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The Use of a Precursor and Latency-Based Functional Analysis to Reduce Aggression with a Pet Dog

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Abstract

Dog aggression is a serious public safety issue that can result in the harm of animals or others (Bieber & Ramirez, 2024; Haug, 2008) and reinforcement-based procedures have shown success in previous research for addressing problematic behaviors with dogs (Certification Council for Professional Dog Trainers, 2009). One procedure that has received much attention in the research literature with human populations is differential reinforcement of alternative behavior (DRA) and one component of these procedures that has shown to be critical for the reduction of undesirable behavior includes the implementation of a functional analysis (FA). Although previous research has shown success with the use of an FA to identify functions of nonhuman behavior, the literature base with nonhumans is limited (Rotta et al., 2023), and to the current authors' knowledge, no previous studies have examined the use of a precursor or latency-based FA with nonhumans. Thus, the purpose of the current study was to evaluate the use of a DRA procedure to reduce aggression with a pet dog following the results of a combination of a precursor FA (PFA) and a latency-based FA. The results showed that the PFA and latency FA identified escape as a maintaining variable and showed that the DRA procedure was successful for training a "Place" cue.

Keywords: aggression, differential reinforcement, dog, functional analysis, latency, precursor

The Use of a Precursor and Latency-Based Functional Analysis to Reduce Aggression with a Pet Dog

Dog aggression is a serious public safety issue that can result in the harm of the animal or others, as more than 4.5 million dog bites are estimated to occur each year with approximately 800,000 of those bites requiring medical attention (Bieber & Ramirez, 2024; Haug, 2008). Thus, interventions to reduce aggressive behavior (e.g., biting, lunging) should be considered an important part of animal research. Reinforcement-based procedures have shown success in previous research for addressing problematic behaviors with dogs and can minimize the unwanted side effects that can result from punishment techniques (Certification Council for Professional Dog Trainers, 2009; Protopopova et al., 2016). For example, Yin and Fernandez et al. (2008) tested the efficacy of a remote-controlled positive reinforcement training system for modifying problem behaviors (e.g., jumping, barking, crowding) exhibited by six canines, recruited from a dog training class, when someone knocked at the door or rang the doorbell. Using an automatic treat dispenser (i.e., Sharper Image Remote Dog Treat Dispenser), the researchers used an 11-step shaping procedure with positive reinforcement to teach the dogs to remain in a down-stay for 1 min during a variety of distractions. The results demonstrated that all six dogs successfully completed the down-stay in the absence of jumping or barking behaviors including generalizing the skill with other handlers. Additionally, Protopopova et al. (2016) evaluated the effects of an automated food delivery device in combination with differential reinforcement of other behavior (DRO) to reduce barking behaviors when canines were left alone. The DRO procedure consisted of automated software that delivered preferred edibles to the dogs on a fixed-time schedule for engaging in behavior other than the target behavior. The results showed a decrease in barking for three of the five dogs in the study.

One reinforcement-based procedure that has received much attention in the research literature with human populations is differential reinforcement of alternative behavior (DRA). DRA is a procedure in which reinforcement is provided contingent on the occurrence of a preferred alternative behavior instead of the target behavior (Vollmer et al., 2020). One component of differential reinforcement procedures that has shown to be critical for the reduction of undesirable behavior in human populations includes the implementation of a functional analysis (FA) to identify key environmental variables maintaining the problem behavior. The use of an FA to identify causes of problem behavior has a limited but growing research base with nonhumans. Rotta et al. (2023) conducted a review of the research literature and found 13 articles that utilized an FA to determine the functions of undesirable behaviors emitted by nonhumans, including cats (two studies), dogs (seven studies), primates (two studies), a vulture, and a lemur. The results showed that 12 of the13 studies reviewed successfully employed a function-based intervention based on the results of the FA (Rotta et al., 2023). For example, Dorey et al. (2009) conducted an FA to determine the function of a captive baboon's self-injurious behaviors. The researchers used five test conditions (ignore, attention, demand, play and tangible) and found that self-injury was maintained by human attention. Following the results of the FA, the researchers conducted their baseline in a similar fashion to their attention condition and implemented a treatment condition using DRA with extinction. During the treatment, the SIB no longer resulted in attention delivery, however if the baboon engaged in an alternative behavior (e.g., lip-smacking response) it received positive reinforcement in the form of compliments, resulting in a successful decrease of the SIB and increase of the alternative

behavior. Mehrkam et al. (2020) examined decreasing occurrences of food guarding behavior in a pet dog using an FA and DRO procedure. The subject was exposed to four conditions including: control, escape, tangible and attention and the results showed that resource guarding was maintained by multiple environmental variables. The implementation of the FA and subsequent DRO decreased aggressive behavior upon intervention and the results were maintained after a 2-week follow-up. Fritz et al. (2022) used an FA to determine the function of aggression exhibited by three cats toward humans. The cats were exposed to three conditions, control, attention, and escape and the results indicated that all cats' aggression were maintained by social-negative reinforcement. The study implemented a resetting DRO plus within-session stimulus fading (i.e., gradually increasing the number of pets required without aggression before reinforcement). The results showed that aggression decreased across cats and the results generalized to unfamiliar people.

Although previous research has shown success with the use of an FA to identify functions of nonhuman behavior (Rotta et al., 2023), severe problem behaviors with nonhumans, such as aggression, may pose as a safety risk for those implementing the FA. One variation of the traditional FA includes the precursor FA (PFA). This variation was developed as a response to some identified limitations of the standard FA when assessing severe problem behaviors (Heath & Smith, 2019). A PFA is conducted with the same antecedent conditions typical of the standard FA (e.g., attention, escape, tangible) but reinforcement is provided contingent upon identified precursor behavior to the target behavior (Heath and Smith, 2019). Precursor behaviors are those that reliably occur prior to the target behavior and although they may be topographically different, the behavior's function can be the same as the target behavior. Thus, examining precursor behaviors allows experimenters to determine the function of severe behavior with reduced safety risks (Najdowski et al., 2008). Another variation includes the latency-based FA. This variation allows the function of behavior to be determined, while only causing a fraction of the problem behavior during the analysis (Caruthers et al., 2015). Conditions for the latency FA are conducted typical to the standard FA, but contingent on the problem behavior occurring, the corresponding consequences are presented, and the trial is then immediately ended. The time from the start of the condition to when the target behavior occurs (i.e., the latency) is measured, and the condition with the shortest latency indicates function (Caruthers et al., 2015).

Despite previous findings, more research is needed on differential reinforcement procedures to teach an alternative response to reduce problematic behaviors with canines. Further, methods to determine the functions of nonhuman dangerous behaviors while minimizing safety risks that undesirable behaviors may pose to experimenters are needed. Thus, the purpose of the current study was to evaluate the use of a DRA procedure to reduce aggression with a pet dog following the results of a combination of a PFA and latency-based FA.

Method

Participant and Setting

One spayed 5-year-old female German Shepherd, Maggie, participated in the current study. At the time of the study, Maggie was privately owned by the primary investigator and all experimental procedures occurred in the private home of the experimenter where Maggie resided. Throughout the study, Maggie was the only dog in the home. Maggie had no known

health problems and previously received puppy obedience training when she was 20 weeks old from a qualified professional dog trainer. Training included teaching Maggie the desired response upon hearing the cue "Place" in which she responded by locating her elevated bed and lying down on the bed. Maggie was reported to engage in aggressive behaviors (e.g., lunging, baring teeth; see Dependent Variables section) when unknown individuals (specifically males) approached the door and was not successful in following the directive "Place" in these situations The Institutional Animal Care and Use Committee (IACUC) approved all procedures.

Materials

The participant wore a collar (YOULY Adjustable Dog Collar) and a 6 ft (72 in.). (Top Paw Traffic Leash) leash to assist with physical maneuvering when necessary. There was an elevated bed approximately 8 in. tall and 15 in. wide used for the "Place" location which was positioned approximately 5 ft (60 in.) away from the door. The experimenter used an iPhone 13 to record sessions to allow experimenters to track data on the occurrence of precursor behavior, aggression, and for following the "Place" cue. The experimenters wore protective equipment including padded weight-lifting gloves with long sleeves and a hoodie to cover their arms. Additionally, the participant wore a muzzle in all conditions in which the experimenter/unknown person was near, to prevent further experimental risks. The unknown persons included a male and female individual who had no history of being in the home. At the end of the treatment, the experimenters provided the unknown persons the choice to conduct the sessions without protective equipment. Consent was obtained by both unknown persons signing the consent form and agreeing to all parts of the intervention including wearing protective equipment and being in the room with the participant during potentially aggressive episodes. The female participant consented to removing protective equipment during the final trials.

Dependent Variables and Response Definitions

The primary dependent variables included the cumulative number of independent "Place" responses across trials, the presence or absence of precursor behavior, and the presence or absence of aggression across trials. Independent responding for following the "Place" cue was defined as Maggie climbing on top of the elevated bed and lying down in the absence of aggression and remaining in the position unless directed by the experimenter. Prompted responding for following the "Place" cue was defined as the experimenter using the leash to guide Maggie to the bed while using a gesture to indicate a down motion (i.e., pointing toward the bed). Incorrect responses for following the "Place" cue were defined as Maggie engaging in any other behavior besides traveling to the "Place" location and lying down. Precursor behavior was defined as stiffening, slight raise in hackles, intense staring lasting for 3 s or longer, and a low audible growl, and was scored as being present "1" or absent "0" during each trial. Aggression was defined as any instance or attempt at biting, lunging, baring teeth, or snapping.

Pre-Experimental Conditions

Functional Analysis

Due to the severity of the behaviors and potential safety risks, a PFA in combination with a latency-based FA was implemented. Once Maggie began to display precursor behavior (e.g., stiffening, slight rise in hackles, intense staring) the corresponding consequences would then be delivered depending on the condition and the condition would then be terminated. The time from the onset of the condition to the time in which precursor behavior was exhibited was measured in seconds. Conditions included attention (positive reinforcement by mild verbal reprimands), escape (unknown person leaving) and a control condition. The experimenters conducted three cycles of conditions within 1 day. The participant was positioned in the living room (approximately 12 m by 12 m) near the front door across conditions.

Attention

To start the condition, Maggie was in the living room with the primary investigator, who was holding Maggie's leash but not delivering any other form of attention. An unfamiliar person knocked on the door prior to entering the living room. Contingent on precursor behaviors and/or aggression, the primary investigator verbally reprimanded Maggie in a neutral tone (e.g., "No Maggie") and the condition ended. The unknown person remained in the location until problem behavior and/or precursor behavior ceased. If precursor behavior or aggression did not occur after 1 min (e.g., the dog engaged in appropriate behavior) the experimenter ended the session.

Escape

The escape condition began likewise to that of the attention condition. The primary investigator was in the living room with Maggie holding onto her leash. An unfamiliar person knocked on the door and walked into the room. Contingent on precursor behavior and/or aggression the unfamiliar person immediately left the home and walked back outside, and the condition ended. No attention was provided by the experimenter. If precursor behavior or aggression did not occur after 1 min the experimenter ended the session.

Control

The experimenter began the control condition in the living room. During this condition the experimenter provided Maggie with continuous access to positive reinforcement in the form of verbal praise (e.g., "Good girl Maggie!") and an unfamiliar person was not present. If Maggie displayed any precursors or aggression during this condition, the session ended. If precursor behavior or aggression did not occur after 1 min the experimenter ended the session. We used mild reprimands in the attention condition and verbal praise in the control condition to match what happened in the natural environment with Maggie.

General Procedure

The experimenter completed six trials during baseline and six sessions with 10 trials per session during the intervention, within the same day. Additionally, the experimenter included 30-min breaks between each session. The participant was positioned in the living room (approximately 12 m by 12 m) near the front door across sessions.

Baseline

During baseline, when the unknown person knocked on the door, the primary experimenter stated the "Place" cue without any additional prompting. The experimenters scored correct independent responses for Maggie if she climbed on top of her bed without additional prompting or aggression. Due to safety reasons, Maggie remained on a leash but was not physically maneuvered to the bed.

Intervention

During intervention, experimenters contrived situations in which an unknown person knocked on the door and entered the living room from outside. Maggie was given the directive to "Place" at a 0 s delay and was immediately physically guided with her leash to the "Place" location. The experimenter delivered reinforcement (determined from the results of the FA) for following the "Place" cue in the absence of aggression. For example, if escape was determined to be a maintaining variable during the FA, the unknown individual immediately left the area at a 0 s delay contingent on Maggie placing without aggression. The experimenter increased the prompt delay from 0 s to 2 s (see Figures for when this occurred).

Experimental Design

The experimenters utilized an ABCBCBC reversal design following the initial baseline, in which the intervention was alternated between female and male unknown persons to evaluate the effects of treatment. By using a reversal design and alternating unknown people, experimenters could assess intervention replication when the participant was exposed to different people without having to withdraw treatment.

Interobserver Agreement and Treatment Integrity

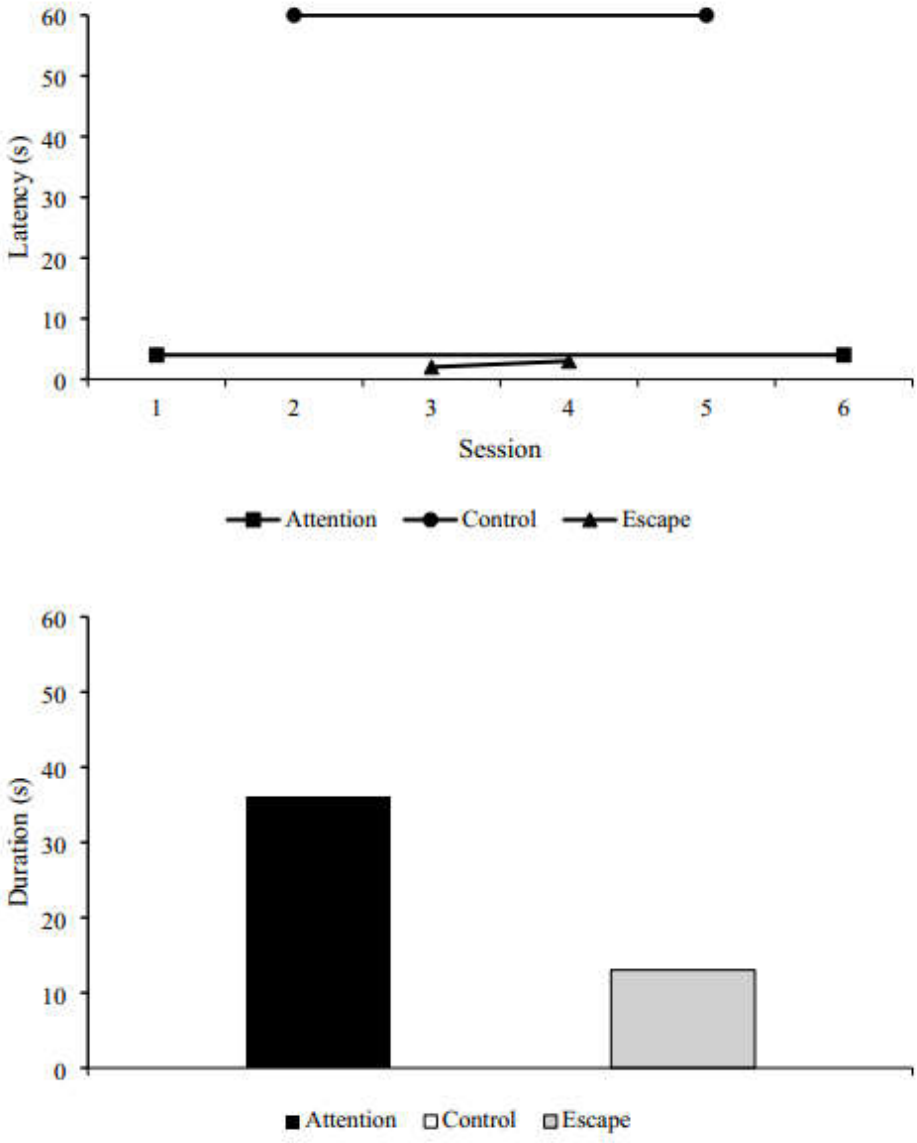
A secondary observer who was located in the hallway on the other side of the room, parallel to the entry door independently and simultaneously collected data for an average of 33% (range, 33%-39%) of sessions to obtain interobserver agreement (IOA) data. Total count IOA was calculated by dividing the smaller total count observed by the larger total count and multiplying by 100 to obtain a percentage. IOA averaged 96.7% (range, 94%-100%). The secondary observer also collected treatment integrity (TI) data for 33% of trials on correct protocol implementation for both the FA and the intervention. TI was calculated by dividing the number of trials implemented correctly by the total number of trials then multiplied by 100 to obtain a percentage. TI averaged 100% (range, 99%-100%).

Results

The results of the FA are shown in Figure 1. During the first and second cycles of conditions (first graph in Figure 1), the participant's latency for precursor behaviors during the attention and escape conditions were both within 2–3 s of the unfamiliar person walking through the door whereas precursor behavior did not occur during any control conditions. During the

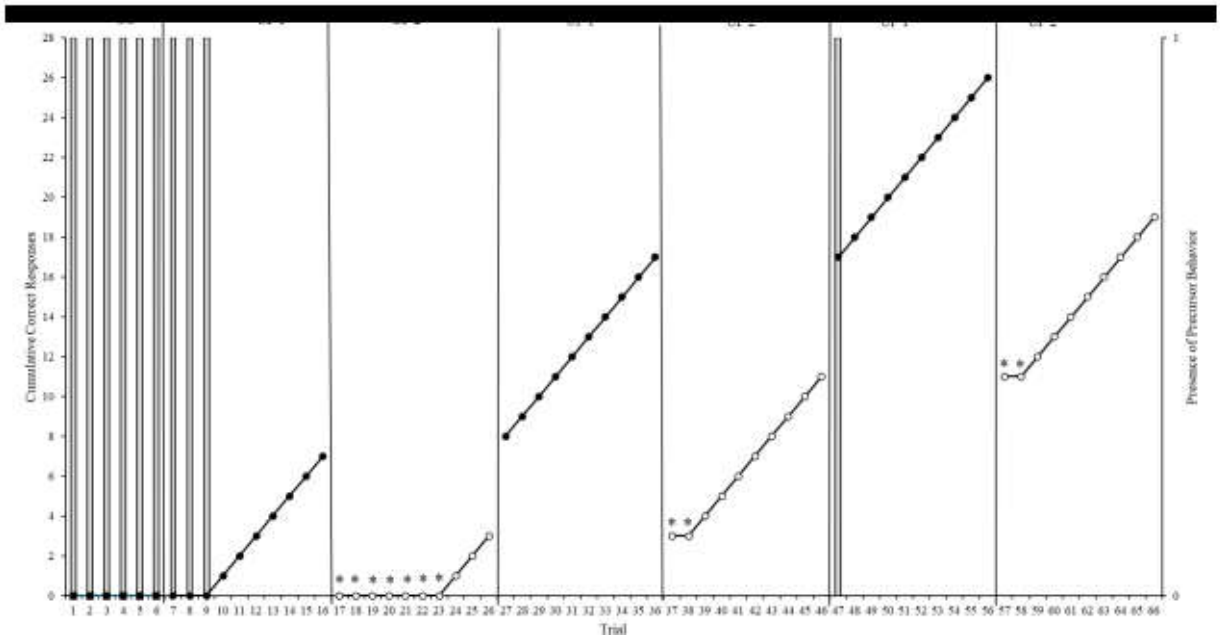
third cycle of conditions (second graph in Figure 1), the experimenter collected duration data on precursor behaviors to help isolate maintaining variables. After adding this modification, precursor behavior during the attention condition in which the unfamiliar person remained in the room occurred for a duration of 36 s whereas precursor behavior during the escape condition in which the unknown person left contingent on precursor behaviors, occurred for a duration of 13 s. Duration data showed that the participant had a shorter duration of precursor behaviors during the escape condition, which indicated the behavior was likely maintained by social-negative reinforcement (i.e., precursor behaviors occurred for a longer duration during the attention condition, due to the unfamiliar person remaining present). Additionally, the participant never escalated to aggression during any cycles of the FA.

Figure 1 *FA Results*



Note. The first graph depicts the results from the first two cycles of the FA (latency) whereas the second graph depicts the results from the third cycle of the FA (duration).

Figure 2 *Cumulative Correct Responses and Presence of Precursor Behavior and Aggression Across Conditions*



Note. BL =baseline; UP 1 = unfamiliar female person; UP 2 = unfamiliar male person; * = aggression in the form of lunging and/or baring teeth occurred. Line markers depict cumulative correct responses whereas bars depict presence of precursor behavior. The 0-s time delay was increased to a 2-s time delay during Trial 10.

The cumulative number of independent "Place" responses across trials and presence of precursor behavior and aggression across trials are displayed in Figure 2. During baseline, Maggie never independently placed, precursor behavior was present across all trials, and aggression never occurred. During intervention with the female unknown person (first presentation), Maggie independently placed across seven trials (with the 0 s time delay increased to a 2 s time delay on the fourth trial within intervention), precursor behavior occurred during the first three trials, and aggression never occurred. During intervention with the male unknown person (first presentation), Maggie independently placed across the last three trials, precursor behavior never occurred, and aggression (in the form of lunging and baring teeth) was present across the first seven trials. During intervention with the female unknown person (second presentation), Maggie independently placed across all 10 trials (for a total of 17) and precursors and aggression never occurred. During intervention with the male unknown person (second presentation), Maggie independently placed across eight trials (for a total of 11), precursor behavior never occurred, and aggression (in the form of baring teeth only) occurred during the first two trials. During intervention with the female unknown person (third presentation), Maggie independently placed across nine trials (for a total of 26), precursor behavior was present during the first trial, and aggression never occurred. During intervention with the male unknown person (third presentation), Maggie independently placed across eight trials (for a total of 19), precursor behavior never occurred, and aggression (in the form of baring teeth only) occurred during the first two trials.

Discussion

The purpose of the current study was to examine the use of a DRA procedure to reduce aggression with a pet dog following the results of a combination of the PFA and a latency-based FA. The results from the precursor and latency FA showed that escape was a maintaining variable for aggression. The results from the DRA intervention showed an increase in cumulative independent "Place" responses and a decrease in precursor behavior and aggression across trials when unknown individuals came to the door. The current results may provide a framework for others for determining functions of aggressive canine behavior while minimizing safety risks.

Although the results are encouraging, limitations should be noted. First, as a safety precaution (as required by the university's review board), Maggie wore a muzzle, and the experimenter and unknown persons wore protective equipment during the intervention. Thus, it is unclear if this influenced Maggie's behavior. Second, the study was conducted with one dog and due to the limited availability of the unknown persons, intervention was carried out within the same day, limiting the conclusions that could be made regarding response maintenance and if similar results would be demonstrated with other dogs. Future research should include these measures. However, although the study was implemented within the same day, the results demonstrate the efficiency of the intervention. Next, the study was carried out in the owner's home and the owner (primary experimenter) implemented all conditions, which may have influenced results and this warrants further examination in future studies.

Additionally, it should be noted that a dog becoming aggressive toward an unknown individual approaching the home may be desired in some situations regarding safety (e.g., an unknown person breaking into the home). Future research should investigate methods to gain stimulus control over aggressive behavior across different situations (e.g., responding differentially based on the cue or contextual variables present). For example, Salamon and Száraz (2020) conducted a study that used movement and vocal intonation together with dogs to evoke a social reference toward owners when presented with a suspicious stranger. The study tested two experiments. The first one found that alternating conditions between a reassuring owner (RO) and a suspicious owner (SO) evoked a social referencing glance toward the owner from the canine. The owners displayed a more friendly and higher tone when in the (RO) condition. In the second experiment, the owners displayed more distinct behavioral reactions such as taking a step back. The owners of the study used key words such as "Don't come close" or "Go away" "No" when in the SO condition. The study found a correlation between the owner's approach toward unfamiliar individuals and a dog's behavior when that unknown person entered the room. Future research should continue to examine this.

Finally, generalization across other situations, locations, and people was not formally assessed. However, anecdotally, the participant completed the "Place" cue with a dog sitter when another person not part of the current intervention approached the door without protective equipment. Maggie was also reported to display independent responding when a mail carrier approached the door unexpectedly and did not aggress toward the door following the "Place" cue. Despite limitations, the current study offers promising results for the use of a PFA and latency-based FA to identify maintaining variables for canine aggression and showed the

effectiveness of a function-based intervention to reduce aggression and increase an alternative behavior.

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