



# Association between increased behavioral persistence and stereotypy in the pet dog



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## ABSTRACT

The aim of the present study was to evaluate whether dogs that exhibit stereotypy also show higher behavioral persistence in an extinction-learning task. Thirteen pet dogs with stereotypy and 13 breed-matched control dogs were assessed on a resistance to extinction test. Each dog was trained for 40 trials using a food reinforcer to nose-touch the experimenter's hand on a continuous reinforcement schedule. After acquisition, the dogs entered an extinction phase, during which food was no longer delivered. The numbers of nose-touches as well as inter-response times during this phase were recorded. A linear regression found that stereotypy status ( $t = -2.46, P = .027$ ) and breed type ( $t = 2.44, P = .023$ ) were significant predictors of the number of responses in extinction. Dogs with stereotypy responded more in extinction than control dogs. The mean number of responses was 13.4 (SD = 14.7) in the control group and 26.0 (SD = 15.3) in the stereotypy group. These results suggest a link between previous laboratory and zoo animal findings on the neurophysiology of stereotypy and the pet dog population. They also have implications for the use of extinction procedures to reduce stereotypic behaviors in pet dogs, as these dogs show enhanced resistance to extinction.

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## 1. Introduction

Repetitive and/or unvarying behaviors without an apparent goal, hereafter “stereotypy,” occur in both human and non-human animals. Stereotypy is common and widely studied in captive animals housed in zoos and laboratories. Furthermore, stereotypy is widely considered an indicator of poor welfare, deprived environments, and/or the result of CNS dysfunction (for a review see Mason et al., 2007).

Pet dogs have also been reported to engage in stereotypy such as excessive circling, tail chasing, flank-sucking, fly biting, self-mutilation, pacing, spinning, staring, pica, some repetitive vocalizations, some aggressions, and fabric sucking (Moon-Fanelli and Dodman, 1998; Overall and Dunham, 2002). About 3.4% of dogs presenting at a Cornell University veterinary behavior clinic from 1991 to 2001 were diagnosed with Canine Compulsive Disorder (CCD) (Bamberger and Houpt, 2006), in which the above described stereotypies represent the main clinical symptom. Furthermore,

the American Kennel Club (AKC) Canine Health Foundation listed CCD as a top health concern for some breeds of dogs, such as Bull Terriers and Border Collies (AKC, 2012). In most cases, canine stereotypies significantly decrease the welfare of both the affected dog and its owner. Owners report that such abnormal behaviors interfere with the daily functioning of their dogs, preventing them from being able to eat, play, and interact normally with people (Moon-Fanelli and Dodman, 1998; Overall and Dunham, 2002). In addition, these dogs typically show some tendency to mutilate themselves, for example by biting their tails, wearing out their paw pads, and circling until complete exhaustion, leaving owners to explore undesirable treatments such as tail amputation and even euthanasia of their pet (Moon-Fanelli and Dodman, 1998).

At this time, however, our understanding of the causes and factors related to canine stereotypy is limited. The question remains whether dogs with stereotypy show systemic and fundamental behavioral differences from normal dogs. Alternatively, dogs with stereotypy and normal dogs may not show any general behavioral differences, but instead may only differ in the presence or absence of stereotypy. The fact that animals that exhibit one stereotypy are likely to exhibit other seemingly unrelated problem behaviors and siblings often share a predisposition toward stereotypic behaviors (Hewson et al., 1998), suggests that there may be more fundamental behavioral differences between normal and affected dogs. These observations support the assumption

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that there are some underlying predispositions among dogs with stereotypy.

Phenotypes, such as an individual's general sensitivity to reinforcement, have previously been associated with complex behavioral disorders such as Attention Deficit Hyperactivity Disorder in people (Murray and Kollins, 2000). In addition, researchers have identified other general phenotypes such as impulsivity (Neef et al., 2005) that differentiated their target population from typically functioning individuals. Furthermore, Frith and Done (1983) found that schizophrenic patients differed from others in their perseveration of responding. These patients displayed a very low switch-over rate on a concurrent choice task (Frith and Done, 1983). Such perseverative responding and problems with response inhibition largely characterize people with autistic spectrum disorders (see review by Russo et al., 2007; but also see Geurts et al., 2009 and Van Eylen et al., 2011). Numerous animal studies, spanning a wide variety of species, have investigated behavioral disinhibition as a behavioral process that may separate animals that show stereotypic behaviors from those without behavioral stereotypies. Disinhibition of behavior may result in elevated rates of switching behaviors, perseveration of behavior in tasks that require inhibition, and shorter latencies to initiate behaviors (Garner et al., 2003). Whereas stereotypic behavior, as we have described it above, refers to the behavior of the animal outside of an experimental procedure, repetitive responding within an experiment is termed perseveration (Garner et al., 2003). Perseveration, as measured through resistance to extinction (a measure of the continuation of responding after reinforcement is discontinued), was found to correlate with presence or severity of stereotypic behavior in a study with bank voles (Garner and Mason, 2002), two species of tits (Garner et al., 2003), Asiatic black bears (Vickery and Mason, 2003), Malayan sun bears (Vickery and Mason, 2005), horses (Hemmings et al., 2007), and rhesus macaques (Lutz et al., 2004; Pomerantz et al., 2012). Tanimura et al. (2008) found that frequency of stereotypy in mice was positively correlated with the number of errors in a reversal-learning task. In other studies, perseveration was assessed through an analysis of change-over patterns in a concurrent choice task with equal schedules of reinforcement on both choices (e.g. Campbell et al., 2013; Dallaire et al., 2011; Gross et al., 2011; Garner et al., 2003); however, Gross et al. (2011), unlike other studies reviewed here, did not find a correlation between stereotypy and perseveration. Furthermore, a correlation between perseverative behavior and the frequency of self-directed behavior or displacement activity (such as self-touching, scratching, manipulating objects, etc.) was found in lion-tailed macaques, squirrel monkeys, and capuchin monkeys (Judge et al., 2011).

The aim of this study was to extend the large literature on the association between behavioral persistence and stereotypy to the pet dog population. We set out to examine whether resistance to extinction is a fundamental behavioral phenotype that distinguishes pet dogs that exhibit stereotypy from those that do not. We predicted that dogs with stereotypy would show higher resistance to extinction on an arbitrary novel task than dogs from a normal population. As previous research has differentiated between topographies of canine stereotypies and indicated that certain breeds have different topographies (Mills and Luescher, 2006), we also aimed to explore these additional variables in our data set.

## 2. Materials and methods

Twenty-six dogs were recruited through advertisements online, social networking sites, local veterinary clinics, and dog parks. All owners completed a questionnaire describing the dog's form, frequency, and intensity of the stereotypy. After completion of the questionnaire, a consultation was conducted (by AP and NH) to verify that the dogs exhibited the reported stereotypy. Dogs in the control group were matched to dogs with stereotypies by breed. If possible, dogs were further matched by other criteria in the following order: dogs were siblings, shared the same household, similar age, and same sex. Table 1 lists the subjects that participated in the experiment. The different forms of stereotypy were classified into five categories: licking (excessive licking and/or sucking on part of the dog's body or inanimate objects), circling (repeatedly spinning in one direction), light chasing (excessively following shadows or reflections), light fixating (staring at a light source for a prolonged time), and fly snapping (snapping at the air as if catching invisible flies).

Each dog was tested in its home by one experimenter, either the first author (AP), who was not blind to the hypothesis of the study ( $n=22$ ) or the dog's owner, who was blind to the hypothesis, if the dog was fearful towards AP ( $n=4$ ). All sessions were videotaped. Each dog received one continuous session, which was divided into two phases: acquisition and extinction. During the whole session, the experimenter stood still with her left hand down by her side with the palm facing the dog, and her right hand behind her back. During the initial learning phase, the dog was given a small piece of hot dog ( $\sim 0.5\text{ cm}^3$ ) every time it touched the experimenter's palm with its nose. Upon a nose-touch, the experimenter withdrew the left hand and placed it behind her back and, with her right hand, reached into a container with food and delivered one food item. If 1 min passed with no response during this phase, the experimenter re-presented the left hand while calling the dog by name

**Table 1**  
The form and frequency of stereotypy (for experimental dogs, as reported by the owner), age and sex of each dog. Control dogs that lived in the same household as their counterparts are represented with an asterisk. Control dogs that were siblings of their counterparts are represented with a dagger sign. Dogs shaded in gray were tested by the owner.

Stereotypy group					Control group	
Breed	Age	Sex	Stereotypy	Frequency of stereotypy	Age	Sex
Bull Terrier	9	M	Licking	1/day	9	M
	1	M	Circling	10/day	2	F
	1	M	Circling	1/day	4	M
Border Collie	4	F	Light chasing, light fixating	1/day	4	M
	Shetland Sheepdog	7	M	Circling	3/day	8
		8	F	Circling	1/day	8
Australian Shepherd	2	F	Circling, light fixating, fly snapping	3/day	6	F <sup>*</sup>
Cattle Dog mix	5	F	Circling	5/day	5	F
American Pit Bull Terrier	5	M	Light chasing	1/day	2	M
Blackmouth Cur	3	F	Light chasing	1/day	3	M <sup>†</sup>
Miniature Dachshund	3	F	Licking, circling	5/day	9	M <sup>*</sup>
Doberman	2	M	Licking	1/day	5	M
Terrier mix	3	F	Light chasing	1/day	3	F

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