

**OWNER-REPORTED AGGRESSIVE BEHAVIOR TOWARDS FAMILIAR PEOPLE  
MAY BE A MORE PROMINENT OCCURRENCE IN PET SHOP-TRADED DOGS**

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## **Abstract**

There is longstanding recognition of the adverse effect of stressful experiences during early critical developmental periods and the later association with problematic behavioral issues in dogs. The aim of this study was to evaluate whether the origin/source of puppies (pet shop vs. breeder) was associated with later potential problematic behaviors. We did a cross-sectional survey of Italian dog owners, who were asked to complete an online version of our *Relazione Cane-Proprietario* questionnaire, providing information about themselves, their dogs, and whether the animals exhibited any of 16 potential problem behaviors. Pearson X<sup>2</sup> test of independence was applied in 2 x 2 contingency tables and binary logistic regressions to analyze the effects of source of acquisition on behavioral patterns while controlling for various owner- and dog-related variables. The odds of displaying owner-directed aggression were significantly greater for the dogs that had been purchased from a pet store as puppies than those purchased from a breeder (control group). We also found an association between a dog's pet store origin and other potential problem behaviors, including house soiling, body licking, and separation-related behavior, but this relationship was confounded by the effect of a set of owner-related factors. These findings indicate that obtaining puppies from pet stores may predispose them to potentially exhibit owner-directed aggression as adults. We suggest that further research in prevention of problem behaviors in adult dogs should be aimed at identifying the root causes of pet store-related behavioral issues, without ignoring confounding at a household level.

**Keywords:** pet store; dog behavior; puppy behavior; canine aggression

## **Introduction**

Adverse early life experiences may affect the behavior of humans later in life (Heim and Nemeroff, 2001; Rinne et al., 2000). The effects should be similar in dogs. Although the relationship between behavioral problems and a dog's early experience has gained increasing attention by scientists over the last decade (Appleby et al., 2002; Pierantoni et al., 2011), one issue being debated concerns the potential detrimental effect of a pet store origin. Publications on the subject (Bennett and Rohlf, 2007; Gaultier et al., 2008; Jagoe, 1994) reported inconsistent findings.

In our previous study (Pierantoni et al., 2011), although the source of the dogs was not directly associated with reports of behavior problems, the prevalence of potential problem behaviors among dogs separated early from the litters was higher if they came from pet shops rather than from other sources. More recently, McMillan et al. (2013) found that dogs acquired from pet stores were more likely to develop behavioral problems, particularly aggressive behavior, than those obtained from noncommercial breeders. However, the analysis of McMillan et al. was conducted without including demographic and background information on the dog owners, some of which might be related to the exhibition of dogs' behavior problems (Colley, 2013). Owner gender, age, education, previous experience with dogs, and the reason for having the dog, as well as the number and composition of family members and the type of housing have been shown to have detectable effects on a dog's behavior (Jagoe, 1994; Kobelt et al., 2003; Kubinyi et al., 2009). If the owners receive advice for a proper management of the puppy, the dog will exhibit fewer problematic behaviors (Gazzano et al., 2008). If any factor associated with problematic behavior was also associated with obtaining dogs from pet stores in the general population, it could act as a confounding factor. Confounding is a situation in which an association between a given risk factor (e.g., a dog's pet store source) and an outcome of interest (e.g., problem behavior) is observed as a result of the influence of a third variable (the confounder) (Szklo and Nieto, 2013). Ignorance of potential confounding events may lead to an overestimate or underestimate of any true association and may change the direction of the observed effect (Dos Santos Silvas, 1999). In this article, we discuss information on the prevalence of owner-assessed potential problem behaviors exhibited by dogs that had been acquired from pet stores and compare those to responses from owners whose dogs came from official breeders. The aim was to evaluate whether and how having a pet store as the source of dog acquisition affects behavioral outcomes, while controlling for a set of confounders that includes owner-related variables.

## **Materials and methods**

### *Participants*

Participants were recruited via the Internet. The questionnaire used for assessment (Relazione Cane-Proprietario) was posted online and published in the media (pet magazines and Web sites). Participation was restricted to residents of Italy who were older than 18 years and directly involved in the pet's care. A subset of these data consisting entirely of companion dogs whose owners reported obtaining them as puppies from official breeders (349) and pet stores (173) was selected for analysis. The breeders in the present study, who are recognized by the National Board of Italian cynophiles (E.N.C.I.), work on a small scale with the intent to produce healthy dogs and to ensure that all animals are provided with responsible homes and socialization. None of the dogs was younger than 1 year at the time of the survey.

### *Questionnaire*

Information about the owners and the dogs were obtained by use of an online modified version of the Relazione Cane-Proprietario questionnaire, a standardized survey tool that has already been included in previous articles (Pierantoni et al., 2011; Pirrone et al., 2015). It consists of 4 sections. The first section contains questions on the participant's demographics, such as gender, age, municipality of residence, region of residence, marital status, household, presence of children, education, presence of a house yard, and past dogs. In the second section, owners are asked to indicate demographic variables for their dogs: age, sex, sexual status, age at acquisition, breed, size, and source. The third section contains single-choice questions related to the relationship between the owners and their dog. Last, within the fourth section, 16 common types of potentially problematic behaviors are listed: some separation-related behavior, destructiveness, excessive barking, fearfulness on walks, reactivity to noises, toy possessive-ness, food possessiveness, attention seeking, aversion to strangers, stranger-directed aggression, owner-directed aggression, dog-directed aggression, tail chasing, body licking, pica or consumption of non-food-related objects, and house soiling. A brief explanation is provided describing the definition and behaviors included in each behavioral category; however, these are descriptions, not diagnoses. Participants

are required to indicate whether their dog exhibits any of these behaviors. The response options were only yes or no.

### *Statistical analysis*

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp, Armonk, NY). Pearson  $\chi^2$  test of independence was applied in 2x2 contingency tables to compare animals' behaviors in the 2 origin-related groups and to identify potential confounders. Fisher exact test was performed when the expected frequency of the observations was lower than 5. Statistical modeling was provided by backward stepwise binary logistic regressions, including all potential confounders, to estimate the value of their induced bias in the study results. Initially, all owner and dog variables were entered into the model, with the least significant variables removed one at a time until only significant variables associated with values of  $P < 0.05$  remained. The significance of each predictor was assessed using likelihood-ratio tests, and the odds ratio was calculated to evaluate the strength of such a relationship. The Hosmer-Lemeshow test was used to assess the goodness of fit of the logistic regression models. A 2-sided  $P < 0.05$  was considered statistically significant.

## **Results**

A statistically significant overall association with a pet store origin was found for 4 of the 16 behaviors included in the study. Pet store-obtained dogs had a much higher prevalence of reported separation-related behaviors (30%) compared with the breeder-obtained dogs (17%) ( $X^2$  5.796 on 1 degrees of freedom [df],  $P$  0.023). The proportion of dogs from the pet store-obtained group that showed house soiling was 15%, whereas the proportion from the breeder-obtained group that showed house soiling was only 5%. The difference in proportions was significant ( $X^2$  8.468, df 1,  $P$  0.004). Pet store dogs were reported to display body licking (30%) significantly more often than did dogs purchased from breeders (14%) ( $X^2$  10.665 on 1 df,  $P$  0.001). Finally, pet store-obtained dogs had a much higher prevalence of reported owner-directed aggression of any kind (21%) compared with the breeder-obtained dogs (10%) ( $X^2$  6.869 on 1 df,  $P$  0.009). The Mantele-Haenszel odds ratio for these reported behaviors are presented in Table 1.

A set of both owner- and dog-related factors emerged as potential confounders in the association

between these behaviors and obtaining dogs from pet stores (Table 2). The results from the logistic regression analyses are summarized in Table 3. As indicated by the Hosmer-Lemeshow tests, the overall fit of the models was good. Source was a significant predictor for owner-directed aggression. As shown by the Exp(B) coefficient in the logistic regression, dogs obtained from pet stores were twice more likely to exhibit aggressive behavior to owners than those obtained from official breeders. Conversely, the association between a pet store origin and the occurrence of house soiling, body licking, and separation-related behavior was eliminated via the confounding effect of owner-related variables.

## **Discussion**

The results of the present study indicate that obtaining a puppy from a pet store may increase the dog's chances of showing owner-directed aggression as an adult. This finding is partially consistent with results by McMillan et al. (2013) and with that reported in the study of Casey et al. (2014), where a 1.8 times increased risk of aggression toward family members was found in dogs obtained from a combined category of sources, including pet shops, as compared with those obtained directly from breeders. Experience, genetics, and environment jointly influence most aspects of behavior, exerting interactive effects (Gottesman and Hanson, 2005). Rearing experiences, such as rearing condition, can have a profound effect, both positive and negative, on the developing organism. Consistent with these considerations, several explanations may account, either singularly or in combination, for the behavioral difference we found between pet store-derived and breeder-derived dogs.

According to Bennet and Rohlf (2007), group differences in aggressive behavior might depend on the fact that pet store dogs might be less adequately socialized as puppies than are other dogs. Dogs that are appropriately socialized as puppies are less likely to exhibit behavioral problems as adults, including aggression (Howell et al., 2015). Because socialization should begin early in a puppy's life, it is the responsibility of the puppy breeder and owner. Breeders can ensure that puppies are exposed to age-appropriate experiences while in the litter, and owners must ensure that the dog continues to have varied experiences throughout his life. Official breeders must sign and comply with the Dog Breeder Code of Ethics provided by the Italian Kennel Club E.N.C.I. (E.N.C.I., 2015), which establishes both standards and guidelines for the ownership, breeding, and sales of the dogs. Breeders shall maintain the highest possible standards of health, including regular contact with people and exposure to the outside environment for proper socialization of

dogs, and constantly strive to improve their knowledge of their chosen breed or breeds, as of the requirements for the care, welfare, and betterment of dogs. Most puppies sold by pet stores in Italy come from high-volume substandard breeding facilities, the so-called puppy mills or puppy factories, located in Eastern Europe (Ferrari and Antonioli, 2015; FOUR PAWS International, 2015), where little care is taken about health and welfare. McMillan et al. (2013) hypothesized the existence of potential sources of stress in similar commercial breeding establishments in the United States. Prenatal exposure to maternal stress has been shown to induce epigenetic methylation of glucocorticoid receptor promoter regions, which causes hyper-reactivity in rodents and humans (Radtke et al., 2011). In addition, stressors including those related to transport, spatial restriction (confinement), and limited access to positive human and social interactions experienced by pet store dogs early during the socialization period might be potential predisposing factors for problematic behaviors (McMillan et al., 2013). There are few data on effects of anxiety on learning in dogs (Overall, 2013), but we know from studies on rodents and human children that chronic glucocorticoid excess, at any time, interferes with learning at the cellular level (Yau et al., 2002). Chronic glucocorticoid exposure also affects the structural development of the hippocampus (the brain region responsible for associational learning and its further integration into cortical function) and the amygdala (the region responsible for developing and modulating fear) (Carter et al., 2002; Gogolla et al., 2009). Alternatively, group differences could be a function of different owner knowledge. Some owners may have poor knowledge regarding dog socialization practices and canine behavior (Howell et al., 2015) and may be unable to recognize whether the pup has a problem with which he needs to cope.

These owners are more likely to have dogs with behavioral problems (Landsberg et al., 2012; Peachey, 1993). The role of the breeder is not only to raise healthy and sociable puppies but also to appropriately select and educate potential owners about the importance of correct ongoing socialization and training for companion dogs (Howell et al., 2015). In accordance with the E.N.C.I. Code of Ethics (E.N.C.I., 2015), Italian official breeders shall provide to all new buyers responsible dog ownership information, ensuring that they understand the requirements for the care, management, and welfare of the dog, and that they have the time and facilities to fulfill their responsibilities. It is thus possible that puppies from pet stores are more likely to have been passed onto owners without an appropriate match and/or with limited information or advice (Casey et al., 2014). Any of these mechanisms could contribute to problematic behaviors in pet store puppies.

Perhaps surprisingly, in the logistic regressions' final model, the dog's source factor was not

included among the statistically significant predictors of the 3 other behavioral outcomes (separation-related behavior, house soiling, and body licking), for which the Pearson  $\chi^2$  tests revealed a significant overall association with a pet store origin. This finding is in contrast to that of McMillan et al. (2013), where a robust effect of a pet store origin of puppies was found for some of these behaviors. Nevertheless, McMillan et al. did not include owner-related factors, some of which might have affected the findings. In our study, the association between the dogs' origin from pet stores and these 3 potentially problematic behaviors arose precisely because of the confounding effect of various owner-related factors, which differed in the 2 groups of dogs and supported the aforementioned speculations. Among these factors were nonattendance at training courses, unawareness of veterinary behaviorists' existence, no experience with past dogs, and short daily walks. However, our study did not include some other critical factors related to the owners (e.g., income) in the logistic models and so could not measure the exact extent to which human characteristics and behaviors affected the findings.

Moreover, although the chance of a dog developing a behavior problem has been reported to be dependent on the dog's breed (Jagoe, 1994), we found no breed predisposition for the list of complaints surveyed. However, we did not ascertain whether purebred dogs were registered with an appropriate breed society and simply grouped dogs for analysis according to whether their owners believed them to be purebred or crossbred. The 2 populations studied differed somewhat with respect to breed group: all dogs obtained from official breeders were purebred, whereas 5 of the 173 pet store dogs were mixed breeds (data missing). A more detailed and rigorous analysis would be required to demonstrate any existence of at-risk canine breeds. There are some additional limitations to our study. The findings should be interpreted with caution because owners were required to interpret their dog's behavior patterns, inevitably resulting in a degree of subjectivity. Thus, factors that influence the differences between dogs showing milder and more severe types of aggression could not be evaluated. It is also possible that the respondents' answers were influenced by both popular stereotypes and/or perceptions of which answers would be deemed acceptable, although the questionnaire was anonymous.

## **Conclusions**

In conclusion, the present study was designed to investigate whether potentially problematic canine behaviors were associated with a dog's pet store provenance cross-sectionally. We controlled simultaneously for a number of owner- and dog-related variables, which might distort



the assessment of a pet store origin as a potential risk factor for the development of problematic behavioral characteristics. Adjusting for these potential confounders using binary logistic regression, we found that puppies obtained from pet stores exhibited more aggression to familiar people, as assessed by the owners. The pet store origin of a dog otherwise has no effect on other behavioral categories for which previous studies found a significant association. None of these studies assessed owner characteristics, knowledge, and attitudes. As in every other field, research concerning prevention of behavior problems in companion dogs aims to reduce potential risk factors and their effects. Proper focus on highly effective risk factors is critical to set priorities for any preventive and/or intervention program.

### **Acknowledgments**

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

### **Ethical consideration**

This study did not require ethical approval.

### **Authorship**

The idea for the article was conceived by Ludovica Pierantoni and Federica Pirrone. The experimental protocol was designed by all authors. The data were statistically analyzed by Federica Pirrone and discussed by all authors. The article was written by Federica Pirrone.

### **Conflict of interest**

The authors declare no conflicts of interest.

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Table 1

The Mantel-Haenszel OR for the difference between pet store-obtained and breeder-obtained dogs in the reported behaviors

Behavior	OR	95% CI
Body licking	5.580	1.440-4.620
House soiling	3.081	1.398-6.794
Owner-directed aggression of any kind	2.396	1.227-4.678
Separation-related behaviors	1.997	1.129-3.532

OR, odds ratio; CI, confidence interval.

Table 2

Potential confounders in the association between a dog's source of acquisition and the presence of problem behaviors

Variables	Pearson $\chi^2$ test of independence		
	Value	df	P
Dog's size (small)			
Source (pet store)	54.784	2	0.001
House soiling	17.078	2	0.001
Body licking	31.430	2	0.001
Acquisition of the dog decided by someone else			
Source (pet store)	16.529	2	0.001
House soiling	7.601	2	0.022
Dog's principal place to sleep (owner's bed)			
Source (pet store)	16.583	2	0.001
House soiling	13.075	2	0.001
Owner's perception on dog's problem behaviors			
Source (pet store)	10.228	2	0.008
House soiling	11.742	2	0.003
Body licking	24.645	2	0.001
Owner aggression	18.432	0	0.001
Positively punitive homecomings			
Source (pet store)	13.776	2	0.001
Body licking	12.734	2	0.002
Separation-related behavior	29.789	2	0.001
Mean duration of each daily walk (<20 min)			
Source (pet store)	15.469	3	0.001
House soiling	12.207	3	0.005
Body licking	10.683	3	0.011
Owner aggression	17.603	3	0.001
No past dogs			
Source (pet store)	5.630	1	0.018
Body licking	7.576	1	0.005
Belief that intraspecific relationships are dangerous for the dog			
Source (pet store)	17.725	6	0.003
Body licking	18.786	6	0.002
Practice to buying dog clothes			
Source (pet store)	24.645	1	0.001
House soiling	14.617	1	0.001
Body licking	23.274	1	0.001
Nonattendance at training courses			
Source (pet store)	17.970	1	0.001
House soiling	6.207	1	0.014
Body licking	15.036	1	0.001
df, degrees of freedom. Significance: $P < 0.05$			
Awareness of the existence of veterinary behaviorists			
Source (pet store)	17.427	1	0.001
House soiling	4.436	1	0.029
Body licking	17.947	1	0.001
Separation-related behavior	7.113	1	0.011

Table 3  
 Logistic regression models predicting problem behaviors from the list provided to owners

Problem behavior	P	Exp(B)	95% CI for Exp(B)		Hosmer-Lemeshow significance test
			Lower	Upper	
Separation-related behaviors					
Punitive homecomings (negative punishment)	0.011	3.990	1.381	11.525	0.720
Punitive homecomings (positive punishment)	0.001	10.349	3.464	30.922	
House soiling					
The respondent is not the person who decided to obtain the dog	0.003	7.800	2.016	30.183	0.571
Principal place where the dog sleeps (dog's bed)	0.011	2.986	1.290	6.911	
Mean duration of each daily walk (<20 min)	0.020	5.042	1.297	19.595	
Body licking					
Practice of buying dog clothes	0.010	2.452	1.240	4.847	0.630
Nonattendance at training courses	0.008	2.273	1.245	4.150	
Unawareness of existence of veterinary behaviorists	0.004	3.251	1.464	7.219	
No past dogs	0.046	1.817	1.012	3.262	
Owner-directed aggression of any kind					
Source (pet store)	0.034	1.944	1.051	3.597	0.783
Owner's perception of problem behaviors	0.001	3.443	1.782	6.651	
Mean duration of each daily walk (<20 min)	0.022	3.683	1.207	11.242	