EVALUATING LATENCY TO RELAPSE WITH MATCHED AND UNMATCHED STIMULI: A PROOF OF CONCEPT

by

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ABSTRACT

Researchers have demonstrated that noncontingent reinforcement (NCR) is an effective treatment for the reduction of problem behavior maintained by automatic reinforcement (Roscoe, et al., 1998). However, researchers have not evaluated methods for mitigating return of problem behavior when noncontingent reinforcers are removed, or NCR schedules are thinned in the context of NCR-based intervention for automatically maintained problem behavior. Extant research shows that NCR including either matched or unmatched stimuli can effectively reduce automatically maintained problem behavior. To gain a better understanding how stimulus type might impact return of automatically maintained behavior following NCR, Experiment 1 attempted to evaluate the effects of matched versus unmatched item exposure on a non-clinically relevant behavior. Exposure to the two NCR conditions did not result in a reduction in analogous problem behavior. The researcher conducted Experiment 2 to evaluate the effects of presession exposure to matched or unmatched stimulus in the absence of the analogous problem behavior. Following exposure, data were collected on overall engagement in analogous problem behavior as well as latency to engagement. A reduction in overall engagement in analogous problem

behavior following presession exposure was observed regardless of stimulation type. The researcher predicted that exposure to matched items would result in a longer latency to re-emergence of analogous problem behavior; however, no such effect was demonstrated.

INDEX WORDS: NCR, competing stimulus assessment, matched stimuli, presession exposure, latency

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DEDICATION

I dedicate this work to my supportive parents. Thank you, mom and dad for creating an environment where I thrived. To my brothers, let me say this: education is not a competition. But if it was, I would be winning.

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CHAPTER 1

INTRODUCTION

The development of a functional analysis of severe problem behavior by Iwata, et al., (1982/1994) allowed researchers and practitioners to identify the likely operant mechanism maintaining problem behavior. These mechanisms can be categorized into two broad groups: a) behavior maintained by socially mediated positive and negative reinforcement (e.g., attention from care providers and escape from aversive tasks), and b) behavior maintained by nonsocially mediated reinforcement (i.e., maintained by automatic reinforcement). When problem behavior is maintained by socially mediated reinforcers, the reinforcement process requires the participation of another individual (e.g., a parent to provide attention). When problem behavior is maintained by automatic reinforcement, the reinforcement occurs independent of social reinforcers and does not require the participation of another individual. The behavior itself, rather than another person, produces the reinforcer (Vaughan & Michael, 1982).

Because they are not under the control of the implementer, clinician, or researcher, automatic reinforcers are more difficult to manipulate than socially mediated (i.e., provided by another person) reinforcers. This lack of control results in behavior that can be difficult to effectively treat. Noncontingent reinforcement (NCR) involves providing an individual response-independent access to alternative reinforcers and has been demonstrated to be effective. Thus, NCR us a common treatment approach used to reduce problem behavior maintained by automatic reinforcement (Rooker et al., 2018). For NCR to be successful, the individual's

response allocation (i.e., choice) must favor the responses that produce or access the alternative reinforcers over the responses that produce the automatic reinforcers (i.e., problem behavior). While the behavior analytic literature has identified methods to improve NCR as a treatment (Carr et al., 2000), it typically requires ongoing, uninterrupted access to the alternative stimuli to be effective. The behavior analytic literature provides demonstrations of the effectiveness of NCR to reduce socially mediated problem behavior, as well. Implementation of NCR to reduce socially mediated problem behavior typically involves providing access to the functional reinforcer (e.g., attention or escape) on a fixed-time (FT) schedule and placing the problem behavior on extinction (Saini et al., 2017). The NCR procedure differs when being used to treat automatically maintained behavior. Due to the inability to control the reinforcers maintaining the problem behavior, the extinction component of NCR is not possible, unless the intervention includes additional components such as response blocking or sensory extinction. Additionally, the functional reinforcer for automatically maintained behavior often remains unknown and arbitrary reinforcers (i.e., stimuli with reinforcing properties but not related to maintenance of the target behavior) are incorporated into the intervention (e.g., Roane et al., 2003). The research has shown that even with the absence of extinction and the use of arbitrary reinforcers, NCR is an effective treatment for the reduction of automatically maintained behaviors (Berg et al., 2016; Rooker et al., 2018; Roscoe et al., 1998). However, the lack of data showing successful schedule thinning limits the practicality of the intervention approach.

One way to identify arbitrary reinforcers for use in NCR interventions is to conduct a competing stimulus assessment (CSA; Piazza et al., 2000). This assessment specifically identifies items that compete with the reinforcement offered by the behavior. The CSA procedure

appears similar to a stimulus preference assessment in that the individual can engage with one item or another; however, during a CSA, the researcher collects data on both item engagement and the problem behavior. Roscoe et al. (1998) conducted a CSA to identify items that competed with participants' engagement in self-injurious behavior (SIB). The researchers tested five to six items, selected arbitrarily, for each participant. During assessment, they provided participants access to an item for 5 min, during which time data were collected on both item engagement and SIB. The items that competed with the participant's lowest level of SIB and highest engagement was subsequently used in the NCR-based treatment. NCR sessions which used competing stimuli resulted in lowered levels of automatically maintained SIB more rapidly when compared to treatment sessions which used suppression equipment.

Researchers have found that an individual's highest preferred items do not necessarily compete with engagement in automatically maintained problem behavior. Groskreutz et al. (2011) designed an NCR-based treatment to reduce a participant's engagement in automatically maintained vocal stereotypy. During their assessment process, they first conducted a paired stimulus preference assessment to identify high-preferred items. Next, they used the same items in a CSA to identify high-competitive items. During this assessment they collected data on the participant's engagement in stereotypy and item manipulation. They evaluated noncontingent access to the high-preferred or high-competitive items relative to baseline using a reversal design. The participant's engagement in vocal stereotypy decreased when the high-competitive items were available but continued at high rates when the high-preferred items were available. Thus, based on the findings of Groskruetz et al. (2011), when evaluating potential sources of

alternative reinforcement for use in NCR-based interventions to reduce automatically maintained behaviors, a CSA may provide more information than a preference assessment.

Other researchers have used assessments to determine alternative reinforcers that match the hypothesized sensory consequences of the problem behavior. For example, Britton, et al. (2002) conducted a sensory class assessment to identify alternative stimuli that matched the hypothesized type of stimulation maintaining automatically preferred problem behavior for each participant. For two of the three participants, the researchers attempted to limit access to the automatic reinforcement. Janet, a participant who engaged in face rubbing, wore gloves to block the hypothesized reinforcing hand stimulation. The other participant Brian, who engaged in repetitive hand movements near his face had a visual blocker placed between his hand and his face to block the hypothesized reinforcing visual stimulation. They gave Dylan, the final participant, a noncontingent neck massage in test conditions, as it was hypothesized that his head rocking behavior was to gain stimulation to neck muscles. The researchers evaluated the interventions using an ABA reversal design for all three participants. The A condition was their assigned stimulation (or extinction of stimulation), and the B condition was no interaction. All three participants exhibited a higher rate of stereotypy in the no-interaction conditions. The researchers used the results from this assessment to identify items that could potentially match the sensory stimulation provided by the participants' problem behavior. The researchers then used each participant's preferred matched stimulus in NCR conditions, which reduced engagement in problem behavior for all participants when they were prompted to engage with the alternative reinforcers.

While Britton et al. (2002) used matched stimulation in their study, other researchers have shown that matched sensory consequences may not be necessary for effective competition. Berg et al. (2016) used NCR to reduce a participant's engagement in automatically maintained SIB. A preference assessment was conducted daily to determine the participant's preferred tangible items, which did not match his SIB sensory input. These items and attention were then provided to the participant throughout the NCR sessions. The participant's SIB was reduced by 97% when compared to baseline levels, and treatment effects were maintained demonstrated for 10 months.

In each of the previously described studies, the researchers did not thin the NCR schedule. In fact, the current literature only provides one example of schedule thinning in the context of NCR-based treatment to reduce automatically maintained problem behavior (Slocum et al., 2020; two total participants). However, researchers have thinned reinforcement schedules in the context of NCR-based treatments of socially mediated behaviors. Slocum et al. (2018) thinned the reinforcement schedule of NCR for the treatment of tangible or attention-maintained aggression for three participants using a multiple schedule. In NCR conditions, the researchers provided participants with access to the functional reinforcer as well as alternative reinforcers (either toys or attention). During NCR, researchers placed aggression on extinction and an orange-colored card was used to signify that the NCR schedule was in effect. After the NCR treatment proved successful for reducing aggression, the researchers began to thin the schedule of reinforcement. They provided the participants with a white colored card to signify when NCR was not in effect. During schedule thinning, aggression was still on extinction, but the functional reinforcer was no longer available. The researchers continued to provide the participants with

access to alternative reinforcers. The first thinning period was 10 s in duration but was gradually increased after two consecutive sessions with a rate of 0.1 responses per minute or lower. The thinning procedure was effective at reducing the NCR session time by 50% for all three participants with reinforcement being withheld for 1 to 2 min at a time.

Thinning the reinforcement schedule during NCR-based interventions has important clinical implications because, over time, NCR may fail to be effective due to satiation related to the arbitrary reinforcers. Lindberg et al. (2003) evaluated the long-term effects of NCR in the treatment of automatically maintained SIB. Items which competed with engagement in SIB were identified through a CSA. These items were then provided during 10-min sessions and SIB decreased for all participants. Lindberg et al. (2003) then evaluated NCR effects during 120-min sessions. For two of the three participants, engagement with the items decreased during the longer treatment sessions. One participant continued to show a reduction in problem behavior when provided with a variety of items. The other participant did not demonstrate continued treatment effects in 120-min NCR sessions, even when provided with a variety of items. This study demonstrated the limitations of NCR treatment when applied for longer durations than those often explored in the clinical setting.

Additionally, NCR procedures may be difficult to implement in the natural setting if the schedule of reinforcement is too demanding for caretakers. Roane et al. (2003) used an NCR procedure to reduce a participant's engagement in object mouthing across three natural settings. They provided the student with continuous access to snacks that he carried in a fanny pack throughout his day. The consumption of these food items competed with his engagement in object mouthing. They did not attempt to thin the student's access to the edibles. However, in the

natural setting continuous access to competing stimulation (such as edibles) may not always be available or ideal. The ability to fade access to alternative reinforcers would provide a more appropriate intervention for generalization.

One obstacle to thinning the schedule of reinforcement with automatically maintained behavior is that the individual typically has access to the functional reinforcer. When the alternative reinforcers used in the NCR schedule are removed briefly, the individual can revert to engagement in problem behavior and can access the reinforcers related to that response. Hagopian et al. (2000) stated that to thin the NCR schedule extinction was a necessary component for socially mediated behaviors. Extinction is not usually a component in the treatment of automatic behaviors, because the ability to withhold access to the problem behavior may be impossible. For example, when a participant engages in automatically maintained vocal stereotypy the researcher cannot place these vocalizations on extinction since she does not have control over the reinforcing stimulation.

Researchers have demonstrated that NCR is an effective treatment for the reduction of problem behavior maintained by automatic reinforcement. Roscoe et al. (1998) compared NCR to extinction as a treatment for automatically maintained SIB. They concluded that NCR decreased the problem behavior more rapidly and with more complete suppression when compared to extinction (e.g., gloves, protective sleeves) for all three participants. They also noted that NCR was easy to implement and increased appropriate item engagement. One limitation of their study was that they did not attempt to fade out the dense reinforcement schedule used in NCR.

The behavioral literature demonstrates that NCR as a treatment for automatically maintained problem behavior can be efficacious. However, the process used to develop specific NCR procedures reported in the literature seem to be underspecified, and the NCR procedures lack uniformity. Given these gaps in the literature, the first author conducted a review of recently published NCR studies to determine the distribution of studies that focused on matched versus unmatched stimuli in NCR-based interventions, the process for identifying those stimuli, and the overall outcomes of these studies. Chapter 2 provides a detailed account of the participants, settings, dependent variables, and the rigor of the articles that resulted from this search.

CHAPTER 2

LITERATURE REVIEW

There have been several reviews evaluating published demonstrations of NCR as a treatment to reduce problem behavior. Gover et al., (2019) reviewed studies that used environmental enrichment as a treatment for problem behavior maintained by automatic reinforcement which included self-injurious behavior (SIB), motor stereotypy, vocal stereotypy, pica, or 'other.' Their search resulted in a total of 265 applications of environmental enrichment (EE) used either as stand-alone treatment or in combination with other interventions. treatments. Results of their review indicated that environmental enrichment reduced problem behavior from baseline by 80% or more in 40.9% of its applications. The authors compared matched to unmatched stimuli used across studies. Their analysis found that matched stimuli were used in 17 cases and resulted in effective treatment for 64.7% of applications. They found that researchers used unmatched stimuli in 16 cases, and it was effective for 6.3% of those applications. The authors defined effective as an 80% reduction of problem behavior when compared to baseline. These percentages suggest there is an advantage to identifying the hypothesized reinforcing properties of the problem behavior. Rooker et al. (2018) also published a review which differed in that it focused exclusively on automatically maintained SIB. The most common treatment component found in their review was NCR. They further concluded that NCR informed by a competing stimulus assessment was more effective than when informed by a preference assessment.

The purpose of the current review was to evaluate studies that used matched or unmatched stimuli in NCR treatments for automatically maintained problem behavior. The current review focused on studies that used NCR as a stand-alone treatment. Additionally, this review reported on the usage of preference or competing stimulus assessments prior to treatment. This literature review further differs from other published literature reviews in that it did not focus on one specific category of automatically maintained behavior (e.g., SIB in Rooker et al., 2018). This review provides an investigation into how matched items are identified for NCR sessions and how NCR is currently being used to decrease automatically maintained behaviors in an effort to identify areas for improvement.

Method

Search Procedures

The first author (a doctoral student and board-certified behavior analyst) searched PsycInfo for the keywords "noncontingent reinforcement AND "*automatic**" AND *"behavior."* The first author served as the primary coder and evaluated the articles for inclusion based upon title and abstract. Articles included in this review had to meet the following criteria: (a) conducted with human participants, (b) published in English, (c) included a functional analysis (FA), (d) specific to behavior maintained by an automatic function, (e) used NCR as a stand-alone intervention and (f) also had to be an original article (not a review or discussion paper). Next, the first author evaluated articles by their full texts using the same inclusion criteria. Finally, the first author conducted an ancestral search by screening the reference lists of the 14 included articles. The ancestral search resulted in seven additional articles, resulting in a total of 22 articles included in this review. The authors completed the search process using the Preferred

Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, et al., 2009).

Coding Procedures

Following the identification and inclusion process, the first author coded the following variables for each participant: age, gender, diagnosis, problem behavior, treatment setting, treatment effect, assessments conducted, treatment stimuli type (i.e., matched or unmatched), if maintenance of treatment effects were measured and if NCR was thinned. A graduate student served as a second reviewer and coded these variables for 30% of the articles to obtain interobserver agreement (IOA). The articles evaluated by the second reviewer were randomly selected by a number generator. The two reviewers' answers to each question in a spreadsheet were compared. If the answers of both reviewers matched that cell was scored as a 1. If the answers disagreed, that cell was scored as a 0. IOA was calculated by dividing total agreements by total agreements plus disagreements, which resulted in an average of 95.45% (range, 89.47%-100%)

The 22 articles reviewed resulted for a total of 55 participants. When percentages are provided in this review prior to the quality and rigor section, they reflect the 55 participants, given that each participant's information was coded as if it were an independent study. Thus, the reviewer coded the outcomes of 55 studies. This coding method differs from that used in the Rigor and Quality section, which will be explained later in the review.

Participants and Setting

The reviewer coded the 55 participants by their age, gender, and treatment setting. The reviewer selected an age range for each participant. The ranges included 5 and under, 6 to 10, 11

to 15, 16 to 19 or 20 years and older. If the article's authors did not provide an age, the reviewer marked 'unspecified' for that participant. Additionally, the reviewer coded the participant's gender based upon their name, pronouns used, or the author's specific label of the participant's gender. Next, the reviewer classified the participant's treatment setting as clinic, day program, home, school, residential facility, or inpatient unit. If the authors did not specify where the intervention took place, the reviewer marked 'unspecified' for that participant. Finally, the reviewer coded if the participant had a diagnosis of autism, intellectual disability, multiple diagnoses, an unspecified developmental disability, or none.

Dependent Variables

All studies in this review attempted to decrease automatically maintained problem behaviors, but the topography differed among the studies. The reviewer coded the problem behavior for each participant. The categories for problem behavior were self-injurious behavior (SIB), motor stereotypy, vocal stereotypy, object mouthing, pica, and dangerous acts.

Assessments

The reviewer coded if the authors of the study conducted a preference assessment, a competing stimulus assessment or both with each participant. A preference assessment was marked if the authors conducted a multiple stimulus without replacement (MSWO), free operant, paired choice or unspecified preference assessment and reported they only took data on item engagement or selection. The reviewer marked 'competing stimulus assessment' if the authors recorded both item engagement and problem behavior during a preference assessment. If the authors did not conduct an assessment the reviewer coded 'none' for this variable.

Matched Stimulation

Along with the type of assessment used to identify items for the NCR conditions, the reviewer coded if the researchers labeled the items as matched to the hypothesized sensory stimulation provided by the problem behavior. The reviewer further noted if the researchers performed an assessment to test their hypotheses of a sensory match.

Quality and rigor

There is common agreement within the field of behavior analysis that standards should be used to evaluate single case design research (Horner et al., 2005; Gast & Ledford, 2014). In an effort to assess quality of the studies, the reviewer coded 'yes' or 'no' for the following questions: did the researchers collect IOA data for at least 20% of baseline and treatment sessions resulting in at least 80% agreement; were procedural fidelity data collected; were at least three data points shown in each baseline and treatment condition and did the treatment evaluation display three demonstrations of effect. The coder also coded for each study if NCR was the chosen treatment following the intervention evaluation and if schedule thinning occurred at any time with 'yes' or 'no.'

The reviewer coded all studies in the review for quality and rigor which resulted in a total of 44 studies. This number is different from the previous coding, because in the previous section the reviewer coded each participant as one study. However, for rigor the reviewer did not code studies that used a multiple baseline design across participants individually since all participants were necessary to demonstrate treatment effect.

Results

Participants and Setting

The largest number of participants were between the ages of 6 to 10 years (n=14). The second largest group of participants were 20 years or older, (n=12). Children aged 5 and under accounted for 11% of the participants (n=6). The remaining participants were between ages 11 to 15 (n=5), or 16 to19 years old (n=1). For 17 of the 55 participants, the authors did not specify age. It should be noted that Roscoe et al. (2013) did not specify each participant's age thus the reviewers were unable to report age for 14 participants. However, they stated that their participants ranged in age from 16-55 years old.

Over half of the participants were males, with a population of 58% male (n=32) and 42% female (n=23). The most commonly observed treatment settings were residential facilities (n=22), clinics (n=10), and inpatient units (n=6). It should be noted that 14 participants that were treated in a residential setting were participants from the same study (Roscoe et al., 2013). The remaining settings included day programs (n=5), schools (n=5), and homes (n=4). Authors did not specify the setting in which they conducted NCR for three of the participants. The most common diagnosis reported for 47% of participants was an intellectual disability (n=26). Other diagnostic categories included multiple diagnoses (33%), autism (11%), an unspecified developmental disability (5%) and no diagnosis (4%).

Dependent Variables

Thirty-one of the participants (56%) engaged in a form of SIB. SIB included hitting oneself (Dustin from Berg et al., 2016; Laura from Lindberg et. al., 2003; David from Rosales, et al., 2010), skin picking (Clay et al., 2018; Deleon, et al., 2000; Ellen from Roscoe et al., 1998);

forceful rubbing of a body part (Ray from Roscoe et al., 1998; Robert from Lindberg et al., 2003), ear digging (Davis et al., 2013), putting substances into eyes (Van Camp et al., 2001), hand mouthing (Julie from Lindberg et al., 2003; Monique from Roscoe et al., 1998; Tyrone from Piazza et al., 2000; Roscoe et al., 2013) or thumb sucking resulting in tissue damage (Kyle from Rosales, et al., 2010). Thirteen participants (24%) engaged in a form of motor stereotypy which included head rocking (Dylan from Britton et al., 2002), face rubbing (Janet from Britton et al., 2002; Karen from Rosales et al., 2010), repetitive hand movements (Brian from Britton et al., 2002; Oriville from Dozier et al., 2013; Higbee et al., 2005; Slocum et al., 2020), card lining (Ray from Dozier et al., 2013), straw flicking (Eric from Dozier, et al., 2013) or salvia play (Rose from Rosales et al., 2010; James from Deleon, Toole, Gutshall, & Bowman, 2005; Brad from Piazza et al., 2000). Five participants engaged in vocal stereotypy (9.4%) which was defined as repetitive vocalizations (Rapp, 2007; Rispoli, et al., 2018). Two participants (3.8%) engaged in object mouthing (Lanovaz & Archimedes, 2010; Roane et al., 2003) which was defined as the placement of an inedible object past the plane of the participant's lips. Two participants engaged in dangerous acts which included standing in a tub (Ward & Higbee 2008) and standing on furniture (Betsy from Piazza et al., 2000). Two participants engaged in pica (Read from DeLeon, et al., 2005; Piazza, et al., 1998) which was defined as the consumption of non-edible items.

Assessments

Most of the studies evaluated used either a preference assessment or a competing stimulus assessment to determine stimuli to be used in NCR treatment conditions. There were three articles that did not report an assessment with their participants, accounting for 9% of total

participants coded (N=5). Roscoe, Iwata, and Goh, (1998) reported that, for one of their participants, they used staff report and observation to identify an item that was preferred and had been shown to decrease SIB. Similarly, Ward and Higbee (2008) reported that they had observed the toys they used as reinforcers to be highly preferred by the participant. Rather than items, Rispoli et al. (2018) used non-contingent attention and did not evaluate its effect prior to the study. Overall, researchers used a competing stimulus assessment with 65% (N=36) of participants and a preference assessment with 24% (N=13) of participants. The reviewer coded "both" for Deleon et al. (2005), because this study conducted a preference assessment followed by a competing stimulus assessment.

Matched Stimulation

In the coded studies, 24% (N=13) of the researchers reported to have used items that were hypothesized to match the stimulation provided by the participant's problem behavior. The studies varied on how they determined what was matched stimulation. Some studies used a sensory class assessment to identify matched items (Britton et al., 2002). In other studies, the researchers formed a hypothesis regarding the stimulation provided by the problem behavior and provided the participant with items hypothesized to match that stimulation (Lanovaz & Archimedes, 2010). For example, food and teething items were hypothesized to match the sensory input of pica (Deleon et al., 2005) and object mouthing (Roane et al., 2003). Of the 13 studies that used matched stimulation, 62% of these compared matched to unmatched items to determine the most effective stimulation for treatment conditions. Of the eight studies that compared the two, 100% of studies determined that matched stimulation showed a more significant reduction in problem behavior when compared to unmatched stimulation.

Quality and Rigor

The majority of studies coded used a reversal (N=23) design. The remaining studies used an alternating treatment design (N=5), an alternating treatment design embedded in reversal (N=8), a multiple baseline across participants (N=5) or a multiple baseline across settings (N=1). The reviewer coded two interventions as using 'other' designs (Ray from Dozier et al., 2013; Ward & Higbee, 2008).

In all studies except two, researchers collected data for the purpose of obtaining IOA during at least 20% of sessions which resulted in an average of 80% agreement. Ward and Higbee (2008) did not report IOA data. In Van Camp et al. (2001) they reported they had collected IOA data on 35% of the FA sessions, but only 15% of the treatment conditions. Four of the studies in this review conducted a form of procedural fidelity (Britton et al., 2002; Dozier et al., 2013; Rispoli et al., 2018 and Slocum et al., 2020).

The reviewer coded the majority of studies, 89% (N=39) as 'yes' to having demonstrated at least three data points in baseline and intervention comparison conditions. Three of the five studies that did not contain three data points were targeting SIB and reported two high data points in a reversal to baseline before returning to intervention (Dustin from Berg et al, 2016; Deleon et al., 2000; and David from Rosales et al., 2010).

Furthermore, the reviewer coded 75% (N=33) of the studies as showing at least three demonstrations of effect specific to NCR treatment success. In 14% of the studies, NCR failed to be an effective treatment and the researchers demonstrated another treatment as effective with three demonstrations. In 11% (N=5) of the coded studies the researchers failed to demonstrate

experimental control (Ray from Dozier et al., 2013; Brian and Nevin from Rapp 2007; Martha from Ringdahl, Vollmer, Marcus, & Roane, 1997; and Maude from Ward & Higbee, 2008).

Schedule Thinning

Two of the 22 articles evaluated schedule thinning (Ward & Higbee, 2008; Slocum et al., 2020).

Discussion

Consistent with previous reviews, this literature review demonstrated that NCR is often a successful treatment for automatically maintained behaviors as 75% of studies showed a therapeutic intervention effect. Additionally, consistent with a recent review on CSAs conducted by Haddock and Hagopian (2020), the majority of studies which were coded as using a matched item failed to test their hypothesis in any systematic manner. To identify the matched item most of the studies used CSA (Piazza et al., 2000) or a preference assessment (Davis et al., 2013; Higbee et al., 2005) with items that they hypothesized provided the same sensory input as the problem behavior. Two studies predicted the reinforcing sensory input based on the problem behavior, specifically auditory stimulation for vocal stereotypy (Rapp, 2007) and edible items for mouthing (Lanovaz & Argumedes, 2010). The limitation of these studies is that there was no objective measurement conducted to determine the sensory input of problem behavior and thus the label of ‘matched’ was arbitrary.

Two of the coded studies attempted an objective evaluation of the sensory input provided by the participants’ problem behavior (Britton et al., 2002; Slocum et al., 2020). Britton et al., 2002 used a sensory class analysis with each participant to determine the preferred sensory input. A limitation in Britton et al., (2002) was that after the analysis the items were assigned based on

preference assessment results. For example, Brain's engagement in repetitive hand movements were maintained by visual stimulation and his assigned matched item was a supersonic space ball identified by a multiple stimulus preference assessment. Britton et al., (2002)'s study was a step toward analyzing sensory input; however, it still failed to provide a way to objectively identify if an item was matched to that input. Slocum et al., (2020) conducted their sensory analysis differently for their two participants that engaged in handclapping. They evaluated sources of sensory input (visual, auditory, and tactile) for both reinforcing qualities (e.g., exposure to hand clapping audio) as well as extinction qualities (e.g., noise cancelling headphones). The researchers evaluated each sensory stimulation's impact on handclapping in an alternating treatment design and compared it to an alone condition. For both participants, the researchers hypothesized a tactile item (vibrating hand massager) matched the sensory input of handclapping. Inconsistent with this hypothesis was the that the extinction (shock absorbent glove) evaluation for the tactile stimulation did not have an impact on handclapping. The authors concluded that either the hand massager was preferred over handclapping but was not an actual match or the gloves failed to provide extinction.

The results of the literature review also confirm that there is a lack of research involving the reduction of reinforcement (i.e., schedule thinning) following NCR treatment for automatically reinforced behaviors. Only two of the 22 studies attempted to thin the schedule of reinforcement following NCR treatment success. While Ward and Higbee (2008) were able to thin the schedule of NCR from 2 min to 3 min, they used an AB approach which failed to demonstrate experimental control. Unlike the other studies in the review, Slocum et al. (2020) provided a systematic procedure for thinning the schedule of NCR. They used a multiple

schedule with colored cards to show the participant when reinforcement was and was not available. Then they gradually increased the amount of time the reinforcer was not available. If handclapping returned at high rates during a session, they would return to the last successful session's schedule. Slocum et al. (2020) provided an example of the practical problem faced by behavior analysts when using NCR to treat automatically maintained behaviors. NCR is often a successful treatment but when the reinforcement interval is thinned, problem behavior may quickly return.

Rapp (2007) argued that NCR studies have been limited in that researchers often do not evaluate the change in behavior that occurs when matched or unmatched stimuli are removed following treatment. The purpose of this study is to evaluate matched and unmatched competing stimuli in the context of non-clinically relevant behavior because matched stimuli may impact the value of the automatic reinforcer and result in a longer latency when compared to unmatched stimuli. This information would provide proof of concept related to the utility of matched stimuli in NCR and may provide a starting point to conduct more in-depth research on systematic schedule thinning in the context of NCR as an intervention for automatically maintained problem behavior. This study will focus on non-clinically relevant behavior because the risks involved in removing the sensory stimulation provided in NCR is that it could result in an increase in automatic problem behavior. To minimize risk, the current study will evaluate this concept with a non-clinically relevant behavior.

Table 1

Published studies on NCR treatments for automatically maintained problem behavior

Citation	N	Diagnosis	Topography	Setting	Research Design
Berg et al., (2016)	1 male Age 20 or older	Multiple	SIB	Clinic	Reversal
Britton et al., (2002)	2 males 1 female Age all 20 or older	Multiple	Motor stereotypy	Day program	Reversal
Clay et al., (2018)	1 female Age 11-15	Multiple	SIB	Clinic	ATD
Davis et al., (2013)	1 male Age 6-10	Autism	SIB	School	ATD/Reversal
Deleon et al., (2000)	1 female Age 11-15	Multiple	SIB	Clinic	Reversal

DeLeon et al., (2005)	2 males Age all 6-10	Multiple	Motor stereotypy/pica	In patient unit	Reversal
Dozier et al., (2013)	3 males Age not reported	ID	Motor stereotypy	Not reported	Reversal
Higbee et al., 2005	1 male Age 11-15	None	Motor stereotypy	Home	Reversal
Lindberg et al., (2003)	1 male 2 females Age all 20 or older	ID	SIB	Day program	Reversal
Piazza, et la., (1998)	1 female Age 5 or under	Multiple	Pica	Clinic	ATD/Reversal
Piazza, et al., (2000)	2 males 1 female Age 6-10, 6-10, and 15-19	Multiple/ID	Motor stereotypy/SIB	In patient unit	ATD/Reversal

Rapp (2007)	2 males Ages all 6-10	Multiple	Vocal stereotypy	Residential Facility	Reversal
Rispoli, et al., (2018)	3 males Age all 6-10	Autism	Vocal stereotypy	Clinic	Reversal
Ringdahl et al., 1997	2 males 1 female Ages 5 or under	Unspecified DD	Duration of on task behavior	Classroom	Reversal
Roane, et al., (2003)	1 male Age 6-10	Multiple	Object mouthing	Day program	MB
Rosales et al., (2010)	2 males 2 females Age 20 or older; 6-10	Multiple	SIB	Residential Facility	ATD/Reversal

Roscoe et al., (1998)	2 males 1 female Age 20 or older	ID	SIB	Residential Facility	MB
Roscoe et al., (2013)	5 males 9 females Age unspecified	ID	SIB	Unspecified	MB

CHAPTER 3

METHOD

General Method

The current study focused on the non-clinically relevant behavior of stimulus engagement, with stimuli selected via a free operant preference assessment. For each participant, engagement with a specific preferred stimulus was labeled as "analogous problem behavior." Engagement with this stimulus served as an analogue to engagement in automatically maintained problem behavior (hereafter referred to as "analogous problem behavior"). This study consisted of two experiments. Experiment 1 was designed to evaluate the effects of NCR that incorporated matched or unmatched stimuli on participants' subsequent relapse of analogous problem behavior in terms of latency. Specifically, Experiment 1 sought to evaluate latency to relapse of analogous problem behavior as a function of stimulus type during NCR. Experiment 2 evaluated the effects of presession exposure to matched or unmatched items on participants' subsequent analogous problem behavior. Specifically, Experiment 2 evaluated overall engagement in analogous problem behavior as a function of stimulus type during exposure and latency to engagement in analogous problem behavior

Dependent Variables

Item engagement, which was defined as the participant touching the specified item with one or both hands, was a dependent variable measured across both experiments. The researcher collected duration data on item engagement and reported this data as percentage of session time.

Latency to the first re-emergence of analogous problem behavior was an additional dependent variable planned for both experiments. However, it was only able to be measured during Experiment 2. Latency was defined as the time between the presentation of the item needed for analogous problem behavior, following termination of presession exposure to a matched or unmatched stimulus, and the participant's engagement with it. Latency was reported in seconds.

Interobserver Data Collection and Procedural Fidelity

Two independent observers collected data throughout the study using the mobile app Countee (Design & Hernandez, 2020). Researchers used Countee to record data during the free operant preference assessment, competing stimulus assessment, and all experimental sessions (baseline, NCR, pre-exposure, and post-exposure). Observers collected data using pen and paper during the relative preference assessment. The first author served as Observer 1, primary data collector and collected data as the session occurred. A master level graduate student served as Observer 2 and collected data from videos of the sessions. Observer 2 recorded data for the purpose of calculating interobserver agreement (IOA) during at least 30% of sessions in each condition across participants. For duration measures, duration-per-interval agreement was calculated by dividing the smaller duration by the larger duration for each 10-s interval, obtaining the average across intervals, then multiplying by 100%. The agreement between Observer 1 and Observer 2 for duration measures ranged from 87.5% to 100% for Conner, 91 to 100% for Amelia, and 86% to 100% for Greg. Latency IOA was calculated by dividing the shorter latency (in seconds) by the longer latency. IOA for latency measures averaged 96% for Conner, 88% for Amelia, and 99% for Greg. IOA percentages are presented in Table 1.

Observer 2 also collected procedural fidelity data using pen and paper on the first author's behavior when conducting sessions from video recordings. Each session type had a

checklist of steps that the researcher needed to complete to maintain procedural fidelity (See Appendix). Observer 2 completed the checklists for at least 30% for each session type across participants. Procedural fidelity across all sessions of all conditions was 100%.

Pre-Experimental Assessments

Free Operant

The researcher conducted two free operant assessments (Roane et al., 1998) with each participant to identify a preferred item to serve as analogous problem behavior. Before the session began, the participant was allowed to sample each item. The researcher allowed free access to five toys, which were selected based on parent report of the participant's preferred items. The following toys were included in the assessment: cars with a garage, dolls with doll house, or dragons (dependent on participant), Lego blocks, Play-Doh, and a music toy. During the assessment, the researcher collected duration of item engagement for 5 mins and reported these data as percentage of session. The item with the highest rate of engagement was selected as analogous problem behavior for each participant.

Competing Stimulus Assessment

Selection of Matched and Unmatched Items. The researcher selected matched items for the CSA by methods described by (Piazza et al., 2000). The researcher hypothesized the sensory input provided by the participant's analogous problem behavior and selected potential matched items that would provide similar sensory input. The following items were tested as competing matched items for Conner's engagement with Lego blocks: Playmobil blocks and magnets. The following items were tested as competing matched items for Amelia's engagement with Play-Doh: clay and kinetic sand. The following items were tested as competing matched items for Greg's engagement with cars with a garage: train, animals with barn, and house with furniture.

The researcher selected unmatched items for the CSA based upon parent and participant's report of preferred items. The researcher selected items hypothesized to provide different sensory input than that provided by the participant's analogous problem behavior. For Conner, the following were tested as unmatched competing items for engagement with analogous problem behavior (Lego blocks): coloring, cars, sensory toys, Nerf gun and targets, and slime. For Amelia, the following items were tested as unmatched competing items for engagement in analogous problem behavior (Play-Doh): magnets, puzzle, and barn animals. For Greg, the following items were tested as unmatched competing items for engagement in analogous problem behavior (cars and a garage): coloring, clinging orbs, keyboard, sink toy, kinetic sand, and water table.

CSA Procedure. The researcher conducted CSAs to identify stimuli that competed with the analogous problem behavior. The CSA procedure was similar to the procedure described by Piazza et al. (1998). To reduce the impact of novelty on assessment outcomes, the researcher allowed the participant to sample each item singly for 5 s prior to start of the CSA trial. In the CSA control condition, the researcher provided the participant access to the analogous problem behavior. In each trial after the control condition, the researcher allowed access to one matched or unmatched item, along with the item needed for analogous problem behavior. The observers recorded duration data of item engagement with the potential competing item and engagement in analogous problem behavior for 2 min. The researcher defined item engagement, as one or both hands touching the item. The data were reported as percentage of the session. The researcher conducted this assessment once with unmatched items and then again with hypothesized matched items to identify an item that competed with analogous problem behavior. The researcher selected items that resulted in the most item engagement and least analogous problem behavior

for NCR treatment conditions. If multiple unmatched items showed similar rates of engagement during the CSA, the researcher allowed the participant to choose from among these items by asking would you rather play with X or Y?

Relative Preference Assessment

Once identified, the researcher evaluated the participants' relative preference among the two identified competing stimuli using repeated paired choice presentations (Fisher et al., 1992). This preference assessment between the matched and unmatched items was conducted because the researcher hypothesized that the participant's exposure to the matched stimuli would result in longer latencies to re-engagement in the analogous problem behavior. The assessment was conducted to assure that differences in analogous problem relapse behavior were a function of stimulus match, rather than stimulus preference. If the participant showed a higher preference for the unmatched item or a similar preference between the items, then the assessment ended. But if the participant's selection favored the matched item, then a second unmatched item was assessed.

The researcher presented the unmatched and matched competing items simultaneously and asked the participant to "pick one." Following selection, the researcher provided access to the selected item for 30 s. Items compared in this assessment included slime and NERF gun (unmatched) and Playmobil blocks (matched; Connor), puzzle and magnets (unmatched) and clay (matched; Amelia) and sink toy and water table (unmatched) and train (matched; Greg). The researcher continued the assessment until visual analysis suggested that the participant's preference was similar for the two items or that the unmatched item was more preferred.

Experiment 1: NCR Evaluation

Participants and Setting

Two children, given the pseudonyms of Amelia (age 3) and Conner (age 6), participated in Experiment 1. Their parents reported that they were neurotypical, and both attended an age-appropriate educational setting. Amelia attended a daycare preschool program and Conner attended kindergarten full time. The researcher conducted the sessions individually once a week with each participant in a 14.9 m^2 therapy room located in a behavior clinic for 60-min sessions with Amelia and for 30-min sessions with Conner. The room contained the toys needed for that session, a child size table and chair, as well as a rolling office chair for the researcher.

Design and Procedures

The researcher used a multi-element design with an initial baseline phase (Cooper et al., 2020). The researcher conducted five baseline sessions for both participants, then introduced analogous matched and unmatched NCR treatment conditions using an alternating treatments design. Conditions were alternated in a randomized order (with no more than two of the same session consecutively).

Baseline

During baseline, the participant had access to analogous problem behavior. The researcher did not play with the participant. Thus, there was no programmed social contingency in place for the analogous problem behavior. If the participant asked the researcher to play, she made a statement such as “I can’t play with you now. I must finish this work on my phone. When I’m done, I can play.”

NCR

The researcher implemented NCR across two conditions: NCR unmatched and NCR matched. The researcher alternated conditions in a randomized order (with no more than two of the same session consecutively), for example, ABAABABBA (where A = matched/unmatched and B = unmatched/matched). During the NCR unmatched condition, the participant had noncontingent access to analogous problem behavior and the unmatched item. During the NCR matched condition, the participant had noncontingent access to analogous problem behavior and the matched item. There were no programmed social contingencies for analogous problem behavior. However, the researcher did provide ongoing attention noncontingently throughout these sessions by making comments or asking about the holidays. The researcher continued to use the statement stated in baseline when participants asked her to play with the items with them. The observers collected duration data on analogous problem behavior and item engagement with the competing stimuli.

The results of Experiment 1 (presented in Chapter 4) precluded the ability to investigate the latency with which analogous problem behavior would return after exposure to matched and unmatched stimuli. Specifically, exposure to the two NCR conditions did not result in a reduction in analogous problem behavior. Thus, its relapse could not be measured. To address this limitation, Experiment 2 arranged exposure to the two stimulus types in the absence of the analogous problem behavior. Following exposure to the matched or unmatched stimulus, overall engagement in analogous problem behavior as well as latency to engagement, during a 5-min observation, was measured.

Experiment 2: Presession Exposure Evaluation

Participants and Setting

Participants from Experiment 1 also participated in Experiment 2, along with a third participant, Greg (age 3). Greg's parents described his development as neurotypical, and he attended a half-day preschool program. Amelia and Conner's session continued to occur in the same room. Greg's weekly sessions were 30 min in duration and were conducted in a 14.9 m^2 therapy room in the behavior clinic. Greg's therapy room contained a bookshelf located in the corner of the room where the researcher would place toys out of Greg's reach when they were unavailable.

Baseline

The researcher conducted baseline procedures as described from Experiment 1 with Greg.

Latency to Analogous Problem Behavior

The researcher conducted a two-component session lasting up to 15 min in duration. The first component consisted of presession exposure which included giving the participant access to the matched or unmatched stimulus for 10 min, or until the participant indicated they were done. This component was followed by a 5-min post exposure observation with the analogous problem behavior available along with two moderately preferred stimuli. Observers recorded engagement in analogous problem behavior duration until the session ended as well as latency to the first re-emergence of engagement.

Table 2

Percent of sessions with IOA and average IOA

Participant	Session Type	% Of Sessions IOA was Collected	Average % of IOA Agreement (PB = analogous problem behavior; Mod toy = moderate toy)
Conner	FO	50	99.69
	Paired Choice	50	100
	CSA	37	PB: 95.1; Other item: 95.8
	Baseline	40	99.82
	Experiment 1	33	PB: 97.9 Competing item: 99.84
	Experiment 2	40	PB: 99.03; Mod toy: 97.51; Latency: 96.16
Amelia	FO	50	99.85
	Paired Choice	50	100
	CSA	100	PB: 98.6; Other item: 97.59
	Baseline	40	99.28
	Experiment 1	60	PB: 95.85; Competing item: 92.23
	Experiment 2	50	PB: 97.38; Mod toy: 94.85; Latency: 88.89
Greg	FO	50	96.49
	Paired Choice	50	100
	CSA	30	PB:96.6; Other item: 90.60
	Baseline	40	PB: 91.11
	Experiment 2	33	PB: 96.29; Mod toy: 95.31; Latency: 99

CHAPTER 4

RESULTS

Pre-Experimental Assessments

Free Operant

Figures 1-3 display the results of the free operant assessments for each participant. Conner engaged with dragons 6.7%, and Lego blocks 99.3% of the session time. He did not engage with the other items. During the assessment, Conner pretended the dragons were fighting each other and he built structures with the Legos. The researcher selected engagement with Lego blocks as Conner's analogous problem behavior. Amelia played with Play-Doh for 99% and with cars for 3.7% of the session time. She did not engage with the other items. During play, she created animals out of the playdoh and pushed the cars on a ramp. The researcher selected engagement with Play-Doh as Amelia's analogous problem behavior. During the free operant assessment Greg engaged with cars for 75.7%, dragons for 4%, Lego blocks for 5%, and the musical toy for 5.3% of the session time. He did not engage with Play-Doh. During play, Greg pushed the cars on the ramp, built houses with the Legos and spun the musical toy.

A second free operant assessment was conducted with each participant which resulted in the same preferred items for Conner and Amelia. Greg engaged with Lego blocks for a greater percentage of the session time during his second free operant assessment. However, because Lego blocks were difficult for him to take apart and Greg had engaged in cars at a higher rate in the previous free operant assessment the researcher selected engagement with cars as Greg's analogous problem behavior.

Competing stimulus assessment

During the control condition of the CSA, Conner engaged in analogous problem behavior for 93.3% of the session time. He engaged in the lowest rates of analogous problem behavior and the highest rates of engagement with cars, slime and the Nerf gun. During the control condition, Amelia engaged in analogous problem behavior for 99.2% of the session time. She engaged in lower percentages of analogous problem behavior and the highest percentages of engagement with magnets, puzzle, barn animals, and clay. Greg engaged in analogous problem behavior for 94.2% of the session time during the CSA control condition. Across the CSA, he engaged with the train and the water table for higher percentages of the session time and engaged in the least amount of analogous problem behavior when these items were present. Figures 4-6 display the CSA results for each participant.

Relative Preference Assessment

The researcher conducted a paired choice assessment between matched and unmatched items with each participant. The paired choice assessment continued until items with similar preferences were identified or until the participant demonstrated a greater preference for the unmatched item. In each paired choice assessment, the participant's matched item stayed the same and unmatched stimuli were changed to identify the specific one to incorporate into Experiments 1 and 2.

During the first paired choice assessment, Conner selected the Playmobil blocks (matched) for 10 out of 10 opportunities and never selected the slime (unmatched). In the paired choice assessment between the Playmobil blocks (matched) and a Nerf gun (unmatched), Conner selected the Nerf gun for 9 out of 10 opportunities. The researcher selected the Nerf gun as Conner's unmatched item.

Amelia preferred clay (matched) over the puzzle (unmatched) and selected it 6 of 10 opportunities. When clay and magnets (unmatched) were presented, Amelia selected each item 50% of 10 opportunities. The researcher selected magnets as Amelia's unmatched item.

The paired choice assessment for Greg identified the train as high preferred relative to the sink (7 selections versus 3, respectively). In the second assessment, Greg showed a higher preference for the unmatched item of water table selecting it 9 times and the matched train, 1 time out of 10 opportunities. The researcher selected the water table as Greg's unmatched item.

Experiment 1: NCR Evaluation Results

The first top panels of Figures 7 and 8 display the results of Experiment 1 for Conner and Amelia, respectively. Specifically, data for Experiment 1 are presented in the first two phases (Baseline and NCR) for each participant. During Baseline, both participants engaged in high levels analogous problem behavior (Conner *M* = 99.1% of session time) and Amelia (*M*= 99.5% of session time). During NCR, both participants continued to engage in analogous problem behavior, regardless of whether matched or unmatched competing stimuli were present. Conner engaged in analogous problem behavior an average of 85.9% (58.3% – 99.7%) and with the matched item an average of 13.6% (0% – 40.7%) of the session time during NCR matched. During NCR unmatched, Conner engaged in analogous problem behavior an average of 81.8% (68.7% – 99.7) and with the unmatched item an average of 18.2% (4.7% – 31%) of the session time. Amelia engaged in analogous problem behavior an average of 79.3% (45% – 99.7%) and with the matched item an average of 28% (0% – 88%) of the session time during NCR matched. During NCR unmatched, Amelia engaged in analogous problem behavior an average of 82.7% (25% – 100%) and with the unmatched item an average of 22.5% (0% – 88.3%) of the session time.

Experiment 1: Discussion

For both participants, the results indicated NCR did not result in enough of a reduction in engagement in analogous problem behavior, regardless of competing stimulus type (matched or unmatched), to measure latency to relapse. Both participants continued to engage in high levels of analogous problem behavior even when competing items were present. Because NCR did not result in participants allocating responding to the matched or unmatched items, the experimental question related to how engagement with matched and unmatched stimuli impacted relapse of analogous problem behavior could not be answered, as analogous problem behavior did not appreciably reduce. Experiment 2 was designed to arrange exposure to matched and unmatched stimuli in the absence of the analogous problem behavior to compare their impacts on re-emergence of that behavior.

Experiment 2: Presession Exposure Evaluation Results

During Baseline, Greg engaged in analogous problem behavior during an average 88.8% (range, 70.7%–95.7%) of the session time (See Figure 9).

Figures 7-9 display the results of Experiment 2 for Conner, Amelia, and Greg, respectively. During presession exposure (middle panels), Conner engaged with the matched item an average of 59.3% (51.4%–67.6%) of the session. During the unmatched sessions, Conner engaged with the unmatched item an average of 54.3% (46.1%–69%) of the session. During matched sessions, Amelia engaged with the matched item an average of 66.7% (65.9%–67.3%) of the session. During the unmatched sessions, Amelia engaged with the item an average of 52.6% (23.1%–70%) of the session time. During matched sessions, Greg engaged with the matched item an average of 64.9% (59.5%–68.3%) of the session time. During the unmatched sessions, Greg engaged with the unmatched item an average of 55.6% (46.9%–64.3%) of the

session time. Of note, exposure components were ended early with Conner on sessions 5 through 10 due to a lack of interaction. Similarly, exposure components were ended early with Greg on sessions 4 through 6 due to lack of interaction.

The bottom panel of Figures 7-9 displays the latency to recurrence of analogous problem behavior. Conner's latency to engagement in analogous problem behavior after matched exposure averaged 161.4 s (7s–292s), latency after unmatched exposure resulted in an average of 195 s (7s–300s). Amelia's latency to engagement after matched exposure averaged 82.5 s (3s–284s), latency after unmatched exposure resulted in an average of 156.75 s (18s–288s). Greg's latency to analogous problem behavior after matched exposure averaged 88 s, latency after unmatched exposure resulted in an average of 84 s (55.5s–64.3s)

Finally, the right section of the top panel of Figures 7-9 displays the overall level of analogous problem behavior during the 5-min post exposure components conducted during Experiment 2. Conner engaged in analogous problem behavior an average of 11.24% (0%–40.6%) of session after exposure to the matched item and an average of 5.88% (0%–21.6%) after exposure to the unmatched item. Amelia engaged in analogous problem behavior an average of 20.6% (0%–27.3%) of the session time after exposure to the matched item and an average of 13.5% (0%–29.2%) after exposure the unmatched item. Greg engaged in analogous problem behavior an average of 10% (6.8%–12.2%) of the session time following exposure to the matched item and an average of 24.6% (19.9%–32.8%) of the session time after exposure to the unmatched item.

Figure 1

Free Operant Preference Assessment Results for Conner

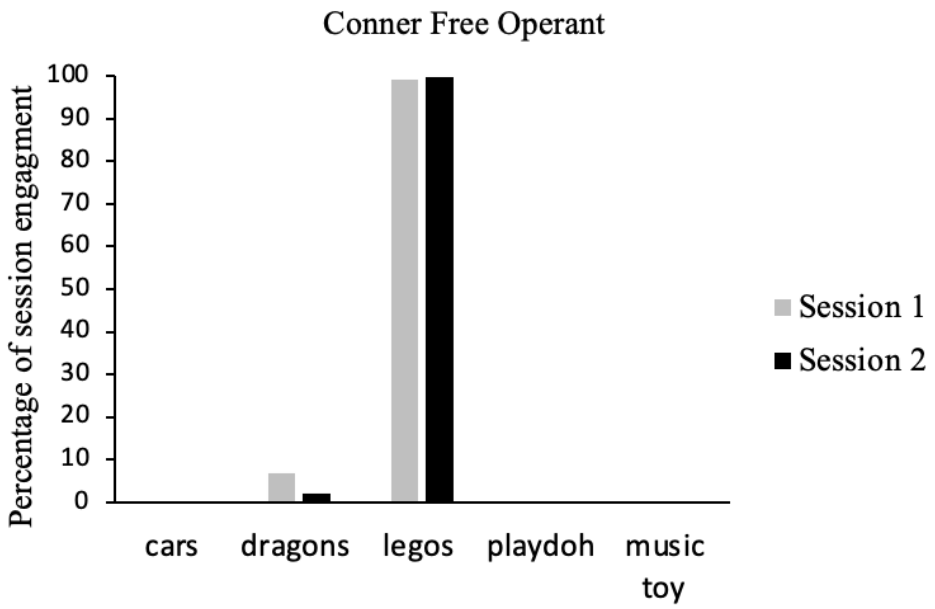


Figure 2

Free Operant Preference Assessment Results for Amelia

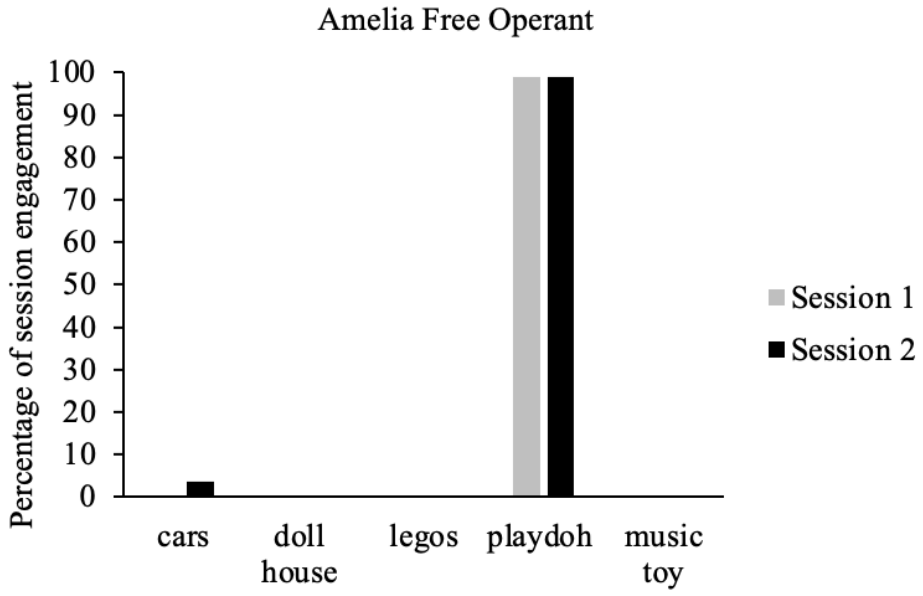


Figure 3

Free Operant Preference Assessment Results for Greg

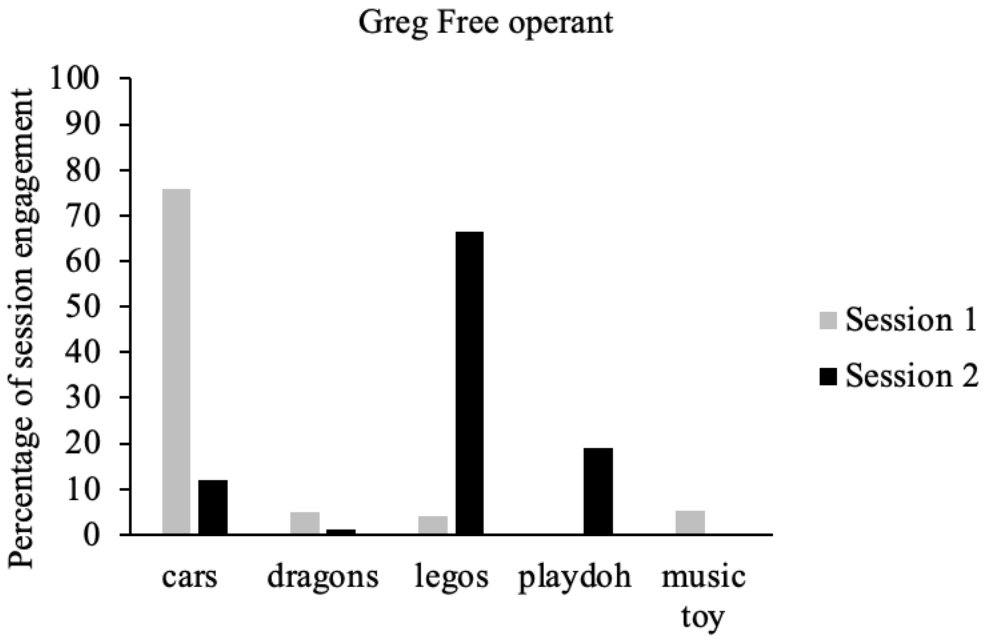


Figure 4

Competing Stimulus Assessment Results for Conner

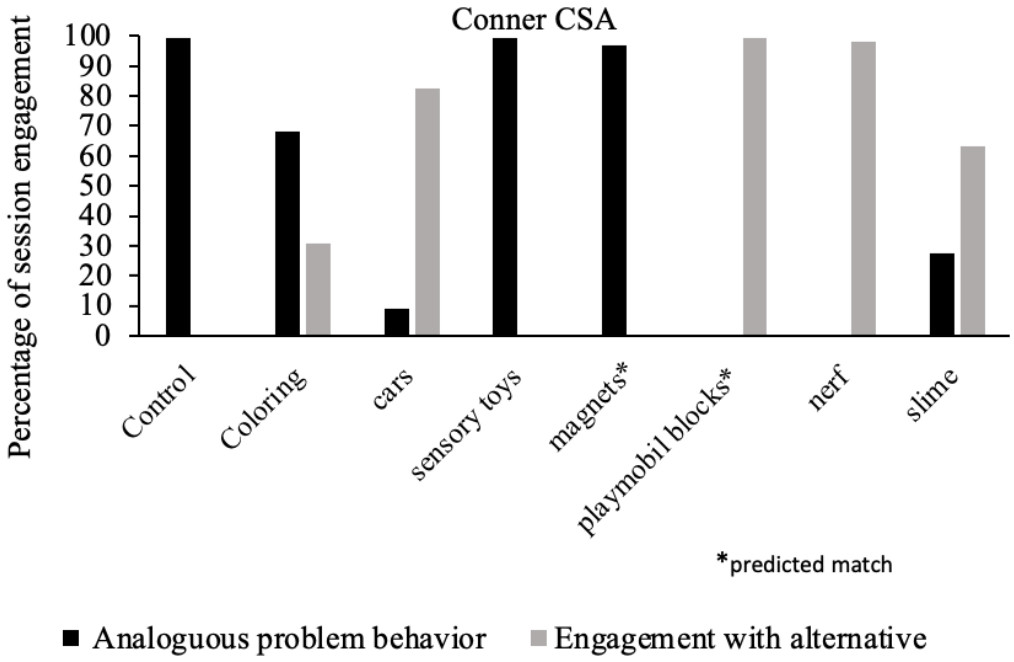


Figure 5

Competing Stimulus Assessment Results for Amelia

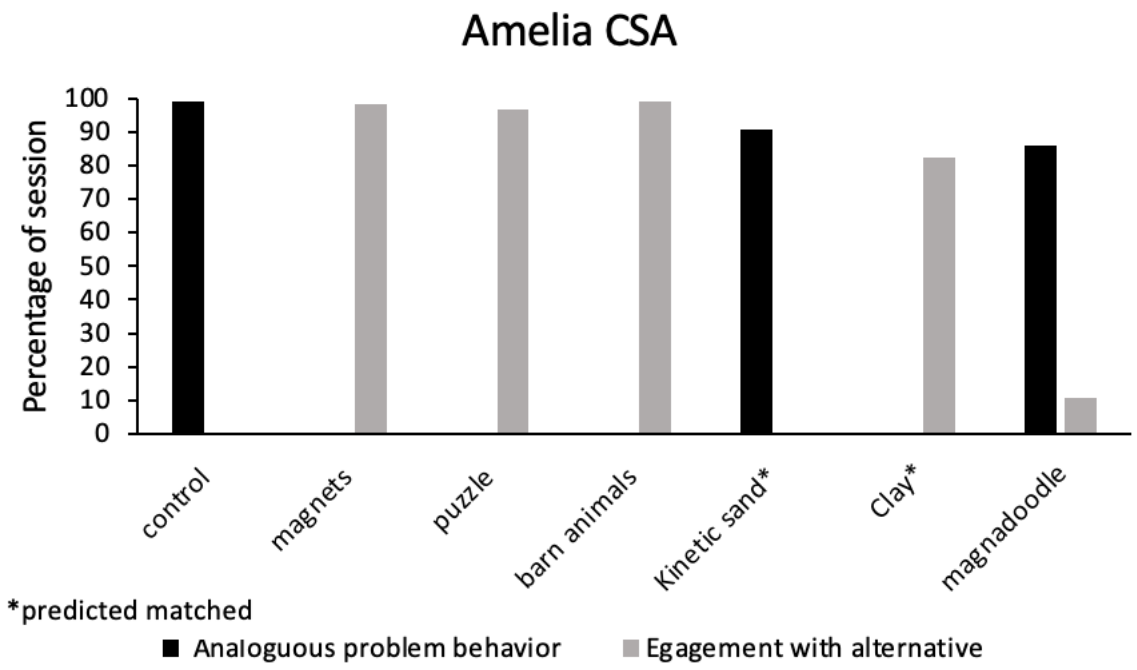


Figure 6

Competing Stimulus Assessment Results for Greg

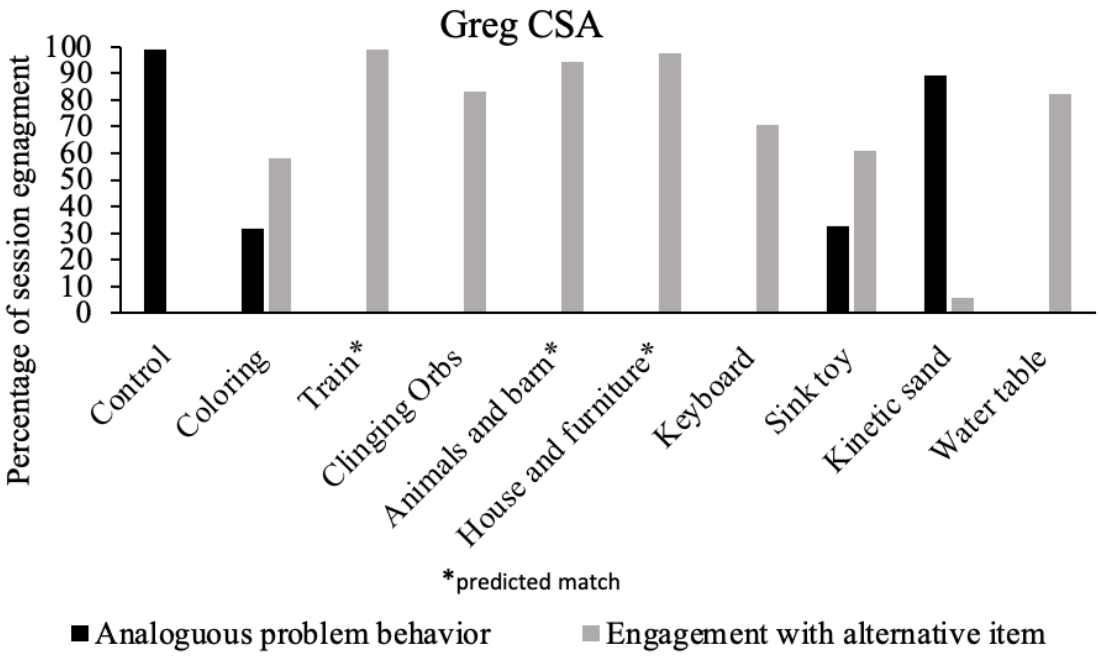


Figure 7

Experiment 1 and 2 Results for Conner

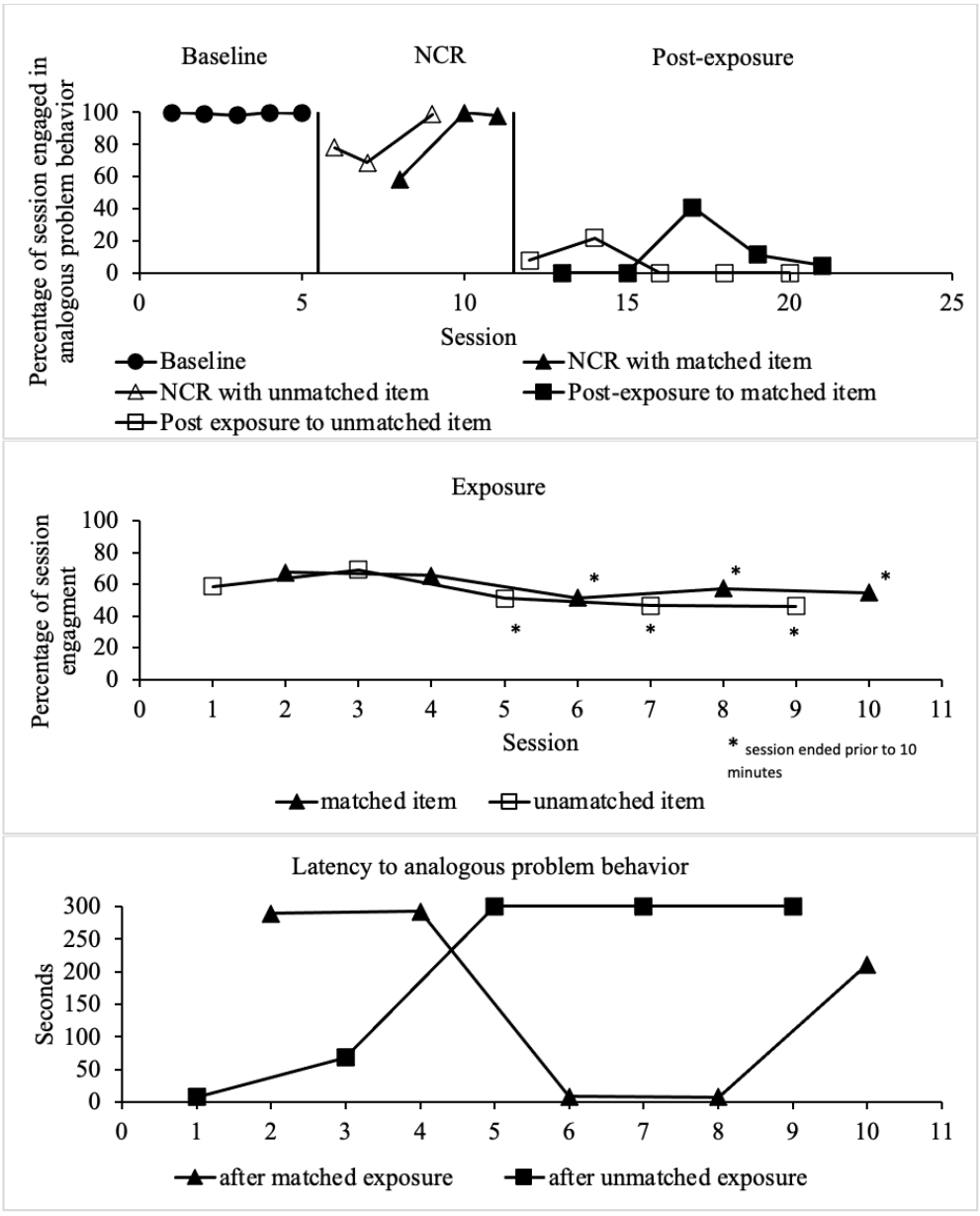


Figure 8

Experiment 1 and 2 Results for Amelia

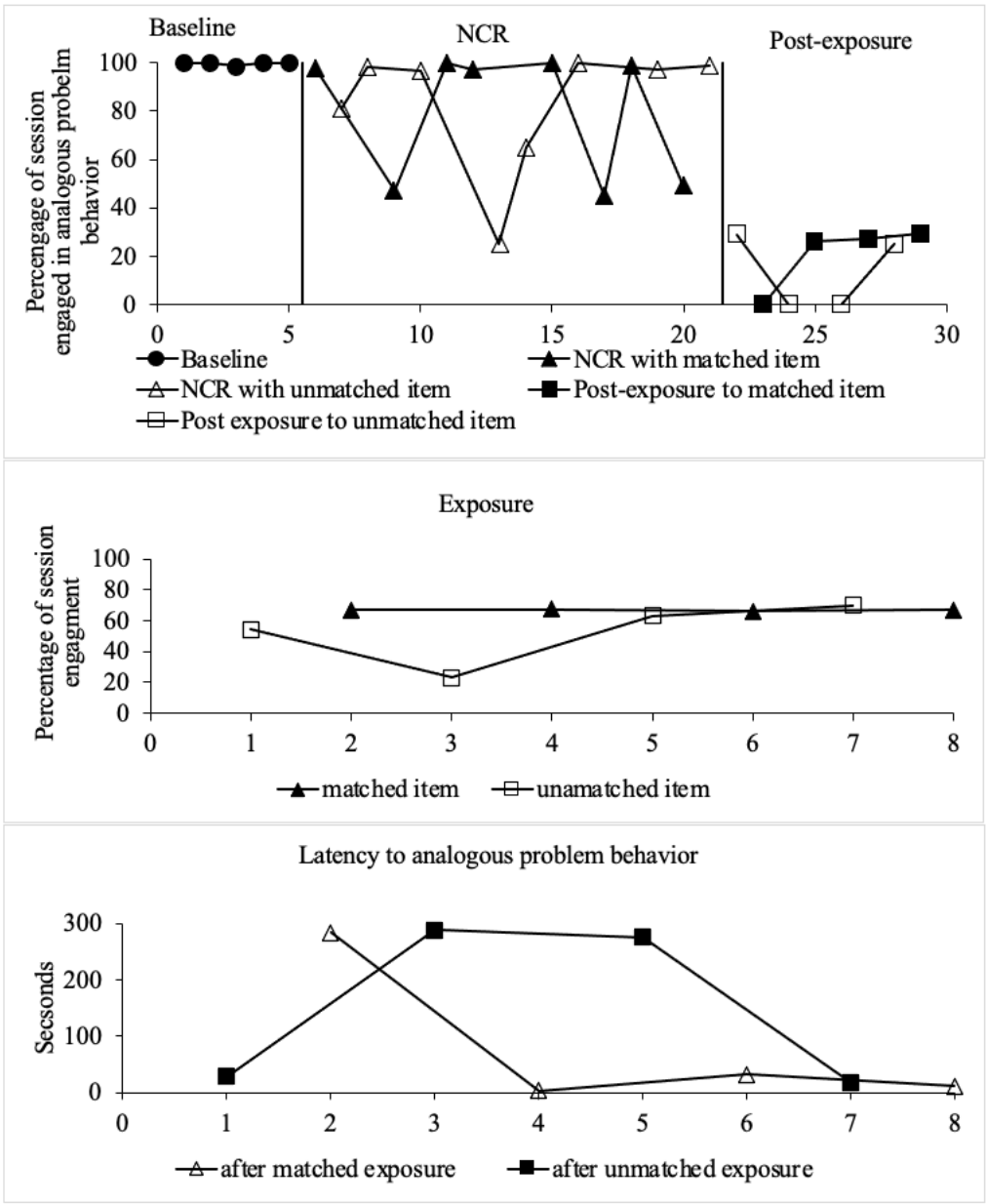
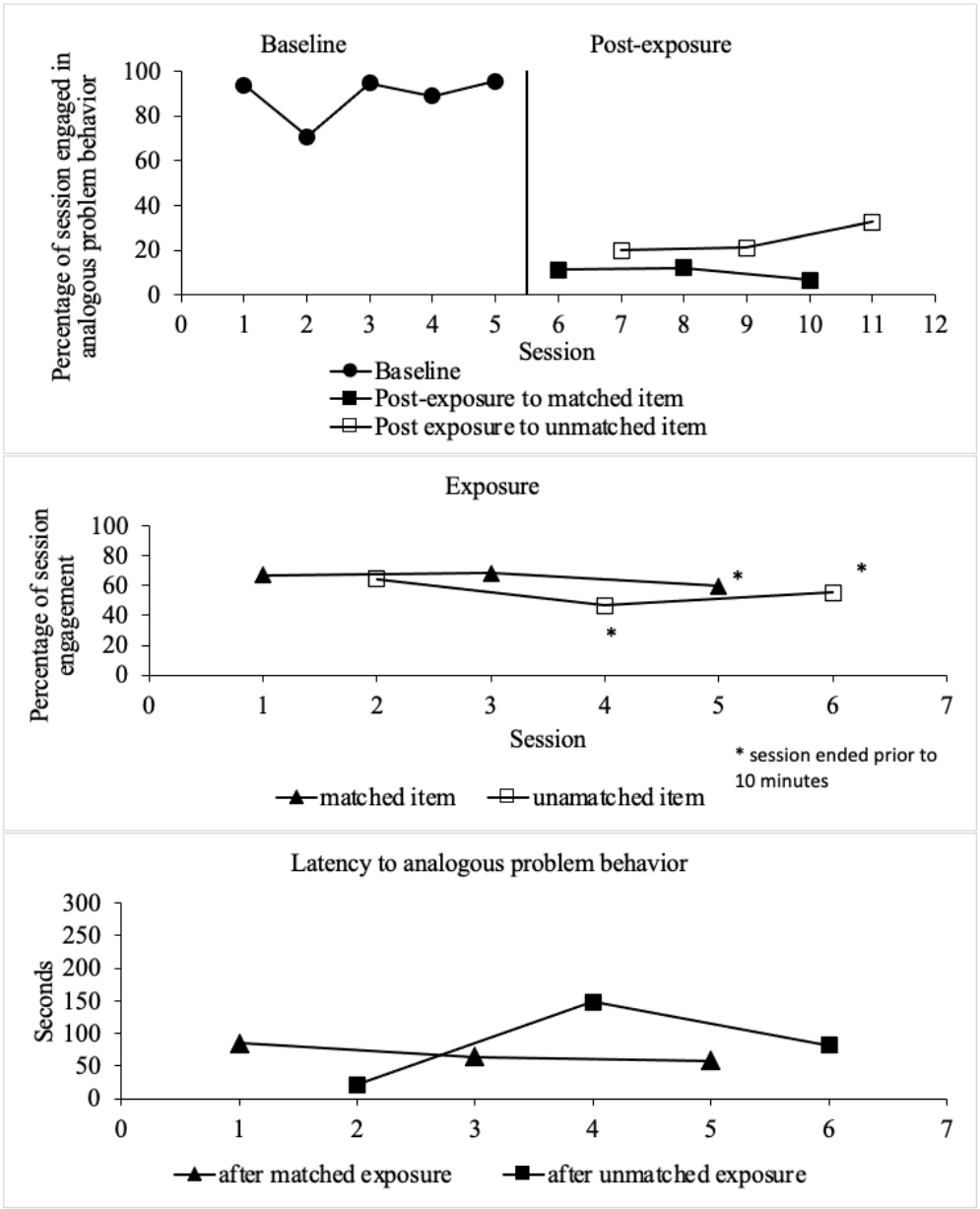


Figure 9

Experiment 2 Results for Greg



Chapter 5: Discussion

The current study evaluated the impact of putatively matched and unmatched competing stimuli on three participants' non-clinically relevant stimulus engagement. The overall goal of the study was to provide information on how competing stimuli (based on the outcome of a CSA) of different types impacted re-emergence of analogous problem behavior (as represented by engagement with a preferred item). The researcher predicted that engagement with matched stimuli would lead to decreased engagement in analogous problem behavior, potentially brought about because engagement with matched stimuli momentarily decreases the value of the automatic reinforcer maintaining analogous problem behavior. This change in value would then impact engagement in analogous problem behavior and result in longer latencies to re-emergence when compared to levels of analogous problem behavior following noncontingent access to unmatched stimuli. That is, engagement with the matched stimulus was predicted to function as an abolishing operation. During Experiment 1, the goal was to measure latency to recurrence of analogous problem behavior following NCR sessions that included either matched or unmatched stimuli. During Experiment 2, the goal was to measure both latency and subsequent engagement in analogous problem behavior following exposure to matched and unmatched stimuli in a restricted operant arrangement.

Experiment 1 failed to replicate the predictive validity of a CSA in this proof-of-concept experiment focused on a non-clinically relevant behavior. The CSA results identified matched and unmatched items that competed with Conner's and Amelia's engagement in analogous problem behavior. However, during the subsequent NCR evaluation, neither item competed with

either participant's analogous problem behavior. Thus, the goals of Experiment 1 related to latency to recurrence could not be pursued. One potential reason for this failure to replicate was that the experiment did not address problem behavior maintained by automatic reinforcement. In their review on CSAs, Haddock and Hagopian (2020) evaluated CSA predictive validity and found that for 12 of 19 comparisons, the engagement rates during intervention were consistent with the rates observed during the CSA. However, these results were only obtained in the context of intervention for problem behavior. Thus, the generality of findings to non-problematic behavior such as item engagement is unknown. Haddock and Hagopian (2020) also concluded that, while the CSAs reviewed demonstrated high predictive validity, they could not control for publication basis as a variable contributing to their findings. It is possible that the findings obtained in Experiment 1 (i.e., lack of correspondence between CSA and subsequent NCR outcomes) is one that is frequently obtained in research and practice, but infrequently disseminated because researchers do not pursue publication of, and journals rarely publish, negative findings unless they identify a subsequent treatment success (Sham & Smith, 2014; Tincani & Travers, 2019).

Experiment 1 did not result in reductions in analogous problem behavior during NCR, eliminating the ability to evaluate subsequent relapse of that behavior. Thus, Experiment 2 evaluated whether presession exposure to matched or unmatched stimuli in a restricted operant arrangement would differentially affect latency to and overall engagement in analogous problem behavior. The results of Experiment 2 indicated that exposure to matched or unmatched items resulted in lower subsequent engagement in analogous problem behavior when compared to baseline. However, the exposure did not show consistent differences in latency to engagement.

All three participants showed reductions in analogous problem behavior after exposure to both matched and unmatched items. No differential effects were noted for Conner. That is, reductions in analogous problem behavior were similar regardless of stimulus type included during exposure. Amelia engaged in less analogous problem behavior following exposure to the unmatched item, relative to the matched item. Greg engaged in less analogous problem behavior following exposure to the matched item, relative to the unmatched item. Thus, exposure to the items yielded idiosyncratic outcomes that might be explained by different mechanisms.

The literature includes at least two examples demonstrating that exposure to maintaining reinforcers fails to reduce engagement in target behavior maintained by that reinforcer. Roantree and Kennedy (2006) conducted a functional analysis (FA) with one participant who engaged in stereotypy. Their results were inconclusive, as the FA resulted in undifferentiated patterns of responding. However, they found that after exposing the participant to presession attention, the FA indicated that the participant's engagement in stereotypy was maintained by attention. For this participant, the presession exposure functioned as an EO rather than an AO for engagement in stereotypy. Chung et al., (2010) found a similar effect when they evaluated presession exposure to different conditions on four participants' subsequent engagement in automatically maintained problem behavior. The four presession conditions were 15 min in duration and consisted of attention, response blocking, attention with response blocking and no-interaction (participant was free to engage in problem behavior). They found that presession exposure to the no-interaction condition functioned as an abolishing operation for half of the participants, and it functioned as an establishing operation for the other half. They concluded that presession conditions may need to be participant specific because what functions as an AO for one participant, may function as an EO for another. In the current study, unlike Roantree & Kennedy

(2006) and Chung et al. (2010), reductions in analogous problem behavior were noted following exposure to stimuli. However, these reductions (a) did not appear to be related to matched or unmatched status, and (b) did not result in zero or near-zero occurrence of the target response, which would be a likely goal of intervention.

Collectively, this study adds to what is known about competing stimuli, intervention success, and the impact of exposure to matched and unmatched stimuli on behavior maintained by automatic reinforcement. While not the contribution that was expected, the findings from Experiment 1 contribute to the literature as they demonstrated that CSA outcomes are not necessarily predictive of NCR success. The findings from Experiment 2 extend the literature by suggesting (1) exposure to matched and unmatched stimuli might beneficially impact overall re-engagement levels; (2) exposure to matched stimuli may not beneficially impact latency to re-engagement.

Limitations

Several identified limitations may have impacted the outcomes and rigor of the study, including participant attrition, lack of replication across participants' outcomes, failure to evaluate satiation, failure to demonstrate experimental control, and lack of a method for validating matched/unmatched items. Related to attrition, Amelia's family was in the process of moving and her mother asked to end her participation after Session 8 of the exposure phase (Experiment 2). Additionally, Greg's participation in sessions began to decline in his last two visits. During his final visit, the researcher attempted to conduct an additional session. After a few minutes, Greg stated he did not want to play. Greg's father offered to continue to bring Greg. However, when asked if he wanted to come back to play with the toys, Greg said no. Thus, these two individuals' participation in the study was shorter than optimal. Continued participation

might have resulted in stability for Amelia's post-exposure data and continued and pronounced differences in Greg's post-exposure data.

A second limitation was a lack of replication across participants. For one participant (Greg) in Experiment 2, the data suggested that exposure to a matched item functioned as an abolishing operation for engagement in analogous problem behavior. However, another participant (Amelia), engaged in lower levels of analogous problem behavior following exposure to the unmatched item. These findings limit experimental control and generality of outcomes, but they suggest the effects of matched and unmatched stimuli on automatically maintained behavior are idiosyncratic and may need to be investigated at the individual level.

A third limitation was that the study did not account for the impacts of satiation. Some participants engaged with the items for the entire presession exposure time, while others stopped engagement sooner, potentially indicating satiation occurred. Rispoli et al. (2014) demonstrated that presession satiation of the hypothesized reinforcer provided by the participant's engagement in automatically maintained stereotypy resulted in a small decrease in engagement in stereotypy for a percentage of 10-s intervals for two participants (Antonio, 18% decreased to 9%; Jeff, 26% decreased to 13%), and a significant decrease for one participant (Joel, decreased from 57% to 13%). Rispoli et al. (2014) used an alternating treatment design and compared participants' engagement in stereotypy following presession exposure (provided access to a matched item) versus no-presession exposure. During presession exposure, each participant was allowed to engage with the putative reinforcer until satiation occurred. Satiation was defined by the researchers as three occurrences of item rejection (walking away, sitting it down, or pushing it away) for 5 s. Rispoli et al. (2014) found that the amount of time it took to reach satiation was participant specific (Antonio ranged from 1 to 15 min; Jeff, 4 to 10 min; Joel, 1 to 25 min). In the

current study, the researcher conducted presession exposure for a duration of up to 10 min. Based on the results of Rispoli et al. (2014), presession exposure should be specific to the participant, rather than an arbitrarily chosen duration.

A fourth limitation was that Experiment 2 only demonstrated the impact of exposure on overall recurrence of analogous problem behavior using an A-B design. Although the alternating treatments component allowed for differential effects based on stimulus type to be identified, the A-B nature of the Experiment did not allow for a demonstration of any functional relation between exposure and subsequent engagement.

A final limitation was that an objective measure was not used to validate whether items were matched, thus the matched items used may not have been a match to the reinforcement provided by analogous problem behavior. The researcher identified the hypothesized tactile sensory input provided by the analogous problem behavior item but did not match items based upon other features such as smell or color. This limitation is common when evaluating the effects of matched items since no objective measures exist (Haddock and Hagopian, 2020). Slocum et al., (2020) attempted to create a sensory analysis assessment that evaluated for both sensory input of matched items as well as extinction of the reinforcer mechanism with limited success. Specifically, they identified potentially matched items by identifying items which competed with engagement in problem behavior. Their method failed to provide an assessment for objectively identifying sources of sensory input since they were unable to extinguish the sensory input provided by the problem behavior. In the current study the researcher identified matched items through methods as described in the literature (Piazza et al., 2013).

Clinical Applications and Future Research

Despite its limitations, this study may have implications for problem behavior maintained by automatic reinforcement. The results for all participants indicated that exposure to both matched and unmatched stimuli resulted in reductions in analogous problem behavior when compared to baseline (albeit in a repeated A-B arrangement). This finding is consistent with Ahearn et al. (2005) which suggested that competing items do not necessarily need to match problem behavior. Additionally, the idiosyncratic findings suggest that individualized assessment and screening should be conducted to determine whether matched or unmatched are used, as some may respond better to one than the other.

Future research should conduct this study within the context of NCR and evaluate participants' responding following the removal of matched and unmatched stimuli. This design would allow for researchers to work toward developing a method for thinning the reinforcement schedule of NCR for automatically maintained problem behavior. Studies such as this are needed as a first step in identifying how researchers can go about developing practical and generalizable interventions for individuals who engage in automatically maintained problem behavior.

Summary and Conclusion

The purpose of this study was to evaluate the concept that exposure to matched items would result in a longer latency to re-emergence of analogous problem behavior; however, no such effect was demonstrated. The results indicated that exposure to matched and unmatched stimuli might beneficially impact overall re-engagement levels. More research is needed to evaluate presession exposure in the context of NCR and determine the impact of re-emergence of automatically maintained problem behavior.

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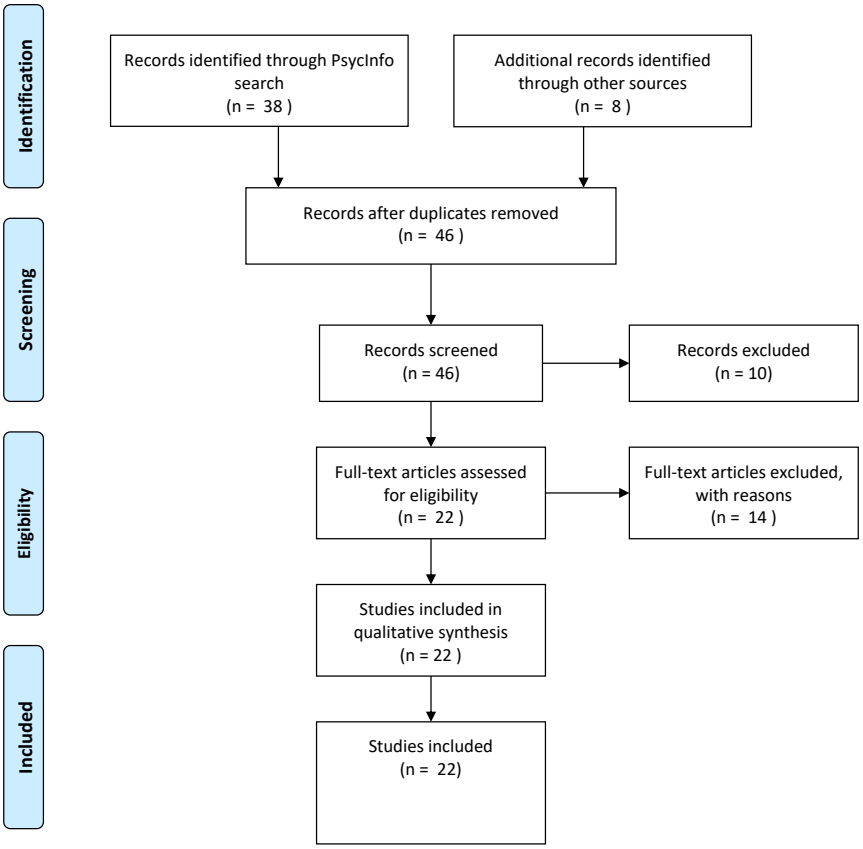
Appendices

Appendix A: PRISMA Flow Chart



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

Appendix B: Procedural Fidelity Checklists

FO Procedural Fidelity Checklist

Free Operant assessment PF	Date: Session:
Researcher allowed participant to sample toy options before collecting data	Yes No
Researcher conducted a full-length session of 5 minutes	Yes No
Researcher allowed noncontingent access to the toys for the duration of the session	Yes No

CSA Procedural Fidelity Checklist

Procedural Fidelity CSA	Date Session
Researcher allowed participant to sample the new toy option before collecting data	Yes No
Researcher conducted a full-length session of 2 minutes	Yes No
Researcher allowed noncontingent access to either set of toys	Yes No
Researcher made a statement that the participant could play	Yes No

Paired Choice Procedural Fidelity Checklist

Procedural Fidelity Paired Choice	Date Session
Did the researcher alternate which side the stimuli were presented on?	Yes No
Did the researcher offer a choice between the two items by making a statement such as “pick one” or “what do you want to play with?”	Yes No
Did the researcher provide access to the selected stimuli?	Yes No

Baseline Procedural Fidelity Checklist

Procedural Fidelity Baseline	Date Session
Did the researcher allow noncontingent access to the analogous problem behavior item	Yes No
Did the researcher make a statement about doing work on her phone prior to the start of the session?	Yes No
Did the researcher ignore analogous problem behavior (no consequence was provided)?	Yes No
Did the researcher collect data for a full 5 minutes?	Yes No

NCR Procedural Fidelity Checklist

Procedural Fidelity NCR	Date Session
Did the researcher allow noncontingent access to the analogous problem behavior item along with the {specify: unmatched or matched} item?	Yes No
Did the researcher make a statement that the student could play?	Yes No
Did the researcher collect data for a full 5 minutes?	Yes No

Latency Evaluation Procedural Fidelity Checklist

Procedural Fidelity Latency Eval	Date Session
Did the researcher allow noncontingent access to the {unmatched or unmatched} item for the first 10 minutes of session (or less if participant stated they no longer wanted to play) prior to the removal?	Yes No it was less than 10 minutes, but more than 5
During the removal of the exposure item, did the researcher remove the item and replace it with the moderately preferred toys {insert items} and analogous problem behavior item {nsert item}?	Yes No
After the toy exchange, did the researcher make a statement that the student could play?	Yes No