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Establishing and Testing Conditioned Reinforcers: Evaluating the Effects of the Discriminative Stimulus Procedure Using Intermittency with Individuals with Developmental Disabilities

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ESTABLISHING AND TESTING CONDITIONED REINFORCERS: EVALUATING THE EFFECTS OF THE DISCRIMINATIVE STIMULUS PROCEDURE USING INTERMITTENCY WITH INDIVIDUALS WITH DEVELOPMENTAL DISABILITIES

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A common characteristic of individuals with developmental disabilities is a restricted range of interest. Developing procedures to establish new reinforcers for such individuals can promote the acquisition of new skills and ameliorate decreases in motivation related to satiation. Several procedures for conditioning reinforcers have shown to be effective in the research literature for establishing neutral stimuli as conditioned reinforcers. Most of this literature is basic research with animal subjects (e.g., rats, pigeons). Few applied studies have directly evaluated the use of these procedures. Additional research is necessary to determine their effectiveness. The purposes of this study were to: (a) evaluate two S^D procedure arrangements in the establishment of discriminative stimuli while adding an intermittency of reinforcement component, (b) and evaluate the reinforcing effects of newly established discriminative stimuli when made contingent upon a response for three adults with developmental disabilities. A concurrent operants model of the S^D procedure was effective for all participants in establishing a neutral stimulus as a discriminative stimulus. In addition, using a multiple baseline across participants within-subject design, the newly conditioned stimulus was successfully used to reinforce and maintain responding for only one out of three participants.

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by

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INTRODUCTION

Limited Range of Reinforcers

A common characteristic of individuals with developmental disabilities is a restricted range of interests (American Psychiatric Association [APA], 2000), that is, individuals having a limited range of effective reinforcers. For example, it is common for some individuals with autism to be motivated to work only for certain types of food items or to only engage with one or two leisure items. This deficit places these individuals at risk for slowed development, because reinforcement is a quintessential element for the development of operant behaviors (Pace, Ivancic, Edwards, Iwata, & Page, 1985). This deficit is also a barrier for caregivers and teachers attempting to engage these individuals in enriching activities or to teach them novel social and functional skills. Finally, if only a limited number of reinforcers are available, a teacher may need to use the same reinforcer repeatedly, and the individual may satiate on that reinforcer (Cooper, Heron, & Heward, 2007). This may lead to a decrease in motivation to learn new skills. Motivation for learning new skills could be significantly greater if currently neutral stimuli could be conditioned as reinforcers.

In recognizing the importance of reinforcement in promoting new responses, investigators have developed various methods for the identification of pre-existing reinforcers for individuals with developmental disabilities (e.g., DeLeon & Iwata, 1996; Fisher et al., 1992; Roane, Vollmer, Ringdahl, & Marcus, 1998). Less applied research has investigated

procedures to establish conditioned reinforcers and how to maintain reinforcing effects with this population. Identifying and developing procedures for establishing a wider range of functional reinforcers for individuals with limited interests could promote effective teaching of new skills and promote autonomy. In order to understand how conditioned reinforcement operates with humans, an understanding of conditioned reinforcement from the perspective of basic science may be helpful.

Conditioned Reinforcement

For a complete discussion of concept of reinforcement, it is necessary to address the concept of conditioned reinforcement. Whereas a primary reinforcer typically relates to a stimulus which increases an organism's rate of responding in and of itself (i.e., without prior associations with another stimulus) because the stimulus has some biological or survival value (e.g., food, water, sexual stimulation), conditioned reinforcers acquire their response-strengthening properties because they have been repeatedly associated with a primary reinforcer (Mazur, 2006; Williams, 1994) or other conditioned reinforcers. Procedurally, the establishment of conditioned reinforcers is often akin to respondent (Pavlovian) conditioning in which previously neutral stimuli acquire response-eliciting properties via repeated associations with an unconditioned stimulus (Williams, 1994). Similarly, conditioned reinforcers acquire their reinforcing properties via repeated associations with a reinforcer. The reinforcing effects of conditioned reinforcement are generally tested under two types of conditions (Zimmerman, 1959). One condition involves the maintenance of a previously established response (Zimmerman, 1963; Zimmerman & Hanford, 1966). Another condition involves the strengthening of a new response. In both types of conditions, testing occurs under conditions in which the subject does not have access to the primary reinforcer – only the conditioned reinforcer being tested is delivered. According to Zimmerman (1963), conditioned reinforcement has been attributed a significant degree of explanatory power in

describing numerous behavioral events in the behavioral literature. Therefore, investigations that would further our understanding of the critical variables involved in developing conditioned reinforcers and maintaining their effects are warranted.

Basic Research on Establishing Conditioned Reinforcement

The basic literature has explored and informed the scientific community of the variables, preparations, and various dimensions that have been studied (e.g., Kelleher, 1966; Kelleher & Gollub, 1962; Rashotte, Griffin, & Sisk, 1977; Williams, 1994). Williams (1994) presents a summary of procedures used in empirical investigations on conditioned reinforcement. He identifies at least five characteristic procedures that emerge from the literature on conditioned reinforcement (for a review of conditioned reinforcement, see Kelleher, & Gollub, 1962). These procedures and preparations include second-order schedules, chain schedules, concurrent chains, observing responses, and delay-of-reinforcement. Each of these procedures produces some degree of success in the establishment of conditioned reinforcers with non-human subjects. For example, in chain-schedules, a primary reinforcer is delivered at the end of a sequence of responses (or, component) which are each consequated with a stimulus (a neutral stimulus that acquires conditioned reinforcement properties). In the procedure, the neutral stimulus actually serves a dual function; it is a reinforcing stimulus for the responses in the previous component, and it is a discriminative stimulus for the responses in the next component. The established discriminative stimulus is said to be a conditioned reinforcer if another response increases or is maintained when the discriminative stimulus is made contingent on that response – in other words, it is used as a consequence for a response. This dual property of the neutral stimulus has been evaluated in the applied literature and has been coined the operant discriminative stimulus procedure (or, S^D procedure) (Holth, Vandbakk, Finstad, Grønnerud, & Sørensen, 2009; Lovass et al., 1966). In addition to specific preparations used in the study of

conditioned reinforcement, other dimensions of conditioned reinforcement have been explored and include the magnitude of the reinforcer used (e.g., duration of access or quantity), the delay used in the association between the neutral stimulus and the primary reinforcer, or the intermittency of these associations (Zimmerman, 1957, 1959), among other dimensions.

Intermittency of Reinforcement

Zimmerman (1957) proposed that introducing intermittency during the establishment of conditioned reinforcers and during tests for reinforcing value of conditioned reinforcers could produce noticeable conditioned reinforcing effects. Zimmerman (1959) tested the effects of intermittency in the establishment and then testing of conditioned reinforcers with rats. The experimental group first experienced a conditioned reinforcer establishing procedure in which a buzzer and a door opening signaled the availability of food reinforcers. However, these stimuli and access to food became available only after a variable number of responses were emitted (i.e., VR schedule). During the testing phase, food reinforcers were completely removed and only the buzzer and door opening were produced for responding on a newly introduced lever. Again, the delivery of the buzzer and door opening (now conditioned reinforcers) were also programmed on a variable ratio schedule. Results showed that rats' responses in the experimental group were significantly greater compared to the two control groups, suggesting that the stimuli that had been intermittently correlated with the availability of food were conditioned reinforcers.

Applied Research on Establishing Conditioned Reinforcement

Conditioned reinforcers play an important role in the development and maintenance of many socially relevant human behaviors (e.g., social praise, stimuli associated with reading books and articles, tokens; Cooper et al., 2007). The importance of conditioned reinforcement is made more apparent when caring for and working with individuals who do

not have a well-developed or sophisticated range of conditioned reinforcers available to them or who only have a few. An overview of a sample of behavior analytic textbooks (e.g., Malott, 2008; Greer & Ross, 2008; Cooper et al., 2007) shows that the concept of conditioned reinforcement has been well integrated into the applied account of operant behavior. However, it is equally evident that these resources provide few procedural details for the establishment of conditioned reinforcement with the exception of general statements such as "a stimulus paired with a reinforcer," or "one must pair oneself with reinforcers." Little is known regarding the necessary and sufficient conditions under which neutral stimuli may acquire conditioned reinforcing properties and how to maintain effects with human beings. In recent years, an emerging body of research studies has explored the process of extrapolating preparations from the basic literature on conditioned reinforcement and applying them to humans in a systematic way.

Lovass et al. (1966) conducted one of the earliest studies on establishing conditioned reinforcers with humans using basic research manipulations. Two schizophrenic children (4 years old) received pairing of social events (i.e., the word "*good*" and a light physical touch on their back) with food. An S^D procedure was used in which participants' responses (approaching the experimenters) were differentially reinforced with food (primary reinforcer) in the presence of the social events. Approach responses were placed on extinction when the social events were not present during trials. Thus, the social events were initially established as discriminative stimuli. Then, the social events were used as (conditioned) reinforcers during a testing phase in which the social events were presented contingent on bar pressing (a new response). Lovaas et al. also integrated the procedures described in Zimmerman (1959), who found that responding could be maintained over time when reinforcers were presented intermittently during the establishment and also when conditioned reinforcers were presented intermittently during the testing phase. Results indicated that the social events maintained

relatively high rates of bar presses for both participants using the S^D procedure and the "double-intermittency" preparation. This study illustrates the successful use of basic research preparations in the establishment of neutral stimuli as conditioned reinforcers. One limitation of the Lovaas et al. study is they did not introduce an S^Δ stimulus during the discrimination training. It is unknown if reinforcing effects observed would have been more or less robust if they had introduced an S^Δ stimulus (see Taylor-Santa, Sidener, & Carr, 2014 below for more details).

Nearly a decade after Lovass et al. (1966) established social events as conditioned reinforcers, Stahl, Thompson, Leitenberg, and Hasai (1974) conducted a study in which they established a neutral stimulus (i.e., social praise) as a conditioned reinforcer by pairing the neutral stimulus with a reinforcers (i.e., token) for three psychiatric patients for whom praise statements initially were not effective reinforcers. The study evaluated the effects of praise alone (pre-and post-conditioning), tokens alone, and praise + tokens on individual-specific responses (e.g., verbal utterances, eye contact, or activities of daily living skills). The preparation used to associate the neutral stimulus with the reinforcer was the pairing procedure, which involved the presentation of the neutral stimulus (here, the praise statement) immediately preceding the presentation of a known reinforcer (tokens). Unlike the Lovaas' et al., Stahl et al. did not use food (primary reinforcer) to establish the neutral stimulus as a conditioned reinforcer. Instead, they used already established conditioned reinforcers (tokens). Procedurally, the pairing procedure was the same, but this type of conditioning is generally referred to as second order conditioning. The results indicated that when social praise and tokens were paired, responding increased for each subject. In addition, responding was maintained when social praise alone was made contingent on responding (post-pairing procedure phase), suggesting that social praise had acquired response-strengthening properties. Similar to the Lovass et al. (1966) study, the procedure used was similar to the

terminal link in a chain schedule preparation in which participant emits sets of responses which are immediately followed by a reinforcer. In their study, the reinforcer was a generalized reinforcer (the token) or a newly established conditioned reinforcer (the praise statement). However, the conditioning procedure did not occur at the beginning of the component (like in the operant discriminative stimulus procedure in which a neutral stimulus is established first as a cue). Instead, the conditioning procedure occurred at the end of the component when the neutral stimulus was presented and immediately followed (i.e., paired) with the reinforcer, following a target response. The schedule of reinforcement was different for each participant but generally involved a fixed-ratio schedule of reinforcement, in which each the reinforcer was presented following a certain number of required responses. This conditioning procedure has been called the response-contingent (or dependent) stimulus pairing procedure, because the pairing of the neutral stimulus and the reinforcer (generally primary) occurs dependent upon the emission of a response by the participant (Dozier, Iwata, Thomason-Sassi, Worsdell, & Wilson, 2012). This pairing procedure is contrasted with another type of procedure which involves a response-independent association between the neutral stimulus and the primary reinforcer, as in a study by Holth et al. (2009).

Holth et al. (2009) conducted a similar experiment as Lovass and colleagues (1966) in which the S^D procedure was used to establish social stimuli (i.e., praise) and other stimuli (e.g., sound of a toy) as conditioned reinforcers for eight children with and without disabilities. However, Holth et al. extended their work by comparing the S^D procedure with a response-independent pairing procedure. The S^D procedure was similar to that described the Lovass et al. (1966) study. For the response-independent pairing procedure, participants were seated at a table and a neutral stimulus (e.g., social utterance “yay”) was presented and was immediately followed (1-second delay) by the presentation of a known reinforcer (i.e., edibles or toys). The experimenters programmed for the overlap of the neutral stimulus

presentation and the reinforcer presentation. The response-independent pairing procedure distinguishes itself from the response-dependent pairing procedure by not requiring the participant to emit a response prior to the implementation of the conditioning procedure. In other words, participants were passive during the conditioning. Unlike Lovaas et al. (1966), Holth et al. (2009) did not incorporate the double-intermittency manipulations during the establishment and testing of the newly conditioned reinforcers. But, their S^{Δ} condition during discrimination training was similar to Lovaas et al. in that no S^{Δ} stimulus was used – only the absence of the S^{D} stimulus. The results of the reinforcer tests indicated that the S^{D} procedure was more effective than the response-independent pairing procedure in maintaining responding for five of the seven participants involved in the study. For one participant, both procedures were equally effective, and for another participant, the pairing procedure was more effective. Long-term maintenance of the effects in the absence of ongoing conditioning procedures could not be determined on the basis of the available data. Again, the procedures used in the Holth et al. (2009) study are similar to the one component, chain schedule discussed above.

More recently, Dozier et al. (2012) compared the response-independent pairing procedure with the response-dependent pairing procedure with 12 individuals with intellectual disabilities. In the first experiment, participants experienced the response-independent pairing procedure in which a neutral stimulus (praise) was immediately followed by the presentation of food (primary reinforcer). A total of 1600 to 2400 pairing trials were conducted before testing effectiveness of praise as a reinforcer. Results found that praise did not produce appreciable increases in responding for 3 of 4 participants during the test for reinforcing effects. Some increase in responding was observed for 1 participant. In Experiment 2, the response-dependent pairing procedure was used in which participants were required to engage in a target response before the praise-food pairing occurred and

immediately followed the target response. The results indicated that for 4 of 8 participants, responding on the target response increased during the conditioning procedure and maintained during the test condition for the other four participants, suggesting that praise had acquired reinforcing value. The conditioning procedure did not produce appreciable effects for the other 4 participants. The authors concluded that the response-dependent pairing procedure was more effective than the more traditional response-independent pairing procedure. However, it is not clear why the response-dependent pairing procedure was ineffective for half the participants during Experiment 2. In addition, there was no evidence that Zimmerman's (1957, 1959) use of intermittency of reinforcement was used in the study, and there was no evaluation of whether effects were maintained over time.

Taylor-Santa et al. (2014) also demonstrated that the S^D procedure was effective in establishing conditioned reinforcers for 3 children diagnosed with autism. In their study, an investigator initially taught participants to respond in the presence of a neutral visual stimulus (e.g., picture depicting sound waves). The neutral stimulus was functionally established as a discriminative stimulus (S^D) using a discrimination training paradigm similar to Lovaas et al. (1966) and Holth et al. (2009). However, the procedures also included another stimulus, which functionally served as an S^Δ in the presence of which responses were not reinforced (i.e., extinction). The rationale for introducing a specific stimulus as an S^Δ (as opposed to S^Δ merely being the absence of the S^D) was to increase the salience of the S^D and supposedly strengthen conditioning effects. The results indicated the S^D procedure (with the added S^Δ stimulus) was effective in establishing neutral stimuli as conditioned reinforcers for all 3 participants, evidenced by increase rates of responding (simple motor responses) during post-conditioning tests. However, again, these results did not maintain over time.

Schenk (2015) replicated the Holth et al. (2009) study by comparing both the response-independent pairing procedure and the S^D procedure and testing the conditioned

reinforcer effects using a progressive ratio of reinforcement. Two participants received reinforcer test probes prior to experiencing any conditioning procedure. Reinforcer test probes required participants to emit a response prior to the delivery of the neutral stimulus (e.g., light, sound). Using a progressive ratio schedule, the number of responses prior to the delivery of the neutral stimulus gradually increased by 2 until participants' responding on a device (e.g., pulling a string) stopped. These initial test probes served as baseline data upon which conditioned reinforcing effects could be compared. Then, each participant experienced as series of the response-independent pairings or S^D trials to condition neutral stimuli as conditioned reinforcers. The response-independent pairing procedure involved presenting the neutral stimulus and immediately following its presentation with a known reinforcer, similar to the Holth et al. (2009) procedure. The S^D procedure involved differentially reinforcing participants' responses on a microswitch in the presence of a neutral stimulus (i.e., establishing the neutral stimulus as a discriminative stimulus). Each participant experienced a minimum of 40 to 80 pairing or S^D trials. Following conditioning sessions, reinforcer test probes were administered to evaluate the conditioned reinforcing effects of the neutral stimuli. Results indicated that both the response-independent pairing procedure and the S^D procedure were effective for 1 participant in establishing neutral stimuli as conditioned reinforcers. For the second participant, only the S^D procedure effectively established the neutral stimulus as a conditioned reinforcer. Like all other applied studies described here, however, the effects did not last over time when the conditioning procedures were discontinued.

Together, these studies provide promising but idiosyncratic effects of various preparations used the applied literature in establishing conditioned reinforcers. For example, the response-independent pairing procedure has been shown to be relatively ineffective for conditioning reinforcers based on the empirical evidence, except for one participant in the

Schenk (2015) study and two participants in the Holth et al. (2009) study. In contrast, the currently available data suggest that the response-dependent pairing and the S^D procedures are the most effective procedures for conditioning a reinforcer, although more research is necessary given the idiosyncratic effects observed. Unfortunately, the durability of the reinforcing effects of these conditioned reinforcers also seem to be very limited. If these reinforcers are to be utilized to teach new skills, the effects need to be durable. Thus, it is important to conduct research on how to produce long-lasting conditioned reinforcers. With the exception of Lovaas et al. (1966), none of the applied studies on conditioned reinforcers incorporated a method for building durability of conditioned reinforcers in their procedures. One solution may be to incorporate intermittency procedure, such as the one described by Zimmerman (1957, 1959), during the reinforcer conditioning procedure.

Purposes of the Study

The purposes of this study were to: 1) provide empirical data evaluating the effects of two discrimination training procedures on establishing neutral and non-social stimuli as discriminative stimuli using a single-stimulus presentation preparation (similar to Taylor-Santa et al., 2014) and/or a concurrent-stimulus presentation preparation, plus intermittency of reinforcement; and 2) evaluate the reinforcing effects of the newly established discriminative stimuli when made contingent upon simple motor responses with individuals with disabilities. The specific research questions were:

Preliminary Questions (Phase 1)

1. What are neutral stimuli and preferred stimuli for target participants? Do preferred stimuli function as reinforcers for arbitrary responses. Do the neutral stimuli function as reinforcers for arbitrary responses at baseline?

2. Given that a preferred stimulus is an effective reinforcer for an arbitrary response, can participants consume at least 30 sample-sized reinforcers without showing satiation effects?

Primary Research Questions (Phases 2 and 3)

3. What are the effects of an S^D training procedure in which a neutral stimulus is presented as an S^D and another neutral stimulus is presented as an S^Δ on correct and independent button-presses when these stimuli are presented in a single-item presentation and/or concurrent-item presentation? Specifically, does either procedure produce discriminated button-pressing?
4. Given that a neutral stimulus does not serve as a reinforcer for an arbitrary response during baseline, how does an S^D procedure with the addition of an intermittency component establish and maintain a neutral stimulus as a reinforcer for an individual with developmental disabilities?

GENERAL METHOD

Participants

Three participants were included in this study. Participants were recruited from a local community mental health (CMH) organization and from agencies contracted through CMH. Participants were recruited via flyers posted at the above locations, via referrals from CMH, or from participants' guardians directly contacting the principal investigator. Investigators obtained approval for the recruitment protocols and experimental procedures from the university's Human Subject Institutional Review Board (HSIRB) prior to the beginning of the study. Upon receiving a referral or if a guardian contacted the investigator, the investigator scheduled a meeting with the guardian and the formal consent was obtained. The inclusion criteria for this study were individuals who: were diagnosed with autism and/or developmental disability, between the ages of 3 and 60 years, were able to follow one-step instructions (e.g., comply with requests to make a choice selection when an opportunity is

given, or perform simple motor tasks), had minimal or no motor deficits (i.e., have range of motion sufficient to complete simple motor tasks), and reportedly lacked a wide range of known preferred activities or reinforcers (e.g., caregivers were able to identify one or two functional reinforcers, such as edible items). Participants were excluded from this study if they had a wide variety of reinforcers across a range of domains (e.g., edible, tangible, social) that were reportedly effective for teaching and leisure time, and/or had significant behavioral issues (e.g., aggression, self-injurious behavior, non-compliance with demands) that could pose safety issues to participant or investigators or prevent the study from being conducted. An informal interview with guardians and/or caregivers and a review of psychological records were used to determine whether each participant met inclusion and exclusion criteria.

Eric was a 41-year-old African American male with diagnoses of autism spectrum disorder, obsessive compulsive disorder, and moderate mental retardation. Eric had limited vocal language (he emitted sounds) but could communicate needs using basic signs or by pointing. Eric could accurately imitate simple motor responses and he could also follow simple verbal instructions.

Aubrey was a 41-year-old African-American female with a diagnosis of severe mental retardation. Aubrey had limited functional language but could mand for some preferred stimuli using one-word statements. Aubrey also had limited vision from one eye but this did not prevent her from accurately tacting objects and colors in her environment ("car," or "yellow"). Aubrey could engage in simple motor responses, imitate models, and could follow simple instructions.

Shannon was a 41-year-old Caucasian female and was diagnosed with moderate developmental disability and cerebral palsy. Shannon could communicate her needs using short sentences. Shannon's verbal repertoire was relatively complex. She could hold simple conversations, tact objects and colors accurately, and mand for specific items. Shannon

followed instructions and could imitate simple motor responses. Shannon was not ambulatory and typically used a wheelchair to get around the community or laid in bed at home. Shannon also had a limited range of movement with her right hand. Shannon could move her left arm slowly but had relatively good fine motor skills (e.g., pick up objects or point to specific stimuli). Procedures described below were modified when necessary to accommodate Shannon's limited mobility.

Settings and Materials

All experimental sessions were conducted in the living or community room at participants' homes or day programs, or in a therapy room. Experimental procedures were conducted at a table with the participant sitting opposite or adjacent to the experimenter.

Most experimental sessions included a table, two chairs, microswitch buttons for the S^D procedures (see Figure 1), a variety of devices and materials for emitting arbitrary responses (R) (see Figure 2), neutral stimuli (S) (see Figure 3), and primary reinforcers (SR+). Participants' pressing of the microswitches (Phase2) and manipulations of the devices and materials (Phase 3) served as the primary dependent measures. Ss were different colored gels with printed patterns to produce formally distinct stimuli. For each participant, two different Ss were used for Phase 2 during the S^D procedure and in Phase 3 during the testing of the discriminative stimulus as a conditioned reinforcer. One S was selected to be established as an S^D in Phase 2 and then tested for its reinforcing function on one R in Phase 3 and another S was selected and established as an S^Δ and then tested for its neutral or abative function on another R. For each participant, four Rs were selected for use during Phase 3 in testing the conditioned reinforcing effects of Ss. SR+ consisted of edible stimuli and were identified via a stimulus preference assessment and tested via a reinforcer assessment (procedures described in Appendix A). Parents, guardians, and/or caregivers assisted in the identification of SR+ that were used in the study. They also ensured identified SR+ did not

pose an allergy or choking hazard to participants and that there were no other medical or social concerns regarding the delivery of edible reinforcement.

S^D Procedure Microswitch

Figure 1: Phase 2 Response – S^D procedure microswitch required participants to press down on the circular button.

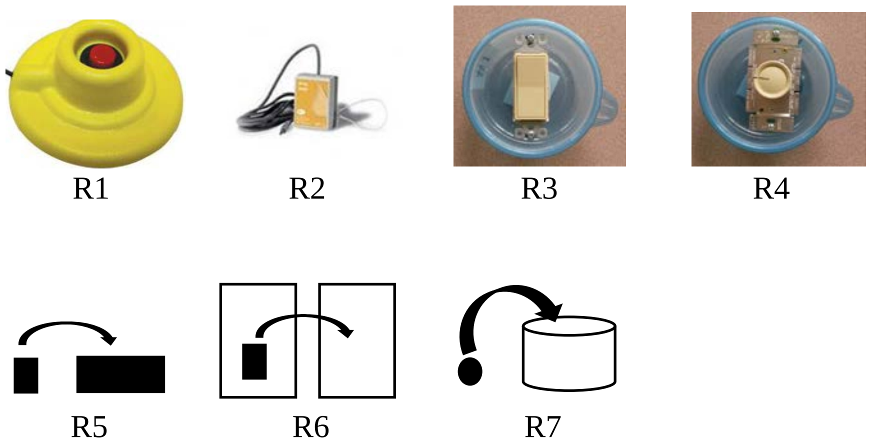
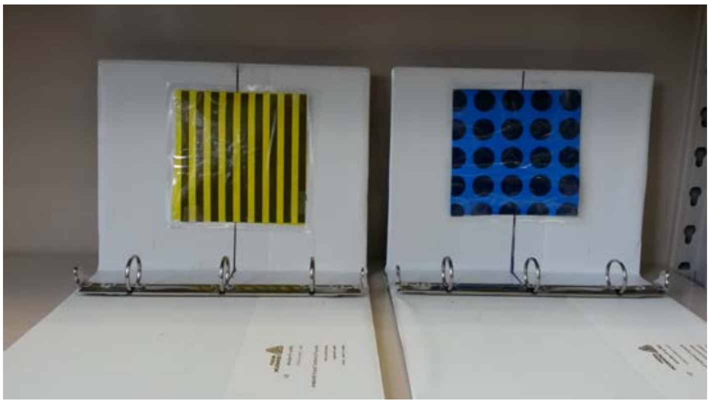


Figure 2. Phase 3 Responses – top row, from left to right: R1 required participants to press the red button using a finger, R2 required participants to pull the string, R3 required participants to press a the switch, R4 required participants to turn the switch; bottom row, from left to right: R5 required participants to place a small block on top of a large block, R6 required participants to place a block laying on one side to the other side, R7 required participants to place a small ball inside a bowl.



S1 S2

Figure 3. Phase 2 and 3 Neutral Stimuli (Ss) – colored gels and printed patterns were used to produce distinctive S^D and S^{Δ}. S1 was a yellow gel placed on a white page with vertical lines, S2 was a blue gel placed on a white page with a circular pattern. Both Ss were affixed inside a binder, at the center of the top flap.

Interobserver Agreement and Integrity of the Independent Variable

Interobserver Agreement. A second investigator independently collected interobserver agreement (IOA) data from video recordings of sessions for at least 30% of all sessions in the study, equally distributed across phases for each participant. IOA was calculated using an exact agreement method (trial by trial). IOA for each participant are shown in Table 1. Average IOA across participants was 98% (range: 50% to 100%).

Table 1. Interobserver agreement scores across participants

	Avg. IOA Score (%)	Range (%)
Eric	98%	50%-100%
Aubrey	100%	100%
Shannon	98%	50%-100%

Fidelity of the Independent Variable. To ensure accurate presentation of the independent variable procedures, all investigators were trained using fidelity checklists for each phase. Fidelity of the independent variable was assessed for at least 30% of all sessions,

equally distributed across the study for each participant. Average treatment fidelity was 99% (range: 83% to 100%).

PHASE 1: PRELIMINARY ASSESSMENTS

Overview

Preliminary assessments answered Research Questions #1 and #2. Investigators gathered information regarding participants' preferred stimuli (specifically edible stimuli) using the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD; Fisher, Piazza, Bowman, & Amari, 1996). The RAISD is an informant-based assessment tool which permits assessors to obtain subjective information from parents and other caregivers regarding individuals' reinforcers across different sensory inputs and types (e.g., touch, social, taste, etc.). Investigators also conducted a multiple stimulus without replacement (MSWO) preference assessment (DeLeon & Iwata, 1996) to identify SR+s in the form of edibles (e.g., cookies, pretzels, m&m's) for each participant. Stimuli included in the MSWO were derived from the RAISD results. To ensure identified primary reinforcers functioned as reinforcers (and were not merely preferred), investigators also conducted a reinforcer assessment using the top three to four primary reinforcers identified during the MSWO. SR+s were used later in Phase 2 to establish Ss as a discriminative stimulus. In Phase 1, a satiation assessment was also conducted to assess how many small, sample-sized, SR+s participants could consume. Finally, Ss in the form of colored gels with different printed patterns (see Figure 3) were selected and tested to rule out pre-existing reinforcing functions. See Appendix A for more details on preliminary assessment procedures, dependent variables, measurement systems, and results of the Phase 1 analyses.

At the conclusion of Phase 1 and based on its results, two sets of two Rs (four Rs) and two Ss per participant were created to form combinations for further testing in Phase 3 (e.g., R1 and R2 with S1, and R3 and R4 with S2). These two sets of response-stimulus

combinations were used during reinforcer test probes in Phase 3 if Ss were successfully established as an S^D and S^Δ in Phase 2. In other words, the S in one RR-S combination was programmed to be established as an S^D during the S^D procedure and then tested for its reinforcing function on one of the two Rs during test probe sessions. The other S in the other RR-S combination was programmed to become established as an S^Δ during the S^D procedure and then tested for its neutral or abative function on one R during test probe sessions. Tables 2 through 4 list which Rs and Ss were combined and assigned for each participant.

Table 2. Stimuli and response assignment for Eric

	Stimuli	Responses Pairs	Phase 3 Contingency
S^D	S1 = Yellow + Lines	R5 = Block on block	R6 → S1
		R6 = Move block from left to right	
S^Δ	S2 = Blue + Circles	R1 = Press red button	R1 → S2
		R2 = Pull string	
Discrimination training		Microswitch button(s)	

Table 3. Stimuli and response assignment for Aubrey

	Stimuli	Responses Pairs	Phase 3 Contingency
S^D	S1 = Yellow + Lines	R1 = Press red button	R2 → S1
		R2 = Pull string	
S^Δ	S2 = Blue + Circles	R6 = Move block from left to right	R7 → S2
		R7 = Put ball in cup	
Discrimination training		Microswitch button(s)	

Table 4. Stimuli and response assignment for Shannon

	Stimuli	Responses Pairs	Phase 3 Contingency
S^D	S1 = Yellow + Lines	R1 = Press red button	R1 → S1
		R2 = Pull string	
S^Δ	S2 = Blue + Circles	R3 = Switch press	R3 → S2
		R4 = Switch turn	
Discrimination training		Microswitch button(s)	

PHASE 2: ESTABLISHING NEUTRAL STIMULI AS S^D AND S^Δ VIA TWO S^D PROCEDURES

Overview

Phase 2 was designed to answer Research Question #3 and assessed whether Ss could be established as an S^D and an S^Δ stimulus for each participant via two S^D procedure strategies. For all participants, based on an empirical demonstration that S1 and S2 were neutral, S1 was always programmed to be established as an S^D and S2 was always programmed to be established as an S^Δ. Discrimination training proceeded in a 3-step process. In Step 1, an S1 was established as a reliable S^D. Step 2 involved the introduction of an S^Δ (i.e., S2). Finally, Step 3 involved thinning the reinforcement schedule for responding in the presence of the S^D.

Two discrimination training procedures were used to establish stimulus function of both Ss. The first discrimination training procedure was similar to that described by Taylor-Santa et al. (2014), who used a single-stimulus (single-s) presentation arrangement. The second discrimination training procedure used a concurrent-stimulus (concurrent-s) presentation preparation in which both S1 (as S^D) and S2 (as S^Δ) were simultaneously presented. Several modifications to the procedures described below were required for individual participants. The section below describes the general procedures, and the individual modifications are described in the Results section.

Method

Step 1. Prior to beginning each discrimination training session, participants were presented with an array of the top two or three SR+s identified in Phase 1. Participants were then taught to respond on the microswitch and exposed to the reinforcement or extinction contingency in effect in each of the three steps. Prior to each session, participants were prompted to activate the microswitch following the S^D presentation. Participants were seated at a table with the microswitch placed in front of them. The investigator first presented the S1

in front of the microswitch for 3 to 4 s (effectively blocking access to the button), and then placed the S1 behind the microswitch and immediately prompted (verbal, gestural, or physical) participants to press the button. Following the prompted response, the investigator immediately removed the S1 and delivered the SR+. After two pre-session trials ended and a 1-min break occurred, the session began. During the session, participants were seated at a table with a microswitch placed in front of them (20 cm) and experienced 10 S1 presentation trials per session. The investigator was seated next to the participant to provide additional prompts as needed. During each trial, S1 was first placed in front of the microswitch for 3 to 4 s (blocking access to the button), then the S1 was placed behind the button for 5 s. If participants pressed the microswitch within 5 s, S1 was immediately removed, SR+ was delivered, and the microswitch was not removed. If participants did not press the microswitch within 5 s, the investigator provided a verbal, gestural, or physical prompt, and then removed the S and delivered the SR+. If participants failed to respond in subsequent trials, the investigator continued prompting the response using the prompt level that was successful during prior prompted trials and faded prompts systematically as described above. Step 1 was terminated following two consecutive sessions in which participants pressed the microswitch independently on each trial.

Step 2. Prior to each session in Step 2, participants were presented with an array of the top two or three SR+s identified in Phase and prompted to complete the chain of responses required and were exposed to contingencies in effect for pressing the microswitch in the presence of either the S1 and S2. Pre-session training was the same for both discrimination training preparations (i.e., single- vs. concurrent-s presentation) with the exception that one vs. two microswitches and Ss were present during the single-s and concurrent-s presentation sessions, respectively. Participants were seated at a table with one (or two identical) microswitches, and an observing response card was placed in front of them.

The investigator verbally, gesturally, or physically prompted participants to engage in the observing response (initial link), which consisted of participants using their hands or fingers to touch a card. Touching the card revealed the Ss (i.e., S1 and/or S1 stimuli) in effect. For the single-s preparation, the S1 or S2 stimuli was positioned inside a binders and was placed behind the microswitch, and the top flap of the binder was lifted (revealing the stimulus) following the observing response. For the concurrent-s preparation, the S1 and S2 stimuli were positioned inside two separate binders and were placed behind the two identical microswitches, and the top flaps of the binders were lifted (revealing the stimuli) following the observing response. Figure 4 shows the single-s vs. concurrent-s preparation for each trial.

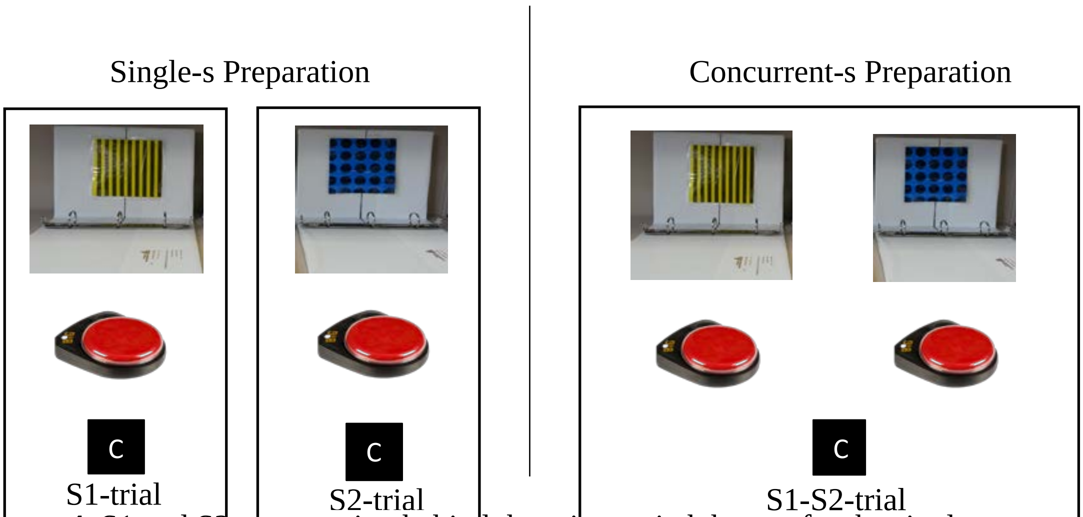


Figure 4. S1 and S2 presentation behind the microswitch button for the single-s preparation (left). S1 and S2 presentation behind the microswitches button for the single-s preparation (right).

In the second link of the chain, participants were prompted to press one of the microswitches using their hands. On prompted trials in which participants pressed the microswitch associated with S1, the investigator immediately closed the binder(s) (effectively removing the S1 and/or S2) and delivered the SR+ that participants selected before starting the session. On prompted trials in which participants pressed the microswitch associated with

S2, the investigator immediately closed the binder(s) and did not deliver an SR+. For single-s and concurrent-s preparations, pre-session training ended after participants were prompted through the chain of responses twice per stimulus. Participants were given a 1-min break before beginning discrimination training sessions. Eric, Aubrey, and Shannon first experienced the single-s preparation followed by the concurrent-s preparation.

Single-s trial discrimination training sessions were administered as described in Step 1 except that participants experienced 10 conditioning trials (5 S1 and 5 S2) per session, an observing response was added, and S2 presentation trials were interspersed with S1 trials. During each trial, an observing response card (10 cm by 10 cm) was placed in front (15 cm) of participants. Participants touched the observing response card, which served as a cue for the investigator to lift the binder flap, revealing either the S1 or the S2 stimuli. Whether the S1 or the S2 stimulus was presented behind microswitch button was determined semi-randomly via a coin such that the S1 stimulus and the S2 stimulus were presented an equal number of times. In addition, a stimulus was not presented for more than two consecutive trials. For example, if two consecutive trials presented the S1 stimulus, the following trial automatically presented the S2 stimulus.

The concurrent-s preparation was similar to the single-s preparation except that two identical microswitches were placed side by side (20 cm apart) in front of them (20 cm), and a binder with either the S1 and S2 stimuli was placed behind each of the two microswitch buttons. Participants experienced 10 conditioning trials per session. Each trial consisted of placing the two binders behind the two microswitches, and then placing an observing response card (10 cm by 10 cm) in front (15 cm) of participants. Participants touched the observing response card, and the investigator to lifted both binder flaps simultaneously, revealing both the S1 and the S2 stimuli. Whether the S1 or the S2 stimulus was presented behind the left or the right microswitch was determined semi-randomly via a coin such that

the S1 stimulus and the S2 stimulus were presented on both sides an equal number of times. In addition, s stimulus was not presented on the same side for more than two consecutive trials. For example, if two consecutive trials presented the S1 stimulus on the right side, the following trial automatically presented the S1 stimulus to the left side. The next trial was again decided via a new coin flip.

For both the single-s and the concurrent-s preparation, if participants pressed the microswitch associated with S1 within 5 s, Ss and the observing response card were immediately removed (i.e., binder flaps were closed) and SR+ was delivered. If participants pressed the microswitch associated with S2 within 5 s, Ss and the observing response card were immediately removed and SR+ was not delivered. If participants did not press the microswitch within 5 s, the investigator provided a verbal, gestural, or physical prompt to press the microswitch associated with S1, and Ss and the observing response card were immediately removed, and SR+ was delivered. If the participant failed to respond in subsequent trials, the investigator continued prompting responding on the microswitch associated with S1 using the prompt level that was successful during prior prompted trials and faded prompts systematically as described above. A 20 s inter-trial period followed each trial. Step 2 was terminated and Step 3 began following two consecutive sessions in which participants independently and correctly responded on the microswitch button associated with the S1 stimulus 100% of the time or following three consecutive sessions at 80%.

Step 3. Participants who successfully demonstrated discriminated responding in Step 2 participated in Step 3. Discriminated responding in Step 2 indicated that S1 was now an S^D. Step 3 was administered using the concurrent-s preparation and consisted of additional sessions similar to procedures described in Step 2 but in which intermittency of reinforcement was gradually introduced. SR+ deliveries for participants' responses on the microswitch associated with S1 became gradually more unpredictable with fewer and fewer

reinforced responses. During initial sessions of Step 3, microswitch presses associated with S1 were reinforced 80% of the time (i.e., 8 out of 10 trials). Then, if participants responded 100% of the time correctly during one session, the schedule of reinforcement became gradually leaner over the next sessions until responses on the microswitch associated with S1 were reinforced on average 40% of the time (terminal criteria). The specific trial in which a correct response was reinforced was semi-randomly determined and distributed evenly across session trials to avoid large clusters of consecutive unreinforced responses in the presence of S1. For example, participants' correct responses on the microswitch associated with the S^D could involve the following sequence: SR+ is delivered contingent on the 1^{st}, 3^{rd}, 5^{th}, 8^{th}, and 10^{th} correct responses and withheld contingent on the 2^{nd}, 4^{th}, 6^{th}, 7^{th}, and 9^{th} correct responses (i.e., 50%). Procedurally, unreinforced correct responses in the presence of the S1 were the same as unreinforced responses on microswitch button associated with the S2 stimulus. Step 3 was terminated following two consecutive sessions in which participants independently pressed the microswitch associated with the S1 100% of the time, or three consecutive sessions in which participants independently pressed the microswitch associated with the S1 80% or more of the time when correct responses were reinforced only 40% of the time.

Dependent variables and measurement. During Step 1, observers recorded the number of prompted and independent responses on the microswitch button emitted by participants during S1 presentation trials. During Steps 2 and 3, and for both the single-s and concurrent-s preparation, observers recorded the number of prompted, and independent and correct responses emitted by participants during each trial. A response was independent if participants pressed a microswitch within 5 s of the presentation of the S1 (in Step 1) and S1 and S2 (in Steps 2 and 3). A response was prompted if the investigator verbally, gesturally, or full physically prompted the participant to press a microswitch after 5 s elapsed. A response

was correct if participants pressed a microswitch associated with S1. A response was incorrect if participants pressed the microswitch associated with S2 or if an attempt to press the microswitch associated with S2 was blocked by the investigator. Correct and independent responses were recorded with a +, and prompted and incorrect responses were recorded with a “P” plus the prompt level (e.g., P + F for full physical prompt), and –, respectively.

Results and Discussion

Results of the discrimination training procedures for each participant are depicted in Figures 5.

Eric. Eric completed Step 1 of the S^D procedure in 4 sessions. The single-s preparation was first administered during Session 5 using the procedure described in Taylor-Santa et al. (2014). After 6 sessions, Eric showed no evidence of response discrimination and responded 100% of the time during S1 and S2 trials. The observing response component was, thus, introduced in Session 11 and required Eric to lift a binder to reveal the Ss in effect. The investigator then held the binder in front of the microswitch for 3 to 4 s and then moved it behind the microswitch for 5 s. This modification did not produce discriminated responding. Further modifications were introduced at Session 14 consisted of changing the observing response to touching a card and adding a secondary observing response in the form of pointing to the stimulus prior to choosing to emit a response. In addition, a blocking component was interspersed throughout sessions in which S2 trials were blocked. These changes produced no evidence of response discrimination, with the exception of Session 19 in which Eric responded on the microswitch during S2 trials 90% of the time. The concurrent-s arrangement was introduced during Session 20. In addition, blocking was removed but the observing response of touching a card remained. Introducing the concurrent-s arrangement produced an immediate effect. Eric met criteria for moving from Step 2 to Step 3 within 3 sessions of introducing the concurrent-s arrangement with 90%, 100%, and 100%.

In Step 3, Eric met criteria in 4 sessions with 100% correct responding across sessions, when reinforcement for correct responses was thinned such that 8 out of 10, 6 out of 10, 4 out of 10, and 4 out of 10 responses were reinforced.

Shannon. It took two sessions for Shannon to complete Step 1. The single-s preparation was first administered during Session 4. In Step 2, prior to introducing the observing response card (as described above), another observing response was used and required Shannon to lift the binder herself to reveal Ss. However, because she struggled to lift the binder, the observing response card was introduced and used across participants. Another procedural modification was added during sessions and consisted of a second observing response in the form of pointing to the stimulus prior to pressing the microswitch. In addition, the definition of correct and independent response on trials was extended from 5 s to 10 s for Shannon only, because Shannon tended to require more time to emit a microswitch press due to her limited mobility. Although Shannon's performance initially appeared to show discriminated responding using the single-s preparation, her errors continued to remain high during S2 presentation trials, and an overall decreasing trend in responding was observed during Sessions 5 and 6. Thus, the concurrent-s arrangement was introduced during Session 7. After 10 sessions, Shannon's responding was at chance levels, with her responding equally distributed across both microswitches. Additional modifications were administered in Sessions 17 through 19 and consisted of adding a verbal statement of S1 and S2 contingencies during pre-sessions training trials and a 40-s delay penalty following incorrect responses. Although Shannon's responding showed some separation between correct and incorrect responding, her performance continued to be at chance levels. Further modifications were administered in Session 20 and consisted of removing the delay penalty and changing the position of the S1 and S2 stimuli such that they were placed on top of the microswitches (instead of inside the binders and placed behind the microswitches). This latter change

produced immediate effects, and Shannon met criteria for completing Step 2 within 4 sessions with 30%, 70%, 100%, and 100%. In Step 3, Shannon met criteria within twelve sessions. Shannon performed 100% correct when reinforcement was delivered 8 out of 10 correct trials. Her performance was more variable when only 6 out of 10 correct responses were reinforced. Finally, she met criteria within two sessions when correct responses were only reinforced 4 out of 10 correct trials.

Aubrey. Aubrey completed Step 1 of the S^D procedure in four sessions with 100%, 80%, 100%, and 100%. The single-s preparation was first administered during Session 5 and consisted of an observing response which required Aubrey to lift the binder herself to reveal the Ss (but this was replaced with the card-touch in Session 7), the open binder was held by the research for 3 s to 4 s with S1 or S2 stimulus presented in front of the microswitch followed by a 5-s period in which Aubrey could choose to press the microswitch associated with S1 or S2, which was placed behind the microswitch. (This arrangement was different from the protocol described above in the S^D Procedure section and constituted the original protocol as described in Taylor-Santa et al. 2014 study, with the addition of the observing response as the initial-link.) A procedural modification was added during Session 7 because Aubrey showed no evidence of response discrimination. This modification consisted of two observing responses in the form of touching a card and pointing to the stimulus prior to pressing the microswitch. Aubrey continued to show no evidence of response discrimination and responded 100% of the time in the presence of both S1 and S2 stimuli. Responses during S2 trials were blocked between Sessions 13 and 18. Although responding during S2 trials initially decreased, they remained high. In addition, responses during S1 trials were also degraded following the addition of the response-blocking during S2 trials. The concurrent-s arrangement was introduced during Session 19 and was conducted the same as Sessions 13 through 18 except that there were two microswitches and two Ss presented concurrently.

Aubrey's performance was at chance level during these sessions. Additional modifications were administered in Sessions 27 through 34 in which blocking was removed to evaluate the effects of blocking S2 response in the previous phase. Again, responding remained at chance level. Additional changes were introduced during Session 35 and consisted of adding a 40 s delay penalty following incorrect responses (i.e., S2 responses). Aubrey's performance remained at chance level following the introduction of the penalty component. The investigators briefly introduced a verbal statement of the contingencies in effect with both S1 and S2 stimuli during the pre-session training trials during Sessions 38 and 39 but her performance remained at chance levels. Further modifications were introduced in Session 41 and consisted changing the position of the S1 and S2 stimulus and placing them on top of the microswitches. This latter change produced immediate effects and Aubrey met criteria for moving from Step 2 to Step 3 within five sessions with 90%, 90%, 90%, 100%, and 100%. Aubrey competed Step 3 within five sessions. She performed correctly 100% of the time when reinforcement for correct responses was gradually decreased from 8, 6, and finally 4 out of 10 correct trials.

All of the participants successfully completed Step 2 or Step 3 of the S^D procedure using the concurrent-s arrangement and none of those who experienced the single-stimulus preparation were successful using the single-s preparation. Initially, it was believed that participants were not attending to the stimuli prior during each trials. Thus, one or two observing response were added across all participants. Multiple modifications introduced during the single-s arrangement were not successful in producing response discrimination for any participant. Finally, introducing the concurrent-s preparation was successful in producing discriminated responding for all three participants, although additional modifications were still required for Shannon and Aubrey. These findings are inconsistent with Taylor-Santa et

al. (2014), who found that participants reached mastery criteria in Step 2 using a single-s presentation quickly.

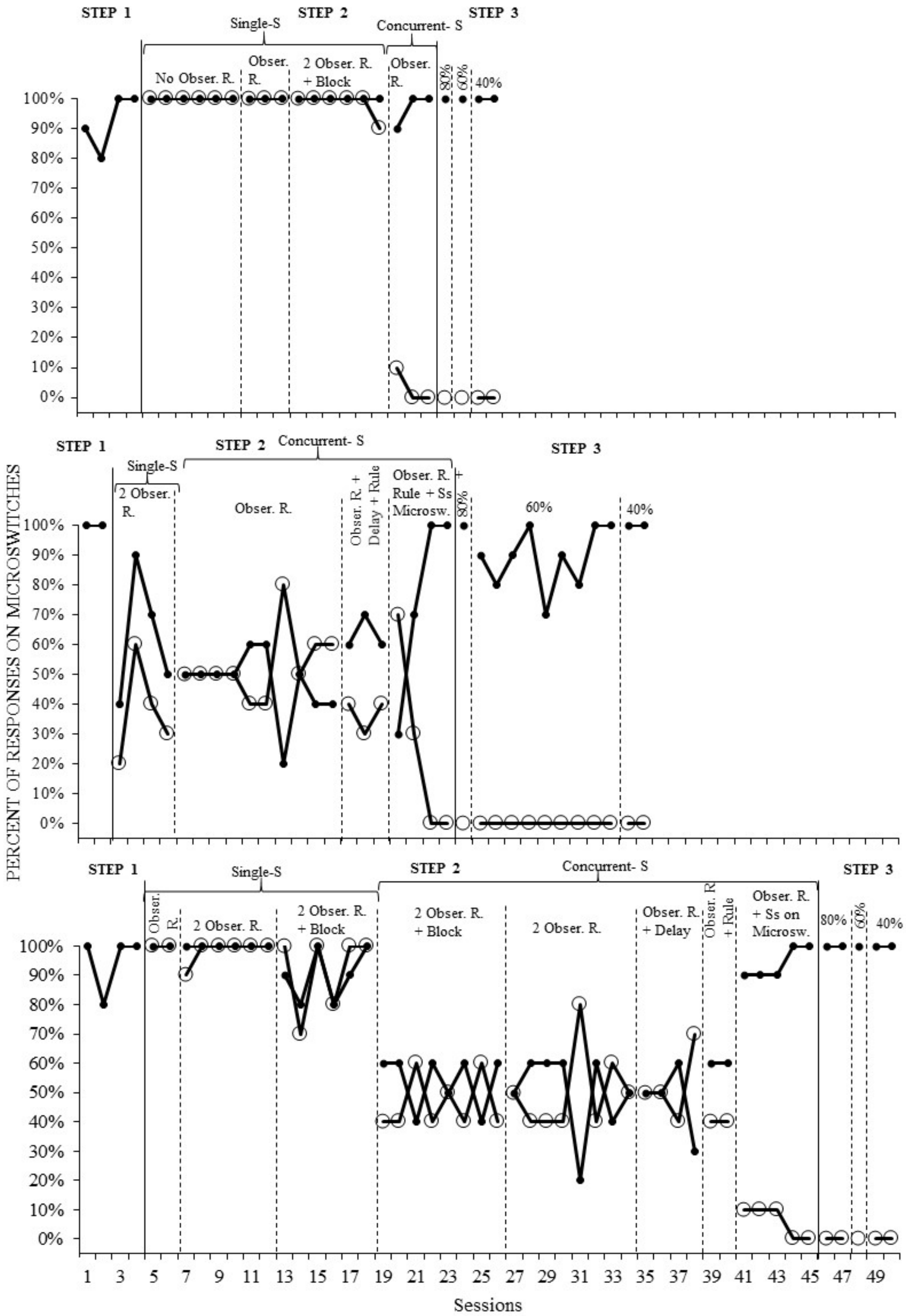


Figure 5. Results for Eric, Shannon, and Aubrey on the S^D procedures using the single-s and concurrent-s presentations. Closed markers are responses on the microswitch associated with the S^D stimulus, and open markers are responses on the microswitch associated with the S^Δ stimulus.

PHASE 3: REINFORCER TEST PROBES

Overview

This assessment addressed Research Question #4 and was conducted only with participants who successfully completed Phase 2, in which a neutral stimulus (S1) was established as an effective S^D and the reinforcement schedule associated with the S^D was thinned to 40% of trials. The purpose of this assessment was to evaluate whether the S^D established in Phase 2 functioned as an effective reinforcer when it was provided contingent upon a simple response.

Test probes were conducted using a concurrent operants arrangement in which two Rs were simultaneously presented side by side. A minimum of three reinforcer test probes (described below) were conducted for two RR-S combinations and for each participant in baseline prior to administering the S^D procedure and then again following S^D conditioning procedure sessions. Post-conditioning test probe sessions were administered over time for the two RR-S combinations to evaluate the durability of reinforcing effects. No additional S^D procedure sessions were conducted at this stage—that is, no edible reinforcement was provided during this phase, only the S1 and S2.

Method

Pre-baseline and baseline test probes. Pre-baseline assessment data were the data from Phase 1 when S1 and S2 were assessed for their neutrality. S1 and S2 were made contingent on Rs in an alternating fashion. Specific response patterns demonstrated that Ss did not shift responding on R and were selected for Phase 2 and 3 of the study.

Pre-baseline session data matching the contingencies in effect during baseline were carried over into baseline, when additional sessions were conducted. For each session, participants were seated at a table, and the investigator stood next to participants. Two different Rs were concurrently placed on the table 20 to 30 cm in front of the participant and

20 to 30 cm apart from each other. Before each session, the investigator provided a verbal, model, or full physical prompt for the participant to engage in each R two times. Following each prompted R on the device that was combined with a specific S (either S1 or S2), both Rs were removed, and the programmed S was immediately presented in front of the participant for 5 s. Following each prompted R on the device that was not combined with a specific S, both Rs were removed for 5 s but no specific consequence was programmed. Participants could not engage on either R during a 5-s inter-trial interval immediately following each response. After both Rs were prompted twice, the session began. The investigator said “Do whatever you want, but stay in the chair” while making both Rs concurrently available on the table in front of participants, as described above. Immediately after participants operated the R, the S with which it was combined was delivered on an FR 1 schedule and both Rs were removed for 5 s. After 5 s elapsed, the S was removed and the two Rs were represented. When participants operated the R with which no S was combined, both Rs were removed for 5 s but no programed consequence was delivered. No verbal instructions were provided. All test probe sessions lasted 5 min. Sessions were terminated after 5 min elapsed or if participants left the research area (i.e., get up and leave the table) during the session, whichever came first.

For each participant, this process was conducted for two different pairs of Rs, each assigned to S1 or S2. See Tables 2 through 4 for a summary of the specific R and S combinations and assignments for each participant.

Post-conditioning test probes. Post conditioning probes were identical to the baseline probes, except that they were implemented after Step 3 of Phase 2, during which the conditioning and discrimination procedure were implemented.

Dependent variables and measurement. Responses per minute served as the primary dependent measure during test probe sessions. The number of independent responses

on each R was recorded during each 5 min test probe sessions and converted into rate (number of responses per minute). If the session lasted 5 min, the investigator divided the total number of responses by 5 to obtain the rate of responding during the session. If participants left the research area prior to 5 min, the number of Rs (if any) prior to leaving the area were recorded and converted into a rate measure by dividing the total number of Rs by the number of minutes and seconds the participants were in the research area. Some devices (R1 and R2) could be plugged into a digital tally counter, and a tally was added each time the R was emitted. For R1, a response was emitted when participants pressed down on the red button. For R2, a response was emitted when participants pulled a string towards themselves. R1 and R2 responses were verified by observing the tally counter increase by one tally. In these cases, the number of tallies recorded by the counter served as the frequency count. Other devices (R3, R4, R5, R6, R7) did not. In these case, the investigator observed the observable and measurable environmental change produced by the R and made a tally. For R3, a response was emitted by pressing down on a switch using one or two fingers. The response was verified by observing the depressed switch (which did not resume to its original position following the response) and by the sound (“click”) the response product produced when it was emitted. For R4, a response was emitted when a knob on the device was twisted clockwise. The response was verified when a black line (which was added to the knob to increase the salience of the response product) was observed to have been moved clockwise, at least 45 degrees to the right from its original starting position. For R5, a response was emitted when a small block placed next to a larger block (original position) was placed on top of the larger block (final position). Specific placement or position of the small block on top of the larger block was unimportant. For R6, a response was emitted when a block placed on a 20 x 30 cm board (original position) was placed on another 20 x 30 cm board placed next to each other (final position). Specific placement or orientation of the block after it was placed on the

second board was unimportant. For R7, a response was emitted when a small ball placed next to a bowl (original position) was placed inside the bowl (final position).

Experimental design. A multiple baseline design across participants was used to evaluate the effects of the S^D procedure with the addition of an intermittency component on the establishment of Ss as conditioned reinforcers. The S^D and intermittency procedures were introduced with each participant in Phase 2 in a staggered fashion to establish the multiple baseline design. The first participant for which both RR-S combinations showed stability during baseline experienced the S^D procedures, while the other participants remained in baseline (extended baseline). The next participant to show stability during baseline test probe sessions then experienced S^D procedure. The same steps were followed for the following participants.

Results and Discussion

Results of the reinforcer test probes during tests33 for the neutrality of S1 and S2 (pre-baseline), and during baseline and post-conditioning are depicted in Figure 6. It was hypothesized that the Ss conditioned as the S^D and the S^Δ would initially produce low, stable rates on Rs during the initial pre-baseline and baseline probes (before administering the S^D procedure). After the conditioning procedure, it was hypothesized the S1 conditioned as an S^D would produce higher and robust response rates on R while the S2 conditioned as an S^Δ would continue to produce low, stable rates on R, or even acquire an abative function on R.

Eric. Pre-baseline probes indicated that R5 and R6 occurred at equivalent rates, regardless of the consequences, suggesting that both responses were equivalent and that S1 was not a reinforcer. This pattern was the same during baseline, where R5 was followed by no consequence and R6 was followed by S1 (i.e., the S^D). After the conditioning procedure, R6 occurred more often than R5. Although variable, this pattern continued over time, even though the S^D procedure was no longer implemented. These results suggested that the S1

acquired reinforcing properties that were durable over time.

Pre-baseline probes for R1 and R2 showed a clear preference for R1, but this preference was not affected by the consequences that followed it. That is, similar levels of behavior were observed when it was followed by S2 and when it was followed by no consequences, and the trend was stable over time. The same response pattern was observed for R1 and R2 during baseline when R1 was exclusively followed by S2 (i.e., the S^{Δ}) while R2 received no consequence. Following the conditioning procedure, R1 initially decreased, suggesting an abative effect of S2. These effects on R1 did not maintain, and rates of responding resumed to baseline levels in Session 18 and thereafter, suggesting any abative effect of the S^{Δ} was short-lived. R2 initially increased during the first post-conditioning test probe session but then rapidly resumed to baseline levels.

In sum, Eric's data suggest that S1, which was conditioned as an S^{D}, functioned as a conditioned reinforcer that remained effective over a long period of time, even though it was no longer associated with any primary reinforcers. S2, which was conditioned as an S^{Δ} appeared to have a short-lived abative effect when later used as a consequence for a response.

Shannon. Pre-baseline test probes test probes indicated that R1 and R2 were low and stable, irrespective of the consequence that followed, indicating that S1 was not a reinforcer. The same response pattern was observed during baseline when R1 was followed by no programmed consequence and R2 was exclusively followed by S1. Following the conditioning procedure, an initial increase was observed for both R1and R2. R1 and R2 then decreased to near baseline levels and remained at these levels over the remaining sessions. Although the initially elevated response rates of R1 may be suggestive of weak reinforcing effects of S1, a strong conclusion cannot not be made given an equal increase in R2.

Low and stable levels of responding on R3 and R4 were observed during pre-baseline test probes, regardless of when S2 was delivered, suggesting S2 was not a reinforcer. The

same response patterns were observed in baseline where R3 was exclusively followed by S2 and R4 had no programed consequence. Following the conditioning procedure, an upward trend was initially observed for both R3 and R4. An increase in R3 seemed counter-intuitive because it was followed by an S^{Δ}, however anecdotal observations during post-conditioning probes provide some insight. Shannon was heard making comments after manipulating R3, which made a “clicking” sound. Shannon attempted to recruit the investigator’s attention by saying, “It’s funny what this does.” Therefore, R3 may have produced reinforcing effects that were not initially observed during pre-baseline and baseline. Effects may also have carried over to R4. However, the observed decrease in response rate on both R3 and R4 for in Session 20 suggest any reinforcing effects were short-lived.

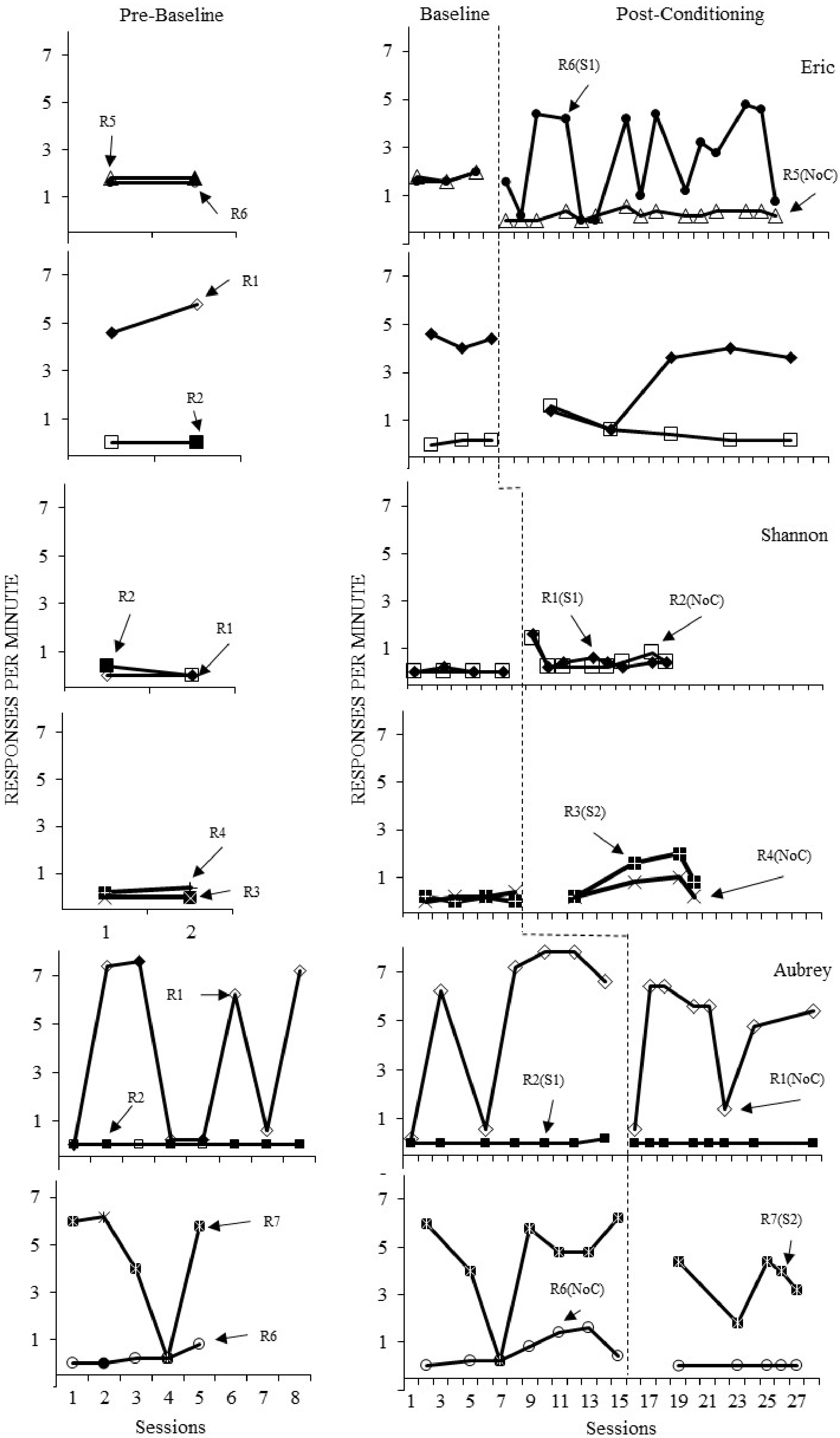
In sum, Shannon’s data suggest that S1, which was conditioned as an S^{D}, did not function as a conditioned reinforcer when it was applied contingent on a response. S2, which was conditioned as an S^{Δ} appeared also appeared to have no effect when later used as a consequence for a response.

Aubrey. Pre-baseline rates for R1 were high and variable while rates of R2 were consistently at zero levels, regardless of what consequence followed each response, suggesting that S1 did not function as a reinforcer. These patterns of responding were similar during baseline, when R1 was followed by no consequences and R2 was followed exclusively by S1. During post-conditioning probes, the same variable and high pattern of responding was observed for R1, while R2 remained a zero levels, even though it was followed by S1 – the established S^{D} – suggesting S1 did not acquire reinforcing value following the S^{D} procedure.

A similar response pattern was observed in pre-baseline for R6 and R7 as for R1 and R2. Response rate for R6 was low, while R7 was variable and high. These same response patterns were observed during baseline when R6 was not followed by programed

consequences and R7 was exclusively followed by S2. Following the conditioning procedure, response rates for both R6 and R7 were similar to pre-baseline and baseline levels. These rates and patterns of responding suggest S2 remained neutral even after conditioning as an S^{Δ}.

In sum, Aubrey's data suggest that S1, which was conditioned as an S^{D}, did not function as a conditioned reinforcer when it was applied contingent on a response. S2, which was conditioned as an S^{Δ} appeared also appeared to have no effect when later used as a consequence for a response.



Pre-Baseline
Baseline
Post-Conditioning
Eric
R5
R6
R6(S1)
R5(NoC)
R1
R2
Shannon
R1(S1)
R2(NoC)
R4
R3
R3(S2)
R4(NoC)
Aubrey
R1
R2
R2(S1)
R1(NoC)
R7
R6
R6(NoC)
R7(S2)
RESPONSES PER MINUTE
Sessions

Figure 6. Top and bottom left panels show participants' rates of responding during pre-baseline test probes for the neutrality of Ss. Top and bottom right panels show participants' rates of responding on Rs during baseline and post-conditioning test probes. Open markers depict when Rs are followed by Ss (S1 top panels; S2 bottom panels), and closed markers depict when Rs are not followed by programmed consequence (NoC).

GENERAL DISCUSSION

The purposes of this study were twofold: (1) To evaluate the effects two types of S^D procedures on establishing a non-social, neutral stimulus as discriminative stimulus with three individuals with developmental disabilities; and (2) To evaluate the effects of the newly established discriminative stimuli on the rate of responding when they are used to reinforce simple responses following the introduction of intermittency of reinforcement during the discrimination training procedures. Primary reinforcers in the form of edibles, and non-social, neutral stimuli in the form of colored gels with printed patterns were identified and tested for their reinforcing function. Edible reinforcers were found to function as reinforcers and non-social stimuli were determined to be neutral. Non-social stimuli were successfully established as discriminative stimuli for all participants. However, a great deal of training was required for all participants for this to occur, and many modifications to the training procedures were required. Notably, all participants appeared to be most successful in this phase under a concurrent operant training presentation. Following the discrimination training procedures, reinforcer test probes suggested that the neutral stimulus acquired a reinforcing function after being established as a reliable discriminative stimulus for only 1 of 3 participants, despite using an intermittency procedure during training. These findings support results from previous applied research (i.e., Holth et al., 2009; Lovaas et al., 1966; Taylor-Santa et al., 2014) showing that for some individuals, a neutral stimulus can acquire discriminating function via S^D procedure preparations and that it can then serve as an effective conditioned

reinforcer when delivered contingent upon a response. The S^D procedure was ineffective in producing conditioned reinforcers for 2 of 3 participants, also replicating the idiosyncratic findings of previous studies. This begs the question, why does this procedure work well for some participants than others?

Most applied studies on conditioned reinforcement (e.g., Holth et al., 2009; Lovaas et al., 1966) have included young children or adolescents as participants. The Dozier et al. (2012) and the current studies represent the few studies that have included adult participants. It is worth noting that studies including adult participants seem more likely to have non-responders. For example, seven out of twelve participants in the Dozier et al. (2012) study showed no appreciable reinforcing effects using two types of pairing procedures. All participants in the study were 17 years old or older (range: 17-56 years). Non-responders were 23, 26, 38, 39, 47, 54, and 56 years old Perhaps participant age is a factor in the effectiveness of these procedures. Age itself may not be the single variable predicting larger numbers of non-responders, however. Older participants may not have had access to early behavior interventions, which focus on specific interventions designed to increase attending to and discriminating a variety of stimuli. Perhaps these skills are prerequisites for developing conditioned reinforcers. Or perhaps participation in discrete trial teaching, which many young children with autism and developmental participate in and many adolescent children have recent experience participating in, is a factor in the success of procedures to condition reinforcers. Older participants may have no history of this kind of instruction, or it may have been a long time since they engaged in formal instructional procedures.

The current study adds to current research with the introduction of intermittent reinforcement during the establishment of S1 as an S^D. Zimmerman (1959) found that introducing intermittency during the S^D procedure produced robust effects on responding over time. For one participant, making S1 contingent upon R following the conditioning

procedure produced sustained responding over 15 sessions. This is important because one limitation of previous studies on establishing conditioned reinforcement is that either reinforcing effects did not maintain for very long or robustness was not assessed. Clinically speaking, it is most useful for stimuli established as conditioned reinforcers to maintain their reinforcing properties so they can be utilized several times during a variety of learning situations. However, it should be noted that this effect was observed for only 1 of 3 participants. For two participants, no reinforcement effect was observed following the S^D plus intermittency procedure. It is unclear whether a conditioned reinforcer was ever established for the other two participants, with or without the intermittency procedure, because we only measured the effects of the reinforcer after the intermittency procedure. Thus, it is unclear whether the intermittency procedure actually interfered with the development or maintenance of the conditioned reinforcer. Future investigators may want to test the reinforcing efficacy of the S^D prior to implementing the intermittency procedure to determine if a reinforcing effect is produced by the SD procedure. Then, intermittency could be introduced to determine if it produces durability of the reinforcement effect. Future research should also extend this study by introducing double-intermittency of reinforcement which Zimmerman (1957, 1959) proposed. In the double-intermittency preparation, intermittency of reinforcement is introduced both during the establishment and the testing of conditioned reinforcer effects. The present study introduced intermittency only during the establishment of conditioned reinforcers. Zimmerman found that these two manipulations produced robust patterns of responding in the animal basic research using pigeons. We did not introduce the double intermittency in this study, because it would represent two changes from previous research on this topic. We chose to introduce intermittency at only one point—during training—to evaluate its effects alone. Our results suggest that this procedure, in and of itself, may help make the reinforcing effects of the S^D more robust over time. However, more research is

needed. Future research should also investigate the schedule of conditioning-booster probes. Procedural modifications, such as adding intermittency of reinforcement during the establishing of effects of conditioned reinforcers, may help address part of the question of robustness of the conditioned stimulus as a reinforcer. However, previous studies, including the current one, have tested the reinforcing function of stimuli in the absence of additional conditioning trials. Repeatedly presenting a conditioned stimulus in the absence of known reinforcers is likely to degrade the stimulus-stimulus relation which exists between the conditioned stimulus and the reinforcer, resulting in the loss of reinforcing effects of the conditioned stimulus. In addition, it is reasonable to posit that established conditioned reinforcers maintain their reinforcing effects because these stimuli continue to be intermittently paired with established reinforcers in the natural environment. Therefore, determining the most effective and efficient schedule of conditioning booster sessions would be valuable to ensure reinforcing effects are maintained over time.

The current study also extends the literature by proposing an alternative S^D procedure preparation, which consisted of concurrently presenting the S^D and S^Δ stimuli during discrimination training trials. This preparation constituted a deviation from previous studies, which presented S^D and S^Δ stimuli individually on each trial. The concurrent stimulus preparation may provide an alternative discrimination training method investigators and practitioners may use in the event discriminated responding does not occur when S^D and S^Δ stimuli are presented individually. Participants experienced several procedural modification using the single stimulus presentation during each trial (e.g., adding an observing response to reveal the stimulus in effect, blocking responses during S^Δ trials) without success. However, under the concurrent stimulus presentation of the S^D and S^Δ stimuli during each trial, response discrimination occurred within the first session for Eric, and following modifications for the other participants.

It is also important to note that two participants responded maximally during reinforcer test probes when single devices or materials were placed in front of them. Test probes were originally designed to a) evaluate participants' rate of responses on one device without any consequence, b) then when S was made contingent upon the response but prior to the S^D procedure, and c) then again after S was established a discriminative stimulus using the S^D procedure and used as consequence for responses. The participants' high rate of responses was problematic during this phase due to the high level of responding in baseline and ceiling effects this caused. One possible explanation for participants' high rates of responding on devices may be due to pre-existing histories of following instructions or that it was reinforcing to manipulate any stimuli placed in front in front of them. Although there were no programmed consequences for manipulating the devices, responding may have produced stimulation and reinforcement. This is consistent with the findings of Pace and colleagues (1985) and Fisher et al. (1992), who reported that single presentations of stimuli during preference assessments can result in participants approaching all stimuli that were placed in front of them, making it challenging to differentiate between preferred from non-preferred stimuli. As a result, Fisher et al. (1992) evaluated the effects of a concurrent operants paradigm in which two stimuli were presented simultaneously during the assessment, which resulted in better differentiation between stimuli. In the current study, we implemented a concurrent operants preparation for all participants during test probes because the participants approached all stimuli placed in front of them initially.

A second limitation of the current research was the unexpected challenges encountered in Phase 2 in the establishment of a neutral stimulus as a discriminative stimulus. We originally used a discrimination training procedure (i.e., single-s preparation) informed from previous studies which successfully and quickly (28-53 min) produced discriminated responding with participants (Taylor-Santa et al., 2014). However, the single-s preparation

did not produce discriminated responding for any participant, even when adding additional modifications to promote response discrimination. After introducing the concurrent-s preparation, all participants showed response discrimination. Failure to establish a neutral stimulus as a discriminative stimulus using the single-s preparation may have occurred because participants were not orienting to the stimulus presented, but simply responding to the microswitch presented in front of them. Also, the introduction of second stimulus (i.e., a comparison stimulus) during the concurrent-s preparation may have made the S^D stimulus more salient, facilitating discrimination. Attempts were made to address participants' failure to orient to the relevant stimuli by requiring them to engage in one or two observing responses (i.e., touching a card, touching the stimuli), but these were insufficient to affect response discrimination using the single-s preparation. Failure to effectively discriminate between relevant stimuli in the natural environment that reliably signal the availability of reinforcement may be one possible explanation why a characteristic of individuals with disabilities is a limited range of interest and effective reinforcers. Presumably, for an organism to respond differentially to stimuli in their environment, the organism must first attend to the relevant stimulus being conditioned. Teaching simple visual discrimination to individuals with autism and other related disabilities is often a challenge (Schreibman, 1975). Failure to effectively discriminate between relevant stimuli in the natural environment that reliably signal the availability of reinforcement may be one explanation why individuals with disabilities have a limited range of interest and effective reinforcers. Clinical implications can also be drawn from the challenges encountered during the discrimination training. For individuals who show discriminated responding under simple discrimination training arrangement, the S^D procedure can be efficient and effective procedure to promote the establishment of conditioned reinforcers. However, when individuals who do not show discriminated responding within the first few sessions of a discrimination training procedure,

this may suggest there are prerequisite skills that are necessary to effectively discriminate between relevant stimuli are lacking (e.g., visual or auditory stimulus discrimination). Remedial training may be required prior to using the S^D procedure to establish neutral stimuli as conditioned reinforcers.

In summary, a limited range of effective reinforcers is often characteristic of individuals with developmental disabilities. This may prevent these individuals from learning skills that may help promote their autonomy. The current study further evaluated the effects the S^D procedure plus intermittency of reinforcement on the establishing of non-social stimuli as conditioned reinforcers. We found that discrimination training was very challenging with these adult participants, that many training adjustments needed to be made to establish discrimination, and that using a concurrent operants paradigm during discrimination training was more effective than a single-s presentation in establishing neutral stimuli as an S^D stimulus. We also found that the concurrent operant paradigm was more effective than a single operant paradigm for testing the effectiveness of a conditioned reinforcer. We were only able to establish a robust conditioned reinforcer using single-intermittency for one participant of three. It is possible that these procedures are less effective for older participants than younger participants, who may be more likely to have learning histories involving discrete trial instruction. It seems clear that from this and other research on this topic that we are far from an answer as to how to reliably and efficiently establish durable conditioned reinforcers for individuals with autism and other developmental disabilities. Much more research is needed on this very important topic to produce clinically useful protocols for establishing conditioned reinforcers.

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APPENDIX A

Phase 1: Procedures and Results

METHOD, RESULTS, & DISCUSSION

Method, Dependent Variables, Measurement Systems, Results, and Discussion. Preliminary assessments answered Research Questions #1 and #2. The main purpose of Phase 1 was to identify and test for the pre-existing reinforcing effects of neutral stimuli, edible reinforcers, and arbitrary responses that would be used later in Phases 2 and 3.

Reinforcer identification. Investigators gathered information regarding participants' preferred stimuli using the Reinforcer Assessment for Individuals with Severe Disabilities (RAISD; Fisher et al., 1996). The RAISD is an informant-based interview conducted with parents or caregivers to collect information on individuals' preferred stimuli across several sense, including edible stimuli. Stimuli identified in the RAISD was used to inform the array of stimuli used in the preference assessment. Stimuli that were identified in the RAISD in addition to other edible stimuli for each participant are depicted in Figures 7, 8, and 9.

Preference assessment. This assessment specifically addressed Research Question #1. A multiple stimulus without replacement (MSWO) preference assessment procedure (DeLeon & Iwata, 1996) was used to identify SR+ in the form of edibles (e.g., cookies, pretzels, m&m's) for each participant. The purpose of identifying primary reinforcers was to introduce them during the S^D procedure in Phase 2 in establishing new conditioned reinforcers.

Procedure. Prior to the first session, a sampling session was conducted where participants consumed a small piece of each stimulus once. This was performed to reduce confounding effects of selection of stimuli based on novelty. Participants were then seated at a table, with an array of 7 to 10 stimuli placed in front of them (30 cm) and equidistant from each other (7 to 10 cm apart). Participants were given 10 s to make a selection response by either pointing to or picking up one stimulus following the verbal instruction "pick one." Upon selecting a stimulus, participants were given 5 to 10 s to consume the item before

another opportunity to select a new item was initiated. After participants select an edible stimulus, the stimulus was not re-introduced in the array during that session. The order of the remaining stimuli was shifted by taking the stimulus from the far left of the lineup, and placing it to the far right of the lineup, and repositioning the spacing of each stimulus. This process was repeated until participants selected all items in the array, or when participants made no selection within 30 s of the instruction. If participants attempt to select more than one item, the attempt was blocked and the trial terminated. The verbal instruction was represented after a delay of 5 s.

A minimum of three MSWO sessions was conducted for each participant to determine if a clear preference emerged. If a clear preference was determined following three sessions by ranking participants' selection (e.g., if top two or three stimuli could not be identified), an additional two sessions was administered and the stimulus preference ranking was updated.

Dependent variables and measurement. During the preference assessment, observers recorded selection responses as defined by the participant making physical contact with or pointing at one of the presented stimuli in the array (DeLeon & Iwata, 1996). Making physical contact with the presented stimulus was defined as the participant's hand(s) touching or grabbing a stimulus from the array. Pointing at a presented stimulus was defined as the participant's arm and hand moving close (1 to 5 cm) to one stimulus with a finger(s) pointing specifically in its direction. Observers recorded the number of times a specific stimulus is selected and whether it was consumed (e.g., Yes, or No).

After selected stimuli were recorded during each MSWO session (i.e., three or five), they were ranked in order of selection and were assigned ranking scores. Stimuli selected and consumed first were scored higher than stimuli selected and consumed last. For example, in an array of 8 stimuli, the first stimuli selected was assigned a score of 8 and the last stimulus selected was assigned a score of 1. Ranking scores were then summed across three or five

sessions for each stimulus. Most preferred SR+ were those edible items with the top two to four ranking scores. The identified SR+ were tested for their reinforcing function prior to being introduced during Phase 2 to establish Ss as conditioned reinforcers using the S^D procedure.

Results and discussion. The MSWO preference assessment rankings for each participant are shown in Figures 7, 8, and 9. In each figure, stimuli were ranked in the order of preference from most to least preferred based on cumulative ranking scores obtained across sessions. The four most preferred stimuli (indicated by the asterisk) were selected and used during the conditioning procedure in Phase 2.

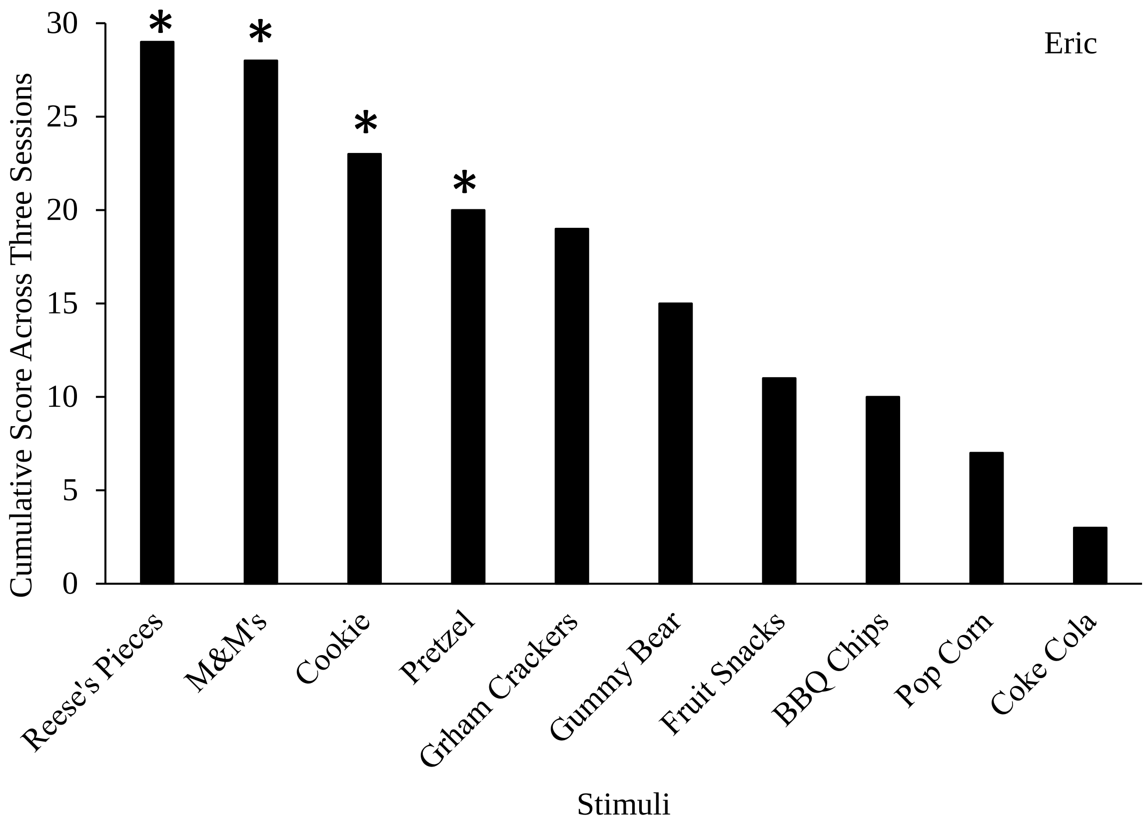

Figure 7. Cumulative ranking scores of stimuli selected during the MSWO for Eric after 3 sessions. Most preferred to least preferred are illustrated from left to right. Reese’s Pieces, M&M’s, Cookie, and Pretzel (with asterisk) were Eric’s most preferred stimuli and were used during the conditioning procedure of Phase 2.

Three sessions were conducted with Eric to identify clear preferences. Eric's four highest ranked edible stimuli were Reese's Pieces, M&M's, Cookie, and Pretzel. These four stimuli were selected as the preferred stimuli to be tested in the reinforcer assessment.

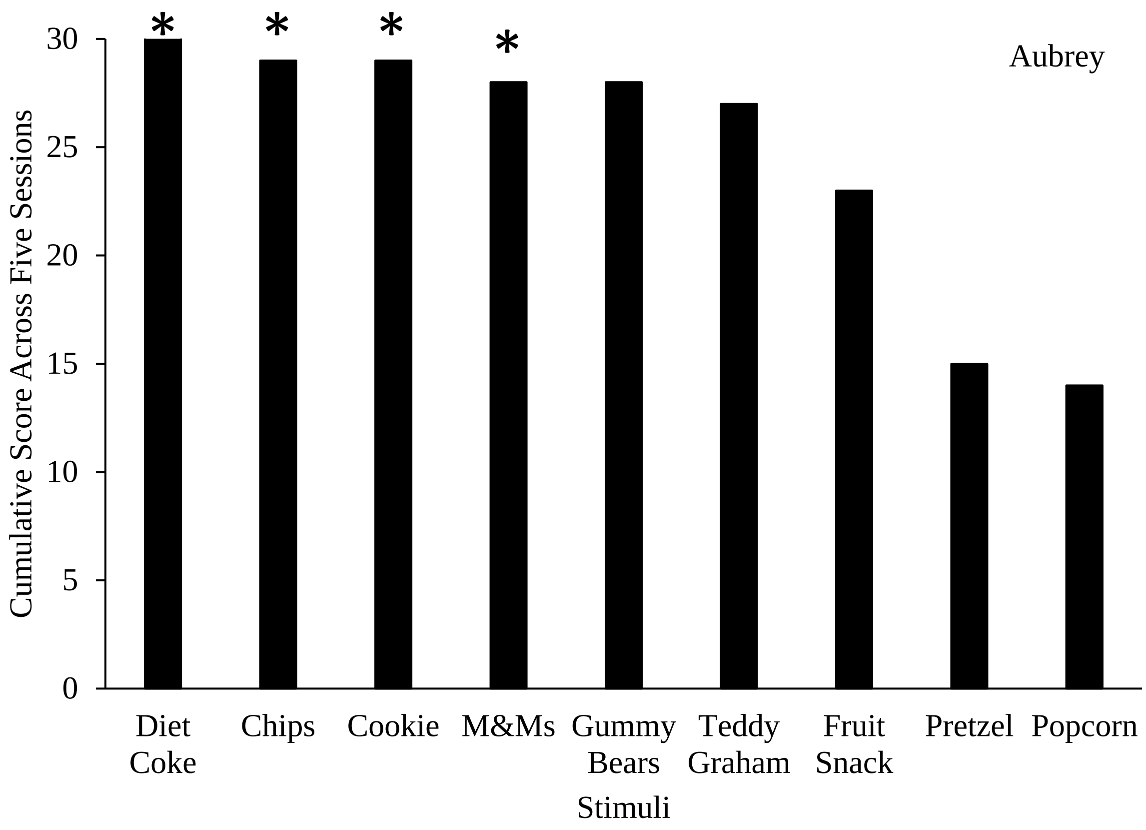

Figure 8. Cumulative ranking scores of stimuli selected during the MSWO for Aubrey after 5 sessions. Most to least preferred are illustrated from left to right. Diet Cola soda, Chips, Cookies, and M&M's (with asterisk) were Aubrey's most preferred stimuli and were used during the conditioning procedure of Phase 2.

Five sessions were necessary with Aubrey to identify clear preferences. Aubrey's four highest ranked edible stimuli were Diet Cola soda, Chips, Cookies, and M&M's. These four stimuli were selected as the preferred stimuli to be tested in the reinforcer assessment.

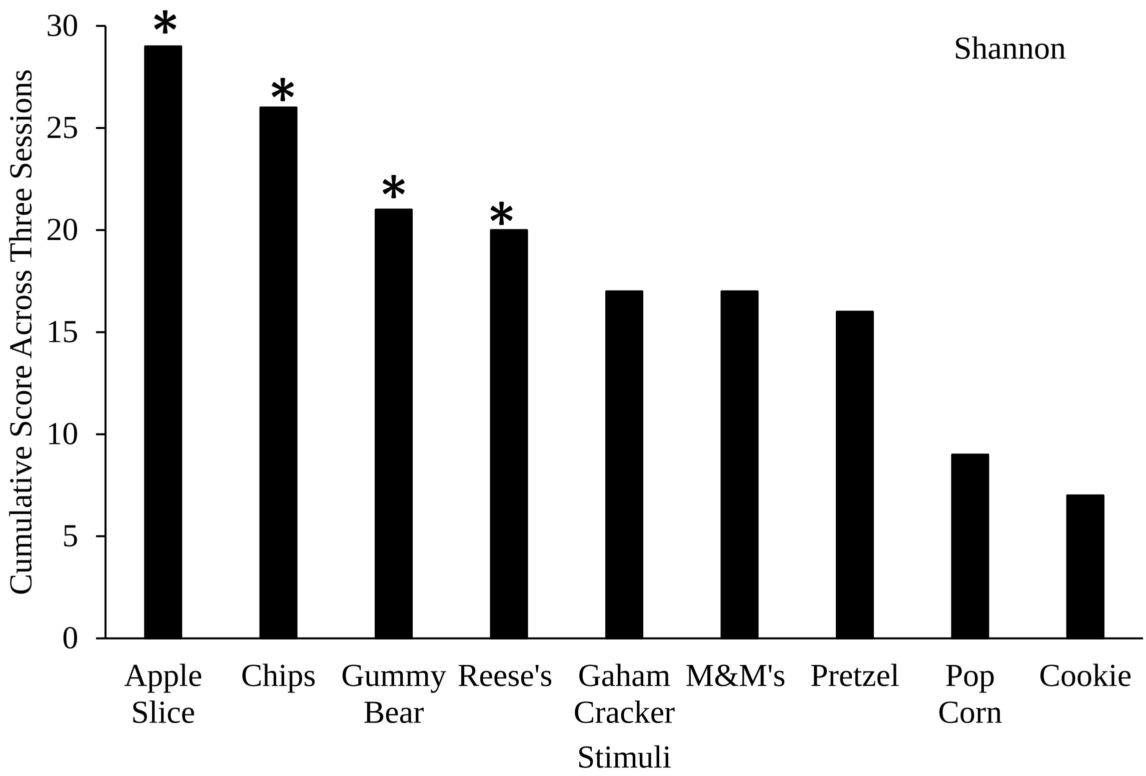

Figure 9. Cumulative ranking scores of stimuli selected during the MSWO for Shannon after 3 sessions. Most preferred to least preferred are illustrated from left to right. Apple slices, Chips, Gummy Bear, and Reese's (with asterisk) were Shannon's most preferred stimuli and were used during the conditioning procedure of Phase 2.

Three sessions were conducted with Shannon to identify clear preferences. Shannon's four highest ranked edible stimuli were Apple slices, Chips, Gummy Bear, and Reese's. These four stimuli were selected as the preferred stimuli to be tested in the reinforcer assessment.

Reinforcer Assessment. The reinforcer assessment also addressed research question #1. The purpose of this assessment was to determine whether SR+s identified in the MSWO actually function as reinforcers for participants.

Procedures. To assess the reinforcing effectiveness of the edible stimuli identified during the preference assessment, two 210 × 297 mm white, printed signs with large, black

letters “A” and “B” were taped at each end of a table approximately 1-2 meters apart, facing participants, at one end of the experimental area. The table with the labels was centered in the room and two boxes (1x1m) were drawn on the floor in front of each label to clearly separate the two choice areas (i.e., “A” and “B”). One of the top reinforcers identified during the preference assessment was placed in front or behind one of the labels, at one end of the table. The placement of the reinforcers was alternated from side A to side B from one trial to another using a coin flip. One trial consisted of having participants stand 2-3 m away from the table (i.e., participants were at the same distance away from side A and side B). The experimenter gave the instruction “pick one side.” Participants were allowed to freely approach one of the two sides (one with a reinforcer, the other with no reinforcers). If participants approached the side without a reinforcer, no programmed consequence was delivered, and a new trial was reset. If participants approached the side with a reinforcer, they could consume a small sample of the reinforcer, and a new trial was reset. A trial ended after a participant entered one of the boxes drawn on the floor and consumed the reinforcer, stood within the box for 10 s., or left the circle before 10 s passed, whichever was observed first. The experimenter then flipped a coin prior to a new trial to determine the placement of the reinforcer. Trials were repeated until participants made no choice responses within 30 s of the instruction “pick one side,” if participants left the assessment area, or if participants showed a clear bias in favor of the side associated with the reinforcer (i.e., participants selected the side with the reinforcer) for three consecutive trials, within 15 trials. This procedure was repeated for each participant and for the top four reinforcers identified during the preference assessment. If 15 trials were conducted and participants did not show a clear bias for the chair associated with the reinforcer, that particular reinforcer was rejected from further use, and a new reinforcer will be assessed and tested. Procedural modifications were conducted with Shannon and Aubrey, and are described in the discussion section.

Dependent variables and measurement. During the reinforcer assessment, observers recorded choice responses defined as participants approaching side A or side B and having at least one foot in, or touching, one of the two boxes drawn on the floor. Duration the participants stood in, or on, one of the two boxes was also measured in seconds to determine when one trial ended and a new could be initiated. For Shannon, the approach response was replaced by reaching with the arm to side A or side B. Also, consumption of the reinforcer was recorded if participants approached or reached to the side associated with the reinforcer.

Results and discussion. Results of the reinforcer assessment for each participant are depicted in Figure 10.

Figure 10. The black bars represent the percent of trials participants selected the side with the reinforcer for each edible stimulus. The grey bars represent the percent of trials participants selected the side without the reinforcer for each edible stimulus. The bars with diagonal lines represent the number of trials necessary to meet criteria for each stimulus.

Eric selected the chair with Reese's, M&M's, Cookie, and Pretzel 100% of the trials and met criteria (3 consecutive correct selections) after the first three trials for each reinforcer. These results demonstrated the top stimuli identified during the preference assessment functioned as reinforcers for Eric.

During reinforcer assessment sessions for Diet Coke, Aubrey selected the side with the stimulus 100% of trials and met termination criteria in 3 sessions. For sessions using Chip, Aubrey selected the side with the stimulus 75% of the trials and the side without the stimulus 25% of the time. Termination criteria was met after 4 trials. For session with Cookie, Aubrey selected the side with the stimulus 60% of the trials and the side without the stimulus 40% of the trials. She met termination criteria after 10 trials. For sessions with the M&M's, Aubrey selected the side with the stimulus 44% of the trials and the side without the stimulus 66% of the trials. Termination criteria was met only after 18 trials, and only after making some procedural adjustments. The procedure was modified while assessing M&M's by reducing the distance from which she started each trial. The research also ensured Aubrey was orienting toward the two labels by saying "look" while pointing at each label prior to initiating the trials with "pick one side." This procedural change was added because it was believed Aubrey was not looking at the two labels (and the reinforcer placed in front of one of the labels) prior to providing the instruction to select a side. It was also hypothesized that the edible stimulus (M&M's) may have been too small for Aubrey to see given her limited vision. These results suggest Aubrey's edible stimuli identified during the preference assessment also functioned as reinforcers.

Shannon selected the side with Apple, Chip, Gummy Bear, and Reese's 100% of the trials and met criteria after the first three sessions for each reinforcer. These results demonstrated that the top four stimuli identified during the preference assessment functioned as reinforcers for Shannon. Procedural adjustments were necessary for Shannon due to her limited mobility (i.e., bed-bound and only had full functional use of one hand). The reinforcer assessment was similar to that described above, but scaled down so it could be conducted on tray placed in front of her while she laid upright in her bed. The same labels (A and B) were placed next to each other (30 cm apart), in front of Shannon. Two paper plates were then placed below the labels such that the labels could still be seen. Finally, using a coin flip, reinforcers were placed on the paper plate on either the A or B side and Shannon was instructed to "pick one side." The selected side and if the reinforcer was consumed was recorded. This procedure was used for Shannon's top four reinforcers identified during the preference assessment.

Satiation Rate Assessment. This analysis addressed Research Question #2 which sought to determine if preferred stimuli maintain their reinforcing properties following repeated consumptions. To assess for satiation effects, edible stimuli were made contingent upon a simple response until 30 small pieces of edible reinforcers were consumed. Then, edible reinforcers were again made contingent upon a simple response using a reinforcer test probe preparation (see Phase 3 procedures for details). Note that if the satiation rate assessment was conducted on the same day as the preference assessment and/or the reinforcer assessment, the number of reinforcers consumed during those assessments were carried over. For example, if a participant was administered the reinforcer assessment (see procedure above) and consumed 12 edible reinforcers, these were carried into the satiation rate assessment such that participants only consumed an additional 18 prior to being administered a reinforcer test probe using edible reinforcers.

Procedures. For this assessment, participants were seated at a table and taught a simple motor response (e.g., hand raising; placing an object in a bowl). Training involved the investigator saying “do this” while modeling the response twice. A most-to-least prompting method was added to training if participants did not emit the modeled response. Each emitted response during training resulted in the immediate delivery of one of the identified SR+ on an FR1 schedule of reinforcement. Following training, the investigator initiated the satiation rate assessment by saying “do this” while modeling the response, and reinforcing every response emitted by participants with a small sample-size piece of SR+, until 30 deliveries of the SR+ occurred. If participants completed the Satiation Assessment and consumed 30 sample-size SR+, then a post-satiation assessment test probe using an arbitrary response (e.g., putting an object in a bowl; completing a puzzle; etc.). Each discrete response was reinforced (i.e., FR1) with a sample-size SR+ during one 5-min session. A one-trial reinforcer preference assessment using participants’ top four SR+ was conducted prior the post-satiation assessment test probe. The selected SR+ was used to reinforce every arbitrary responses during the test probe. For Eric Aubrey, the arbitrary response was placing an object in a bowl. For Shannon, the arbitrary response was placing puzzle pieces on a board.

Dependent variables and measurement. During satiation rate assessment sessions, observers counted the number of reinforcers consumed by each participant. The assessment ended if participants stopped consuming reinforcers before 30 consumption-trials occurs, or after the 30th consumption-trial. If participants stopped consuming reinforcers before 30 consumption-trials were completed, participants were given a 15-20-min break after which trials resumed. The number of reinforcers consumed during the pre-assessment training and the reinforcer assessment were carried over to the satiation rate assessment if sessions were administered the same day. During the post-satiation assessment test probe, the number of

responses emitted during the 5-min session were counted and then converted into rate of responses per minute.

Results and discussion. All three participants completed the satiation assessment by consuming a minimum of 30 sample-size SR+ in one sitting. Immediately following the satiation assessment, a post-satiation test probe was conducted with each participant to determine if they would respond for more edible SR+ following 30 consumption-trials. Figure 11 depicts rate of responding for each participant during the post-satiation assessment test probe.

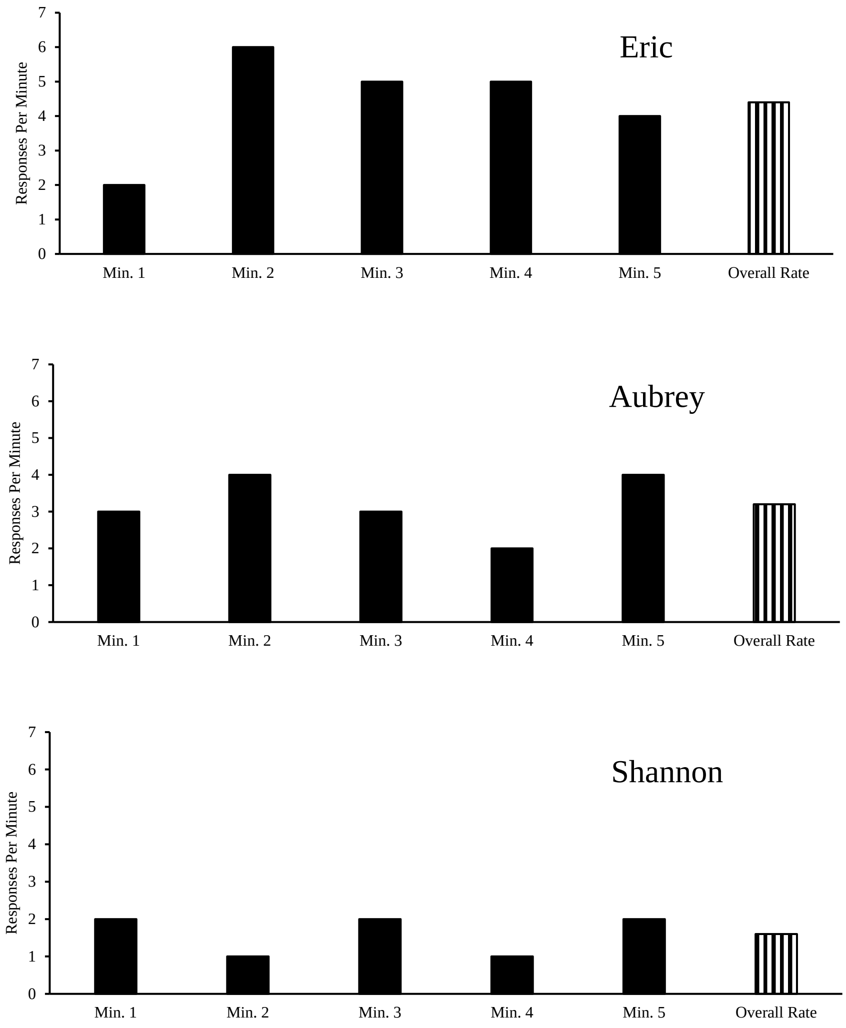

Figure 11: Overall rate of responding for each participant is depicted with the vertical lined bar, on the far right. Within-session rate of responding for each minute are depicted with the black bars.

Eric, Aubrey, and Shannon's overall rate of responding was 4.4, 3.2, and 1.6, responses per minute respectively.

Response and Stimulus Selection: These procedures addressed research question #1. First, four Rs per participant were selected to be used during test baseline and post-conditioning test probes in Phase 3. The four Rs were divided into two pairs that were presented concurrently during test probe sessions. Figure 2 depicts devices and materials that constituted the Rs for participants. R1 required participants to press the red button using a finger, R2 required participants to pull the string, R3 required participants to press a switch, R4 required participants to turn the switch, R5 required participants to place a small block on top of a large block, R6 required participants to place a block laying on one side to the other side, and R7 required participants to place a small ball inside a bowl. Originally, each R was programed to be tested for their automatic function under a single operants arrangement. Early in the assessment, it was observed that some participants tended to emit high rates of Rs when devices or materials were presented in front of them during test probes. The research team decided to use a concurrent operants arrangement during test probes by presenting two Rs for all participants. Test probes using two pairs of two Rs for each participant were conducted in the absence of programmed consequences. These test probes were administered to establish patterns of responding (if any) on Rs in the absence of stimulus delivery.

In addition, two Ss were selected to be established as an S^D and S^Δ via the S^D procedure (Phase 2) and also tested for their reinforcing function in test probes during baseline and after conditioning procedures (Phase 3). Figure 3 depicts S1 and S2 which consisted of stimuli in the form of a yellow gel with lines (S1) and a blue gel with circles

(S2). These stimuli were selected for their simple, unitary features, to reduce possible distracters (e.g., complex features of a stimulus or possible history of interaction with a stimulus such as a toy, or a book). They were also evaluated for their reinforcing function via test probes by making them contingent upon participants' Rs in an alternating fashion.

Procedures. Test probe to establish patterns of responding on Rs were administered similar to the 5 min test probe procedures described in Phase 3 except that no programed consequences were delivered following participants Rs. Rs were still momentarily removed for 5 s before they were again represented. A minimum of two test probes were conducted per pairs of R.

To determine if the Ss were neutral (i.e., no pre-existing reinforcing function) test probe sessions similar to those described in phase 3 were be administered. S1 and S2 were delivered contingent upon Rs in an alternating fashion. For example, if R1 and R2 constituted a pair of Rs, S1 (or S2) was made contingent upon R1 during one test probe session and upon R2 during the next session. Responding on the alternate R resulted in no consequence.

Dependent variables and measurement. For test probes using pairs of two Rs without Ss and with Ss, the number of independent responses on each R was recorded during each 5 min test probe sessions and was converted into rate (number of responses per minute). Rate of responses served as the main dependent measure during test probe sessions. If participants left the research area, the number of Rs (if any) prior to leaving the area were recorded and converted into rate based on the amount of time participants responded prior to leaving the area. Some Rs (devices) were plugged into a digital tally counter and a tally was added each time the R was emitted. Other Rs (items) required participants to manipulate items in a specific way. The product of these Rs resulted in an environmental change that was clearly observable and measurable for the investigator. See Phase 3 section for specific dependent measure definitions on each R.

Results and discussion. See results and discussion section in Phase 3 and figure 6 (left panels) for summary of findings for these procedures.

APPENDIX B

Conditioned Reinforcement: A Review of Applied Procedures and Implications for Future Research

Conditioned Reinforcement: A Review of Applied Procedures and Implications for Future Research

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Abstract

Reinforcement and conditioned reinforcement are ubiquitous, parsimonious, and well-established concepts in the field of behavior analysis. Conditioned reinforcement has been attributed a significant degree of explanatory power in describing a number of phenomena in operant learning. While, basic research has identified several experimental preparations in the development of conditioned reinforcement, few applied studies have attempted to extend basic experimental preparations with humans. This paper reviews basic research preparations used in the study of conditioned reinforcement, discusses the functional role of conditioned reinforcers, and summarizes the applied literature on establishing conditioned reinforcers. The current empirical evidence suggests that two procedures – the discriminative stimulus (S^D) and the response-dependent pairing procedures – have shown promising effects. However, the limited number of studies and the mixed results of current research suggest it is too early to make recommendations for clinical practice. Future studies should focus on further extending basic research preparation into the applied settings, and further investigating S^D and the response-dependent pairing procedures.

Conditioned Reinforcement: A Brief Review of Applied Procedures and Implications for Future Research

Introduction

A brief overview of the current behavior analytic research literature and textbooks suggests that the principle of reinforcement is a ubiquitous, parsimonious, and well-established concept in learning theory (e.g., Cooper, Heron, & Heward, 2007; Malott, 2008). Reinforcement is also a paramount concept in behavior analysis considering most established operant responses in both humans and non-humans can be explained in terms of reinforcement principles. It is reasonable to suggest reinforcement has a central place in a science of behavior.

In defining the characteristics of reinforcement, Skinner (1953) describes reinforcement as an environmental change following a response (e.g., presentation of food after a pigeon emits a key pecking response) which produces a positive shift in the frequency of the response. It is difficult to discuss the principle of reinforcement without discussing the concept of conditioned reinforcement. Whereas a [primary] reinforcer is a stimulus which increases an organism’s rate of responding when made contingent upon a response because the stimulus has some biological value (e.g., food, water, or sexual stimulation) for the organism, a conditioned reinforcer acquire its response-strengthening properties because it has been repeatedly associated with a primary reinforcer (Mazur, 2006; Williams, 1994). Procedurally, the establishment of conditioned reinforcers is often akin to Pavlovian conditioning in which previously neutral stimuli acquire response-eliciting properties via repeated associations with an unconditioned stimulus (Williams, 1994). Similarly, conditioned reinforcers acquire their functional properties via repeated associations with a primary reinforcer. Conditioned reinforcement has been attributed a significant degree of explanatory power in describing numerous behavioral events in the basic literature

(Zimmerman, 1963). The same can be said regarding explaining human behavior, especially when considering the role and mediation of verbal behavior in transforming, altering, or conditioning the function of certain verbal stimuli (see Blakely & Schlinger, 1987; Schlinger & Blakely, 1987). Therefore, understanding the critical variables and manipulations involved in developing conditioned reinforcers is a worthy endeavor to pursue.

The purposes of the present paper are to a) provide a brief overview how conditioned reinforcement has been studied in the basic research literature; b) discuss the functional role of conditioned reinforcers, c) review the empirical studies of conditioned reinforcement in the applied literature, in particular the procedures used to establish conditioned reinforcers; and d) summarize the findings of these studies and propose future directions for research on conditioned reinforcement.

Experimental Preparations Used in Basic Research to Establish Conditioned Reinforcers

Much of our current empirical understanding of the principle of conditioned reinforcement comes primarily from the basic research literature. As a result, the basic literature has explored and informed the field of behavior analysis regarding the variables, preparations, and manipulations related to conditioned reinforcement. Williams (1994) presents an excellent summary of procedures used in empirical investigations of conditioned reinforcement. Williams identified at least five procedures that emerge from the literature on conditioned reinforcement (for a review, see Kelleher, & Gollub, 1962). These preparations are second-order schedules, chain schedules, concurrent chains, observing responses, and delay-of-reinforcement, all of which are briefly described below.

In second-order schedules of reinforcement (or, schedules of schedules), a neutral stimulus (S) is briefly presented to the organism multiple times following a certain response requirement before a primary reinforcer (SR+) is presented (e.g., FI 2 → S → FI 2 → S → FI

2 →SR+; also expressed as FR 3 [FI 2]). Although it is not clear what functional role S acquires under this preparation, an increase in responding is the empirically observed phenomenon. As we will see in in the next procedure, some have suggested that S is established as a discriminative stimulus and indicates that reinforcement with a primary reinforcer is near. In this role, S has an evocative effect on responding. For example, Kelleher (1966) conducted a study in which pigeons' key pecking was well maintained on an FR 30 (FI 2) and FR 15 (FI 4). In the FR 15 (FI 4), pigeons were presented with grain (food) after completing a fifteen FI 4 component, each which was followed by a brief white light presentation (S). Responding maintained even though pigeons contacted the primary reinforcer only after about 60 min of responding, suggesting the white key light (S) had acquired discriminative and/or reinforcing properties.

Another procedure for establishing conditioned reinforcers similar to second-order schedules just described is chain-schedules. In chain-schedules, a primary reinforcer is delivered at the end of a sequence of components, which are each consequated with specific Ss. In this procedure, Ss actually serve a dual function; they serve as a reinforcing stimulus for the response in the previous component, and they serve as a discriminative stimulus for the response in the next component. For example, circus monkeys are taught a sequence of response such as climbing a rope, sliding down a slide, and putting a ball in a hoop. The last component (putting a ball in the hoop) is consequated with food (e.g., banana). This sequence of responses is usually taught using backward chaining in which the last component is taught first, then the preceding component, and so forth. Ss associated with performing the response (e.g., ball and hoop) are then used to reinforce the preceding component (i.e., sliding down a slide), and they also serve as discriminate stimuli for beginning the next component (i.e., putting the ball in the hoop).

In the concurrent chains procedure for establishing conditioned reinforcers, organisms are given a choice between at least two concurrently available chain schedules. Each of the chain schedules is associated with distinct reinforcement schedules (e.g., FR 10 and FI 10). According to William (1994, p. 271), "the assumption underlying the procedure is that choice proportions during the initial links reflect the relative value of the two terminal-link stimuli" which are generally consequated with a primary reinforcer such as food. For example, an organism is presented with two concurrently available two-component chains schedule. It must first be exposed to both available schedules (first one, then the other). In each schedule, completing the first component (e.g., FR10) produces an S signaling that the last component (e.g., FR5) can now be completed. Completing the last component is consequated with a primary reinforcer. The reinforcement schedule is typically different on each available chains schedule. The reinforcing effect of Ss in each available chain schedule is evaluated by measure response allocation made by the organism on each available chain schedules.

The observing response procedure provides yet another example of how conditioned reinforcement has been studied (see Wyckoff, 1952 for a theoretical discussion on the role of the observing response). In an observing response paradigm, the organism experiences periods of food availability for responding and periods of extinction. The observing response does not provide access to the primary reinforcer. Instead, engaging in the observing response provides the organism with "information" on the schedule currently in effect. In other words, engaging in the observing response transforms a mixed schedule of reinforcement (un-signaled schedule) into a multiple schedule of reinforcement in which the effective schedule is revealed. An everyday example of the observing response preparation is when an individual who arrives at 6:45 a.m. to a store that opens at 7 a.m. Typically, this individual can walk up to the doors, push the doors open, and make the desired grocery purchases (primary reinforcers). However, at 6:45 a.m., the store is closed (extinction period). The

observing response in this example would be the individual repeatedly looking at his or her wrist watch. Looking at the watch is maintained because it produces S (i.e., current time) which provide information about the current schedule of reinforcement in effect regarding when the grocery store doors will open when pushed – namely extinction period between 6:45 a.m. and 7 a.m., and reinforcement period between 7 a.m. and 10 p.m.

A final procedure discussed by Williams (1994) in the study of conditioned reinforcement is one that is most often used during delay-of-reinforcement procedures. In this case, a stimulus is introduced during the delay to reinforcement and seems to "bridge" the delay-gap. During long delays, responding is often weak, but with the interspersion of conditioned stimuli that have been correlated with reinforcement, responding can be maintained. For example, Cronin (1980) used a delay-of-reinforcement procedure during a discrimination training in which a 60-s delay was administered between correct responding and the delivery of the reinforcer. Under such "unbridged" delay, discriminated responding was not achieved. However, when colored lights were introduced during the delay, response discrimination was rapidly achieved.

Evaluating the Reinforcing Properties of Conditioned Reinforcers

The reinforcing effects of conditioned reinforcement are generally tested under two types of conditions. One condition involves the maintenance of a previously established response (Zimmerman, 1963; Zimmerman & Hanford, 1966), a test Williams (1994) refers to as resistance to extinction. For example, following a training period in which lever pressing by a rat is strongly established using primary reinforcers (e.g., food or water), the same response is now consequated using the newly established conditioned reinforcer. The reinforcing property of S is evaluated by making S contingent lever pressing and by measuring response rate over time. Another condition involves the strengthening of a new response. For example, the reinforcing property of S is evaluated by using S to shape and

maintain a new response (e.g., chain pulling). Using a shaping procedure, a rat's successive approximation toward the target response of two-pawed chain pulling would be consequated using S. In both types of conditions, testing occurs under extinction in which the organism's behavior is reinforced only using the conditioned reinforcer (not the primary reinforcer) and without additional conditioning trials in which S and a primary reinforcer are associated in any way. Evaluating the effects of conditioned reinforcers under extinction allows to isolate the relative reinforcing effects (if any) of S alone.

Toward an Understanding of the Functional Role of Conditioned Reinforcers

As this overview of procedures used in the study of conditioned reinforcement suggests, investigators have devoted a great deal of time developing a sound conceptualization of conditioned reinforcement. While the procedures to examine the concept of conditioned reinforcement have been refined and somewhat standardized over time, there is no consensus regarding the functional role of the conditioned stimulus as either a discriminative or consequence stimulus. Indeed, conditioned stimuli are often interspersed before and after responding (adding possible confounds in interpretations). Further adding to the lack of agreement regarding the function of conditioned reinforcers is that the complexity of the operations and procedures used in basic research preparations make it challenging to tease out its role.

The function of the stimulus being established as a conditioned reinforcer can be categorized into two main types: a discriminative stimulus function and a reinforcing stimulus function. When the stimulus established as a conditioned reinforcer serves a discriminative stimulus function, the stimulus signals the availability of reinforcement contingent upon some response(s). In this conceptualization, the stimulus has evocative effects on behavior, and the outcome of such effect is an increase in responding (see Davison & Baum, 2006; Fantino, 1977; Fantino & Romanowich, 2007; Shahan, 2010; William, 1994).

For example, Fantino (1977) proposes a delay-reduction hypothesis, in which he suggests that organisms behave to produce stimuli that signal a decrease in time to the primary reinforcement. Here, subjects respond to conditioned stimuli insofar as these “indicate” a reduction in the delay to the terminal, primary reinforcer (e.g., in chain schedules). Shahan (2010) proposes the term “signpost” in lieu of the term discriminative stimulus and suggests organisms respond to produce stimuli that are correlated with primary reinforcers and those stimuli guide the organism by providing information about how to obtain the reinforcer, similar to the observing response discussed earlier in which engaging in the observing response reveals information regarding the schedule of reinforcement in effect.

Conversely, if the conditioned reinforcer serves a reinforcement function, the stimulus increases the future probability of a response when it is presented contingent upon a response. In this formulation, the stimulus acquires response-strengthening effects in and of itself and is functionally substitutable for the primary reinforcer with which the stimulus was originally paired with (see Kelleher & Gollub, 1962; Williams, 1994). For example, in a study by Zimmerman (1963), pecking responses by pigeons were reinforced on two simultaneously available keys. On one key, pecking was intermittently reinforced with food and on the other key, the same response was intermittently reinforced with a set of stimuli that were associated with the availability of food (primary reinforcer). Results suggested that responding was maintained on both keys. Higher levels of responding were observed for the key associated with food, but the authors suggested that, although response rates were lower, responding on the key associated with conditioned stimuli (reinforcers) was maintained “indefinitely.” Response strengthening effects are discussed in terms of the stimulus’ reinforcing, not discriminative, function. Williams (1994) proposes a less familiar term, originally coined by Rachlin (1976) for the reinforcer-conceptualization of the conditioned reinforcers – namely,

"marking." With marking, a stimulus presented following a response is said to emphasize the significance of the response as an important event.

The two main conceptualizations of the functional role of conditioned stimuli as antecedent conditioned stimuli or as conditioned reinforcers have received some empirical attention, but it is not clear if additional studies will help answer the question because current methodologies cannot clearly separate the two functional roles. Although determining the functional role of conditioned stimuli may continue to be of interest to basic investigators for knowledge's sake, the consensus based on empirical data is that they both increase rate of responding. And from a pragmatic standpoint, the fact that these stimuli increase responding because of their evocative, or their reinforcing, effect on behavior makes researching experimental procedures relevant to the applied setting, in particular for individuals for whom few stimuli effectively produce increases in responding.

Preparations Used in Applied Research to Establish Conditioned Reinforcement with Humans

Basic investigators have provided several preparations for developing and examining conditioned reinforcement, and the basic literature is replete with examples of such. However, far fewer examples of applied research on conditioned reinforcement can be found. In this section, we will attempt to review some of these studies to determine what can be said about the utility of these procedures with human participants and to suggest areas of basic research that still need to be conducted so that the basic preparations can be translated to human participants more readily.

Token Economy

One area of applied research that illustrates the concept of conditioned reinforcement can be found in the token economy literature. Token economies are typically used in applied settings as a means of maintaining, teaching, and supporting desirable behaviors by the

delivery of tokens contingent upon target responses. Tokens are typically exchanged by the recipients for backup reinforcers. The tokens are considered conditioned reinforcers as a result of their association with the known reinforcers for which they are exchanged (e.g., edibles, preferred toys, activities). However, in his review on token economies, Hackenberg (2009) concluded that only few studies have empirically identified "the necessary and sufficient conditions for tokens to function as conditioned reinforcers." Little is known about what is the optimal procedure for establishing a stimulus as a conditioned reinforcer and maintaining its efficacy as a reinforcer (Hackenberg, 2009). An experiment that does provide some empirical data on procedures used in the establishment of conditioned reinforcers using tokens was conducted by Moher, Gould, Hegg, and Mahoney (2008). Using a 2-stage protocol, tokens were first presented to subjects and immediately followed (i.e., 0.5 s) by the delivery of an edible reinforcer (i.e., initial pairing; Stage 1). In Stage 2, investigators delivered tokens to participants contingent upon a response (i.e., hand-raising). Participants could then exchange the tokens for edible reinforcers. Reinforcer assessment results indicated that the tokens paired with edible reinforcers acquired reinforcing properties as evidenced by similar rates of responding when responses were reinforced by token as when reinforced by edibles. Though this study contributes to the token economy literature in delineating specific procedures for establishing tokens as reinforcers, tokens were still exchanged for backup reinforcers at the end of the reinforcer assessment. As stated previously, the basic research has typically studied the effects of conditioned reinforcers under extinction conditions. Maintenance of the reinforcing efficacy of tokens beyond the initial pairing, or without the use of backup reinforcers (i.e., under extinction conditions), was not assessed in the Moher et al. (2008) study. Thus, it is not clear whether performance would have continued to persist when only the tokens were available as reinforcers. In sum, while many, many studies using token economies can be found in the literature, few if any provide experimental examples of

how (or whether) the tokens served as conditioned reinforcers, and if so, how this was accomplished. Thus, this literature is not very helpful to the discussion of conditioned reinforcement here.

Translating Preparations from Basic to Applied Research to Establish Conditioned Reinforcers

Conditioned reinforcers (e.g., social praise, stimuli associated with reading books and articles, tokens) serve an important role in the development and maintenance of human behavior. The importance of conditioned reinforcement is perhaps most evident with individuals who do not develop a wide range of effective conditioned reinforcers – a characteristic typical of individuals with autism and/or other developmental disabilities (American Psychiatric Association, 2000). For example, children diagnosed with autism for whom few effective conditioned reinforcers can be identified may be at risk of making slow or little progress in their development. In reviewing a sample of behavior analytic textbooks (e.g., Cooper et al., 2007; Greer & Ross, 2008; Malott, 2008), it is evident that the concept of conditioned reinforcement has been well integrated into our applied account of operant behavior. However, it is equally evident that these resources provide few procedural details for the establishment conditioned reinforcement with the exception of general statements such as "… to create a learned reinforcer out of the statement *good girl* [one needs to] pair *good girl* with other reinforcers such as little bites of … food" (Malott, 2008, p. 181). Little is known regarding the necessary and sufficient conditions under which neutral stimuli may acquire conditioned reinforcing properties with humans, and the limited body of research that does exist suggests that the process of establishing conditioned reinforcers is more complex than merely pairing neutral and reinforcing stimuli together (Dozier, Iwata, Thomason-Sassi, Worsdell, & Wilson, 2012). Only few studies have attempted to extrapolate preparations from the basic animal literature to the applied setting in establishing conditioned reinforcers.

Lovass et al. (1966) conducted one of the earliest studies on establishing conditioned reinforcers with humans, applying basic research preparations to this population. Two schizophrenic children (each 4-years old) participated in experimental manipulations to condition social events (the word “good” and a light physical touch on the back) as reliable discriminative stimuli. An S^D procedure was used in which participants’ responses (approaching the experimenters) were differentially reinforced with food (primary reinforcer) in the presence of the social events; responding was placed on extinction when the social events were not present during trials. Thus, the social events were initially established as discriminative stimuli. Following the discrimination training procedure which established social stimuli as discriminative stimuli, the social stimuli were then operationally used as consequences during a testing phase in which they were presented contingent upon an arbitrary response (i.e., bar pressing). This testing phase was administered to evaluate the reinforcing effects of the discriminative stimuli when made contingent upon a novel response. Results indicated that following the implementation of the S^D procedure, social events maintained relatively high rates of responding when presented contingent upon bar pressing for both participants. This study illustrates the successful use of an S^D procedure to establish initially neutral stimuli as conditioned reinforcers. The S^D procedure utilized an experimental preparation similar to a one component chain schedules (or also concurrent chains) in which the initial and terminal link are essentially the same. In the Lovass and colleagues’ study, participants were initially trained on a FR1 schedule of reinforcement (S → R → SR+ vs. no S → R → no SR+). Although the study lacks social validity with respect to the new response trained (i.e., bar pressing) during the testing phase for conditioned reinforcement effects of the social events, the authors showed that procedures extended from the basic literature can effectively be used in the applied setting with clinical patients.

Nearly a decade after Lovass et al. (1966) established social events as conditioned reinforcers, Stahl, Thompson, Leitenberg, and Hasai (1974) further extended basic procedures to the applied setting by evaluating a pairing procedure to establish social praise and tokens as conditioned reinforcers with three socially unresponsive participants. The study was conducted across several phases in which praise alone, tokens alone, or praise + tokens were delivered contingent on individual-specific responses (e.g., verbal utterances, eye contact, or activities of daily living skills). The preparation used to associate the neutral stimulus with the reinforcer was the pairing procedure, which involved the presentation of the neutral stimulus ("good," "very good") in close temporal proximity with a known reinforcer (tokens). The results indicated that prior to the pairing procedure, social praise remained at baseline levels. Then, during the phase in which social praise and tokens were paired, responding increased for each subject. Finally, responding was maintained in the last phase when social praise alone (no tokens) was made contingent on responding (post-pairing procedure phase), suggesting that social praise had acquired response-strengthening properties for each participant. Stahl et al.'s (1974) study is also an example of chain schedule except that the temporal location of the conditioning strategy is not at the beginning of the component like the Lovaas et al. (1966) study in which S is established first as a discriminative stimulus (S [as an S^D]: R → SR+). Instead, the conditioning strategy is focused at the end of the component where the neutral stimulus is paired with the reinforcer immediately following the target response (R → S-SR+). This conditioning procedure has been called the response-contingent (or dependent) stimulus pairing procedure because the pairing of the neutral stimulus and the reinforcer (generally primary) occurs dependent upon the emission of a response by the individual (e.g., Dozier et al., 2012).

The pairing procedure used in Stahl et al. (1974) can be contrasted with another type of procedure which involves a response-independent association between the neutral stimulus

and the primary reinforcer as in a study by Holth, Vandbakk, Finstad, Grønnerud, and Sørensen (2009). Holth et al. (2009) conducted a similar experiment as Lovass and colleagues (1966) in which the S^D procedure was used to establish conditioned social stimuli (praise, or the sound of a toy). However, Holth et al., extended Lovaas et al.'s (1966) work by comparing the S^D procedure with another common procedure – the pairing procedure, somewhat similar to that used by Stahl et al. (1974). The S^D procedure was similar to that described the Lovass et al. (1966) study, but for the pairing procedure, participants were seated at a table, and a neutral stimulus (e.g., the social utterance "yay") was presented immediately followed by the presentation of a known reinforcer. The experimenters programmed for overlap between the neutral stimulus and the reinforcer presentation. Operationally, the response-independent pairing procedure is different from the response-dependent pairing procedure described earlier in that the associative procedure occurs in the absence of a target response (i.e., no R → S-SR+). In other words, the participant is "passive" during the associative procedure. In their study, Holth et al. compared the effectiveness of the S^D procedure and the pairing procedure in establishing social conditioned reinforcers. The results of the reinforcer tests indicated that the S^D procedure was more effective relative to the response-independent pairing procedure in maintaining responding for five of the seven participants involved in the study. For one participant, both procedures were equally effective, and for another participant, the pairing procedure was more effective. Absolute effects of the pairing procedure were observed for five of the seven participants. Absolute effects of the S^D procedure were observed for all seven participants. Both procedures used in Holth's et al., (2009) study are similar to the one component, chain schedule discussed above with the S^D procedure focusing the conditioning strategy at the beginning of the component (i.e., S: R → SR+) and the pairing procedure focusing on the end of the component (i.e., no R → S-SR+).

In a more recent study, Dozier et al. (2012) conducted two experiments to compare the response-independent pairing procedure with the response-dependent pairing procedure. In the first experiment, four participants experienced the pairing procedure in which a neutral stimulus (praise) was immediately followed by the presentation of food (primary reinforcer) with. A total of 1600 to 2400 pairing trials were conducted before testing the reinforcing effectiveness of praise. Dozier and colleagues (2012) found that the neutral stimulus (praise) did not produce appreciable increases in responding (target response) for 3 of 4 participants. A negligible increase in responding was observed for 1 participant. In the second experiment, a response dependent pairing procedure was used with 8 participants, who were required to engage in a target response before the neutral stimulus reinforcer pairing occurred. The results indicated that for 4 out of 8 participants, responding on the target response increased during the response-stimulus pairing procedure but then returned to baseline levels when praise was delivered without the food. Conversely, responding on the target response increased during the conditioning procedure and maintained during the test condition for the other 4 participants, suggesting that praise had acquired reinforcing value. Praise also increased new target responses for all participants. The authors concluded that the response dependent pairing procedure was more effective than the traditional response independent pairing procedure. However, it is not clear why the response-stimulus pairing procedure was ineffective for half the participants during Experiment 2.

Most recently, Taylor-Santa and colleagues (2014) also evaluated the effects of the S^D procedure in establishing conditioned reinforcers for three children diagnosed with autism. In their study, a investigator initially taught participants to respond in the presence of a neutral visual stimulus (e.g., picture depicting sound waves). The neutral stimulus was functionally established as a discriminative stimulus (S^D) using a discrimination training paradigm similar to Lovaas et al. (1966) and Holth et al. (2009). However, the procedures also included

another stimulus, which functionally served as an S^{Δ} in the presence of which responses were not reinforced (i.e., extinction). In the Lovaas et al. (1966) and Holth et al. (2009) studies, the S^{Δ} was the absence of the S^{D}. The rationale for introducing a specific stimulus as an S^{Δ} (as opposed to S^{Δ} merely being the absence of the S^{D}) was to increase the salience of the S^{D} and supposedly strengthen conditioning effects. Taylor-Santa and colleagues (2014) found that the S^{D} procedure (with the added S^{Δ} stimulus) was effective in establishing neutral stimuli as conditioned reinforcers for all three participants, evidenced by increase rates of responding (simple motor responses) during post-conditioning tests.

Analysis of Current Applied Research Findings: Clinical Implication and Future Direction for Applied Research

There are a handful of studies that have examined conditioned reinforcement directly with human participants. The picture which emerges from these applied studies included in this review is mixed and unclear, though some consistencies have begun to emerge. Table 1 depicts the effects of each conditioning procedure based on the total number of participants who experienced each. Across studies reviewed, the response independent pairing procedure was administered with a total of 11 participants. A conservative analysis of the data reported showed that this procedure produced effects for only 55% (6 out of 11) of participants. Although it is a relatively easy procedure to administer, the data suggest it may not be very effective in establishing neutral stimuli as conditioned reinforcers. Even Lovass et al. (1966) anecdotally reported that they had attempted this procedure, but were unable to produce reinforcing effects, despite reporting conducting numerous pairing trials. In contrast, the response dependent pairing and S^{D} procedures showed the most promising results and appear to be worth investigating further. The response dependent pairings procedure was reported to be effective in establishing neutral stimuli as conditioned reinforcers for 64% (7 out of 11) participants with whom it was administered, and the S^{D} procedure was effective with 100% (12 out of 12) of participants.

Table 1. Effectiveness of Conditioning Procedures

Conditioning Procedures	N	% Effective
Response-Independent procedure (No R → S-SR+)	6/11	55%
Response-Dependent procedure (R → S-SR+)	7/11	64%
Discriminative Stimulus procedure (S^D: R → SR+)	12/12	100%

It is not clear why these the response-dependent and discriminative stimulus procedures are more effective. Dozier et al. (2012) noted that the response-dependency characteristic of the response-stimulus pairing procedure seems to play a key role in facilitating the conditioning process, but no attempt was made to explain why this may be the case. For the S^D procedure, one can posit that conditioning is facilitated because the organism must attend to the stimulus being established as a discriminative stimulus first before it is used operationally as a conditioned reinforcer. This is not necessary in the traditional (response independent) pairing procedure. Unfortunately, teaching simple visual discrimination to individuals with autism and other related disabilities is often a challenge (Schreibman, 1975). Failure to effectively discriminate between relevant stimuli in the natural environment that reliably signal the availability of reinforcement may be one explanation why individuals with disabilities have a limited range of interest and effective reinforcers.

Although some conditioning procedures have demonstrated promising effects, the magnitude of effects varied widely across participants and were relatively weak. Furthermore, the variability in the results and the very limited number of applied empirical studies on conditioned reinforcement make it difficult to make strong conclusions regarding what procedures are more effective in the development, establishment, and maintenance of the effects of conditioned reinforcers. Many of the studies examined the use of praise as the "neutral" stimulus and attempted to condition it as a reinforcer. Little is known about the participants' histories with praise prior to the inception of these studies. Dozier et al. (2012)

noted that although they used verbal phrases that their participants had perhaps never heard prior to participating in the study, the phrases were likely similar enough to other statements participants would have heard throughout their lifetime. Furthermore, Dozier and colleagues also suggested that what may appear to be a simple stimulus such as praise is, in fact, a multi-component stimulus with many dimensions (e.g., tone of voice, eye contact, facial expression, etc.) that participants likely have extended histories with. Furthermore, it is generally accepted that less control can be achieved in applied research compared to what is possible to accomplish in basic preparations where most every aspect of the experiment can be controlled. Perhaps a response to this last limitation is to encourage more applied investigators to replicate basic preparations using simpler stimuli to be conditioned as reinforcers to determine if results from basic research also hold with humans. Taylor-Santa et al. (2014) currently stands out as the only study to arrange their experimental preparation similar to a human operant study in an effort to minimizing confounds present in earlier studies. For instance, instead of using social stimuli (e.g., praise statements, physical touch) as their Ss, Taylor-Santa and colleagues utilized simple visual stimuli in the form of pictures across each of their participants. In addition, responses selected during the testing of the reinforcing function were simple motor responses that were relatively equivalent in terms of effort for each participant. Additional studies like this one will help parse out the variables that do matter from those that are irrelevant in establishing conditioned reinforcers. Studies like this will also enable us to make stronger conclusions regarding the efficacy of each procedure because confounding variables are better controlled.

Finally, in each of the applied studies reviewed here, and consistent with the more recent basic research on conditioned reinforcement (Williams, 1994), tests for the reinforcing property of conditioned stimuli were evaluated by making S contingent upon a new, or low rate (neutral), response. None of the studies utilized the resistance to extinction method

described above. This test is likely the better choice in evaluating the effects of conditioned reinforcers because it better controls for possible confounds. First establishing a response using known reinforcers may complicate the analysis if the same response is now consequated with a newly established conditioned reinforcer. Conclusions are only made more convoluted by having to parse out the current effects the conditioned stimulus has on responding from responding which may be affected by previous reinforcement contingencies using known reinforcers.

In his tutorial on conditioned reinforcement, Williams (1994) concluded his paper by suggesting that each of the experimental procedures he reviewed suffered from ambiguities in how existing data could be interpreted, in particular regarding the functional role of conditioned reinforcers on behavior. If there exists uncertainty in the conclusions that can be made regarding the status of conditioned reinforcement in basic research, where control over variables is tightest, the same must be true for extensions of procedures and findings to the applied and clinical settings, where experimental control is generally weaker. Yet, the current applied research does show promising direction for future research.

Future Research

The applied studies reviewed here provide an example of a pragmatic approach to the extrapolation of basic animal research preparation to the applied setting and they illustrate a type of research characteristic of translational research. Lerman (2003) suggested that translational research starts when basic research findings are replicated and then extended to the clinical setting to solve socially significant problems. Such research may provide the basis for the development of standard operating procedures (e.g., manuals) describing the various steps used to establish conditioned reinforcers with particular populations. Then, as research findings continue to refine our knowledge for the establishment of conditioned reinforcers with humans, practitioners would be equipped with refined procedures and it may even be

conceivable that refinements made would provide reliable information regarding what procedures are most effective with various client profiles (e.g., typically developing individuals, non-verbal vs. verbal, autism vs. down syndrome, etc.), or clients' preferences may even be considered. Although these are promising directions for the clinical setting, we are currently far from being able to inform our practices regarding the establishment of conditioned reinforcers. More research is necessary to replicate and extend the few current studies that exist. For example, most applied studies used some version of chained schedules in establishing conditioned stimuli. However, Williams (1994) suggests that concurrent chains is most often used in the basic research literature in the study of conditioned reinforcement. None of the applied studies have extended this preparation in establishing and evaluating conditioned reinforcers. William proposes concurrent chains has been used because it permits a quantitative analysis of the relative value of conditioned reinforcing effects of Ss on each available schedule by recording proportion of choices made on each schedule. Future research should investigate the effectiveness and utility of the concurrent chains schedule in the applied setting with typically and developmentally disabled individuals. Furthermore, although individuals reported in studies presented in this paper using the S^D procedure constitute responders to this type of preparation, individuals with disabilities often have difficulty discriminating amongst stimuli (Schreibman, 1975), which may undermine the utility of this procedure for a relatively large number of individuals unless remedial discrimination training takes place. Future research should review the current applied research on stimulus control and stimulus discrimination procedures and incorporate these findings into S^D procedure preparation in the establishment of conditioned reinforcers.

Conclusion

Finally, given the difficulties that already exist in interpreting findings on conditioned reinforcement in the basic literature, it may be useful to take a practical approach in the

pursuit of establishing conditioned reinforcers with humans where controlling all relevant variables is not always feasible, or doing so may negatively impact both the social and face validity of these procedures. It is not unreasonable to suggest that applied research may not answer conceptual questions about the functional role of stimuli established as conditioned reinforcers using the above preparation, and it may not be possible to identify why certain preparations are more effective than others, but it does seem reasonable to suggest that applied research may still uncover some regularities in the effects of certain preparations and procedures with humans, and their long-term outcomes. From a clinical standpoint, why particular procedures work or not seems less important than the fact that at least a few do work sometimes and may contribute in producing socially significant changes for clients receiving behavioral services.

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APPENDIX C

HSIRB Approval Letters

WESTERN MICHIGAN UNIVERSITY

Human Subjects Institutional Review Board

Date: February 19, 2014

To: Stephanie Peterson, Principal Investigator
Yannick Schenk, Student Investigator for thesis

From: Amy Naugle, Ph.D., Chair Amy Naugle

Re: HSIRB Project Number 13-11-09

This letter will serve as confirmation that your research project titled "Establishing and Testing Conditioned Reinforcers – Comparison of the Pairing vs. Discriminative Stimulus Procedures with Individuals with Disabilities" has been **approved** under the **full** category of review by the Human Subjects Institutional Review Board. The conditions and duration of this approval are specified in the Policies of Western Michigan University. You may now begin to implement the research as described in the application.

Please note: This research may **only** be conducted exactly in the form it was approved. You must seek specific board approval for any changes in this project (e.g., ***you must request a post approval change to enroll subjects beyond the number stated in your application under "Number of subjects you want to complete the study)."*** Failure to obtain approval for changes will result in a protocol deviation. In addition, if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

Reapproval of the project is required if it extends beyond the termination date stated below.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: November 20, 2014

251 W. Walwood Hall, Kalamazoo, MI 49008-5456
PHONE: (269) 387-8293 FAX: (269) 387-8276

WESTERN MICHIGAN UNIVERSITY

Human Subjects Institutional Review Board

Date: March 29, 2016

To: Stephanie Peterson, Principal Investigator
Yannick Schenk, Student Investigator for thesis
Student Investigators: Marissa Allen, Kristin Hagen, Rebecca Kolb, Cody Morris, Denice Rios Katie Suszek, Nathan VanderWeele, Kelsey Webster, Rebecca Wiskirchen

From: Amy Naugle, Ph.D., Chair Amy Naugle

Re: HSIRB Project Number 13-11-09

This letter will serve as confirmation that the change to your research project titled "Establishing and Testing Conditioned Reinforcers – Evaluating the Durability of Effects of the Discriminative Stimulus Procedure Using Intermittency of Reinforcement with Individuals with Developmental Disabilities" requested in your memo received March 29, 2016 [to revise project title; add student investigator Kelsey Webster; revise study duration to "6-7 hours across 10-18 days/sessions;" modify study procedures (amend neutral stimuli, test probes, dependent measures, conditioning procedures; remove Phase 3); modify risks to participants; revise consent document to reflect these changes] have been approved by the Human Subjects Institutional Review Board.

The conditions and the duration of this approval are specified in the Policies of Western Michigan University.

Please note that you may **only** conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: November 20, 2016

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APPENDIX D

Main Dependent Measure Data Sheets

Phase 2

Session #:			Date:
Trials	Trial-type (SD or SΔ)	Ind. (+) & Prpt (-)	Comments
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
% of (+)			

10-trial data sheet for the S^D procedure

Phase 3

Date:						Totals
Test Probe Session #:						
Minutes	1Min. (0s to 59s)	2Min. (60s to 119s)	3Min. (120s to 179s)	4Min. (180s to 239s)	5Min. (240s to 299s)	Totals
Response Tally						
Rs per minute						

Date:						Totals
Test Probe Session #:						
Minutes	1Min. (0s to 59s)	2Min. (60s to 119s)	3Min. (120s to 179s)	4Min. (180s to 239s)	5Min. (240s to 299s)	Totals
Response Tally						
Rs per minute						

5-min data sheets for reinforcer test probes

APPENDIX E

Treatment Integrity Data Sheets

Phase 2

- Primary Observer Participant #: ____________ Date: ___________
- Secondary Observer Video Code: ____________

SD Procedure (STEP 1) – Treatment Integrity Sheet				
Circle current prompt level: Ind., // F, P, G, V				
Prior to start of each SD procedure session, was a brief preference assessment conducted with an array of 2-3 edible reinforcers?		YES	NO	NA
Pre-session training? PROMPT TWICE?		YES	NO	NA
Trials	Procedural Steps	YES	NO	NA
1	Was S and placed in front of BigMack for 2-3 seconds (blocking access to BigMack)?	YES	NO	NA
	While S remains on, was S then placed behind BigMack for 5 seconds?	YES	NO	NA
	CORRECT trial – If P independently responds on BigMack within 5 sec., then: 1. S and BigMack are immediately removed 2. SR+ (edible stimulus) selected during pre-session pref. assessment is immediately (within 1s) delivered to P (there should be no overlap between S and SR+ delivery)	YES	NO	NA
	INCORRECT trial – If P does not respond on BigMack within 5 sec., then: 1. Appropriate prompt delivered (F, P, G, or V) 2. S and R are immediately removed 3. SR+ (edible stimulus) selected during pre-session pref. assessment is immediately (within 1s) delivered to P (there should be no overlap between S and SR+ delivery)	YES	NO	NA
	Was P given 10-15 second inter-trial time to consume SR+?	YES	NO	NA

Treatment Integrity Data Sheet for the S^D procedure – Step 1

- Primary Observer Participant #: ____________ Date: ___________
- Secondary Observer Video Code: ____________

SD Procedure (STEP 2) – Treatment Integrity Sheet				
Pre-session training? Was response(s) prompted twice?		YES	NO	NA
Trials	Procedural Steps			
1	(If applicable) – Was Observing response (Card, or Closed Binder) and BigMack button(s) placed in front of P before each trial	YES	NO	NA
	Was correct trial type (SD-trial or SΔ-trial), OR was SD and SΔ stimuli placed on correct side (left or right), based on pre-randomized sequence?	YES	NO	NA
	CORRECT trial – If P independently responds correctly on SD trial or on side with SD stimulus on BigMack within 5 or 10 sec., then (P22 = 5 s; P44 = 5 s; P55 = 10 s; P66 = 10 s): 1. S are immediately removed 2. SR+ is immediately (within 1-3s) delivered to P	YES	NO	NA
	INCORRECT trial – If P does not respond on BigMack within 5 or 10 sec., then (P22 = 5 s; P44 = 5 s; P55 = 10 s; P66 = 10 s): 1. Prompt delivered (F, P, G, or V) on correct response 2. S are immediately removed 3. SR+ is immediately (within 1-3s) delivered to P	YES	NO	NA
	INCORRECT trial – If P independently responds incorrectly on SΔ trial or on side with SΔ stimulus on BigMack within 5 or 10 sec., then (P22 = 5 s; P44 = 5 s; P55 = 10 s; P66 = 10 s): 1. S are immediately removed 2. SR+ is NOT delivered to P	YES	NO	NA
	Was P given correct inter-trial to consume SR+ ? • Generally, inter-trial time is 20s. • During some sessions, 20s for correct responses, 40s for incorrect responses	YES	NO	NA

Treatment Integrity Data Sheet for the S^D procedure – Step 2

- Primary Observer Participant #: ____________ Date: ___________
- Secondary Observer
- Video Code:

SD Procedure (STEP 3) – Treatment Integrity Sheet				
Pre-session training? Was response(s) prompted twice?		YES	NO	NA
Trials	Procedural Steps			
1	Was Observing response (Card) and BigMack button(s) placed in front of P before each trial	YES	NO	NA
	Was correct trial type conducted (SD and SΔ stimuli placed on correct side [left or right]) based on pre-randomized sequence?	YES	NO	NA
	CORRECT trial – If P independently responds correctly on SD trial or on side with SD stimulus on BigMack within 5 or 10 sec., then (P22 = 5 s; P44 = 5 s; P55 = 10 s; P66 = 10 s): 1. S are immediately removed 2. SR+ is immediately (within 1-3s) delivered to P EXCEPT for unreinforced Trials (see DV sheet): 1. S are immediately removed 2. SR+ is NOT delivered to P	YES	NO	NA
	INCORRECT trial – If P does not respond on BigMack within 5 or 10 sec., then (P22 = 5 s; P44 = 5 s; P55 = 10 s; P66 = 10 s): 1. Prompt delivered (F, P, G, or V) on correct response 2. S are immediately removed 3. SR+ is immediately (within 1-3s) delivered to P	YES	NO	NA
	INCORRECT trial – If P independently responds incorrectly on SΔ trial or on side with SΔ stimulus on BigMack within 5 or 10 sec., then (P22 = 5 s; P44 = 5 s; P55 = 10 s; P66 = 10 s): 1. S are immediately removed 2. SR+ is NOT delivered to P	YES	NO	NA
	Was P given correct inter-trial to consume SR+ ? (20s)	YES	NO	NA

Treatment Integrity Data Sheet for the S^D procedure – Step 3

Phase 3

- Primary Observer Participant #: ____________ Date: ___________
- Secondary Observer

Correct Consequence:

Phase 1 → Testing automatic reinforcing function of Rs →Consequence = nothing (no consequence)
Phase 1 → Testing pre-existing reinforcing function of Ss or S^{Δ} → Consequence = Ss or S^{Δ}
Phase 3 → Testing baseline and post-conditioning reinforcing effects of Ss or S^{Δ} → Consequence = Ss or S^{Δ}

Phase #: _____; Procedure: ________________R: _____________; Consequence: ________________

Test Probe – Treatment Integrity Sheet				
	Procedural Steps	YES	NO	NA
Pre-session	Before starting the test probe session, was P prompted twice to engage in R and was the correct consequence (S, S^{Δ}, or nothing) following each R?	YES	NO	NA
During each session	To begin the session, was P given the instruction: "*Do whatever you want, but stay in your chair*" immediately following the second prompted R?	YES	NO	NA
	Was stopwatch started immediately following the instruction *"…, but stay in your chair"*?	YES	NO	NA
	Was correct consequence (S, S^{Δ}, or nothing) delivered within 1-3 second of P's R?	YES	NO	NA
	Was correct consequence (S, S^{Δ}, or nothing) delivered after each P's Rs? (i.e., was consequence delivered on an FR1 – each and every R?)	YES	NO	NA
	Was test probe session terminated after 5 minutes or after P left experimental area?	YES	NO	NA

Treatment Integrity Calculation	# Yes	# No	# NA
Count # of Yes			
Count # of No			
Count # of NA			
Treatment Integrity: (# Yes) / (# Yes + # No) * 100 → ____________________			
Treatment Integrity Score: ________________			

Treatment Integrity Data Sheet for Reinforcer Test Probes