REDUCING UNDESIRABLE BEHAVIOR WITH STIMULUS CONTROL

Matthew Alan Davison, B.A.

Thesis Prepared for the Degree of

MASTER OF SCIENCE

UNIVERSITY OF NORTH TEXAS

May 2012

APPROVED:

Jesús Rosales-Ruiz, Major Professor
Shahla Ala'i-Rosales, Committee Member
Jonathan Pinkston, Committee Member
Richard Smith, Chair of the Department of Behavior Analysis
Thomas Evenson, Dean of the College of Public Affairs and Community Service
James D. Meernik, Acting Dean of the Toulouse Graduate School

Davison, Matthew Alan. Reducing Undesirable Behavior with Stimulus Control. Master of Science (Behavior Analysis), May 2012, 35 pp. 7 figures, 15 titles.

The present experiment investigated the application of signal-detection theory to undesirable behavior as a method of reducing unwanted behaviors using reinforcement and extinction. This experiment investigated the use of this stimulus control technique to reduce undesirable behaviors using a multiple-baseline design. Once the cue for a target behavior was established and maintained, the use of the verbal cue was reduced in frequency and the rate of unprompted undesirable behavior was recorded. Generalization was tested across multiple people. Data for this experiment showed that undesirable behavior could be reduced by altering the stimulus control that maintained it.

ACKNOWLEDGEMENTS

First, I would like to thank my advisor, Jesús Rosales-Ruiz for his support throughout this project and my time in this program. You have taught me so much about both the science and the art of behavior analysis. I would like to thank Shahla Ala'i-Rosales and Jonathan Pinkston for being on my committee and for their thoughtful insight on this project. I also want to thank Kate Kellum for her initial push into this amazing world. I would like to thank ORCA for their continued support and feedback during every step of this project. I would like to thank Katie Rossi, Laura Coulter and Bernard for being integral participants and for making this project such a success. Finally, I would like to thank Thomas Currier for wading through hours of video to collect interoberver agreement. I appreciate each and every one of you.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Problem behavior affects most people at some point in their lives, either directly or indirectly. Problem behavior happens everywhere: a child throwing a tantrum in the grocery store, a dog jumping on guests when they walk in the front door, or a co-worker's incessant chatter during working hours. Some of these behaviors are viewed as annoying and bothersome, but others like self-injurious behavior (SIB) or the consumption of non-edible items (pica), can be dangerous.

The research of Azrin and Holz (1966) has guided many solutions for reducing undesirable behavior. One set of solutions is to directly reduce behavior by means of punishment (Azrin, 1959), satiation (Holz & Azrin, 1963), physical restraint (Wallace, Iwata, Zhou, & Goff, 1999), increased response effort (Irvin, Thompson, Turner, and Williams, 1998) and extinction (Holz & Azrin, 1963).

Another solution is to replace the undesirable behavior with appropriate behaviors. For example, Holz, Azrin and Ayllon (1963) demonstrated that time-out from reinforcement was more effective when an alternative response was made available for access to reinforcement than time-out alone. Durand and Carr (1991) described a procedure using differential reinforcement of an alternative behavior, namely functional communication training, as a way to teach individuals with developmental disabilities to use vocal verbal behavior to request things like items or activities instead of performing problem behaviors to obtain them. Teaching a child to say “cheerios” instead of crying provides the child with an alternative way of acquiring something they want. Other suggestions for reducing problem behavior by increasing other behavior include differential reinforcement of other behavior (Mazaleski, Iwata, Vollmer, Zarcone, & Smith, 1993) and differential reinforcement of incompatible behavior (Basinger & Roberts, 1972).

Another possibility is to arrange the environment in a way that the problem behavior is not evoked. Vollmer, Marcus and LeBlanc (1994) used environmental enrichment to reduce the rate of stereotypy and SIB. They did this by adding certain preferred items to the environment during times when SIB and stereotypy were likely to occur. This resulted in a reduction of problem behavior and an increase in appropriate behavior.

Finally, stimulus control can be used as a method to reduce rates of behavior (Azrin & Holz, 1966; Pryor, 1999). Basically, this solution amounts to discrimination training; there are situations where the undesirable behavior is reinforced and situations where the undesirable behavior is punished. For example, Piazza, Hanley and Fisher (1996) demonstrated that cigarette pica could be reduced using a purple index card as a discriminative stimulus for verbal reprimands contingent on consuming cigarette butts. They showed that as long as the participant carried the purple card, cigarette pica was suppressed. Similarly, Doughty, Anderson, Doughty, Williams and Saunders (2007) used a wristband as a discriminative stimulus and a “hands down” procedure (the experimenter guided the participants hands down to the table after stereotypical behavior occurred) as a punisher to reduce stereotypic behavior. McKenzie, Smith, Simmons and Sunderland (2008) also used a wristband as discriminative stimulus for mild reprimands to reduce eye poking. These few applied interventions have demonstrated that stimulus control is an effective means of reducing undesirable behavior. They also have in common that the discriminative stimulus was correlated with punishment and its absence with reinforcement of the undesirable behavior. The present paper investigates if the use of stimulus control established by positive reinforcement and extinction can be an effective method for reducing undesirable behavior.

An additional purpose of this research is to expand the measurement and the establishment of stimulus control to cover the four outcomes included in signal-detection theory (Green & Swets, 1966). Typically, researchers often record only responses to the discriminative stimulus that signals reinforcement (S^D) and responses to the discriminative stimulus that signals extinction (S^Δ). These responses are often depicted as two lines representing the responses to each, or percent/portion of correct responding to the S^{DR} (e.g., Anger & Anger, 1972; Cheng and Spetch, 1995; Galloway, 1973; Morse & Skinner, 1958; Van Houten & Rudolf, 1972; and Zeiler, 1970). Accordingly, contingencies are scheduled with respect to responses to the S^D and S^Δ only. However, two other contingencies could be scheduled for other behavior occurring in the presence of the S^D and the S^Δ. For example, Pryor (1999) suggested four separate rules for perfect stimulus control:

> 1. The behavior always occurs immediately upon presentation of the conditioned stimulus (the dog jumps when told to).
> 2. The behavior never occurs in the absence of the stimulus (during a training or work session the dog never jumps spontaneously).
> 3. The behavior never occurs in response to some other stimulus (if you say “Lie down,” the dog does not offer the jump instead).
> 4. No other behavior occurs in response to this stimulus. When you say, "Jump!" the dog does not respond by lying down or by sitting and licking your face). (Pryor, 1999, p. 73)

Rules 1 and 2 are usually what have been measured in applied research. Signal-detection theory adds Rules 3 and 4.

In signal-detection theory (Green & Swets, 1966), a matrix displays the relationship between the stimulus and the response (see Figure 1). When using signal-detection theory, an organism is asked to identify whether a signal is present. When a signal and noise are presented, the organism can either respond “yes “ or “no.” When only noise is presented, the organism can respond “yes” or “no.” When an organism responds, “yes” in the presence of a signal, it is designated as a “hit.” This is equivalent to Rule 1, above. When an organism responds “yes” in the absence of the signal, this is termed a “false alarm.” When the signal is present and the organism responds “no,” it is termed a “false rejection.” When the organism responds “no” in the absence of the signal, this is designated as a “correct rejection” (Rule 4).

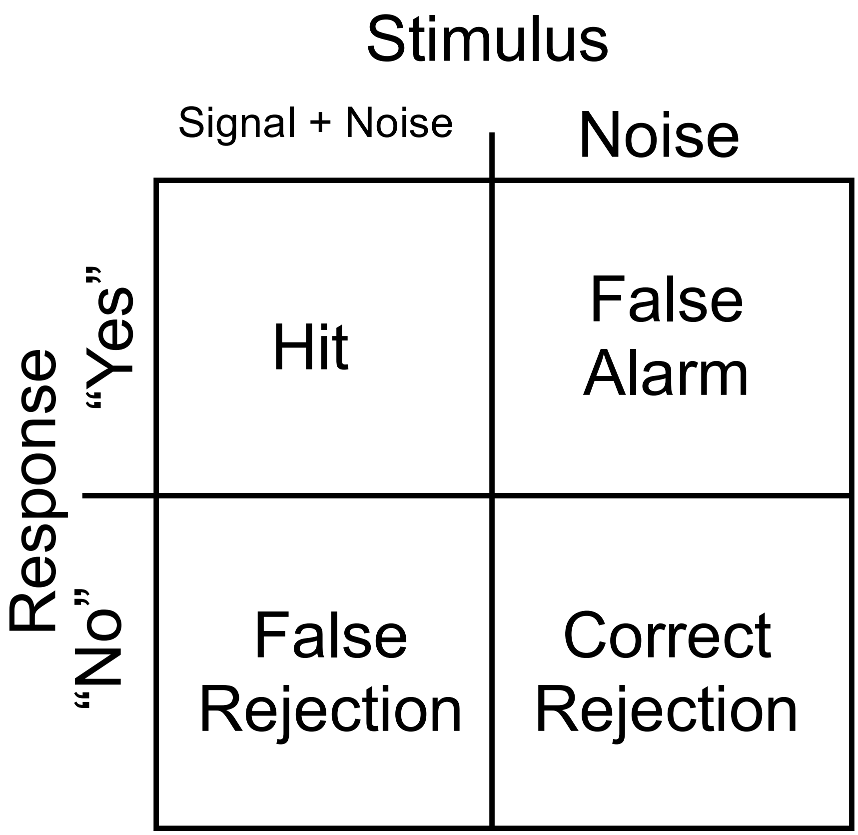

Figure 1. The matrix outlined in signal-detection theory. Along the top are stimuli presented. Along the side are the responses given. The matrix displays the outcomes of the interactions between the stimuli and responses.

Using a similar matrix, stimulus control can be conceptualized as comparing an organism's responses in the presence of certain discriminative stimuli. S^{Δ} is not useful in this framework because, by definition, reinforcement is unavailable when an S^{Δ} is presented. Therefore, a distinction must be made between the two stimuli presented. With two stimuli and two response classes, this framework adds two additional contingencies to the establishment of stimulus control. Thus, four outcomes are produced (see Figure 2).

Reinforcement would follow when the problem behavior is emitted in the presence of the S^{Dn} (new discriminative stimulus) and when other behavior is emitted in the presence of the S^{Do} (old discriminative stimulus). Extinction will be in effect when the problem behavior occurs in the presence of the S^{Do} and when other behavior occurs in the presence of the S^{Dn}.

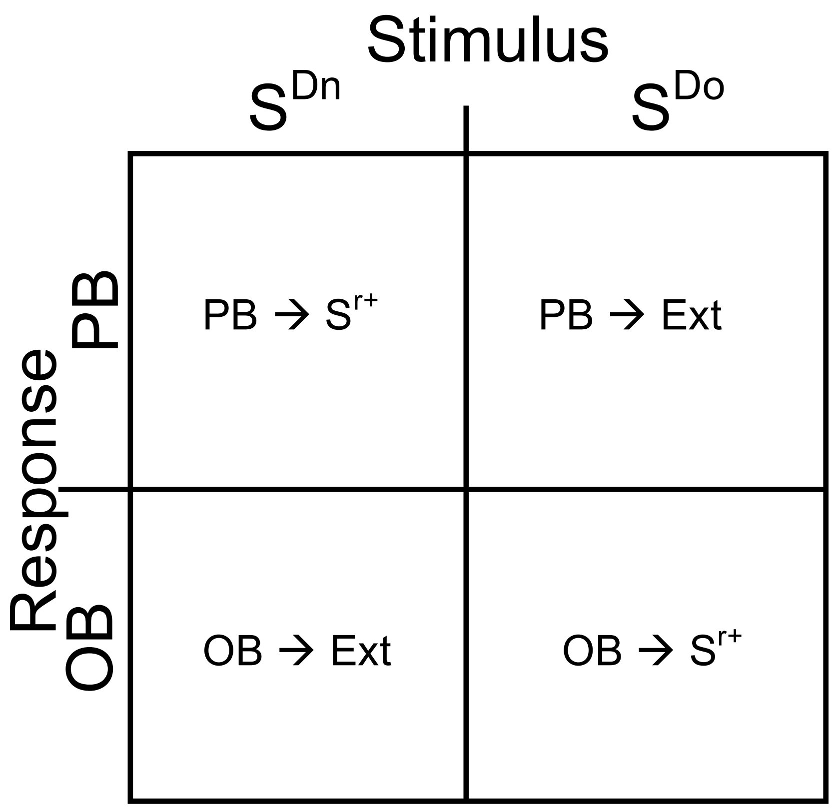

Figure 2.
S^{Dn}= New discriminative stimulus
S^{Do}= Old discriminative stimulus
PB= Problem behavior
OB= Other behavior

The stimuli presented are along the top. Possible responses are on the side. The matrix displays the arranged contingencies for all possible outcomes.

METHOD

Participant

The participant for this experiment was a domestic dog whose owner offered him as a participant due to his general problem behaviors. Bernard was a 1-year-old male Rottweiler/American Bulldog mixed-breed dog that lived with an adult female owner alone in a one-bedroom apartment in a suburban area. The dog was adopted at 6 months of age from an animal shelter. He was adopted with the intent to train and have as a companion animal in the apartment. Problem behaviors developed over the course of the next six months that included mouthing hands, jumping on his owner and other guests who came to visit, and tackling his owner on the couch. The participant would jump on his owner under different circumstances and in multiple places throughout the apartment. The mouthing of hands could range in intensity from simple playful mouthing to very firm grasping and dragging. When the owner sat down on the couch, the tackling behavior included standing on the owner, biting and pawing; similar to behaviors exhibited by puppies that wrestle in a litter.

The owner had been successful at training simple behaviors such as asking the dog to sit, lay down, and to go to his bed. The participant had a history of clicker training before the start of the experiment.

Setting

The first setting for training was the owner's living room, which was an approximately 10 ft (3 m) by 12 ft (4 m) area and contained a small television stand, a short bookshelf, a couch, a coffee table, a chaise lounge and two end tables. There was a walkway through the room to the patio door with the television stand and bookshelf on one side and all the other furniture on the other side. Trials were conducted in this walkway. This walkway was about 3 ft (1 m) across and 10 ft (3 m) long.

The second setting for training was in the owner's new home that contained the same furniture with addition of another couch and a fireplace. A similar walkway was established with the bookshelf, television stand and fireplace on one side and all the other furniture on the other side. The new walkway was about 4 ft (1 m) across and 8 ft (3 m) long.

Materials

The materials for the experiment consisted of a Karen Pryor Clicker Academy**™** clicker and a mixture of different dog treats, cut into approximately 2 cm^3 size pieces.

Measurement

The behaviors that were selected for recording were jumping up, hand mouthing, and jumping on the furniture.

Jumping up was defined as any contact of the bottom of the participant's front paws with any part of the experimenter above his or her waist. The experimenter must be standing but may or may not be facing the participant.

Hand mouthing was defined as any contact between the participant's teeth and any part of the experimenter's hand. Any contact of the participant's tongue was not counted as hand mouthing.

Jumping on the furniture was defined as any contact of the bottom of the participant's paws with the top part of the couch cushion when the experimenter sat on the couch.

The dependent variables were the cumulative occurrence of hit, miss, correct rejection and false positive as defined in signal-detection theory (Green & Swets, 1966). For jumping up, a hit occurred when the experimenter presented the cue with the body movement and the dog jumped on the experimenter (SDn→PB). A miss occurred when the experimenter presented the cue with the body movement and the dog performed any other behavior (SDn→OB). A correct rejection occurred when experimenter presented the body movement without the cue and the dog performed some other behavior (SDo→OB). A false positive occurred when the experimenter presented the body movement without the cue and the dog jumped on the experimenter (SDo→PB).

Observation and Recordings

All trials were recorded using a video camera and tripod. Trials began when the experimenter and participant entered the room. Trials ended when the experimenter delivered the contingency. Each trial started with the experimenter and participant outside of the room so that the beginning and ending of each trial was apparent. This decreased any chance of confusion between the onset and offset of trials within sessions.

An independent and naïve observer assessed the interobserver agreement. The observer was given written instructions on how to identify trials by presentation of a stimulus, the occurrence or non-occurrence of the target behavior, and the contingency administered. The independent observer watched videos of sessions and coded each trial. The observer coded whether the trial consisted of one of the four outcomes. If the trial did not, the observer would score the trial as “other.” The observer coded 25% of all experimental trials. The method used to calculate IOA was a trial-by-trial method: Total number of trials in agreement divided the number of total trials. The resulting number was multiplied by 100. Interobserver agreement for this experiment was 98%.

Procedures

Baseline

During jump trials the experimenter entered the room with the participant following. The experimenter would stop and turn toward the participant, then the experimenter bent his arms at the elbow and raised his hands up inviting the dog to jump. If the dog jumped, the experimenter moved away as the owner previously did and would leave the room with the participant following. If the dog did not jump, the experimenter would leave as soon as the dog displayed other behavior. The baseline sessions consisted of 10 trials. The owner performed the first 5 trials; the experimenter performed the last 5 baseline trials.

During mouthing trials, the experimenter would enter the room with the participant following. The experimenter bent over at the waist and attempted to pet the participant. As in the jumping trials, the experimenter immediately left the room following the occurrence of mouthing or other behavior. The baseline session consisted of 10 trials. The owner performed the first 5 trials; the experimenter performed the last 5 baseline trials.

During furniture trials, the experimenter would enter the room with the participant. The experimenter would sit down on the couch. The experimenter left the room after the participant jumped on the couch or emitted another behavior. The baseline session consisted of 10 trials. The owner performed the first 5 trials; the experimenter performed the last 5 baseline trials.

During jump stimulus control training (see below), baseline probes for the other two behaviors were taken each day that sessions were run. One trial of mouthing and one trial of furniture were conducted by the experimenter the same way as in earlier baseline trials.

Stimulus Control Training

During stimulus control training for jump, the experimenter entered the room with the participant following. The experimenter turned to the participant and presented the vocal cue, “Hasta!” while performing the bent-arm-hands-up movement (S^{Dn}) during some trials and just the arm movement alone (S^{Do}) during other trials. In trials where both the cue and the arm movement were presented together, if the dog jumped on the experimenter, the experimenter activated the clicker and provided a treat to the participant. The experimenter then left the room. If the participant emitted any other response when presented with the vocal cue and arm movement, the experimenter left the room. In trials where the experimenter only presented the arm movement, two outcomes were available. If the participant jumped on the experimenter, the experimenter left the room. If the participant emitted any other behavior, the experimenter activated the clicker and provided the participant with a treat.

During stimulus control training for mouthing, the experimenter entered the room. He then turned to the participant and bent at the waist. The experimenter engaged in rough play with the dog for a few seconds. The experimenter then presented either the S^{Dn} or the S^{Do}. There were two outcomes in trials where the experimenter presented the vocal cue, “Morder!” and presented his hand (palm side down) in front of the dog’s mouth (S^{Dn}). If the participant made contact with his teeth to any part of the hand, the experimenter activated the clicker and provided a treat to the participant, then left the room. If the participant emitted any other response, the experimenter left the room. In trials where the experimenter only presented the hand, without the cue, (S^{Do}) there were two possible outcomes. If the participant emitted any other response besides mouthing, the experimenter activated the clicker and provided a treat to the participant, then left the room. If the participant engaged in mouthing behavior, the experimenter left the room.

No intervention was implemented for the furniture condition due to a lack of problem behavior in later baseline probes (see Figure 5 and Results section for further details).

During SDo→OB trials, precursors and other behaviors were selected for reinforcement. During jump trials, the dog would have to shift its weight and drop first its front quarters, then drop its hindquarters, followed by extending the front legs and finally extending the back legs in order to produce the correct leverage to jump. An attempt was made to select the early precursors for reinforcement and interrupt the problem behavior cycle at the initial stages. By selecting these precursors (shifting weight, bending legs, etc.) and other non-jump-cycle behaviors (pausing, eye-contact, etc.), a class of responses was created that received reinforcement during S^{Do} trials.

Similarly, in the mouthing condition, after the experimenter engaged in a few seconds of rough play with the dog, the dog might engage in the behavior cycle of mouthing. This involved the dog shifting its weight forward, opening its mouth, making contact with the experimenter’s hand and releasing. Behaviors at the beginning of the cycle were selected for reinforcement (shifting weight and opening the mouth) along with other non-mouthing-cycle behaviors (pausing, making eye contact, etc.).

Three training sessions were conducted per day and each session consisted of 10 trials. Five of those trials consisted of the presentation of the vocal cue and movement. The other five trials consisted of the presentation of the movement alone. The order of each stimulus presentation was chosen unsystematically to avoid any bias or anticipation by the participant. An approximate five-minute break was given between sessions. The experimental conditions lasted until the participant showed a high rate of accurate responding and a very low to zero rate of incorrect responding.

Return to Baseline

During return to baseline-jump trials, the experimenter entered the room with the participant. The experimenter turned toward the dog and presented the raised arm movement alone. If the dog emitted either the problem behavior or other behavior the experimenter left the room with the participant following. Mouthing and furniture trials were run similarly to jump trials except for the difference in stimulus presentations. The owner performed 5 trials during return to baseline.

Maintenance and Generalization

During maintenance-jump trials, the experimenter presented only the arm movement. If the participant jumped, the experimenter left the room. If the participant emitted any other response, the experimenter activated the clicker, provided a treat and left the room. Only one trial was presented per day.

During generalization, similar procedures were used to those used during return to baseline, but utilizing a different person with no history of training the participant.

Design

A single-subject, multiple-baseline design across behaviors was chosen for this experiment. See Figure 2 for the various conditions.

RESULTS

Figures 3, 4 and 5 show the cumulative occurrence of each stimulus presentation and outcome for each behavior during baseline and initial stimulus control training. Figure 3 shows the baseline and treatment for the jump behavior. During baseline, jumping occurred reliably in each trial. During initial training, the participant jumped when the experimenter presented the vocal cue with the arm movement and when the experimenter presented only the arm movement. No other behavior was emitted in the presence of the S^{Dn} or S^{Do}. Incorrect responding during S^{Dn} and S^{Do} trials decreased rapidly across subsequent training trials. At the end of training, the dog jumped in the presence of the S^{Dn} and emitted other behavior in the presence of the S^{Do}.

Mouthing (Figure 4) occurred reliably in each trial of the initial baseline. During baseline probe trials, mouthing continued to occur reliably except for three consecutive trials toward the end of baseline. However, a mouthing response was emitted in the final baseline probe. During initial training, the participant mouthed the experimenter when the experimenter presented the vocal cue with the hand and performed precursors and other behavior when only the hand was presented. Incorrect responding occurred infrequently and decreased rapidly. At the end of the training, the dog mouthed in the presence of the S^{Dn} and emitted other behavior in the presence of the S^{Do}.

Figure 5 shows the baseline session and baseline probes for the furniture behavior. Getting on the furniture occurred reliably in both baseline and initial baseline probes. However, during the last four baseline probes, getting on the furniture did not occur. No intervention was implemented.

Figure 6 shows the follow-up conditions for jump and mouthing behaviors. The top graph shows that during baseline the dog emitted other responses instead of jumping in 4 out 5 trials when only the arm movement was presented. The owner then completed three sessions of training (trials 225-255). Although the participant continued responding to the S^{Do} correctly, responses to the S^{Dn} were correct during the first 10 trials and became incorrect during the next 20 trials. The experimenter ran three more sessions. The participant responded correctly to the S^{Dn} and S^{Do}. The jumping behavior was put on a maintenance schedule while intervention began on the mouthing behavior. The initial maintenance probe resulted in a failed trial. The experimenter presented only the arm movement and the participant jumped on the experimenter. However, the remaining probe trials resulted in correct responding to the S^{Do}.

The bottom graph in Figure 6 shows the continuation of mouthing. During baseline with the owner, the participant performed other behaviors for 3 out of 5 trials. The owner then trained for three sessions. The participant responded correctly to the presentations of the S^{Dn} and S^{Do} in 28 of 30 training trials with the owner.

Figure 7 shows the extinction trials for both the jumping (top graph) and mouthing conditions (bottom graph). In the jumping condition, the first five trials were conducted with a naïve person. The participant was presented with five S^{Do} trials in which he emitted five other responses. The owner then presented five S^{Do} trials. The participant jumped three times and performed other behaviors in two of the trials. The experimenter then presented five S^{Do} trials. The participant emitted four other responses and jumped once. The naïve person then presented five S^{Do} trials in which the participant jumped in all of them. Finally, the owner presented five more S^{Do} trials. The participant jumped in two of them and emitted other behaviors in three trials.

Similarly, in the extinction trials for mouthing, the owner presented five S^{Do} trials. The participant responded in three trials with other responses and two trials with mouthing. When the naïve person presented five S^{Do} trials, the participant emitted other responses in four trials and only one instance of mouthing. Then, the experimenter presented five S^{Do} trials. The participant emitted other responses in three trials and mouthed in two trials. Next, the naïve person presented five S^{Do} trials in which the participant emitted two mouthing responses and three other responses. Finally, the owner presented the last five S^{Do} trials. The participant mouthed in four trials and performed some other response in one trial. Figure 7 shows a steady, progressive decrease in the number of correct responses across subsequent extinction trials in both jump behavior and mouthing behavior.

DISCUSSION

The results of this study show that stimulus control without the use of punishment can reduce the rate of undesirable behavior. After discrimination training the problem behavior (i.e., jumping and mouthing) occurred reliably in the presence of their respective S^D (“hasta” and “morder”); and not under the other stimulus conditions (i.e., body movements without the vocal cue). Body movements without the vocal cue only evoked appropriate responses (e.g., staring, sitting, looking away). During generalization, baseline procedures were resumed and problem behaviors resurfaced at lower frequencies when reinforcement was absent; thus indicating the need for continued programming and maintenance of training contingencies.   These data support Azrin and Holz (1966) and Pryor’s (1999) recommendation to use stimulus control procedures as a way to reduce behavior. It also extends the generality of previous studies using stimulus control to reduce problem behaviors (e.g., Piazza, Hanley & Fisher, 1996; Doughty et al., 1996; McKenzie et al., 2008).

Beginning with Azrin and Holz (1966) stimulus control procedures have been suggested for reducing behavior. Since this recommendation was done in the context of punishment procedures, one suggestion to maximize the effects of punishment included the use of punishment as a discriminative stimulus for the absence of reinforcement or for another punisher. For example, if a rat’s lever pressing is maintained by food reinforcement, then a shock is delivered. After the shock is delivered, a period of extinction is placed on lever pressing. The shock can become an S^D for the absence of reinforcement. In the future, when the shock is delivered, responding will drop to zero because of the discriminative properties that the shock has acquired. Another suggestion more relevant to the present study was to provide an alternative situation in which the target response will be reinforced. The latter suggestion basically amounts to discrimination training. This strategy has been used recently in few studies concerned with the reduction of behavior (e.g., Piazza, Hanley & Fisher, 1996; Doughty et al., 1996; McKenzie et al., 2008). These procedures generally concentrate on not responding with the target response in the presence of the S^{DP}s (discriminative stimuli that signal punishment) and emitting the target response in the presence of S^{DR}s (discriminative stimuli that signal reinforcement). For example, Piazza et al. (1996) had an S^{DP} (purple index card) and an S^{DR} (no index card). Verbal reprimands were delivered for cigarette butt pica only during S^{DP} trials. Doughty et al. (1996) had an S^{DP} (wristband) and an S^{DR} (no wristband) condition. A "hands down" procedure was utilized in the presence of the wristband for stereotypic behavior. McKenzie et al. (2008) had an S^{DP} (wristband) and an S^{DR} (no wristband) with a verbal reprimand delivered for eye poking in the presence of the wristband. Although, differential responding in the S^{DP} and S^{DR} conditions would be indicative of stimulus control, our results show that this might not be enough. Previous research measured only hits and misses (correct responses to the S^{DR} and incorrect responses to the S^{DP}) but did not include false positives and correct rejections. By including the often-disregarded measures involving incorrect responses (responses that occur in the presence of the S^{Do}), this analysis revealed the lack of total stimulus control in some conditions. For example, in Figure 3, correct rejections were obtained in the absence of the cue. The dog did something other than jumping when the owner presented the body movement alone. However, she was unable to produce hits in the presence of the cue near the end of her final training session. The owner cued the dog to jump, but he did not. These results revealed that although the dog was not jumping, which was desirable, the jumping was not under stimulus control. The dog just stopped jumping in both stimulus conditions.

Another benefit of using signal-detection theory is that it makes explicit the contingencies in place for both correct responding and incorrect responding to a given stimulus. This seems valuable for applied settings where what happens in the absence of the discriminative stimulus is just as important as what happens in its presence. In this study, for example, when a certain body movement was presented with the vocal cue, “hasta,” reinforcement was available for jumping behavior only. If the dog looked away, sat down or waited in the presence of the vocal cue, an extinction contingency was implemented. When the same body movement was presented alone, reinforcement was available only for behaviors that did not meet the topography of jumping (e.g., dog looked away, sat down or waited). If the dog jumped, the extinction contingency was implemented. This suggests that defining S^{Δ}s in negative terms (the absence of the target behavior) can be imprecise for a complete analysis of problem behavior in applied settings. It is more productive to treat all the stimuli as S^Ds for particular behaviors. For example, during baseline, a certain body movement evoked jumping; which resulted in reinforcement. However, during discrimination training, the new S^D for jumping was added in the form of a vocal cue paired with the body movement. The baseline S^D (i.e., body movement alone) was then changed to evoke other behaviors that produced reinforcement. Both behavior classes produced reinforcement, but only in the presence of their respective stimulus conditions.

Generally, when undesirable behavior occurs, there are naturally occurring antecedents and contingencies maintaining that behavior. When a more desirable behavior is taught, it does not necessarily replace the undesirable behavior. The newly taught behaviors merely compete for reinforcement and the most successful behavior wins. The undesirable behavior becomes interchangeable with the alternative behavior when stimulus conditions remain the same for both. For example, if Bernard had been taught to look away, sit, stare etc., these behaviors would be added to Bernard's repertoire of possible responses under those stimulus conditions. However, the newly taught behavior will still remain as one possibility from the entire behavior class. In contrast, if the newly taught behavior class is associated with different evocative stimulus conditions than the undesirable behavior, control can be established and maintained over both the desirable and undesirable behaviors. Therefore, the conditions under which the current undesirable behavior is maintained and those that should control the new desired behavior need to be understood. Figuring out how to arrange those conditions (or modify them) to a desired pattern or outcome should be a goal of the applied behavior analyst.

Another important aspect of the procedure is that the criteria for reinforcement in the absence of the cue were a class of behaviors instead of just one alternative behavior. Alternative behaviors may prevent an extinction burst because more behaviors are available that can contact reinforcement before the problem behavior is emitted. If this is compared to just one alternative behavior, a very short extinction burst would occur and the problem behavior would resurface rather quickly. Paradoxically, stereotypic responses to the presence of the cue are preferred as well as variable responses in the absence of the cue.

In this experiment, the participant’s behavior switched quickly to match changes in the programmed contingency. This is more evident when the contingency is switched back to extinction during generalization trials. During the discrimination training, a pattern was set up so that a certain body movement evoked other behaviors besides jumping, and these other behaviors were reinforced. During the extinction trials, desirable behaviors performed in the presence of the body movement alone stopped reliably producing reinforcement. The body movement began to evoke the jumping behavior again. This demonstrates the need for maintaining the training conditions in the natural environment. Stokes and Baer (1977) suggested many different generalization procedures useful for maintaining behavior. One of these procedures involves what the experimenters called “indiscriminable contingencies”. They describe a procedure of intermittent reinforcement that occurs across times, locations and stimuli. This generalization programming technique can be applied to this procedure by offering body-movement-only probe trials throughout the day; in different locations and have different people presenting the trials. The assumption here is that by presenting only the body-movement-only trials and providing reinforcement for correct responses, the discrimination will be maintained even in the absence of the vocal cue.

Another alternative to generalization maintenance would be to reinforce in the S^{Do} trials, which would occur naturally. When an opportunity presents itself, reinforcing any alternative behavior would continue to maintain the new behaviors. An added benefit of signal-detection theory in this situation is that by reinforcing correct rejections (e.g., body movement evoking looking away) the class of appropriate responses is strengthened while the undesirable behavior continues to go unreinforced; all of this without ever presenting the cue.

A future consideration for implementing this procedure would be to have a preliminary interview with the owner or guardian of the client. In this interview, the interventionist and guardian would identify behaviors that could be maintained after training as acceptable behaviors in lieu of the problem behaviors. This class of acceptable behaviors would be a goal for the “no cue” trials and would give a clear outcome for generalization.

An interesting anecdote about the topography of the problem behavior should be noted. In trials where the vocal cue was presented, the topography of the behavior changed from the beginning of training to the end of training. In the beginning, the topography of the jump would include glancing blows and scraping claws down the experimenter after the initial contact. When all of the topographies were reinforced in the presence of the cue, the behavior tended toward a stereoptypically weak response. The contact made during the jump would often occur in the same spot on the experimenter. The mouthing behavior tended toward light pressure or even just light contact between the participant's teeth and the experimenter's hand. The behavior followed a pattern of making eye contact, then touching the hand, followed by a quick release and anticipating the reinforcer. Keller and Schoenfeld (1950) made reference to this phenomenon that occurred in early experiments, which required little effort from the subjects to produce reinforcement. The subjects often emitted the least effortful response that still produced reinforcement. This is an important aspect of the procedure. Often a decrease in the intensity of problem behavior is just as preferable to the rate at which it occurs. Eye touching is preferred over eye gouging. Hand mouthing is preferred over hand biting.

A question that was produced from this experiment is whether or not a current contingency is being modified in the presence of a preexisting discriminative stimulus or an entirely new three-term contingency being set up on top of one that is maintained in the natural environment. Goldiamond, Dyrud and

Miller (1965) examined the difference between topographically similar but functionally different behaviors and topographically different, functionally similar behaviors. In this experiment it could be argued that a new contingency was created since training involved using edible reinforcers that were not part of the original contingency. However, the new behavior once occurring could be trapped by the attention originally maintaining the unwanted behavior. The preferred behavior pattern would be a topographically different, functionally similar behavior. The owner's inattentiveness should evoke some other behavior besides jumping, which was then reinforced by the owner with attention the same way jumping once did.

This experiment demonstrated that stimulus control could be an effective means of both controlling behavior and eliminating it. Examples of these would be teaching adolescents with autism where it's appropriate to engage in "private" behaviors. In these cases, reduction is not always necessary, only the tight control of certain stimuli as S^Ds for acceptable occasions to engage in certain behaviors. Some examples in which stimulus control could be used to eliminate behavior would be pica, some stereotypies and SIB. These procedures should be applied to other populations including animals in zoos, typically developing children and even in organizational behavior management. Obviously, modifications should be made to the procedures in order to individualize them to suit each unique instance of problem behavior.

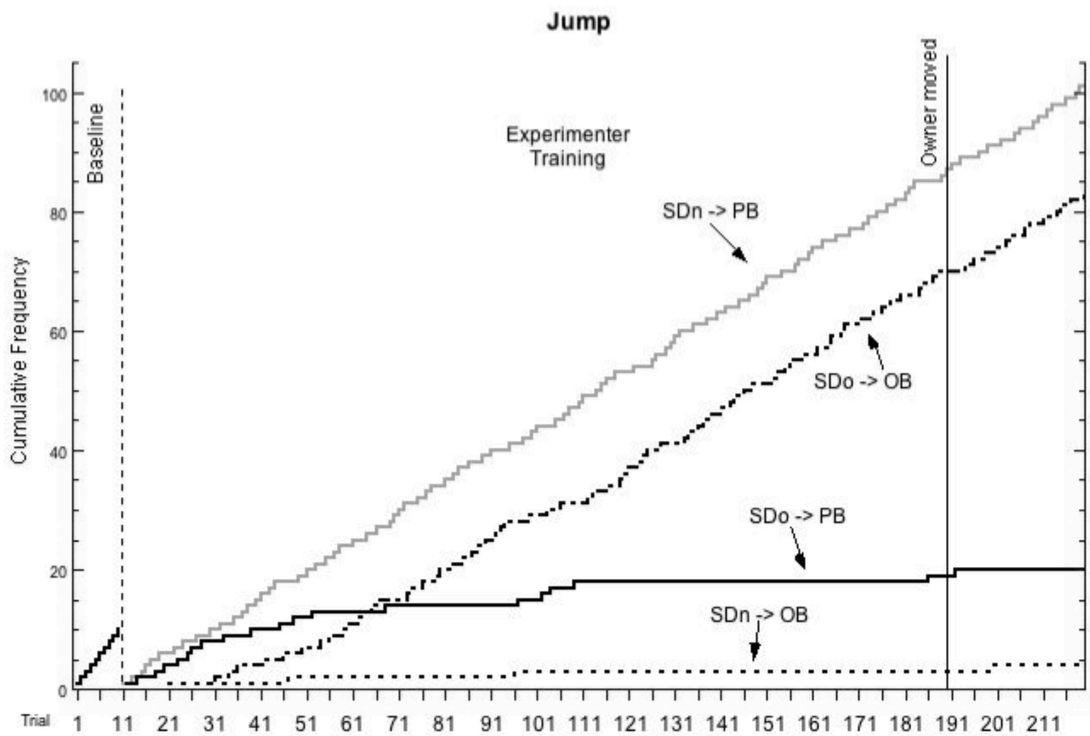

Figure 3. Cumulative responses for the jump condition during baseline and initial discrimination training.

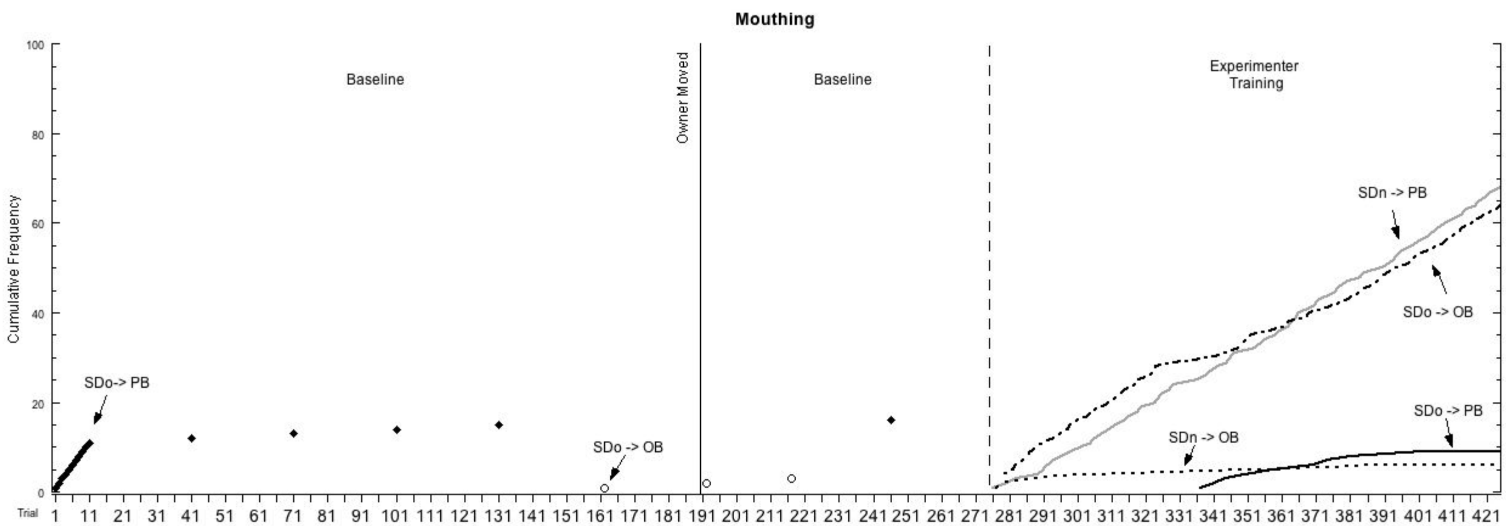

Figure 4. Cumulative responses for the mouthing condition during baseline and initial discrimination training.

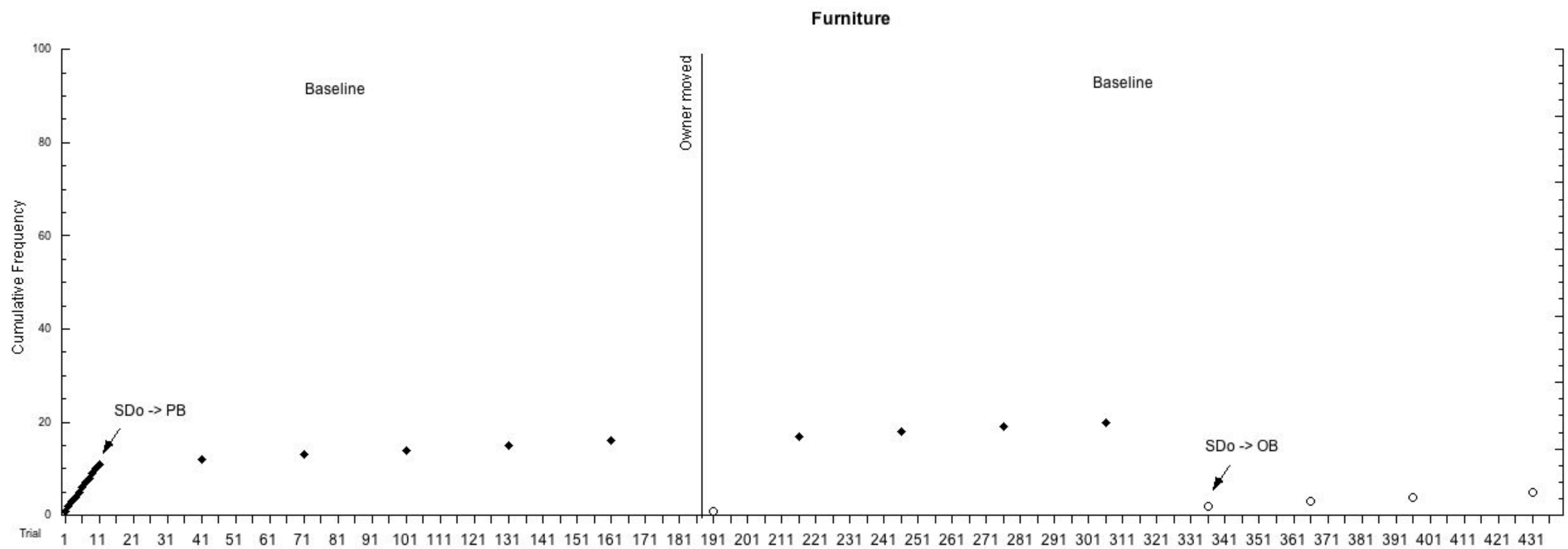

Figure 5. Cumulative responses for the furniture condition.

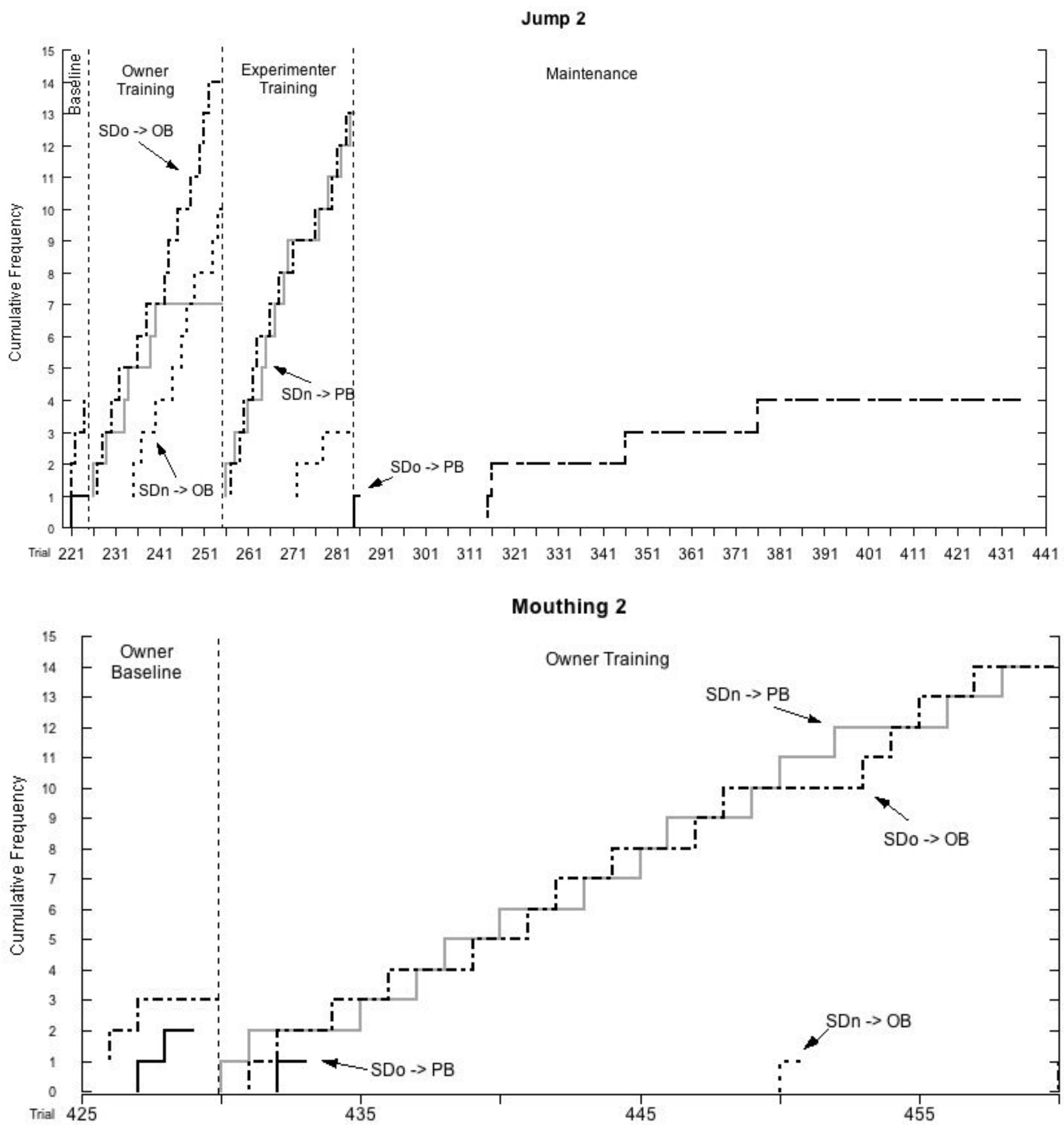

Figure 6. Cumulative occurrences for return to baseline, owner training, and maintenance conditions. Top graph displays data for the jumping condition. Bottom graph displays data for the mouthing condition.

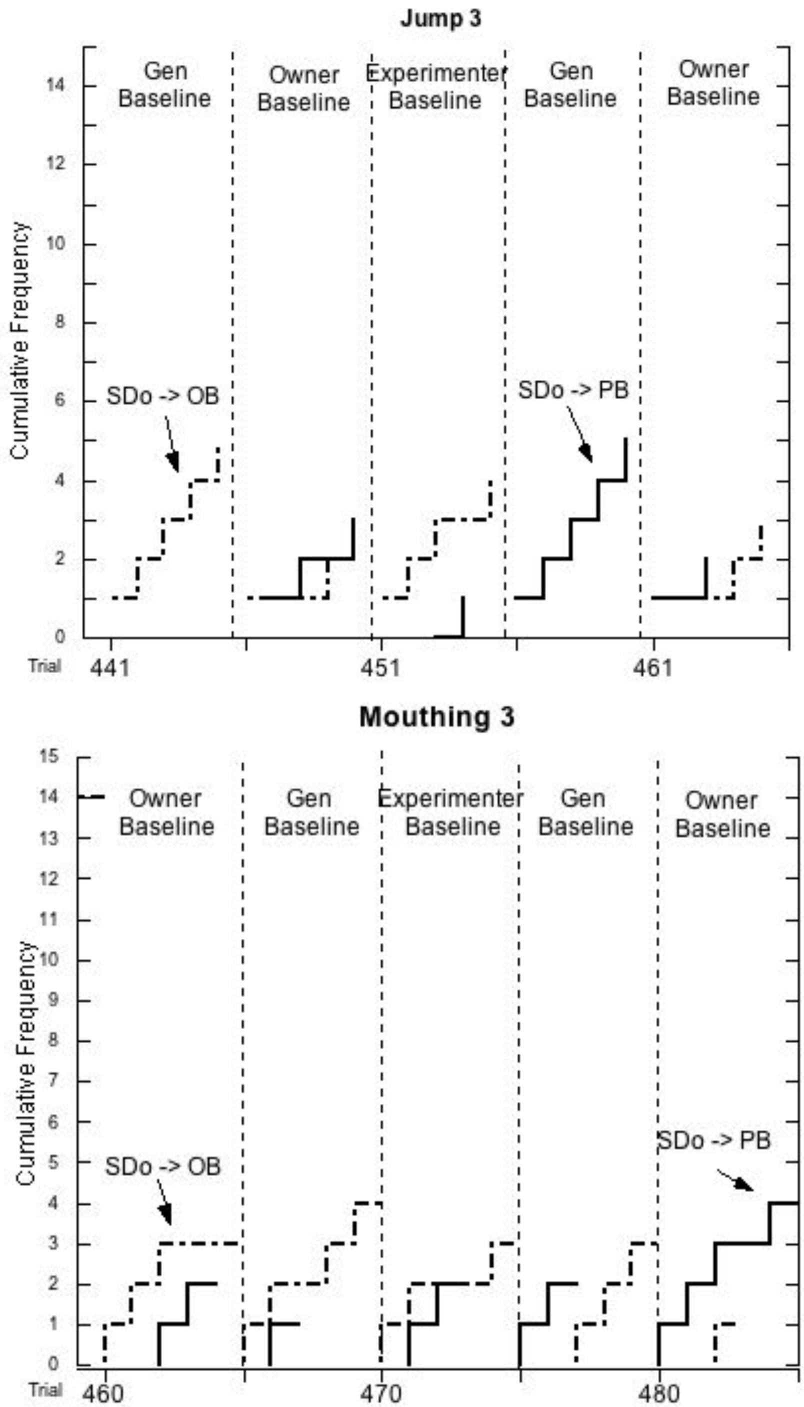

Figure 7. Cumulative occurrences for generalization trials. Top graph displays data for the jumping condition. The bottom graph displays data for the mouthing condition.

REFERENCES

Anger, K. & Anger, D. (1972). The effect of discrimination training on responses to a new stimulus. *Journal of the Experimental Analysis of Behavior, 18,* 435-441.

Azrin, N. H. (1959). A technique for delivering shock to pigeons. *Journal of the Experimental Analysis of Behavior, 2,* 161-163.

Azrin, N. H., & Holz, W.C. (1966). Punishment. In W. K. Honig (Ed.), *Operant behavior: Areas of research and application.* New York: Appleton-Century-Crofts.

Basinger, J. & Roberts, C. L. (1972). Reduction of interspecies aggression in rats by positive reinforcement of incompatible behaviors. *Journal of the Experimental Analysis of Behavior, 18,* 535-540.

Cheng, K. & Spetch, M. L. (1995). Stimulus control in the use of landmarks by pigeons in a touch-screen task. *Journal of the Experimental Analysis of Behavior, 63,* 187-201.

Doughty, S. Anderson, Doughty, Williams, & Saunders (2007). Discriminative control of punished stereotyped behavior in humans. *Journal of the Experimental Analysis of Behavior, 87*, 325-336.

Durand, V. M., & Carr, E. G. (1991). Functional communication training to reduce challenging behavior: Maintenance and application in new settings. *Journal of Applied Behavior Analysis, 24,* 251-264.

Galloway, W. D. (1973). Stimulus control in a two-choice discrimination procedure. *Journal of the Experimental Analysis of Behavior, 20,* 473-482.

Goldiamond, I., Dyrud, J. E., & Miller, M. D. (1965). Practice as research in professional psychology. *Canadian Psychologist, 6(1)*, 110-128.

Green, D. M., & Swets, J. A. (1966). *Signal detection theory and psychophysics*. New York: Wiley.

Holz, W. C., &Azrin, N. H.. (1963). A comparison of several procedures for eliminating behavior. *Journal of the Experimental Analysis of Behavior, 6,* 399-406.

Holz, W. C., Azrin, N. H., & Ayllon, T. (1963). Elimination of behavior of mental patients by response-produced extinction. *Journal of the Experimental Analysis of Behavior, 6,* 407-412.

Irvin, D. S., Thompson, T. J., Turner, W. D., and Williams, D. E. (1998). Utilizing increased response effort to reduce chronic hand mouthing. *Journal of Applied Behavior Analysis, 31,* 375-385.

Keller, F. S., & Schoenfeld, W. N. (1950). *Principles of psychology*. New York: Appleton-Century- Crofts.

Mazaleski, J. L., Iwata, B. A., Vollmer, T. R., Zarcone, J. R., & Smith R. G. (1993). Analysis of the reinforcement and extinction components in DRO contingencies with self-injury. *Journal of Applied Behavior Analysis, 26,* 143-156.

McKenzie, S., Smith, R. G., Simmons, J. N., & Soderlund, M. J. (2008). Using a stimulus correlated with reprimands to suppress automatically maintained eye poking. *Journal of Applied Behavior Analysis*, 41, 255-259

Morse, J. H. & Skinner, B. F. (1958). Some factors involved in the stimulus control of operant behavior. *Journal of the Experimental Analysis of Behavior, 1,* 103-107.

Piazza, C. C., Hanley, G. P., & Fisher, W. W. (1996). Functional analysis and treatment of cigarette pica. *Journal of Applied Behavior Analysis, 29*, 437-450.

Pryor, K. (1999). *Don't shoot the dog! The new art of teaching and training*. New York: Bantam Press.

Stokes, T. F., & Baer, D. M. (1977). An implicit technology of generalization. *Journal of Applied Behavior Analysis, 10,* 349-367.

Van Houten, R. & Rudolf, R. (1972). The development of stimulus control with and without a lighted key. *Journal of the Experimental Analysis or Behavior, 18,* 217-222.

Vollmer, T. R., Marcus, B. A., & LeBlanc, L. (1994). Treatment of self-injury and hand mouthing following inconclusive functional analyses. *Journal of Applied Behavior Analysis, 27,* 331-344.

Wallace, M. D., Iwata, B. A., Zhou, L., & Goff, G. A. (1999). Rapid assessment of the effects of restraint on self-injury and adaptive behavior. *Journal of Applied Behavior Analysis, 32,* 525-528.

Zeiler, M. D. (1970). Fixed-interval stimulus control. *Journal of the Experimental Analysis of Behavior, 14,* 291-299.