior has been termed the interpolation of reinforcement effect (IRE; Higbee et al., 2002). In order to see this effect, a procedure known as the interpolated reinforcement procedure (IRP) is implemented where behaviors are intentionally moved from an INT schedule to a CRF schedule prior to EXT (Carr et al., 2012).

Although the PREE and IRE phenomena have been demonstrated within translational studies, there remains a critical need to replicate these phenomena with human subjects. The majority of this research was conducted with animals (e.g., Rashotte & Surridge, 1969; Dyal & Sytsma, 1976), and the few studies that were conducted with human subjects have produced varied findings with no consistent results (i.e., Carr et al., 2012; Higbee et al., 2002). Continued research on this effect could have implications for treating and decreasing challenging behaviors in individuals with disabilities. If findings consistently demonstrate that the claim of the IRE is substantiated, then moving from an INT schedule to a CRF schedule prior to implementing EXT should make the target behavior less resistant to EXT, and thus, the likelihood that a target behavior will occur in the future under similar conditions will decrease more rapidly than if EXT followed an INT schedule without introducing a CRF schedule.

The controversial nature of continuously reinforcing an aberrant behavior could contribute to the gap in the literature involving research regarding the IRE or PREE.

While most researchers used appropriate behaviors, few conducted studies with aberrant behaviors. In a study conducted by Lerman et al. (1996), a multielement and reversal design was used to investigate the effects of prior exposure to INT and CRF schedules of reinforcement on response patterns during EXT. The participants in this study included three adults with developmental disabilities who engaged in self-injurious behavior, aggression, and disruption. The results showed a reversed PREE for two participants, meaning their response rates were higher during CRF followed by EXT than they were with INT followed by EXT. Results also showed ambiguous findings for the third participant, where data showed they engaged in seven times more self-injurious behavior during the second EXT condition (following the INT schedule) than they did during the first EXT condition (following the CRF schedule).

While these results were not consistent with the anticipated results, researchers discussed many limitations that may have contaminated the study. One limitation reported by the researchers was the threat to internal validity due to the experimental design. The design used in this study was a multielement and withdrawal design and these designs are noted to be vulnerable to sequence effects (i.e., the order of the interventions influences the results) and interaction effects (i.e., there is a relation between adjacent conditions and results carry over from one condition to the other). In addition, researchers reported the specific schedules used during the INT conditions (i.e., VR-6) may have resulted in the reversed PREE and ambiguous results.

Other researchers have strayed from using aberrant behaviors and conducted the study similarly to how the procedure would be used in a clinical setting. Higbee et al. (2002) investigated the effects of the IRP following an INT schedule of reinforcement

with children diagnosed with autism spectrum disorder (ASD). The participants in this study included four male children between the ages of 4- and 6-years-old. A withdrawal design was used, with the order of conditions counterbalanced across participant pairs. The researchers examined response patterns during EXT following the implementation of an INT schedule both with and without the interpolated CRF and found that majority of the participants engaged in more responses during EXT following the implementation of an INT schedule than following interpolated CRF. The data from this study suggest that in order to lessen resistance to EXT, it may be beneficial in terms of treatment efficacy to interpolate CRF between INT and EXT rather than implement EXT following INT alone.

While the IRE has been demonstrated in multiple studies (Higbee et al., 2002) some researchers have found the opposite effect, indicating that a behavior is less resistant to EXT following INT alone versus CRF followed by INT. A study conducted by Carr et al. (2012) investigated the interpolated reinforcement procedure (IRP) which involves putting a behavior that was previously on an INT schedule, on a CRF schedule prior to implementing EXT. The participants included five typically developing 3-year-old children, and the targeted behaviors included placing a foam block into a plastic receptacle. A withdrawal design was used to evaluate the effects of the prior reinforcement conditions (i.e., INT-to-EXT and INT-to-CRF-to-EXT) on participant's target behaviors during EXT conditions. The results of the study indicated that for 3 out of the 5 participants, the IRE was not demonstrated. The researchers reported few limitations in the study, one being that the IRE may have been masked due to repeated exposures to EXT, since each participant was exposed to two EXT conditions. In addition, the researchers note that the specific INT schedule utilized could have affected

the results. Ultimately, these results are not consistent with the literature, and consequently increase the necessity for further research on this topic.

The original proposed study was to be conducted with children with a diagnosed disability and could have had practical implications for behavior analysts and any related service providers. The results of the proposed study could have contributed to the deficient literature regarding the PREE and IRE, which could have had sizable impacts for people with disabilities who engage in challenging behaviors. When individuals engage in challenging behaviors, it can inhibit them from participating in significant daily life activities. Individuals may miss out on social events, be placed in more-restrictive environments, and have overall less independence (Newcomb & Hagopian, 2018). In addition, this research could have benefited the practitioners working with these individuals since decreasing their challenging behavior will make instruction easier. While different interventions can reduce challenging behavior, many of them include EXT components. If practitioners are able to lessen resistance to EXT by implementing a CRF schedule prior to EXT, the efficiency of the intervention should increase.

Research Questions

The original purpose of this study was to extend the findings from Higbee et al., (2002) and Carr et al., (2012) to compare the differential effects of prior exposure to a CRF and INT schedule of reinforcement on responding during subsequent EXT with individuals with or at-risk for cognitive or developmental disabilities. However, due to setbacks with the Institutional Review Board (IRB) and conducting in-person research during the COVD-19 pandemic, the proposed study was conducted with a virtual laboratory rat instead of human participants. The new purpose of the present study was to

compare the differential effects of prior exposure to a CRF and INT schedule of reinforcement on responding during subsequent EXT with Sniffy, a simulated virtual laboratory rat.

METHOD

Participants

Sniffy

The participant in this study was Sniffy, the virtual laboratory rat. The program, Sniffy the Virtual Rat Pro: Version 3.0 (Alloway et al., 2012), allowed the researcher to perform a variation of operant and classical conditioning experiments that simulated a psychological laboratory, but without utilizing live animals (Appendix A). According to Alloway and colleagues (2012), this program was created by videotaping a live laboratory rat in its environment (i.e., a glass box in a laboratory) while it engaged in typical rat behaviors.

Others

Other individuals involved in the study included the researcher and a secondary data collector. The researcher conducted each session throughout the study and was overseen by a Board-Certified Behavior Analyst with experience conducting research and conducting experiments with Sniffy. The researcher, as well as the secondary data collector, were graduate students currently working toward their master's degrees in ABA. The researcher trained the secondary data collector on collecting interobserver agreement (IOA) data by providing her with the instructions, modeling how to collect the data, and then conducting a practice session to ensure the secondary data collector was fully trained. The researcher has had one year of experience working in a community-based ABA clinic that served young children with autism and 16 months of experience working in a university-based clinic that served children with severe challenging

behaviors. In the last 16 months, the researcher has had experience studying and implementing different schedules of reinforcement and EXT.

Instructional Setting and Arrangement

All portions of the study occurred through an online simulation program on a Mac OS X laptop. A Compact Disc-Read Only Memory (CD-ROM) was used to run Sniffy Pro. When the program opens, a new and untrained Sniffy appears on the laptop screen in his operant chamber. Sniffy's operant chamber was a 24 x 40 x 20 cm metal box that contained a water and food dispenser, as well as a lever that, if programmed to do so, would deliver pellets of food when pressed by Sniffy (Appendix C). Each of the experimental sessions took place in the Design Operant Conditioning Experiment where the researcher could determine the specific reinforcement schedule and the behavior to be recorded. Each experimental session was 5 min in length and was conducted in a one-to-one manner (i.e., the researcher and Sniffy). Sessions were conducted multiple times a day over a span of 5 days.

Materials necessary for this study included a Mac OS X laptop, an external CD drive, a CD-ROM, Sniffy the Virtual Rat Pro: Version 3.0 (Alloway et al., 2012), and a mobile device running the data collection application: Countee (Krushka Designs, 2020). In the Countee app, the session name was labeled by the condition, followed by the session number (e.g., "Baseline 2"). The secondary data collector also used this app to collect IOA data. Screenshots of the Countee data collection system are located in Appendix C.

Magazine Training

Two separate Sniffy simulations were utilized for this study in order to mirror one participant with different behaviors. In order for Sniffy to associate the sound of a food pellet being released (i.e., the magazine) with the availability of a food pellet, each Sniffy required magazine training. This training allowed for the sound of the magazine to become a secondary reinforcer which was used when Sniffy would engage in the target behaviors. This training lasted a minimum of 5 min for each Sniffy and was conducted by opening the operant chamber as well as the operant associations window. The associations window allowed the researcher to keep track of each Sniffy's sound-food association. The magazine training was complete once the height of the bar that represented the sound-food association reached three-quarters of the way up the ordinate scale (see Appendix B). Once the magazine training was complete, the sound of the pellet was able to serve as a secondary reinforcer and the researcher was able to begin the study.

Dependent Variables

Each Sniffy engaged in a different target behavior: one Sniffy engaged in grooming his face and one Sniffy engaged in grooming his body. Face grooming was defined as any occurrence that Sniffy lifts his arms and moves them across his face in a swiping motion. Body grooming was defined as any instance that Sniffy tucks his head and moves it back and forth against his body. When using the Design Operant Conditioning Experiment window, the researcher was able to record each of the target behaviors. When Sniffy would engage in the behavior, the program would make a "tap" sound. The researcher would observe Sniffy and record each time he engaged in the target behavior and well as listen for the "tap" sound prior to recording the behavior. The

dependent variables for this study were the count of responses within a 5 min session, and the number of sessions to suppression (i.e., EXT criteria). The assignment of which target behavior would be on which schedule of reinforcement was randomized using an online number generator.

Behaviors were measured using an event recording system. The researcher used count with time stamps to measure the occurrences of the target behavior using the Countee app. At the end of the sessions, the total number of responses for each Sniffy were graphed in order to determine if more sessions needed to be conducted within the experimental condition, or if criterion had been met for that condition.

Experimental Design

To evaluate the effect of the IRE on a behavior's resistance to EXT, an adapted alternating treatments design (AATD) was used. An AATDs utility lies in its ability to compare different established interventions across non-reversible behaviors (Ledford et al., 2018). By comparing these interventions, determinations about the relative efficiency of the interventions could be established. This design was chosen for this study due to its usefulness in comparing effective treatments with one another so that the researcher was able to see which schedule of reinforcement was superior, meaning which schedule was least resistant to EXT. This was measured by looking at the number of sessions to suppression. This design was also chosen because it allowed for the comparison of different behaviors, so long as they were functionally equivalent. Additionally, it was of the utmost importance that the behaviors chosen were of equal difficulty. In Sniffy's behavior repertoire, grooming the face and grooming the body were most similar when compared to the other behaviors (i.e., rearing back or rolling over). While neither of these

behaviors were explicitly taught to Sniffy, grooming body and grooming face required the same amount of continuous reinforcement in order to meet criterion and be at similar levels, which ensured the behaviors were of equal difficulty. Additional information on how threats to internal validity can be controlled for within the AATD are presented in Table 1. To demonstrate superiority, one of the schedules of reinforcement needed to reach EXT criteria in fewer sessions than the other schedule (i.e.., three consecutive sessions where Sniffy responding was at or below the mean count of the final five baseline sessions), and result in lower counts of responding in EXT sessions.

Baseline

During baseline conditions, the researcher opened each untrained Sniffy independently and collected data on the number of occurrences of the target behaviors (i.e., grooming face and grooming body). During the baseline sessions, there were no programmed consequences for the target behavior. The baseline sessions were conducted until each Sniffy exhibited low and stable levels of responding for at least three to five sessions. This criterion was met for both behaviors in three sessions.

Acquisition

Once Sniffy showed stable levels of responding in the baseline condition for both behaviors, he was taught how to perform the target behaviors. Following Sniffy engaging in the target behaviors, a food pellet was delivered. In the beginning of this phase, each of the target behaviors was reinforced on a CRF schedule. Once three consecutive sessions were observed where the response levels were greater than those at the end of the baseline condition, the schedule of reinforcement was thinned from a CRF to an INT (specifically, a VR-3), for both target behaviors. Both of Sniffy's grooming behaviors

Table 1 *Common threats to internal validity as well as how to detect and control for them in an AATD.*

Internal Validity Threat	Likelihood	Detect	Control
Procedural Fidelity	More likely due to rapid alternation and the researcher changing their planned behaviors often	Analysis of procedural fidelity data	Train data collectors, run practice sessions, provide additional supports when necessary
Multitreatment Interference	Likely when multiple sessions are conducted close to one another	Not able to be detected by visual analysis	Test a "best alone" final condition to see if data are similar
Unequal Behavior Difficulty	High likelihood when the researcher chooses behaviors that are of unequal difficulty	One behavior is consistently learned faster for all participants	Have multiple participants and counterbalance the assignment of behaviors

remained on an INT schedule of reinforcement for a minimum of five sessions until responding was stable and or accelerating in a therapeutic direction.

Comparison

An online number generator was used to determine which target behavior would be returned to a CRF schedule (i.e., IRP) and which would remain on an INT schedule. The generator placed Sniffy's groom face behavior on an IRP schedule, meaning each time he engaged in his groom face behavior, a food pellet was delivered (i.e., a return to a CRF schedule). The generator placed Sniffy's groom body behavior on an INT schedule, meaning on the average of every three occurrences of the groom body behavior, a food pellet was delivered. During this condition, data were collected on each occurrence of the target behaviors. Once a minimum of five consecutive data points were observed in which the INT schedule produced higher response counts than the IRP schedule, both target behaviors were moved to the EXT schedule.

Extinction

During the EXT condition, no reinforcement was provided following either of the target behaviors, that is, when Sniffy engaged in grooming his face or grooming his body, no food pellets were delivered. EXT sessions were continued until there were three consecutive sessions where participant responding was at or below the mean count of all baseline sessions.

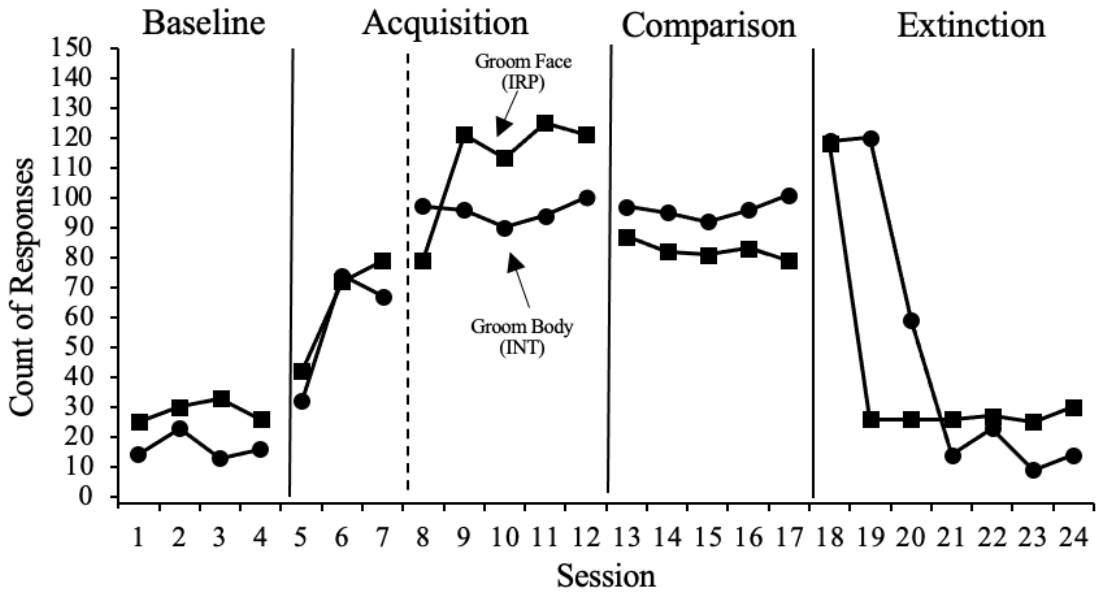
RESULTS

Resistance to EXT following exposure to an INT with and without interpolated CRF was measured by examining the number of sessions to the EXT criteria (i.e., three consecutive sessions where participant responding was at or below the mean count of the final five baseline sessions) as well as the level of responding of each behavior during the EXT condition.

Groom Face (IRP)

The findings are displayed in the graph in Figure 1. Sniffy's grooming face behavior was exposed to four baseline sessions in which the mean response was 28.5 face grooms per session. During baseline sessions, the number of responses of target behavior remained relatively stable, with a range of 25 to 33 occurrences. In the acquisition condition, Sniffy's grooming face behavior was reinforced on a CRF schedule for three sessions until reinforcement thinned to an INT schedule, where an immediate therapeutic acceleration in trend is observed. Grooming face reached INT acquisition criterion within five sessions and moved to the comparison condition where it was reinforced on an IRP schedule, specifically reversed back to a CRF schedule following the established INT schedule. Snffy's grooming face behavior remained on an IRP schedule for 5 sessions, where it remained until five consecutive data points were observed in which the INT schedule produced higher response counts than the IRP schedule. When the behavior was exposed to the EXT condition, a robust (i.e., 118 occurrences of the target behavior) but brief (i.e., 1 session) EXT burst occurred and was immediately followed by a decrease in number of responses. Sniffy's grooming face behavior decreased to below the mean rate

Figure 1 *Number of responses per session during reinforcement and extinction conditions for grooming face (IRP) and grooming body (INT).*



of his baseline sessions (i.e., 28.5) and remained below the mean for the remainder of the EXT condition. Grooming face met the EXT criteria within the second, third, and fourth sessions, and a total of 78 responses were emitted between sessions two and four. Overall, four sessions were required to reach the EXT criterion for the behavior that was previously reinforced on the IRP schedule.

Groom Body (INT)

Sniffy's grooming body behavior was exposed to four baseline sessions in which the mean number of responses was 16.5 body grooms per session. This behavior occurred at a lower number of responses during baseline than the grooming face behavior and continued to be at or below the average number of responses of Sniffy's grooming face when they were reinforced on the same schedule of reinforcement (i.e., CRF and INT). During the baseline condition, the number of responses of target behavior remained stable, and the number of responses ranged between 13 and 23 occurrences. When the target behavior was moved to a CRF, a moderate acceleration in trend was observed until the data began to stabilize in the last two CRF sessions. An immediate increase in level was observed as well as an acceleration in trend when the behavior was thinned to an INT schedule, specifically a VR-3. Grooming body reached INT acquisition criterion within five sessions and moved to the comparison condition where it continued to be reinforced on an INT schedule. Snffy's grooming face was reinforced on the INT schedule for 5 sessions, where it remained until five consecutive data points were observed in which the INT schedule (i.e., grooming body) produced higher response counts than the IRP schedule (i.e., grooming face). When the behavior was exposed to the EXT condition, a substantial (i.e., 119, 120, and 59 occurrences of the target behavior) EXT burst occurred

and maintained at an increased level (i.e., three sessions). Following the EXT burst, an abrupt decrease in number of responses was observed over the next four sessions. The target behavior met the EXT criteria within the fourth, fifth, and sixth sessions, and a total of 49 responses were emitted between sessions four and six. Overall, six sessions were required to reach the EXT criterion.

Reliability and Fidelity

The secondary data collector collected IOA and procedural fidelity data throughout all the conditions. The data collector received a short training conducted by the researcher to ensure fidelity with both types of data collection. The training consisted of a short discussion on how to collect procedural fidelity, behaviors on which data were to be collected, a model of how to collect the data, and a practice data collection session. The data collector collected reliability and fidelity data for at least 20% of sessions within each condition for each target grooming behavior across both Sniffy rats.

Interobserver Agreement

The secondary data collector collected IOA data during baseline, acquisition, comparison, and EXT sessions. Point-by-point IOA with time stamps was used and was calculated by dividing the total number of agreements by the total number of agreements plus disagreements (Ledford et al., 2018). An agreement was defined as any instance of time stamps within +/- 2s of one another. The number was then multiplied by 100 in order to calculate the percentage of agreement. IOA data were collected between 20 – 29% of sessions across all conditions. For the four baseline sessions conducted, IOA data were collected for each behavior one time, totaling 25% of the sessions. The percentage of agreement for the baseline sessions was 100%. For the eight acquisition sessions

conducted, IOA data were collected twice for each behavior, totaling 25% of the sessions. The percentage of agreements for the acquisition sessions was an average of 98%. IOA data were collected for one session of each target behavior during the comparison condition, totaling 20% of the comparison sessions. The percentage of agreements for the comparison sessions was 100%. Lastly, data were collected for two sessions of each behavior during the EXT condition, totaling 28% of the EXT sessions. The percentage of agreements for the EXT condition was an average of 98%.

Procedural Fidelity

The secondary data collector scored the occurrence or nonoccurrence of the researcher's planned behaviors. The formula for calculating procedural fidelity data was the number of observed correct behaviors (i.e., behaviors that were planned and completed correctly) divided by the total number of planned behaviors, which was then multiplied by 100 in order to calculate the percentage (Ledford et al., 2018). The target behaviors that were recorded for the researcher during each condition included: opening the correct Sniffy, recording the correct behavior, implementing the correct reinforcement schedule, setting the data collection timer for 5 minutes, collecting data throughout the interval, stopping the timer at 5 minutes, and pausing the program after 5 minutes elapsed (Appendix D). Procedural fidelity data were collected during each session in which IOA data were collected. The percentage of agreements for the planned researcher behaviors was 100% across all sessions conducted.

DISCUSSION

The purpose of this study was to evaluate the effects of interpolating CRF between INT and EXT conditions. The results of the current study were consistent with prior research regarding the PREE phenomenon and the IRE. Once Sniffy's grooming body behavior remained on an INT schedule and was then exposed to EXT, the behavior persisted at a higher rate and took more sessions to reach EXT criteria, and therefore was more resistant to EXT than the grooming face behavior. In addition, at the end of the EXT condition, the total number of responses for Sniffy's grooming face behavior (IRP) was 278, and the total number of responses for Sniffy's grooming body behavior (INT) was 358. At the conclusion of the EXT condition (sessions 21 through 24) the number of responses for Sniffy's grooming body behavior were consistently lower than the number of responses for Sniffy's grooming face behaviors; however, these patterns were similar to the baseline data for both behaviors. Therefore, it should not be assumed that Sniffy's grooming body behavior is less resistant to EXT due to the lower number of responses at the conclusion of the EXT condition. Conclusively, the behavior that was exposed to IRP prior to EXT was less resistant to EXT and in total, had a lower number of responses during the EXT condition overall.

Limitations

The current study has many limitations. First, the intended population for this study was individuals with or at-risk for cognitive or developmental disability in a clinical setting. Due to unforeseen circumstances with the COVID-19 pandemic and IRB delays, the study was conducted with a simulated laboratory rat. While the results of the present study are consistent with the results of the research conducted with animals

(Rashotte & Surridge, 1969; Dyal & Sytsma, 1976), additional research with human participants is necessary; therefore, the second limitation of this study is the use of animal participants. Additionally, while the program used in this study involves the use of an "animal", Sniffy is a simulation that does not serve as a substitute for a live animal (Alloway et al., 2012). For instance, Sniffy, unlike real rats, does not satiate and will continue to engage in certain behaviors to access food regardless of how much food he has eaten. Furthermore, Sniffy is programmed to learn and discriminate much quicker than a live rat would, making experimentation quicker.

Implications for Practice and Future Research

If Sniffy's results were replicable with the intended target population (individuals with or at-risk with disabilities), there may be vast implications for how behavior analysts teach. EXT is often a tool utilized by providers to decrease challenging behaviors for the individuals who engage in such behaviors. If interpolating a CRF schedule between an INT schedule and EXT could lessen the resistance to EXT, providers could choose to reinforce challenging behavior continuously for a period of time prior to implementing EXT in order for EXT to be more efficient.

While there are practical implications for challenging behaviors, the results of this study could also have implications for appropriate behaviors with the intended target population. If behavior that is previously being reinforced on an INT schedule persists more so than a behavior that was previously being reinforced on a CRF schedule when exposed to EXT, this implies that for appropriate behaviors that need to persist, thinning to an INT is necessary. When behaviors are initially taught or learned, reinforcing them on a CRF ensures a high rate of responding and more learning trials (Lee & Belfiore,

1997); however, once learned, thinning the schedule of reinforcement can ensure the behavior will persist and is less resistant to EXT. In most cases, practitioners do not have control over the schedule of reinforcement behaviors in the environment are on. For example, when using a cellular device, full access to the device is granted when the user enters the correct passcode (i.e., the behavior of 'typing in the passcode" is on a CRF). At times, user error occurs, and the wrong passcode is entered, or the passcode has been changed recently. When this occurs, it is not only important that the behavior persists (i.e., the user continues to try their current passcode), but also that the user engages in different topographies of the response (i.e., lag schedules of reinforcement) that gain access to reinforcement in order to promote behavioral variability (Radley et al., 2019).

Conclusions

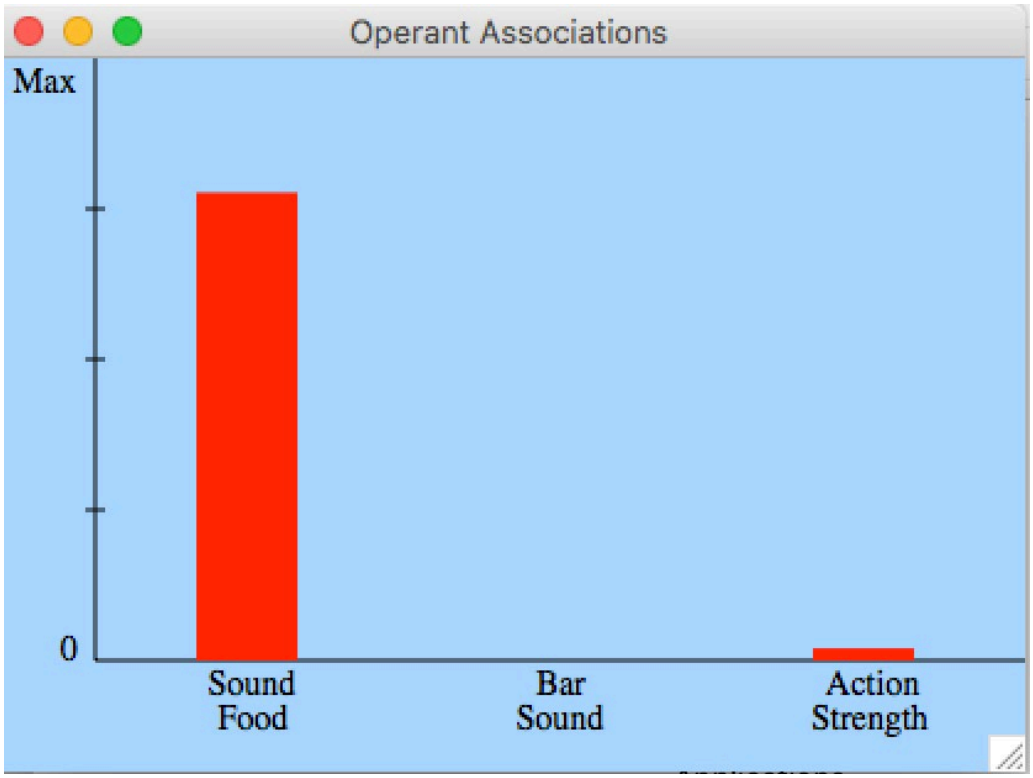
The overall results of this study showed that when a behavior is exposed to the IRP prior to being exposed to EXT, the behavior is less resistant to EXT than a behavior that remained on an INT schedule prior to EXT. While additional research is needed, these results suggest that behavior could be extinguished more efficiently if exposed to an IRP condition prior to EXT, which could be beneficial in decreasing inappropriate behaviors with the study's intended population.

APPENDIX A

Below is Sniffy in his operant chamber, engaging in grooming his face

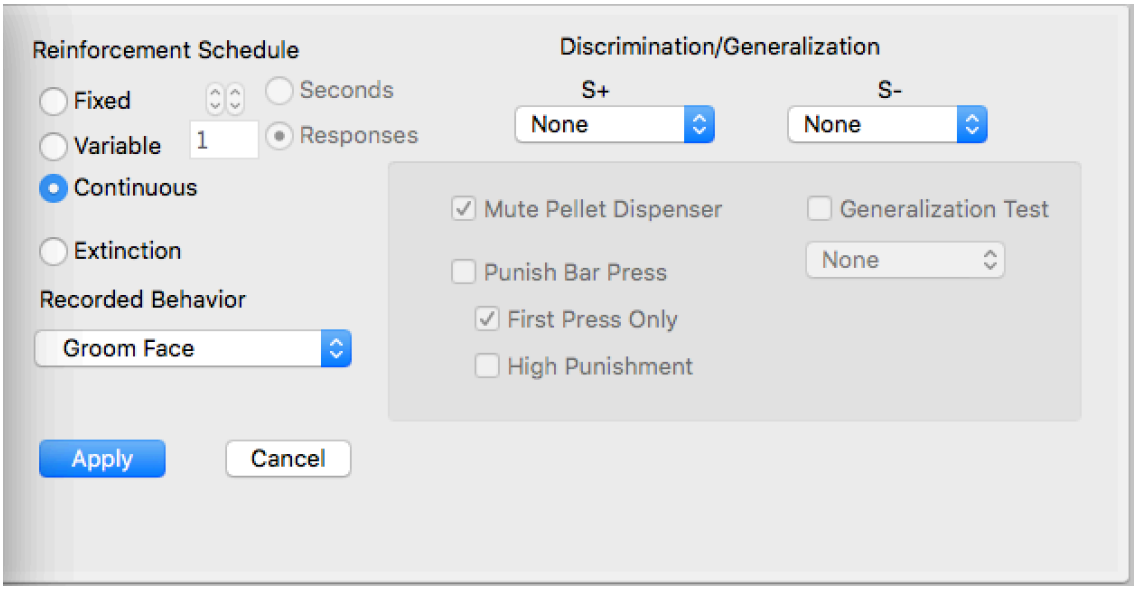
APPENDIX B

Below is the operant associations window that depicts Sniffy's sound-food association.



APPENDIX C

Below is the Design Operant Conditioning Experiment window where the researcher would ensure the correct reinforcement schedule and recorded behavior.



APPENDIX D

Below is an example of one of the Countee data sheets that were used to collect behavior data as well as IOA data.

Sec	To	Sum	Name
2	0	0	Groom face
3	0	0	Groom face
5	0	0	Groom face
9	0	0	Groom face
12	0	0	Groom face
13	0	0	Groom face
15	0	0	Groom face
17	0	0	Groom face
20	0	0	Groom face
21	0	0	Groom face
23	0	0	Groom face
25	0	0	Groom face
26	0	0	Groom face
29	0	0	Groom face
31	0	0	Groom face
36	0	0	Groom face
41	0	0	Groom face
43	0	0	Groom face
45	0	0	Groom face

APPENDIX E

Procedural Fidelity Checklist

Observer: _____
Date: _____
Start time: _____ End:_____
Researcher:_____ Session:_____

Steps For All Sessions:	"+" or "-"
Open correct sniffy (i.e., EXT sniffy for SXT sessions)	
Correct behavior is being recorded	
Correct reinforcement schedule is being implemented	
Timer/data collection app is set for 5 minutes	
Collected data throughout interval	
Timer stopped at 5 minutes	
Sniffy program paused at 5 minutes	
Summary	/
Percentage	%

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