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Functional analysis and operant treatment of food guarding in a pet dog

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The present study extended functional analysis (FA) methodology to human-directed resource guarding in a dog in an in-home setting. The subject underwent four conditions including control, attention, escape, and tangible, arranged in a modified FA. The results indicated multiply controlled resource guarding (i.e., escape, attention, and tangible functions). The experimenter then conducted a treatment evaluation involving three function-based treatments in a concurrent multiple baseline design. Resource guarding decreased to zero levels in treatments for each maintaining contingency. Treatment effects were maintained when the subject was tested with an owner, with an untrained handler, a highly preferred treat, in an untrained setting, as well as after 2 weeks in the absence of training. Behavior analytic techniques may hold promise for lasting behavior change for resource guarding in domestic dogs, and should be examined in other populations and with other canine problem behavior.

Key words: aggression, functional analysis, multiple control, operant conditioning, praise

Aggression is regarded as the most prevalent and serious problem behavior exhibited by domestic dogs and is the most common reason owners refer their dogs to behavioral specialists (American Society for the Prevention of Animal Cruelty [ASPCA], 2019). Although canine aggression is species-typical and adaptive as a communicative response between dogs, the imminent danger posed by human-directed aggression makes its occurrence unacceptable in household settings (Sueda & Malamed, 2014). Shelter dogs who exhibit human-directed aggression are usually deemed unadoptable and are consequently at a greater risk of euthanasia (Bollen & Horowitz, 2008; Mohan-Gibbons et al., 2012). When dogs that exhibit this behavior are already placed in a home setting, however, owners may be legally required to seclude, restrain, relinquish ownership, or ultimately euthanize their pet. Such measures are especially likely if the aggression has the potential to occur around or is directed toward children, who are the most common victims of dog bites and far more likely to be severely injured (American Veterinary Medical Association, 2020; Reisner et al., 1994).

Resource guarding, a common class of aggressive canine behavior, is one of the most common reasons for relinquishment by owners and for labeling a dog as unadoptable in a shelter (Mohan-Gibbons et al., 2012). As with most behavior, resource guarding is a combination of both learned and genetic behavior (Liinamo et al., 2007; Scott & Fuller, 1965). Resource guarding may include “lip curling, making direct eye contact, stiffening body, using an array of vocal behavior and even biting when approached” in the presence of high value items (Mohan-Gibbons et al., 2012, p. 332), and is especially common around food (Marder et al., 2013).

Currently, behavioral diagnosis of resource guarding by veterinarians most commonly

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consists of indirect assessments based on owner report (Mohan-Gibbons et al., 2012). Similar to indirect assessments of human behavior, Luescher and Reisner (2008) stated that for a veterinarian to correctly diagnose canine problem responses, the owner must detail the conditions of when the behavior started (i.e., early history), how the behavior occurs now (i.e., current history), and make decisions based on assumed correct environmental information. Indirect assessments may not generate reliable or accurate information about the complete history of behavior across contexts because it often relies on a caretaker's ability to recall (or even have knowledge of) a great deal of historical information. This becomes even more problematic when the individual who is reporting the information has only recently adopted the dog.

The Safety Assessment for Evaluating Rehoming (SAFER®) Aggression Assessment developed by the ASPCA (2020 a,b) represents an important improvement over indirect measures. The SAFER® is the most prominent direct behavioral assessment method for the treatment of resource guarding, specifically with food. It is used to evaluate the probability of problematic canine behavior, including aggression and guarding food from humans (ASPCA, 2020 a,b). In the food guarding assessment, a dog is presented with a bowl of kibble and, once eating, an artificial hand (usually attached to an elongated pole for the assessor's safety) is presented and used to attempt to pet the dog or pull the food bowl away. The dog's reaction is then rated on a five-point scale, with 1 being *"a low likelihood of aggression"* and 5 being *"growling and/or attempts to bite"* (Mohan-Gibbons et al., 2012). If a dog's score on the assessment indicates a high probability of aggression, the dog may be placed into one of several commonly recommended behavior modification programs. Examples may involve providing ad libitum access to food (i.e., "free feeding") for at least 24 continuous hours (i.e., elimination of the establishing operation for guarding behavior), seclusion during mealtimes, or systematic desensitization and counterconditioning.

There are several limitations to these approaches. First, the SAFER® (as well as other behavior assessments used in shelters) is sometimes insufficient for evoking aggressive behavior that reportedly occurs in naturalistic environments (e.g., Patronek & Bradley, 2016). Second, ad libitum access to food is less likely to reduce aggressive behavior for severe cases and is especially problematic in cases involving children (Reisner et al., 2007). Third, behavior modification interventions may not be formally linked to the environmental variables producing and maintaining the responses. Such arbitrary interventions may be less likely to produce long-lasting behavior change (Pelios et al., 1999). Finally, existing assessments and interventions assume that guarding behavior is always maintained by access to food, and do not assess the possibility that other environmental contingencies may also maintain the behavior. Research evaluating the specific conditions under which canine aggressive behavior occurs might improve treatment outcomes.

Functional analysis (FA) is used widely in the field of applied behavior analysis to identify environmental variables maintaining problem behavior, including behaviors that can cause severe harm to the person engaging in them and to others around them. First applied to the assessment of self-injurious behavior (SIB) in humans (Iwata et al., 1994/1982), FA has been extended to the problems of nonhuman animals, such as SIB in a captive olive baboon (Dorey et al., 2009), feces throwing and spitting in a captive chimpanzee (Martin et al., 2011), aggression in a captive lemur (Farmer-Dougan, 2014), and problem behaviors such as jumping (Dorey et al., 2012), and stereotypy (Hall et al., 2015) in pet dogs. However, to date, no research exists that has used FA as a method for the assessment and treatment of aggression or resource guarding in shelter or pet dogs.

The present study had several distinct aims. First, we sought to extend adapted FA methodology to directly assess several potential environmental contingencies maintaining food aggression in a domestic dog in a home setting. Second, we sought to implement a treatment protocol, using operant conditioning techniques, designed to reduce aggression that appeared to serve multiple functions. Finally, we examined whether treatment effects would maintain in increasingly invasive contexts within each function.

Method

Subject and Setting

The subject of this study was a 10-year-old male, neutered border collie named Chase. Prior to assessment, Chase's owners reported that he exhibited aggressive behavior toward them and other unfamiliar persons in the presence of food, and that this had persisted throughout his lifetime. Chase did not have any underlying medical or veterinary conditions that may have reasonably been expected to influence his aggression toward his owners in the presence of food (e.g., hypothyroidism, neurological conditions, being underweight or on medication that may stimulate appetite) and was up-to-date on rabies vaccinations. Chase had limited prior training experience consisting of basic obedience commands (e.g., sit, down, come).

Chase's owners consented to all procedures used in this study. All sessions were conducted in a closed room in Chase's home where Chase was regularly fed and had been reported to engage in aggression. Chase's owners reported that he was fed twice per day in distinct meals; thus, he was not provided continuous access to food (i.e., free-fed) throughout the day. In all sessions, a video camera was present and used to record the entire duration of a meal. In all sessions for all conditions, the experimenter presented the guarded stimulus (i.e., a bowl of Chase's typical diet) and remained within 1 m of the food bowl to ensure that there was always an opportunity for the target behavior to occur. An artificial hand, securely fastened to a 1-m long steel or wooden pole, was also used in initial functional analysis sessions, as it is typically used to assess resource guarding in dogs and ensures both the dog's and trainer's safety.

Response Definitions

Resource guarding was defined as any instance or bout of aggressive behavior (e.g., biting, lunging, snapping), including precursors to aggression (e.g., freezing, staring, stiffening, growling or barking, and baring teeth). As a safety precaution, we reinforced and scored precursors to aggression to reduce the likelihood of more severe problem behavior occurring. Precursors were identified based on owner report and subsequent direct observation, as well as on operational definitions of resource guarding from prior literature (e.g., Marder et al., 2013). Staring was counted if it lasted a minimum of 0.5 continuous seconds (to distinguish it from simply looking at the trainer). Compliance was defined as engaging in the alternative "Leave it" response within 3 s following the experimenter's verbal command during tangible treatment sessions.

Procedure

All sessions were conducted during Chase's typical feeding times. Each session represented one-half of Chase's usual meal in efforts to both increase the motivation to guard the food and to increase the number of sessions that could be conducted in a single day; thus, the duration of each session was dependent on the time it took Chase to finish half of a typical meal (M = 97.1 s, range, 64 s – 142 s). This arrangement ensured the assessment was reflective of naturalistic contexts and that the time of day remained constant. In order to prevent satiation effects, no more than two sessions were conducted consecutively and no more than four sessions were conducted in a single day.

Pretraining

Prior to the start of the FA, two separate pretraining sessions (approximately 15 trials each) were conducted on separate days to ensure that the whirring noise made by the dispenser acted as a conditioned stimulus that predicted the delivery of kibble. During pretraining sessions, the experimenter remotely dispensed food approximately every 15 s. Once Chase reliably oriented, approached, and ate from the feeder within 3 s of the whirring noise, for at least five consecutive trials, we proceeded with the FA.

Functional Analysis

The FA consisted of four experimental conditions (i.e., control, escape, attention, and tangible) presented in a multielement design, in two separate phases. One phase included an artificial hand, and the second included a human hand (i.e., the experimenter's hand). Subsequently, FA sessions were presented in a pairwise arrangement via counterbalanced test-control sessions. In all conditions, the session began with the experimenter placing the food bowl containing Chase's typical diet in front of Chase and allowing him to consume food for 5 continuous seconds.

Sessions in the multielement FA were presented in a sequential order (i.e., control, escape, attention, tangible) across three cycles for a total of 12 sessions and for an additional 12 sessions in the subsequent pairwise test-control assessment. We chose not to randomize the order of the FA sessions as doing so is likely to mask sequence effects rather than capitalize on establishing operations (Hammond et al., 2013). Furthermore, we decided not to include a condition to test for automatic reinforcement (e.g., no interaction or alone) because aggression cannot occur in the absence of a stimulus (e.g., a hand). Additionally, Beavers et al., (2013) found that the majority of FA outcomes examining aggression as a target response found aggression to be maintained by social reinforcement.

In the control condition, Chase was given continuous free access to his food bowl. Either the experimenter's hand or the artificial hand was present in a stationary position approximately 1 m in front of the bowl and continuously visible to Chase throughout the session. In addition, the experimenter delivered vocal praise (e.g., "Good boy, Chase") on an FT-15 s schedule throughout the session.

In the escape condition, the experimenter's hand or the artificial hand was moved toward Chase's food bowl and contingent on guarding, the experimenter moved approximately 1 m away. Another continuous 5 s was allowed for Chase to engage with the food bowl before either re-presenting the artificial hand or having the experimenter approach the food bowl.

In the attention condition, the experimenter approached Chase and moved the artificial hand or their actual hand on or within 0.5 m toward Chase, where it remained for the duration of the meal. Contingent on aggression, vocal disapproval/praise (e.g., "No, no, Chase"; "It's okay, Chase"), was delivered continuously by the experimenter, such that the onset of guarding immediately resulted in attention, which ended only when guarding was not occurring. In addition, depending on whether the artificial hand or the experimenter's actual hand was presented (as stated above), the experimenter continued to reposition the location of their body (i.e., by moving around Chase, leaning over Chase, turning toward Chase), their hand (i.e., moving across Chase's back and shoulders), or the artificial hand (i.e., by using the hand to move the location of the bowl while eating, petting Chase, or touching Chase's face) throughout the session, without removing this stimulus. The experimenter always introduced the hierarchy of stimulus presentations in the same sequential order, starting from least to most invasive. The hand was repositioned based on the absence of guarding behavior for a continuous 5 s; in other words, if the stimulus presented did not evoke guarding behavior after 5 s, the next most invasive stimulus was presented. The addition of repositioning served several purposes. First, repositioning the hand allowed the experimenter to continuously present the demand without removing it (which would have provided escape). Had the hand remained motionless, it is possible that Chase would have habituated to the presence of the hand, potentially resulting in a false negative. Second, repositioning was intended to increase the invasiveness of hand presentation, thus reducing the potential for Chase to contact an escape contingency in non-escape conditions. Finally, repositioning approximates how resource guarding assessments are conducted in more practical settings (e.g., shelters). Thus, we wanted the procedures to be both a valid test for function and to be generalizable to applied settings.

In the tangible condition, the experimenter either placed the artificial hand on the food bowl or moved their actual body or hand toward Chase. A remote-controlled automatic feeder (PetSafe Manners Minder® Treat & Train Remote Reward Behavior Training System for Dogs) placed 3 cm from the food bowl was used to deliver additional kibble contingent on each food guarding response. As described in the attention condition, the experimenter then continued to reposition the location of her body or hand, or the artificial hand around Chase.

The human hand phase was conducted because we repeatedly observed that the artificial hand did not evoke food guarding and we hypothesized that the experimenter's approach, leaning over, and touching Chase was more likely to evoke food guarding. To ensure the safety of the experimenter, the least invasive stimulus that produced minimal levels of aggression (including precursors described in the response definitions above) was used. This involved having the experimenter approach Chase, stand next to Chase, lean over Chase, touch Chase's back, pet Chase's back, and finally, pet Chase's head or neck. All FA conditions in this second phase were otherwise identical to those in the first phase.

Treatment Evaluation: Function-Based Treatment

Following the FA, a concurrent multiple baseline design across functions (Borrero & Vollmer, 2006) was used to evaluate the effects of three separate function-based interventions to address each reinforcement contingency maintaining Chase's resource guarding.

Baseline. Data from the FA for the escape, attention, and tangible conditions were used as baseline sessions in the treatment evaluation and additional baseline sessions were conducted for attention and tangible functions to maintain the design.

Treatments. The effects of a function-based treatment (differential reinforcement of other behavior, specific to both escape and attention functions) on Chase's food guarding were evaluated. As was the case with baseline sessions, the duration of treatment sessions depended on the length of time it took Chase to consume the food in his bowl. A paired-stimulus preference assessment was conducted before the tangible treatment specifically to identify Chase's highest preferred edible (i.e., chicken jerky), which was subsequently delivered contingent on an appropriate response to the experimenter's verbal command (i.e., "Leave it").

In the treatment for escape, sessions were conducted in the same manner as the escape FA condition (i.e., the experimenter remained within 1 m of Chase and approached/presented stimuli using the same repositioning hierarchy discussed previously). Escape was delivered for 15 s contingent on the absence of aggression or guarding and food guarding no longer resulted in the removal of stimuli (differential negative reinforcement of other behavior, DNRO).

Because Chase's guarding behavior occurred for long periods of time during his meals in the escape condition, we began with a 1-s delay to negative reinforcement to ensure that Chase contacted reinforcement (i.e., if guarding did not occur immediately, the experimenter provided reinforcement by providing escape). We then subsequently increased the delay to reinforcement (Vollmer & Iwata, 1993; see extension below). Edibles and vocal praise were never delivered during escape treatment sessions.

During the treatment for the attention function, the experimenter initially approached Chase at the start of the session, stood next to him while leaning over, and delivered continuous vocal praise (e.g., "Good boy, Chase" "Nice job, buddy") contingent on the absence of aggression (differential positive reinforcement of other behavior, DPRO). Edibles were never provided, nor did the experimenter move away from the food bowl during any part of the session (i.e., escape was not provided). Vocal praise was chosen as the social reinforcer as it was believed to be the most ethical function-based treatment for Chase's attention-maintained food guarding.

Prior to conducting each tangible treatment session, the experimenter conducted five pretraining sessions in the presence of an empty bowl during which Chase received an edible contingent on a) the absence of guarding in response to the experimenter's approach toward the food bowl and b) engaging in the alternative "Leave it" response within 3 s of the command. During pretraining sessions, the experimenter always delivered the highly preferred edible contingent on a compliant "Leave it" of low response effort (e.g., Chase only had to gaze at the experimenter with his head simultaneously lifted away from the food bowl. Pretraining trials were conducted immediately prior to each tangible treatment session as an attempt to enhance Chase's discrimination between tangible treatment sessions and treatment sessions for other functions. If Chase did not exhibit the alternative behavior independently during pretraining within 3 s of the first command, the experimenter remained at the bowl and restated the command. If Chase did not exhibit the behavior following the third command, the experimenter held the edible at Chase's eye level and lured it toward her face. A differential positive reinforcement of alternative behavior (DPRA) was used as treatment for the tangible function. In addition, guarding no longer resulted in access to additional food. During treatment sessions, a full bowl of food was presented to Chase and the requirements for a compliant "Leave it" were increasingly effortful and included, a) the experimenter approaching and stating, "Chase, leave it" for which simply gazing up at the experimenter was reinforced, b) the experimenter approaching and stating, "Chase, leave it" for which sitting and gazing up at the experimenter was reinforced, and, c) the experimenter approaching and stating, "Chase, leave it" for which sitting, gazing up at the experimenter, and allowing the experimenter to pick up the food bowl for 3 s before placing it back down in front of Chase was reinforced. If at any time during tangible treatment sessions Chase did not comply with the experimenter's command within 3 s, the experimenter turned and walked away without providing any edibles, and waited 30 s before reapproaching for the next trial.

Treatment Extensions. We conducted several extension phases and probes following successful treatment for each maintaining function of Chase's food guarding behavior. Extension probes were identical to initial interventions but differed in some specific way for each session. Following the treatment for escape, the experimenter conducted, a) a DNRO 30-s delay phase across multiple sessions, b) an owner probe, during which Chase's owner implemented the contingencies for two sessions, c) a highly preferred stimulus probe, in which a highly preferred stimulus (Bully Stick, 5" straight, RedBarn Pet Products) was used instead of the food bowl and the absence of guarding was immediately reinforced for two sessions, d) a setting probe, in which one session with the food bowl was conducted in an untrained setting, and e) two, 2-week follow-up sessions with in the absence of training, which was designed to assess maintenance of treatment effects.

Following the treatment for attention, extension probes consisted of a) variable petting with continuous attention and fading in petting every 30 s across multiple sessions, b) one session with the food bowl in an untrained setting, and c) two 2-week follow-up sessions.

Following the treatment for tangible, extension probes consisted of a) one session with a full food bowl in the home, b) one session with the food bowl in an untrained setting, and c) two 2-week follow-up sessions.

Data Analysis. For all sessions, the duration of guarding and the duration of the meal were recorded from videotape. The duration of guarding was subsequently divided by the duration of the meal to obtain a proportion of time spent guarding per meal. This proportion was graphed and analyzed visually to identify behavioral functions and evaluate treatment phases across all maintaining functions. To assess interobserver agreement (IOA), a secondary coder, who had never observed experimental sessions, independently coded all food guarding from videotape for 26.9% of all combined FA and treatment evaluation sessions. IOA was then calculated using proportional agreement, in which the smaller duration of guarding in each meal was divided by the larger duration; these quotients were then summed across sessions, divided by the total number of sessions, and multiplied by 100%. Mean IOA across FA and treatment sessions was 84.8% (range, 25% to 100%).

Results

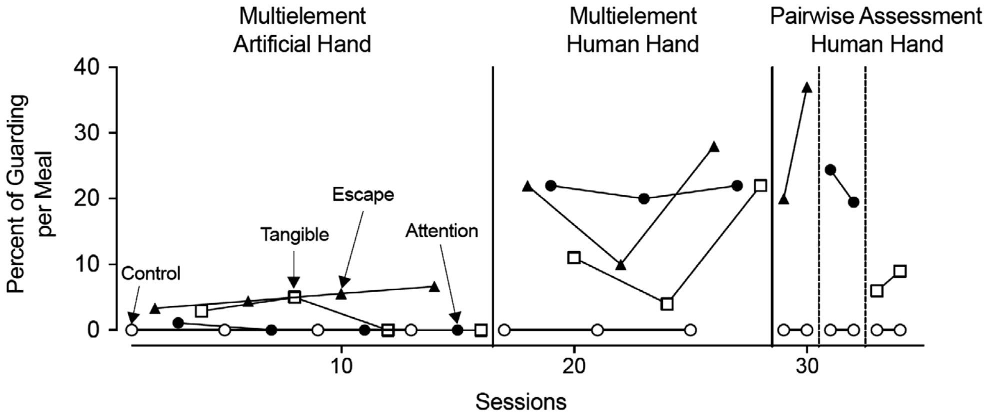
Functional Analysis

Artificial Hand

Overall, Chase exhibited low levels of guarding behavior during FA conditions when the experimenter used the artificial hand exclusively (shown in the left panel of Figure 1), suggesting that the artificial hand was not sufficient to reliably evoke food guarding (control condition M = 0% of session; Ms = 5%, 0.3%,

Figure 1

Functional Analysis Data of Chase's Food Guarding



Note. Artificial hand and human hand phases, respectively with multielement (left and middle panels) and pairwise design (right panel) comparisons.

and 1.9 % in the escape, attention, and tangible conditions, respectively).

Human Hand

Overall, Chase exhibited substantially higher durations of food guarding during multielement FA sessions in which the experimenter approached and used his or her actual hand (middle panel of Figure 1; M = 0%, 20.0%, 21.3%, and 12.3% in the control, escape, attention, and tangible conditions, respectively). Results of the pairwise comparisons (last three phases of Figure 1) support multiple control of food guarding (escape, attention, and access to additional edibles).

Treatment Evaluation

Figure 2 shows the results of Chase's treatment evaluation for the escape, attention, and tangible conditions, respectively. The baseline phases include sessions from the pretreatment FA. During the escape analysis, DNRO resulted in an immediate decrease in rates of food guarding, which remained low and eventually decreased to zero levels (by Session 9). Food guarding remained at very low to zero levels as the DNRO delay increased to 30 s. Food guarding also remained low or at zero in extension probes when the owner conducted sessions, the Bully Stick was replaced with the food bowl, when sessions were conducted in an untrained setting (the family's beach house), and 2 weeks following the last training session with a 30-s delay in the DNRO. As with FA sessions, Chase exhibited only precursors to aggression during all treatment evaluation sessions.

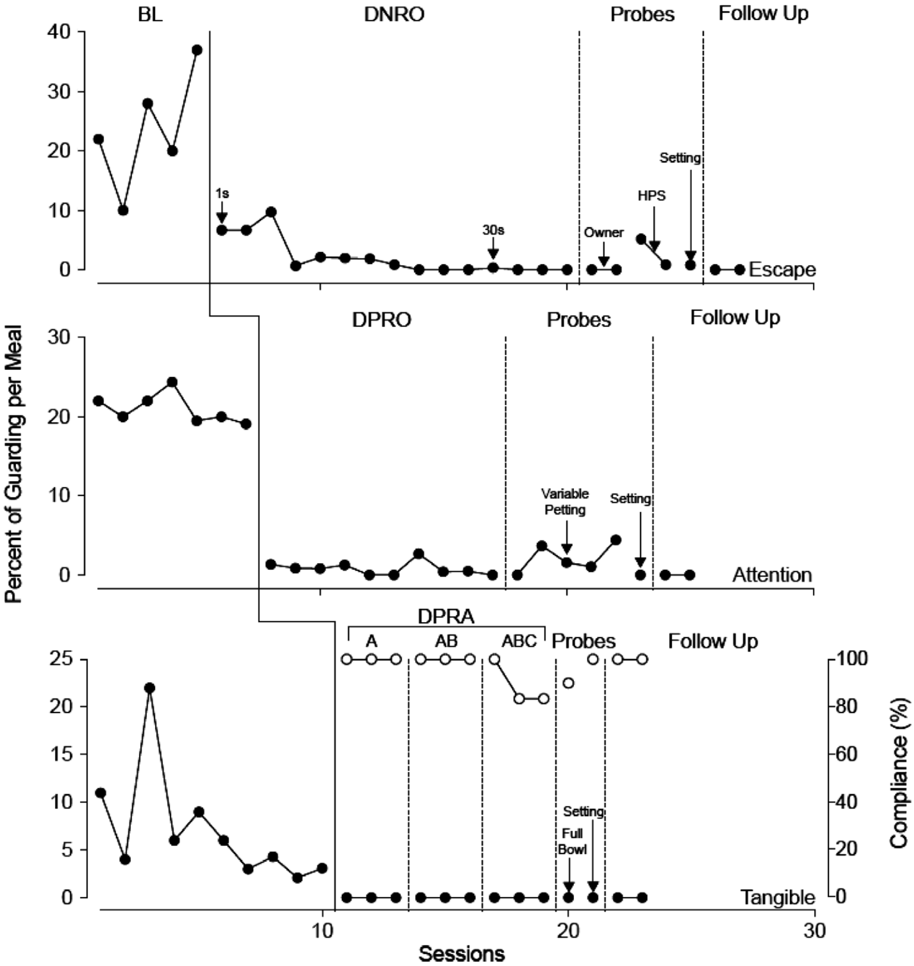
Prior to the attention treatment analysis, two additional baseline sessions were conducted following the pairwise FA; baseline levels remained relatively stable. DPRO decreased food guarding relative to baseline and eventually, to zero levels. Food guarding remained low relative to baseline as petting was intermittently paired with praise (but did not return to zero levels), as well as in an untrained setting, and during the 2-week follow-up.

Prior to the tangible treatment analysis, five additional baseline sessions were conducted following the pairwise FA; during this time, baseline levels steadily decreased but did not decrease to zero. It is possible this was a carryover effect from the other two interventions that were already in place; however, because guarding did not decrease to zero we thought it was important to teach a socially appropriate alternative behavior. DPRA (i.e., gazing at the experimenter contingent on a "Leave it" command as the experimenter approached) immediately decreased food guarding to zero levels with maximum (100%) compliance. Zero levels of guarding were obtained with increasingly difficult topographies of the alternative response including, a) gazing at the experimenter, b) sitting and gazing at the experimenter, and c) sitting and gazing while the experimenter removed the bowl. Although compliance decreased to 80% for two consecutive sessions in the latter contingency, zero levels of food guarding were obtained when Chase was provided with a full bowl of food, the food bowl was presented in an untrained setting (half-bowl, and only looking up on command was required), and 2 weeks following the training session (half-bowl, and removal of the bowl following a sit on command).

Discussion

The findings of this study demonstrate the first systematic demonstration of combined FA and operant treatment procedures for decreasing resource guarding in a pet dog. Furthermore, these results extend previous FA literature in nonhuman animals by demonstrating the assessment and treatment of problem behavior maintained by multiple environmental contingencies. In addition, these results add to the understanding of resource guarding from the veterinary and applied animal behavior fields by

Figure 2
Evaluation of Treatment Protocol for Chase's Food Guarding



Note. On the third panel for tangible, the A phase is when the "leave it" condition was implemented, B phase is when sit and "leave it" was implemented, C phase is when sit, "leave it" and the experimenter would pick up the food bowl was implemented.

providing experimental evidence for the development and maintenance of specific topographies of resource guarding as a learned behavior that is sensitive to operant contingencies, and by providing an analysis of direct behavior outcomes rather than indirect reports of behavior. Such solutions might allow animal behavior professionals to inform owners of specific strategies to employ to promote a safer environment for them and their pets, as human-directed aggression is a major reason owners decide to euthanize dogs, especially when there are children in the household (Reisner et al., 1994). Finally, given that resource guarding is a form of canine aggression that may have severe and fatal consequences for both a recipient of the behavior, as well as for the animal engaging in the behavior (Sueda and Malamed, 2014), it is also worth highlighting that function-based treatments and operant treatments were successful not only initially, but also when extended to additional stimuli, locations, testers, and after a 2-week follow-up.

Overall, the FA procedures used in the current study were successful in identifying multiple environmental variables maintaining food aggression. In addition, it is important to note that this required the presentation of natural stimuli (i.e., a human hand), rather than artificial stimuli, to reliably evoke resource guarding. This provides experimental evidence that the use of an artificial hand, a widely used tool in shelter settings, may be insufficient to evoke guarding in dogs with extensive histories in human homes. This is also a considerable finding given that guarding may go undetected in shelter settings and later emerge postadoption. Marder et al. (2013) showed that 22% of dogs that did not exhibit food aggression in the shelter did so in an in-home setting following adoption. It is also important to note that although we eventually discontinued the use of the artificial hand, the careful monitoring and recognition of precursors to aggression (i.e., fixed staring, freezing, stiff body posture, pausing) was extremely effective in conducting a reliable assessment with valid stimuli while maintaining safety (i.e., there were no instances of contact aggression). Nonetheless, further research is needed to understand and identify the stimulus features and methods of presentation that constitute aversive stimuli and evoke guarding.

Although the present study demonstrates that resource guarding behavior can be sensitive to operant reinforcement techniques across different maintaining variables, the experimental design included limitations that should be addressed in future research. First, in the control condition, we attempted to remove all relevant establishing operations for problem behavior, including the presence of the experimenter. The control condition was the only condition in which the experimenter did not move the hand towards the subject. It is likely, therefore, that problem behavior did not occur in the control condition for this reason. Furthermore, the presence of the experimenter in the other test conditions, regardless of the reinforcer presented, may have exacerbated levels of problem behavior in that condition, possibly leading to the multiple control finding. Future researchers should therefore attempt to parse out the presence of a trainer as an establishing operation for problem behavior. The treatment arrangement also presents some interpretive difficulties because of the implementation of three different treatments across three baselines (but see Borrero and Vollmer, 2006, for an established similar arrangement). However, all treatments were based on differential reinforcement, all were effective for reducing problem behavior, and the implementation was for a novel species and response. Future researchers should continue to explore the appropriate assessment and treatment parameters for nonhuman animal problem behavior.

Finally, it would be worth examining the efficacy of a treatment package that combined multiple treatment functions concurrently, which may be more practical in certain settings (e.g., shelter). For example, negative reinforcement procedures (e.g., removal of the experimenter or artificial hand) could be combined with vocal praise or the delivery of highly preferred edibles. Similarly, an initial alternative response could be trained without the use of negative reinforcement. This is an especially important consideration given that many animal training professionals and organizations advocate the exclusive use of positive reinforcement procedures and recommend avoiding procedures that may involve aversive stimuli. For example, the position statement of the Association of Professional Dog Trainers (APDT) Since this article went to press, this quote is no longer current. Please replace the text immediately after "(APDT)" with the following: "promotes a least intrusive, minimally aversive (LIMA)" approach which "does not justify the use of punishment in lieu of other effective interventions and strategies. In the vast majority of cases, desired behavior change can be affected by focusing on the animal's environment, physical well-being, and operant and classical interventions such as differential reinforcement of an alternative behavior, desensitization, and counter-conditioning" (2020, para. 1) and the Animal Behavior Management Alliance (ABMA) states that it "endorses the use of positive reinforcement as our most effective and ethical method of behavior modification for all taxa" (2020, para. 1) and does not endorse the use of aversives in routine animal management. Thus, it would be worth examining the use of arbitrary reinforcers as opposed to functional reinforcers in evidence-based treatments of problem behavior for nonhuman animals.

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