



## Research

# The role of environmental and owner-provided consequences in canine stereotypy and compulsive behavior



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## ABSTRACT

The present study evaluated whether environmental variables can reinforce and maintain canine stereotypic behavior and whether the removal of these variables can reduce the rate of the behavior. We first present an online survey in which the owners were asked to report the environmental antecedent and consequent events related to stereotypic behavior in their dogs. The survey results indicated that stereotypic behavior, as reported by the owners, was not restricted to specific antecedents. Principal component analysis identified 4 ways that the owners usually responded to stereotypic behavior. In a case study of 5 dogs, functional analysis methodology was used to evaluate whether environmental or owner-provided consequences maintained stereotypic behavior. We demonstrate that owner-provided consequences maintained circling and licking in 2 of the dogs, light movement alone maintained light chasing in 2 of the dogs, and 1 dog showed little-to-no response during sessions preventing further analysis. We subsequently manipulated the consequences of the stereotypic behavior thought to maintain the behavior for 3 of the case study dogs, which led to a reduction in the behavior for all 3 dogs. This study provides evidence that the consequences of stereotypic behavior, such as attention from the owner, can reinforce and maintain high rates of the behavior. Our results suggest that the specific owner-dog dynamic might be an important influence on canine stereotypic behaviors, and that manipulating the relevant reinforcer found to maintain these behaviors leads to a reduction in the behavior.

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## Introduction

Canine compulsive disorder (CCD)/obsessive compulsive disorder (OCD) is diagnosed when dogs present with a variety of stereotypic behaviors including but not limited to repetitive licking or flank sucking, tail chasing or spinning, light or shadow chasing, fly biting at no apparent fly, or extended fixation or staring (Luescher, 2000; Overall & Dunham, 2002). Stereotypic behaviors are typically defined as repetitive behaviors that appear to serve no obvious function (for a review of terminology, see Low, 2003). These behaviors can range from a mild annoyance to owners to severe behavioral problems requiring veterinary intervention (Luescher,

2000). The focus of the present study is on the readily observable stereotypic behavior associated with CCD.

Several studies have found that in combination with behavioral modification, pharmaceuticals can reduce canine OCD (Overall & Dunham, 2002; Seksel & Lindeman, 2001; Veremie et al., 2010). Although CCD/OCD can be reduced pharmacologically, the etiology and motivation of canine stereotypic behavior remains unclear. Exploring the environmental conditions that may contribute to and exacerbate canine stereotypic behavior may enable improved forms of treatment.

Several hypotheses have been proposed to explain canine stereotypy. One hypothesis is that canine stereotypic behaviors is the result of frustration or conflict generalizing to situations where conflict is no longer apparent or appropriate (Luescher, 2000). This hypothesis provides a plausible explanation for the development of canine stereotypy; however, it remains unclear what exact mechanism leads to the conflict and frustrations generalizing to other situations, which thereby maintain canine stereotypic behavior.

An alternative account for canine stereotypy is that the underlying biological differences separate dogs with stereotypy from

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normal dogs (Overall & Dunham, 2002). Dodman et al. (2010) identified a candidate gene associated with compulsive behavior in Doberman pinschers (*CDH2*; for a review, see Hall and Wynne, 2012). Tiira et al. (2012) attempted to extend this finding in a population of Bull Terriers, Staffordshire Bull Terriers, and German Shepherds but found no significant genetic associations with tail chasing using candidate gene analysis with *CDH2*. Instead, they found a significant effect of vitamin intake: dogs that took a multivitamin were significantly less likely to develop tail chasing. Additional study with Doberman Pinschers has shown that dogs with CCD have structural brain differences from control dogs (Ogata et al., 2013). In addition, dogs with stereotypic behavior were shown to be, in general, more perseverative on an arbitrary task than dogs that do not show stereotypic behavior (Protopopova et al., 2014). Together, there is growing evidence for a genetic contribution to canine stereotypic behavior; however, no clear biological mechanism has been identified. More recent research investigating some forms of excessive licking may be associated with undiagnosed gastrointestinal disorders (Bécuwe-Bonnet et al., 2012). These results suggest that there are likely biological contributions to canine stereotypic behavior but leave open the question whether environmental factors may also play a causal role in the development and/or maintenance of canine stereotypic behavior.

Few studies have investigated the potential influence of environmental variables on stereotypic behavior, although such a role is often assumed when behavior modification is recommended to help reduce stereotypes. Behavior modification can only work if the behavior is sensitive to environmental factors. One notable study exploring the potential role of environmental factors analyzed 400 videos of tail chasing in dogs (Burn, 2011). The author reported that owner encouragement of the dog was observed in 43% of the videos and one of the most common descriptors of the behavior by owners was “funny” (46%). These results suggest that humans may intentionally or unintentionally reinforce the behavior with attention and that changes in the owner’s behavior might reduce the dog’s stereotypic behavior.

Empirically assessing whether laughter and encouragement might actually reinforce tail chasing, as suggested by Burn (2011), requires additional evidence. Although people may provide attention contingent on tail chasing, this may have little or no effect on the dog’s behavior. To assess the effects of human attention on stereotypic behavior, we must determine whether the attention serves as its maintaining reinforcer. Researchers working with humans with diverse developmental disabilities have pioneered a single-subject methodology to assess the environmental variables that reinforce an individual’s problem behavior. This method, termed “Functional Analysis,” was first reported by Iwata et al. in 1982 (reprinted in Iwata et al., 1994a) and has been successful in identifying the environmental determinants of behavior in many cases (Iwata et al., 1994b) and cited in more than 1200 publications in Google scholar. This technique has recently been extended to identify the reinforcers of problem behaviors in animal in zoos (Dorey et al., 2009; Martin et al., 2011), and unwanted jumping up in pet dogs (Dorey et al., 2012).

Functional Analysis was designed to identify how the consequences of problem behavior may influence the rates of that behavior. Reinforcers, for the purpose of this study, are any environmental stimuli that when presented as a consequence of a behavior, lead to increased rates of that behavior. To identify these reinforcers with a Functional Analysis, a single subject is exposed to several conditions. Each condition tests whether a putative reinforcer sustains a problem behavior or is unrelated to the rates of occurrence of that behavior. This is tested by delivering the putative reinforcer whenever the problem behavior occurs during the session. If delivering the putative reinforcer increases the rate of the

behavior compared with a control condition, the consequence is confirmed as a reinforcer for the behavior. If, however, experimentally delivering a putative reinforcer when the problem behavior occurs does not increase rates of the behavior compared with a control condition, the putative reinforcer is considered not to be a reinforcer of the behavior. The control condition for a Functional Analysis is designed so that all putative reinforcers are delivered regardless of the occurrences of problem behavior. Thus, low rates of problem behavior are expected in the control condition because reinforcers are delivered without the subject needing to engage in problem behavior.

The aim of this set of studies is to evaluate the impact of environmental variables on canine stereotypic behavior. In the first study, we used a survey to assess owner-reported antecedents (events preceding a behavior) and consequences of stereotypic behavior in pet dogs. We then, in Study 2, used a single-subject assessment of reinforcers, a Functional Analysis, with 5 dogs to assess whether and which environmental variables maintain canine stereotypic behavior. Last, in Study 3, we manipulated the environmental variable found to reinforce behavior from the Functional Analysis in Study 2 for each dog, in an attempt to reduce canine stereotypic behavior.

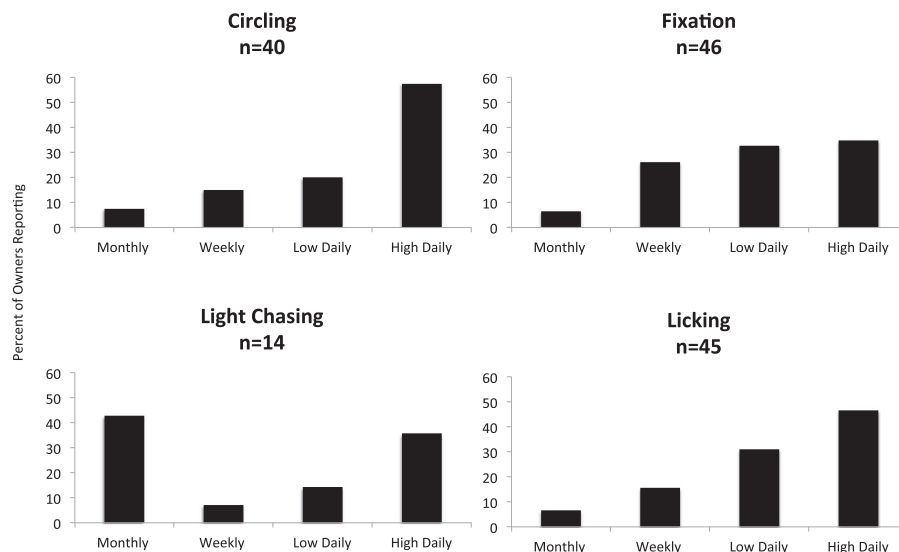
## Study 1

The aim of Study 1 was to identify owner-reported antecedent events to the stereotypic behavior and owner-reported responses to their dog’s stereotypic behavior with a brief survey. Thus, this experiment was exploratory and cannot be taken to identify valid predictor variables of stereotypic behavior—only owner impressions.

## Methods and materials

A custom survey was created using Google docs ([www.docs.google.com](http://www.docs.google.com), see Appendix A for the complete survey). Dog owners answered basic questions about their dog followed by questions on whether it engaged in stereotypic behaviors. These behaviors were described as follows: “spinning” or “circling” was defined as “repeated turning” (4 or more times in single bout) when the dog is not trained or commanded to do so or there was no apparent reason for the activity; “fixation” was defined as an excessive attention to an item or no apparent specific item; “light chasing” was defined as an intense focus or chasing of lights to which most dogs would not usually attend; “licking” was defined as the licking of objects for extended bouts with no obvious purpose or function; and “other” invited owners to report any other problem behaviors that were repeated at least 4 times in a single bout. Finally, the owners were asked to report on the conditions under which the behavior occurred and how they responded to it.

Owners were given multiple choice options (they could select more than 1) and an optional fill in box. To assess antecedent events that may lead to stereotypic behavior, the owners were asked to indicate under which conditions the behavior occurred: “only when crated, and never under other conditions,” “when there is a lack of stimulation (i.e., bored). This can include when being crated but is not limited to crating,” “when I give lots of attention,” “after or during play,” “after I give a command,” “when I have something my dog wants (e.g., a toy or food),” “following a loud noise or after being startled,” “when stressed or anxious,” “under all conditions and/or does not seem predictable,” and “other” with a textbox for an open-ended answer. To assess owner-reported consequent events that may reinforce stereotypic behavior, the owners were asked how they usually respond to such behavior and given the following options: “I give my dog attention,” “I try to block the repetitive behavior (e.g., prevent them from circling or engaging in



**Figure 1.** Owner-reported frequency of each stereotypic behavior. Each graph indicates the frequency of each behavior reported in the survey. Low daily indicates between 1 and 2 times daily, whereas as high daily indicates 3 or more times a day.

repetitions); “give the dog desired objects like toys or food;” “if the dog is in a crate, I let it out;” “I tell the dog to stop;” “I do nothing and ignore the behavior;” and “other” with a textbox.

The initial survey was administered online to the senior author, a veterinarian, and 2 dog owners (1 with a dog with stereotypic behavior). Appropriate clarifications and changes were made. The survey was then distributed through web sites ([www.caninecognition.com](http://www.caninecognition.com)), social networking sites (Facebook), online dog-related forums (e.g. [Rottweileronline.net](http://Rottweileronline.net)), and via e-mail.

### Subjects

A total of 128 responses were received. Of the 128 responses, 99 responses were included in the analysis; 29 responses were excluded as the owners responded that their dogs did not engage in stereotypic behavior. Owners of various breeds and mixed breeds responded to the survey, with most responses pertaining to sporting, working, and herding breeds.

### Analysis

Data are presented as the percentage of owners reporting for that question along with sample sizes. Only the results for questions that at least 50 owners provided interpretable responses are described. Given the exploratory nature of the survey, null hypothesis significance testing was not appropriate. To identify patterns in how owners respond to their dog's behavior, an exploratory principal component analysis (PCA) with a varimax rotation was performed in the statistical package SPSS (International Business Machines, Corp., Armonk, NY). Factor loadings greater than 0.4 were considered meaningful for this analysis.

## Results and discussion

### Sample demographics

Of the 99 responses, 40% of the owners reported their dog to spin or circle, 46% to repetitively lick, 18% to light chase, 47% to fixate, 19% to engage in other stereotypic activities, and 45% to engage in more than 1 form of stereotypic behavior. About 33% of the sample reported seeking professional help for the behaviors

(veterinarian or behaviorist), with 21% of the sample reporting their dogs self-injured.

Figure 1 shows owner-reported frequency of their dog's stereotypic behavior. The reported frequency is summarized as monthly, weekly (occurring between 1 and 6 times per week), low daily (once or twice per day), and high daily (3 or more times per day). Except for light chasing, all distributions of the frequency of behavior are skewed with most owners reporting the behavior occurring more than 3 times daily. Light chasing is the exception with a large percentage of dogs engaging in the behavior only monthly.

### Environmental antecedents

Table 1 outlines the percentage of owners reporting each antecedent event that they felt led to display of the stereotypic behavior for the 4 major classes of behavior surveyed. Interestingly, the dog being “stressed” was reported as the major antecedent for circling in 34% of the cases. “Stressed” was reported as an antecedent for the remaining 3 stereotypies by 0–15% of the dog owners. It should be noted, however, that the dog's state of “stress” may not have been accurately identified by the owners leading to a potential under-reporting of stress as an antecedent. Light chasing was most often reported as being unpredictable or occurring under any situation by 64% of the respondents. About 40% of the owners with dogs that licked reported that beginning or finishing play was an antecedent. Fixation was reported most often when the owner had something desirable and during the commencement or termination of play.

Overall, commencement and termination of play, lack of stimulation, and “unpredictable” were the most frequently reported antecedents to stereotypic behavior. Together, the results suggest that exhibition of stereotypic behavior in our sample is not only limited to conditions of deprivation (i.e., lack of stimulation) but also occurs at high rates under conditions of enrichment (e.g., before and after play or when giving attention). This suggests that in the population we surveyed, stereotypic behavior may not simply be a response to deprivation, but rather that it may be controlled by various antecedent events in different dogs.

### Environmental consequences

A total of 83 owners reported their response to their dog's stereotypic behaviors (Figure 2). Of the 83 owners reporting, the most

**Table 1**  
Owner-reported antecedent events for each stereotypy

Antecedent events	Have something	Lots of attention	Before or after play	"Stressed"	Lack of stimulation	Crated	Command	Noise	Unpredictable	Other	# Reporting
Circling	26.8	19.5	19.5	34.1	26.8	4.9	2.4	0.0	14.6	12.2	37
Licking	13.6	20.5	40.9	15.9	25.0	18.2	0.0	4.5	25.0	11.4	41
Light chasing	0.0	7.1	28.6	0.0	0.0	0.0	7.1	0.0	64.3	0.0	14
Fixation	37.5	6.3	33.3	12.5	29.2	0.0	6.3	6.3	22.9	14.6	43

Numbers indicate the percentage of owners reporting each antecedent. The last column indicates the number of owners reporting antecedents for that stereotypy.

common response was to tell the dog to "stop" (50.6%), followed by ignoring the dog (48.2%), and blocking or preventing the dog from engaging in the behavior (44.6%; percentages do not sum to 100 because of the possibility of multiple responses). Other responses included giving their dog a desired object (26% of the 83 owners) or attention (24% of the 83 owners). Several owners provided other responses. The 3 most common responses were coded and are shown in Figure 2. Giving their dog a command to do something else was reported by 10.8% of the 83 owners responding to this question. A small percentage of owners (4.8%) reported distracting their dog, but not explicitly giving it a command to do something else. Some owners reported removing an item related to the stereotypic behavior (3.6%). After removing these responses from "other," only 1 response remained unclassified. This owner responded that he used DogLeggs LLC (Reston, VA), which could be considered a form of response blocking.

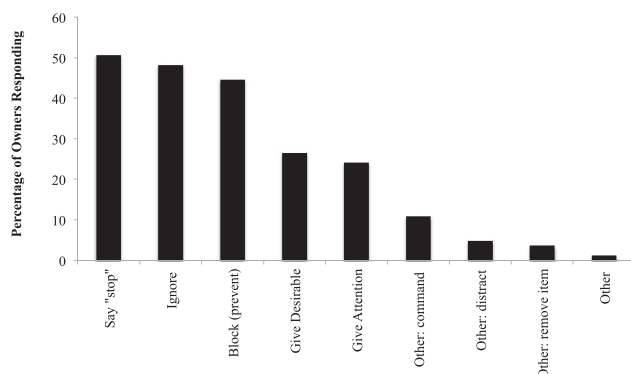
Several owners indicated responding to their dog's stereotypic behaviors in multiple ways. To uncover whether there were systematic patterns of responding, an initial PCA with a direct oblimin rotation was performed. The "other" category was removed as it contained only 1 response. Four components with eigenvalues greater than 1 were obtained. We therefore re-ran the PCA, this time restricting the analysis to only these 4 components. The component correlation matrix showed little correlation among components (all correlations <0.2), indicating that an orthogonal rotation was appropriate (Brown, 2009). A final PCA was performed with a varimax rotation to provide orthogonal components, which is shown in Table 2. Component loadings greater than 0.4 are in bold.

Four components were identified. The first component consisted of the owner ignoring the dog and giving the dog attention. Although attending and not attending to the dog simultaneously is impossible, an owner may ignore the dog on some occasions and give the dog attention on others. This could create an intermittent schedule of reinforcement with attention for the stereotypic behaviors. Component 2 consisted of saying "stop" and attempting to block the dog from the behavior, showing that use of verbal reprimands and physical prevention of the stereotypic behavior were

associated. Although responding to the behavior in this way may immediately terminate it and give the owners the impression they have punished the behavior, telling the dog to "stop" or physically holding the dog may have an unintended consequence of increasing stereotypic behavior. One possible mechanism for this increase would be that the owner's attempts to suppress the behavior may unintentionally lead to anxiety, which may occasion more stereotypic behavior. An alternative mechanism for this increase is that the owners' attempts to stop the behavior may unintentionally reinforce the behavior with attention. Thus, Component 2 may reinforce the dog with attention the owner believes is "negative" ("stop!") and Component 1 may reinforce dogs with positive attention on an intermittent schedule. Component 3 showed highest positive loadings for giving a desirable object and highest negative loadings for taking objects away. This component appears to have highest loading for whether an owner manipulates the dog's environment by adding or subtracting items. Component 4 shows highest loadings for the owner distracting the dog or giving the dog a command. Owners may respond to stereotypic behavior in both of these ways to "redirect" the behavior either by giving a command to do something else, or by trying to distract the dog.

Together, these results indicate that owners report that stereotypic behavior in our sample of dogs occurs under a variety of antecedent circumstances, ranging from playing and giving the dog attention to "boredom." Thus, stereotypic behavior does not appear to be constrained to any particular situation. Some stereotypic behavior, however, did have more common antecedents than others. For example, "being stressed" was only a common antecedent for circling, indicating a potential relationship.

The data also suggest that owners may reinforce stereotypic behavior by providing attention in the form of scolding or blocking the dog as well as providing direct attention on intermittent schedules (Component 1). It is important to note, however, that although owners may respond to such behaviors by giving the dog attention, this does not imply that the behavior is necessarily reinforced by attention. The owner's attention, although a consequence of stereotypic behavior, may not act as a functional reinforcer. To identify whether the consequences identified in the survey function to reinforce the stereotypic behaviors, a more detailed analysis of individual subjects is necessary. In the following



**Figure 2.** Prevalence of responding for owner responses to stereotypic behavior. Percentages reflect the number of owners responding to each response of the 83 owners who responded to this question. Owners could select more than one response.

**Table 2**  
Correlation matrix for principal component analysis

Parameters	Component			
	1	2	3	4
Ignore	<b>0.745</b>	−0.033	−0.080	−0.125
Give attention	<b>0.848</b>	0.120	0.099	0.054
Say "stop"	−0.022	<b>0.820</b>	−0.053	−0.263
Block (prevent)	0.152	<b>0.701</b>	0.300	0.231
Remove something	0.386	0.048	<b>−0.635</b>	−0.137
Give desirable	0.163	0.194	<b>0.710</b>	−0.062
Other: distract	−0.267	0.325	−0.391	<b>0.543</b>
Command	0.001	−0.150	0.108	<b>0.829</b>

The correlation in each component for each behavior is indicated. Component loadings greater than 0.4 are indicated in bold.



study, we conduct a case study of 5 subjects using a Functional Analysis to assess the reinforcers of stereotypic behavior.

## Study 2

This study aimed to identify the environmental consequences that reinforce and maintain stereotypic behavior using the Functional Analysis methodology for individual subjects. Because different dogs engaged in different forms of stereotypic behavior, unique assessments were developed for each dog and form of stereotypy in a case study approach.

## Methods and materials

### Subjects

Dogs with owner-reported stereotypic behaviors were evaluated for inclusion in this study. Owners were asked to complete the survey used in Study 1 that asked them about the conditions under which the behaviors occurred, and how they responded to them. Additional open-ended questions were asked to identify whether there were conditions that lead to the stereotypic behavior not identified in the survey. Six dogs with stereotypic behavior that owners considered problematic and abnormal were recruited. Two dogs chased lights (Maisey and Norman), 3 dogs chased their tail or circled (Jimmie, Dan, and Shellie), and 1 dog repetitively licked the floor (Tina). One dog (Dan) never showed stereotypy during any of the 3 visits to the owner's house and was excluded from the study (see Table 3 for subject information). Maisey was reported to chase ambient lights (sunlight) for large portions of the day. The owner removed the dog's tags to prevent the dog from chasing reflections. Norman was reported to chase bright lights. The owner reported that her veterinarian had previously diagnosed Norman with mild compulsions. Jimmie and Shellie were reported to show repetitive tail chasing. Tina was reported to repeatedly lick the floor while walking in circles for large portions of the day. Throughout Study 2 and 3, all dogs were tested in the dog's home or a place familiar to the dog (dog daycare).

### General procedures

From each owner interview, several potential reinforcers for the stereotypic behavior were hypothesized. This was done by examining the circumstances that led to the specific behavior and identifying events that may occur after the behavior and so act as possible consequences of the stereotypic behavior. Generally, the potential consequences of stereotypic behavior included attention, verbal scolding, light movement (for light chasing), and other owner-delivered reinforcers such as access to the outdoors. All the potential reinforcers that owners reported might occur after the dog exhibited the stereotypic behavior were included in the assessment. Each reinforcer was tested in a single condition. Each dog was tested in 2–5 conditions and a control condition. Each condition lasted 10 minutes (unless otherwise noted) with either the experimenter or the owner delivering the reinforcer contingent on the exhibition of the stereotypic behavior. Each condition was repeated 4 times for each dog. During each reinforcer test condition, if stereotypic behavior occurred, the putative reinforcer was delivered for 10 seconds. During a control condition, putative reinforcers were provided on a time-based schedule that was not contingent on the stereotypic behavior. To assess whether a putative reinforcer reinforced stereotypic behavior, rates in the reinforcer test conditions were compared with the control. If the outcome remained ambiguous after 4 sessions of each condition (e.g., overlapping data points between all test and control conditions, or successively decreasing and increasing data points across the 4 sessions), additional sessions were conducted to clarify the trends.

**Table 3**

Subject information

Subject	Breed	Age	Sex
Maisey	Boxer	2	Female
Norman	Labrador retriever mix	6.5	Male
Shellie	Shetland sheepdog	7	Male
Jimmie	Cattle dog mix	4	Male
Tina	Miniature dachshund	4	Female

Breed, sex, and age for each subject in Experiment 2 and 3 are given.

Between two and six, 10-minute sessions were conducted per day. A total of 15–32 sessions were run for each dog, which required between 3 and 8 days of assessment. Occurrences of the behavior were recorded in each session by a live coder using a partial interval recording method. Each session was divided into 10-second bins. The percentage of bins in which stereotypic behavior occurred was calculated to estimate the proportion of the session the dog engaged in the behavior. Interobserver agreement was assessed for the target behavior of each dog by having a second observer score at least 20% of each dog's video-recorded behavior. Percent agreement was assessed on an interval-by-interval basis by scoring the number of bins for which the 2 observers agreed divided by the total number of bins. Mean percentage agreement across all sessions was 95%.

### Light chasing

Three potential reinforcers for light chasing were tested namely movement of the light, removal of the light, or human attention. When a dog chases and approaches the light, the dog may block the light (the light is "removed"), the dog might manipulate something that moves the light when the dog chases it (e.g., a reflection), or light chasing may cause a human to attend to the dog and provide attention. Each of these reinforcers was tested in separate conditions.

To test whether light movement was the maintaining reinforcer, a 134-lumen MAGLITE LED 2-cell D flashlight (Ontario, CA) was used to shine a light onto the ground. If the dog ran after the light, pounced on the light, or touched the light or light source (the flashlight), the experimenter moved the light in a slow circular pattern for 10 seconds. The light was then presented without motion until the next occurrence of the behavior. The light removal condition was identical to the light movement condition except that contingent on engaging with the light or flashlight, the light was turned off for 10 seconds. The attention condition was similar to the other conditions, but the light was presented on the ground. If the dog engaged with the light or flashlight, the owner called the dog back for 10 seconds. The control condition consisted of the flashlight being held on the ground and facing upward to point the light up. This was done so that engaging with the flashlight or light would not make the light disappear (by blocking the source) or move (the flashlight was held steady).

Minor modifications to the procedure were made for Maisey. First, after each condition was conducted once, the attention condition was discontinued owing to the difficulty in running the session and because very high rates of the behavior were observed in the absence of the owner, indicating that the owner was unlikely a reinforcer of the behavior. Second, after conducting 4 sessions of the remaining conditions, additional sessions were conducted to clarify whether movement of the light and removal of the light reinforced the stereotypic behavior. Further details are described in the results.

### Circling

Two test conditions and a control condition were conducted to assess Jimmie's circling. To test whether circling may be reinforced

by owner attention, rates of circling were compared across conditions in which the owner either provided attention contingent on circling, provided noncontingent attention (attention on a fixed-time 15-second schedule), or was absent (the dog was alone). If the circling was reinforced by the owner, we would expect circling when the owner provided contingent attention, and little to no circling when the owner was absent or providing attention every 15 seconds.

For the attention condition, the owner started the session by petting the dog for 10 seconds, then stood up, and started working on a computer or reading a book while ignoring the dog. If the dog engaged in circling, the owner stopped the dog and attended to it for 10 seconds. In the alone condition, the dog was left alone and observed via video camera for instances of circling. The control condition controlled for the possibility that owner presences or the presentation of attention alone (and consequent excitement) may initiate circling. In this condition, the owner provided noncontingent attention by playing with the dog on a fixed-time 15-seconds schedule.

Shellie's circling was greatest when the owners approached the door of their house to exit. We therefore developed several conditions related to the owner approaching the door. In the first condition, we tested whether the dog may circle because by circling as the owner approached the door, the owner became more likely to take the dog with them (i.e., going outside as a reinforcer). Another condition tested whether the circling was reinforced by owner attention. The owner reported that when approaching the door, if the dog started to circle, the owner would tell the dog to "sit" and would then stop the process of exiting and would give the dog attention for sitting. Alternatively, circling could be controlled by the owner's absence. To test this possibility, the dog was observed after the owner had left (i.e., the dog was alone). A control condition was conducted in which the owner provided attention on a fixed-time schedule (15 seconds) and provided a continuous availability to go outside by leaving the door open. If circling was controlled by variables other than the owner's behavior, we would expect circling to be maintained when the owner was absent and when the owner provided attention and access to the outdoors noncontingently on circling.

Throughout each condition, the experimenter approached the door every 30 seconds (except during the alone condition in which the dog was left alone). For the attention condition, the experimenter approached the door ignoring the dog, and if the dog engaged in circling, the experimenter told it to "sit." The experimenter then gave the dog 10 seconds of praise. If the dog did not circle as the experimenter approached the door, the experimenter opened and then shut the door, and returned to the start location. For the walk condition, the experimenter approached the door, and if the dog engaged in circling, the experimenter led it outside for 10 seconds. If the dog did not circle, the experimenter opened the door briefly and shut the door without going outside or allowing the dog to leave.

For the alone condition, the experimenter approached the door and went outside and around the yard for the duration of the session. The dog's behavior was recorded to observe if the circling was maintained in the person's absence. In the control condition, the door was opened to allow the dog to be inside or outside and the experimenter provided noncontingent attention. This controlled for the possibility that simply being near the door, going outside, or providing attention led to increased circling.

#### Modifications

After 4 sessions of each condition, the results remained ambiguous and the rate of exhibiting the stereotypic behavior did not match the owner's reported experience. Additional sessions were

conducted with the owner taking the role of the experimenter after necessary training. The first author guided the owner during each session. The session lengths were shortened to 5 minutes each for the convenience of the owner.

#### Licking

To assess whether human-delivered consequences maintained licking, rates of licking were recorded when the experimenter provided contingent and noncontingent attention for it, and when the dog was alone. If licking was reinforced by attention, we expect the highest rates of it when attention was provided contingently on licking and lower rates when attention was presented noncontingently (control condition). If licking was influenced by variables other than attention (e.g., a medical condition), we would expect it to occur during the control condition and/or when alone.

For the attention condition, the experimenter engaged in everyday activities while ignoring the dog. If the dog engaged in floor licking, the experimenter called the dog's name in a scolding tone as modeled by the owner. If the dog stopped, the dog was given 10 seconds of attention for stopping. If the dog did not stop, the experimenter touched the dog to interrupt it. If the dog did not stop licking on a touch, the experimenter simply maintained contact with the dog for 10 seconds.

In the alone condition, the dog was left alone for the duration of the session and the behavior was recorded to see whether it was maintained in the absence of people. During the control condition, the experimenter played with the dog and provided the dog noncontingent attention (fixed-time 15-seconds schedule) throughout the session.

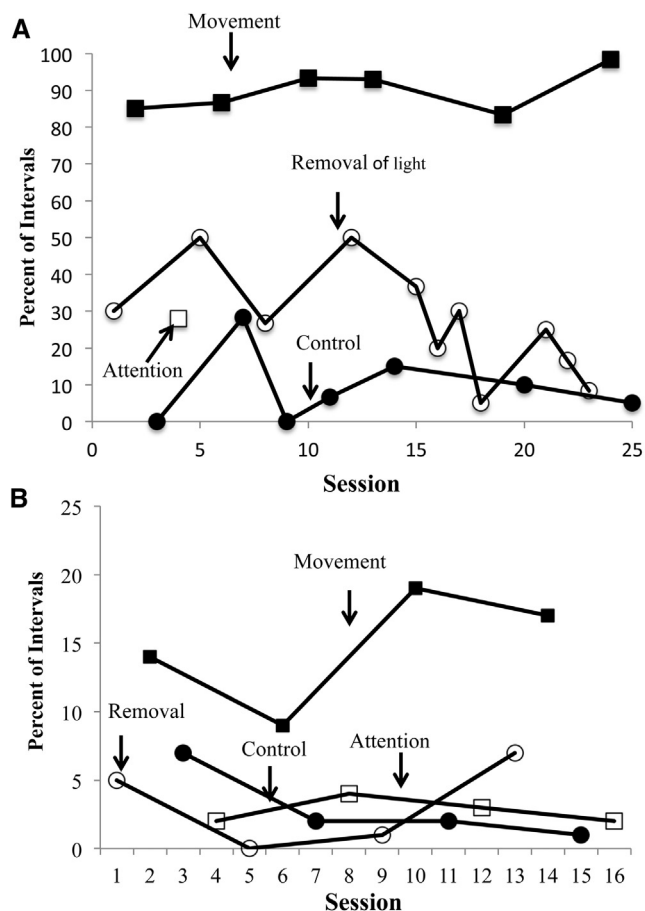
#### Modifications

After 5 sessions of each condition, the results suggested that attention maintained the behavior; however, there was a declining trend (each subsequent point was lower than the previous). Additional sessions were conducted with the owner trained as the experimenter. The first author guided the owner during all sessions.

### Results and discussion

#### Light chasing

The results of the Functional Analyses for Maisey and Norman are presented in Figure 3. Figure 3A shows the Functional Analysis results for Maisey. For the first 4 sessions of each condition (Sessions 1–13), light chasing was clearly highest when light movement was the consequence of the exhibited behavior. These rates of behavior were maintained in the owner's absence, suggesting that the behavior was not maintained by social consequences. Relatively high rates of the behavior compared with the control condition were also observed in the light removal condition during the first 4 sessions. It was unclear whether light removal also served as a reinforcer or whether the dog failed to discriminate between the light movement and light removal conditions as both conditions started the same way (with the light pointing at the ground). Inspection of the within-session data suggested that responding in the light removal condition decreased within a session implying that the behavior was extinguishing. To further test whether light removal was a reinforcer, we conducted repeated light removal sessions to see if responding would decrease (Sessions 15–18). To confirm that any decrease was not a function of exhaustion, immediately following the repeated light removal conditions, a light movement condition was conducted (Session 19). This pattern of 3 repeated light removal sessions and 1 movement session was repeated in Sessions 21–24 to confirm whether light removal was a



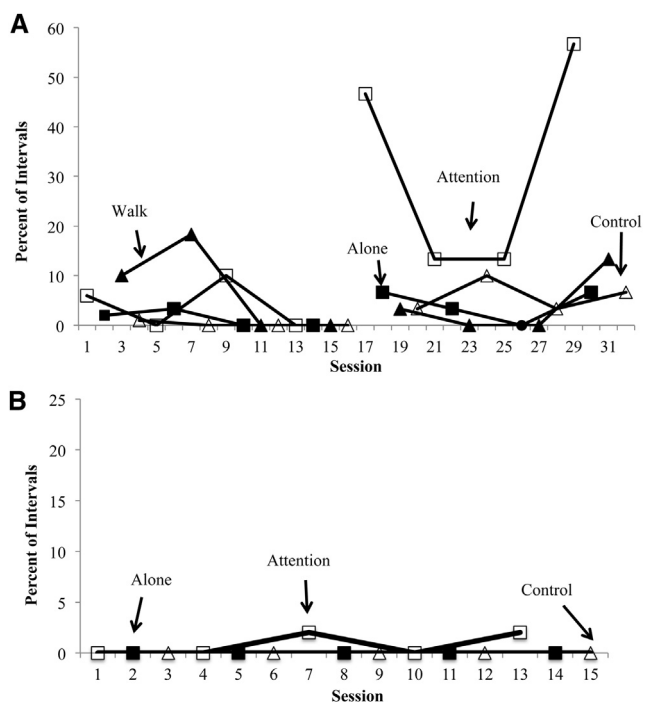
**Figure 3.** Functional Analysis results for Maisey (A) and Norman (B) for light chasing. Each data path are labeled with the appropriate condition.

reinforcer for Maisey. **Figure 3A** shows that after 2 or 3 light removal sessions, the rates of the behavior were indistinguishable from the control condition. Rates of behavior in the light movement condition remained high suggesting that this was not an effect of exhaustion, but rather the behavior was extinguishing during repeated light removal conditions. Thus, light removal was not a reinforcer for Maisey, but light movement was.

Like Maisey, Norman was reinforced by light movement, but not the removal of light (as shown in **Figure 3B**). Attention from the owner (being called back) had no effect on the rate of the behavior compared with the control condition. These data suggest that Norman's behavior was only reinforced by light movement. Thus, both dogs' light chasing stereotypic behaviors were reinforced by light movement and not by its removal or owner attention. Low rates of the behavior in the control condition indicated that when the light remained stationary as the dog engaged with it, contact with the light was not reinforcing to the dogs. This suggests that light chasing may be related to chasing prey or other types of chasing that result in the movement of the chased item. Potentially, an exaggerated chase drive may predispose dogs to engaging in light chasing. In addition, given that light chasing was reinforced by properties of the light itself, this may explain why owners viewed light chasing as "unpredictable."

### Circling

The first 4 sessions of each condition for Shellie were inconclusive with relatively low rates of responding (see Sessions 1–16,



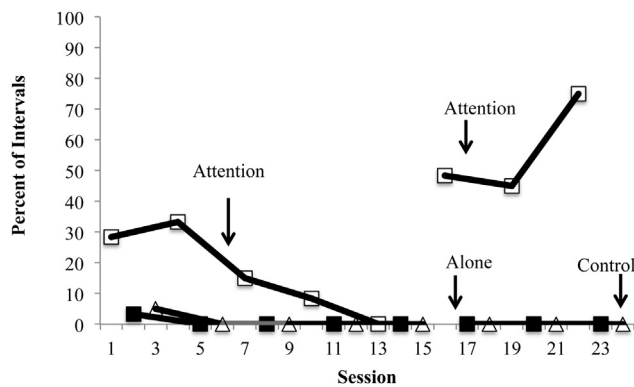
**Figure 4.** Functional Analysis for Shellie (A) and Jimmie (B). Each data path are labeled with the respective condition. Gap in data path for Shellie indicates where the owner acted as the experimenter.

**Figure 4A**). After this initial assessment, the owner was trained to conduct the analysis and guided through the procedures during each condition (Sessions 17–32). These sessions showed a clear pattern of results in which circling was highest in the attention condition. Thus, the highest rates of stereotypic behavior were observed when circling was contingent on owner attention in the form of the owner telling the dog to "sit," which was followed by praise. Rates of stereotypic behavior were low in the condition in which Shellie was given access outdoors contingent on exhibition of the behavior (walk condition) or when simply left inside when the owner went outside (alone condition). The walk and alone conditions were indistinguishable from the control condition. Thus, the behavior was maintained by the owner's effort to reduce it by providing attention in the form of telling the dog to "sit" and giving praise contingent on the stereotypic behavior.

Jimmie showed very low rates of stereotypic behavior during all sessions (see **Figure 4B**). Only 2 instances of stereotypic behavior were recorded, both in the attention condition; however, the overall low rate prevented an assessment of the function of the behavior. Thus, the data suggest the behavior may have an attention function; however, the results for Jimmie were inconclusive.

### Licking

Tina showed high rates of licking in the attention condition (Experimenter said "Tina" to interrupt the behavior and praised for 10 seconds when the dog stopped), but not in the alone or the control condition (see **Figure 5**). Tina, however, showed a decreasing trend in the rate of licking in the attention condition (Sessions 1–15). To test whether this was an artifact of the attention coming from the experimenter, the owner was trained to conduct the sessions under the guidance of the experimenter. During these sessions (Sessions 17–24), high rates of licking were observed in the attention condition, and zero rates during the alone and control conditions, indicating that licking was reinforced by the owner



**Figure 5.** Functional Analysis for Tina. Each data path are labeled with the appropriate condition. The breaks in the data paths indicate when the owner became the experimenter.

calling the dog's name to interrupt the behavior and providing attention for stopping.

We identified reinforcers for stereotypic behavior in 4 of 5 dogs, showing that this behavior can be controlled by environmental consequences. For 2 of these dogs, the behavior was incidentally reinforced by the owner trying to stop the behavior (telling the dog to "sit" or "stop"). The remaining 2 dogs' behavior was reinforced by light movement, which was independent of the owner's behavior. Herein, the reinforcer was related to the behavior itself: when the dog chased and approached the light, the light moved. By identifying reinforcers of the stereotypic behavior, it should be possible to manipulate these reinforcers to decrease the behavior. Disrupting the contingency between the behavior and reinforcer should cause the behavior to extinguish.

### Study 3

The aim of Study 3 was to decrease stereotypic behavior by manipulating the reinforcer for 3 of the 4 dogs for which a reinforcer was identified in Study 2. Because different reinforcers were identified for different dogs, each dog was treated as a case study, receiving a unique treatment plan.

### Methods and materials

#### Subjects

Maisey, Shellie, and Tina from Study 2 participated in Study 3 (1 dog light chased, 1 circled, and 1 dog licked). After completing Study 2, all dogs immediately began Study 3.

#### General procedures

Each dog received a unique treatment depending on the reinforcer for and intensity of the behavior. All treatment sessions lasted 5 minutes each. Two or more sessions in which the behavior was reduced to fewer than 10% of the time intervals (i.e., less than 3 of the 30 intervals) was considered successful for progression to the next treatment component or termination of treatment.

#### Light chasing

For Maisey, light movement maintained the light chasing. To reduce light chasing, a compound treatment was developed. Given that Study 2 demonstrated that repeated sessions in which turning off the light contingent on approaching or engaging with it

decreased responding, we used this manipulation of the reinforcing light movement to decrease behavior. Two additional features were included to reduce behavior. The first was an alternative contingency reinforced with food (differential reinforcement of an alternative [DRA]). Paw lifting or "waving" was selected as an appropriate novel behavior to reinforce. Second, we used a stimulus fading procedure that began with a low-intensity flashlight that was gradually increased across sessions to the highest intensity light (the light intensity used during Functional Analysis sessions).

The design for Maisey's treatment was as follows. We first conducted baseline sessions for paw lifting to the cue "wave" to confirm that the behavior was novel (see Figure 6: Sessions 1–3). Next, Maisey was trained to lift her paw to the cue "wave," by reinforcing successive approximations with food. Following training, Maisey was tested for responding to the cue "wave" when given every 30 seconds during a session (Sessions 4, 5, and 8). In separate sessions, Maisey's responding to the lowest intensity flashlight (9 lumens—Rayovac 2D Flashlight, Madison, WI) was recorded to serve as a baseline for subsequent manipulations (Sessions 6, 7, and 9). Next, reinforcement for waving and extinction for light chasing (turning the light off contingent on engaging with the light) were combined until light chasing decreased to fewer than 10% of the intervals for 2 sessions. Next, the baseline level of stereotypic behavior for the next higher intensity light (85 lumens—Rayovac Lantern) was obtained in 2 probe sessions, followed by the implementation of the treatment. Once the behavior had been reduced to criterion level, baseline for the highest intensity light was obtained through 2 probe trials. Treatment for the highest intensity flashlight was implemented to criterion. Thus, there were 3 replications of the treatment effect from baseline to treatment. Last, the schedule of reinforcement for "waving" was reduced to a fixed interval 5-seconds schedule.

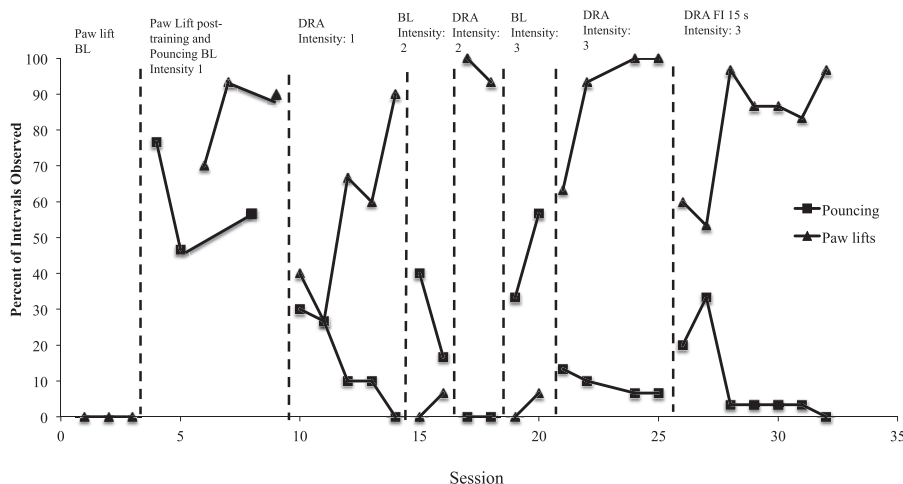
#### Circling

The Functional Analysis in Study 2 indicated that Shellie circled for attention. To reduce Shellie's circling, differential reinforcement of other behavior (DRO) was used by providing owner attention for engaging in behaviors other than circling. If the dog circled, the owner ignored it. Identically to the Functional Analysis sessions, the owner approached the door every 30 seconds throughout the interval. If Shellie circled, the owner continued to proceed through the door and stayed outside for 10 seconds. If the dog allowed the owner to approach and open the door without circling, the owner praised it for 10 seconds. These sessions were conducted at the same door as the Functional Analysis sessions. Once the dog met criterion for progressing, sessions were conducted at a second door in the house (the door most often used by the owners) and the treatment was repeated to replicate the effect. If the dog did not meet criterion after several sessions (10 or more sessions), a time-out contingency was added. A time out was used to remove all forms of owner attention contingent on circling. If, when the owner approached the door, the dog began to circle, the owner placed the dog into a separate empty room for 10 seconds. If, when the owner approached the door, the dog did not circle, the dog was given 10 seconds of owner attention. Once the dog met the criterion at the second door, the final treatment phase required the dog to not only not begin circling as the owner approached but also to refrain from circling while the owner left. All contingencies from the previous condition remained in effect.

#### Licking

The Functional Analysis for Tina in Experiment 2 indicated that her repetitive licking was reinforced by owner attention (calling her





**Figure 6.** Treatment for Maisey's light chasing. Dashed line indicates a change in procedure and the removal of the light contingent on pouncing was in effect. Intensity 1 stands for the 9 lumen light, Intensity 2 is the 85 lumen light, and Intensity 3 is the 134 lumen light. BL, baseline; DRA, differential reinforcement of alternative.

away). First, 5 baseline sessions were conducted in which the owner called the dog away contingent on floor licking. Next, the treatment condition was implemented using a 30-second momentary DRO. In this condition, a timer was set for every 30 seconds throughout the session. If the dog was not engaging in licking when the timer ended, the dog was given 10 seconds of attention. Otherwise, the dog was ignored. If the dog was licking the floor when the timer ended, she was ignored. If this did not sufficiently reduce floor licking, the next component was a time out where the dog was placed in the next room alone for 10 seconds contingent on floor licking. This removed all possible sources of owner attention that may occur when the dog and owner are in the same room. If the dog did not engage in floor licking, the owner ignored the dog. In the following phase, the time-out procedure and DRO were combined so that if the dog engaged in floor licking, it was placed in the next room for 10 seconds. If the dog was not licking the floor when the 30-seconds timer timed out, she was given 10 seconds of attention.

### Analyses

Treatment sessions were conducted until dogs met the minimum criterion of a reduction in behavior to less than 10% of intervals for 2 sessions before moving onto further treatment. Meeting this criterion for at least 3 consecutive sessions was considered successful for the final treatment phase. This criterion represents a minimum of a 78% reduction for Maisey, a 70% reduction for Shellie, and an 89% reduction for Tina.

Interobserver agreement was assessed for the target behavior of each dog by having a second observer score at least 20% of each dog's video-recorded behavior. Percent agreement was assessed on an interval-by-interval basis by scoring the number of bins for which the 2 observers agreed divided by the total number of bins. Mean percent agreement across all sessions was 88%.

## Results and discussion

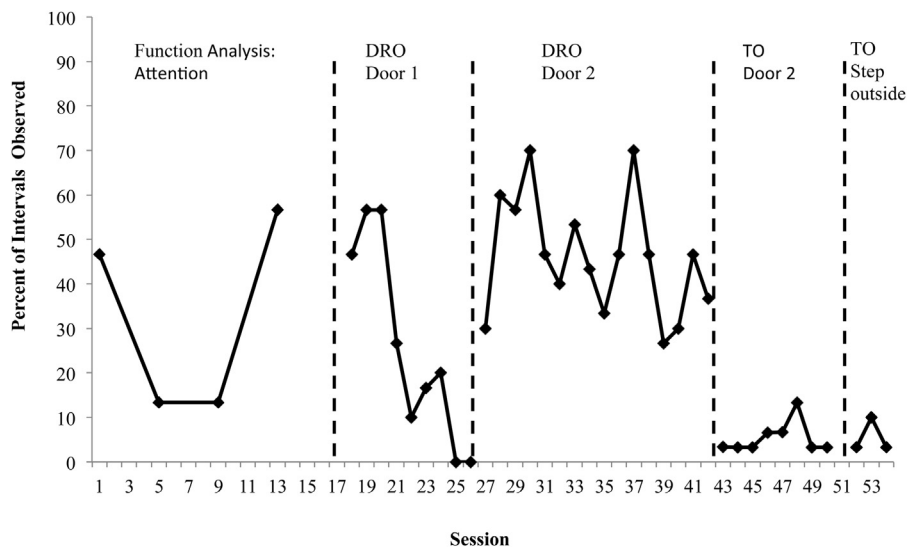
### Light chasing results

During initial baseline sessions for paw lifting, Maisey showed no evidence of paw lifting to the cue "wave" (Figure 6). When she was trained to paw lift to the cue "wave," she showed moderate levels of waving (Sessions 4, 5, and 8). Sessions 6, 7, and 9 show that Maisey pounced on the lowest intensity light at high levels

(between 75% and 90% of the intervals). In the following sessions, reinforcement for waving while the light was on and extinction for pouncing on the light (the light was turned off) was implemented. Rates of pouncing decreased within 5 sessions (Sessions 10–14), whereas rates of paw lifting increased. In the subsequent probe sessions for the next higher intensity of light, pouncing and chasing rebounded slightly (Sessions 15 and 16). When treatment was implemented, pouncing decreased to zero immediately (Sessions 17 and 18). Rates of pouncing rebounded when baseline conditions were reinstituted with the highest intensity light, and then declined again once treatment conditions were implemented in Sessions 21–25. When the schedule of reinforcement was thinned for waving, there was a brief increase in pouncing, which quickly declined. Overall, the effect of the treatment was replicated at each light intensity level. Once the behavior reduction package was implemented at each intensity, the rate of pouncing decreased. Visual inspection of the data suggest that the treatment had a meaningful effect on the behavior because each treatment data point was lower than its respective baseline condition. The mean percentage of intervals with light chasing for baseline sessions was 47%, whereas the mean for treatment sessions was 10%, with the mean of the last 3 treatment sessions at 2.2%. The overall reduction in behavior from baseline to the last 3 treatment sessions was 95%.

### Circling

The first section of Figure 7 includes the results of the Functional Analysis in the attention condition from Figure 4A as baseline for comparison to treatment conditions. When the DRO procedure was implemented, we observed a steady decrease toward zero instances of circling per session (Sessions 17–26). As the DRO procedure was implemented to decrease circling when the owner approached a different door, a resurgence in circling was recorded and little decrease in the behavior was observed across sessions. When a brief 10-seconds time out was implemented (Session 43), a rapid decrease in the behavior was noted, which was maintained even as the owner went all the way through the door (Session 52–54). The rate of circling decreased from 32.5% of intervals during the Functional Analysis attention condition to 5.5% of intervals across all of the time-out sessions to the second door. Comparing the mean rate of circling in the baseline Functional Analysis with the mean of the last 3 sessions of treatment, an overall reduction in stereotypic behavior of 83.6% was observed.



**Figure 7.** Treatment for Shellie's circling. Dashed line indicates a change in procedure. The DRO procedure for both doors is shown. TO step outside indicates when the owner would fully step outside. DRO, differential reinforcement of other behavior; TO, timeout.

These results indicate that the removal of attention contingent on circling by putting the dog in the next room significantly reduced behavior. This further confirms that the dog's circling was reinforced by attention, as the removal of attention contingent on circling led to a significant decrease in the behavior.

### Licking

Figure 8 shows a high and stable baseline for Tina's licking (mean of 92% of intervals), which was obtained after the procedures for the attention condition from the Functional Analysis in 5-minute sessions. When the DRO was implemented, a small decrease was noted; however, the behavior remained at unacceptable levels. We attempted to reverse to baseline (Sessions 28–30); however, no instances of licking were observed. These sessions functionally acted as ignore conditions (i.e., the dog was never instructed to stop licking because licking was never observed). Additional Functional Analysis sessions (Sessions 34–42, not shown) were conducted to confirm that the licking behavior only occurred in the owner's presence and when attention was contingent on licking. These sessions confirmed the Functional Analysis data reported in Study 2: Licking terminated once the owner left (the behavior was observed in 0% of intervals), resurged once the owner returned (70% of intervals), and terminated when the owner provided noncontingent attention (0% of intervals). The DRO treatment was again implemented but unacceptable levels of licking remained (Figure 8). Next, the time-out treatment was implemented with a near-immediate effect. After multiple sessions of little to no licking, the DRO was introduced and licking remained low, occurring in fewer than 6% of the intervals. The mean percent of intervals licking that was observed across the last 3 treatment sessions was 0%. Comparing the baseline with the overall mean of the last treatment phase, a 98.5% reduction in behavior was observed.

The results suggest that Tina's licking can be controlled by manipulating the attention the owner provides the dog contingent on licking. When the owner contingently removed attention (by putting the dog in the next room), decreases in licking were observed. Licking decreased overall from the initial baseline of 92% of intervals to a mean of 1.3% of intervals in the final treatment phase. The results further confirm that Tina's licking was maintained incidentally by owner attention.

### General discussion

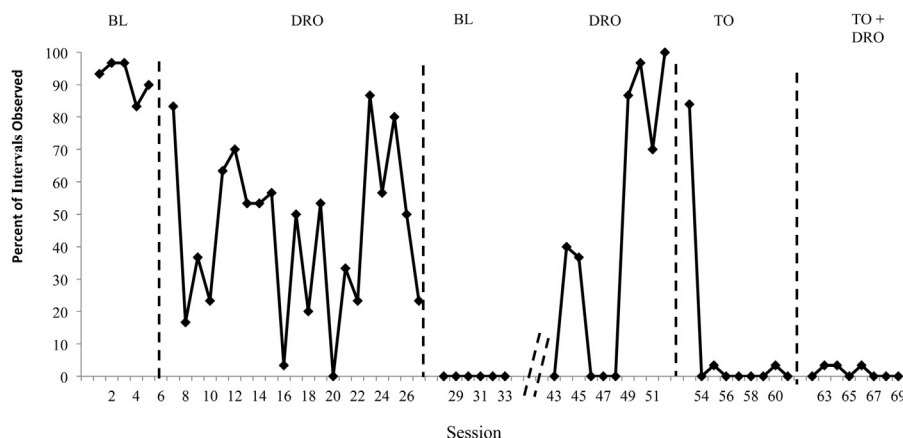
The results of the 3 studies reported indicate that canine stereotypic behavior can be maintained by environmental consequences (Study 1 and Study 2), those consequence can be identified (Study 2), and manipulated to reduce the behavior (Study 3).

Study 1 shows that stereotypic behavior in our sample can occur under a variety of antecedent conditions and is not specific to conditions of deprivation. Instead, owners report stereotypic behavior even under conditions of enrichment such as play. The results of this survey cannot, of course, be generalized to the entire population of pet dogs because the owners who responded were self-selecting. However, the results may serve to indicate some part of the range of possible contexts in which stereotypic behavior may be observed in pet dogs.

The PCA in Study 1 identified 4 independent components that described how owners reported responding to their dog's stereotypic behavior. These components suggest that owners have different styles of responding to such behaviors. Attending to these styles of response can be useful to clinicians and owners, as owners may incidentally reinforce the undesired behavior. Shellie's owner told her dog to sit and reinforced sitting, which corresponds to a "redirect" response (component 4), and incidentally reinforced the dog's problem behavior. Tina's owner also redirected by calling the dog's name to interrupt the behavior, which incidentally reinforced the behavior with attention.

Study 2 indicated that canine stereotypic behavior was reinforced by sensory consequences (light movement) for 2 dogs, and by owner attention for 2 more dogs. This is an interesting difference from the human literature that indicates that human stereotypic behavior (e.g., swaying, hand flapping, or vocal stereotypic behavior) is rarely maintained by attention, but instead by the sensory consequences of the behavior (Iwata et al., 1994b). Given that light movement was shown to reinforce light chasing, light chasing may be functionally similar to the chasing of other moving objects such as prey, which then might generalize to moving lights. This suggests that light chasing may not be a conflict behavior, but rather a hypertrophied form of responding to moving objects. Additional dogs, however, would need to be evaluated to assess whether object movement is the most common reinforcer for light stereotypies.

In Study 3, we showed that breaking the contingency between a behavior and the reinforcer identified in Study 2 led to a decrease in



**Figure 8.** Treatment for Tina's licking. Dashed lines indicate changes in procedure. Double dashed line on the x-axis indicates where additional Functional Analysis sessions were conducted (see results). BL, baseline; DRO, differential reinforcement of other behavior; TO, timeout.

the behavior. For example, we observed decreases in chasing and pouncing at a light when such behavior no longer led to light movement and an alternative behavior was reinforced. We also showed that attention-maintained behaviors could be reduced when the behavior led to the owner's removal. This extends prior research suggesting that owners reinforce tail chasing (Burn, 2011) by providing the evidence that owner attention may reinforce stereotypic behavior. Interestingly, for both of the dogs whose behavior was reinforced by attention, the reinforcer was specifically attention from their owners and not from strangers. Tina showed a decreasing trend when the experimenter was not the owner, but an increasing trend when the owner acted as experimenter. Similarly, Shellie showed an undifferentiated pattern of behavior when the owner was not the experimenter, but a clear attention function when the owner was the experimenter. The specific owner-dog dynamic may be important when considering canine stereotypic behavior.

Our finding that stereotypic behavior in different dogs may be under the control of different reinforcers suggests that therapeutic recommendations for canine stereotypic behavior may be too broad. It may not be advisable to make overly general behavioral treatment recommendations for canine stereotypic behaviors if the behavior may be under the control of different reinforcers. For example, redirection procedures have been shown to be effective in treating humans with stereotypic behaviors (Cassella et al., 2011; Schumacher and Rapp, 2011). However, human stereotypic behaviors is rarely maintained by attention (Iwata et al., 1994b), making it unlikely that a therapist may incidentally reinforce the stereotypic behavior while redirecting the behavior. In some of the dogs we tested here, however, we found that stereotypic behavior was reinforced with attention, and thus redirection procedures (e.g., telling the dog to sit), could exacerbate the problem behavior. For other dogs, however, attention was not a reinforcer and redirection procedures may be effective for these dogs, without incidentally reinforcing the problem behavior. The hypothesis that certain interventions could predictably worsen certain types of stereotypic behaviors (e.g., those maintained by attention do not abate when given the same or similar attention) could not be tested given our sample of 3 dogs.

Generalizations to the larger population of dogs with stereotypic behavior from the present study are limited because of our sample size. Our direct assessment of putative reinforcers (Study 2), and subsequent manipulation of the reinforcer contingency to decrease the stereotypic behavior (Study 3) were limited to 5 and 3 dogs, respectively. We cannot generalize the prevalence of various

reinforcers and environmental consequences to the broader population. Additional study will be required to assess the prevalence of different reinforcers maintaining stereotypic behaviors. Importantly, this study demonstrates that the Functional Analysis methodology is a viable method for assessing possible environmental reinforcers of stereotypic behavior for individual dogs, and may help inform individual-tailored treatments to reduce stereotypic behavior.

This study provides some of the first empirical evidence demonstrating that environmental variables can and do influence canine stereotypic behavior. It is important to note, however, that the present analysis does not exclude the biological hypothesis, but instead adds to it. The stereotypic behavior in our present analysis may also be influenced by genetic factors or may have started as a medical condition. Identifying the environmental determinants of the behavior helps further our understanding of the variables maintaining canine stereotypic behavior that are susceptible to direct manipulation.

In sum, the environmental consequences of stereotypic behavior should be considered as potential reinforcers for the presentation of the behaviors. The Functional Analysis procedure can be used to assess whether such behaviors are reinforced by any of their consequences. Once the reinforcer is identified, programs can be designed to target it and thereby reduce the behavior. This may be preferable to treatments not tailored to individual circumstances, such as redirection, that may have the unintended consequence of reinforcing the behavior. Future research exploring the environmental antecedents and consequent events of stereotypic behaviors will help to further understand variables potentially contributing to such behaviors.

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### Conflict of interest

The authors declare no conflict of interests. Nathaniel J. Hall, Alexandra Protopopova, and Clive D.L. Wynne all contributed to the idea for the article, the design of the experiments, analysis of the data, and the writing of the article. The experiments were conducted by Nathaniel J. Hall and Alexandra Protopopova.

## Ethical considerations

This study was approved by the University of Florida Institutional Animal Care and Use Committee (IACUC).

## Supplementary data

Supplementary data related to this article can be found online at <http://dx.doi.org/10.1016/j.jveb.2014.10.005>.

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