Journal of Veterinary Behavior (2008) 3, 207-217

ELSEVIER

Journal of
Veterinary Behavior
Clinical Applications
and Research

RESEARCH

The relationship between training methods and the occurrence of behavior problems, as reported by owners, in a population of domestic dogs

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KEYWORDS:
dog behavior;
training;
reinforcement;
punishment;
behavior problems;
undesirable behaviors

Abstract In a questionnaire survey of dog owners, 88% of respondents' dogs had received some form of training. Training methods varied; 16% of owners said that they used only positive reinforcement, 12% used a combination of positive reinforcement and negative reinforcement, 32% used a combination of positive reinforcement and positive punishment, and the remaining 40% used a combination of all categories. Seventy-two percent of owners used some form of positive punishment. The mean number of potentially undesirable behaviors reported was 11.3 per dog. Attendance at formal training classes did not significantly affect the total number of potentially undesirable behaviors reported. However, dogs that had attended puppy socialization classes were less likely to show an undesirable reaction to dogs from outside the household, and owners who carried out informal training at home, but did not attend any form of formal training class, were more likely to report some form of aggression in their dog. The training method used by owners was also related to the total number of potentially undesirable behaviors shown by the dogs. When individual categories of potentially undesirable behavior were investigated, the type of training method used was also significantly associated with attention-seeking score, fear (avoidance) score, and aggression score. Other factors related to the overall number of potentially undesirable behaviors included the age and origin of the dog.

Introduction

Behaviors that owners find problematic are widespread in the domestic dog (*Canis familiaris*) population (Voith et al., 1992; Wells and Hepper, 2000; Bradshaw et al., 2002; Kobelt et al., 2003; Hiby et al., 2004) and are a common cause of dogs being abandoned, sent to re-homing centers, or euthanized (Bailey, 1992; Miller et al., 1996; Patronek et al., 1996; Serpell, 1996; Salman et al., 1998, 2000; Scarlett et al., 1999; New et al., 2000; Marston and Bennett, 2003; Shore et al., 2003; Mondelli et al., 2004; Shore, 2005). In this paper the authors will use the terms "undesirable" or "problematic" behaviors to describe behavior patterns that are potentially troublesome to owners. Prevention of undesirable behaviors is important not only because many owners who surrender their dogs might keep the animal should these behaviors be resolved (Hart, 1995; Marston and Bennett, 2003), but also because many behavior problems are associated with increased anxiety levels (Blackwell et al., 2006a) and therefore impact the welfare of affected dogs. Research into possible risk factors for

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1558-7878/$ -see front matter © 2008 Published by Elsevier Inc.
doi:10.1016/j.jveb.2007.10.008

undesirable behaviors (Voith et al., 1992; Jagoe and Serpell, 1996; O'Farrell, 1997; Hiby et al., 2004; Bennett and Rohlf, 2007) provides evidence as to which factors influence the development and persistence of undesirable behaviors and is therefore fundamental in improving rational prevention and treatment strategies.

It is widely accepted that the development of behavior in any species is influenced by both genetic and environmental factors. Although genetic factors clearly predispose individual dogs to develop particular behavioral phenotypes (Overall et al., 2006), environmental factors also have a profound effect (Appleby et al., 2002). The domestic dog is clearly a highly social species capable of complex communication with people (Hare and Tomasello, 2005) and able to associate even subtle visual signals from their owners with positive or negative outcomes (Rooney et al., 2001; Cullinan et al., 2004). It is therefore perhaps not surprising that differences in owners' global approach to handling and training appears to have an influence on the occurrence of undesirable behaviors in their dogs (Hiby et al., 2004). There have, however, been mixed findings as to which specific aspects of "owner behavior" are important in terms of the development of behavior problems (Voith et al., 1992; O'Farrell, 1997; Jagoe and Serpell, 1996; Atkinson et al., 2005). The relationship between previous dog ownership, or owners' general knowledge about dogs, and occurrence of undesirable behaviors has also varied between studies (Borchelt and Voith, 1982; Jagoe and Serpell, 1996; Kobelt et al., 2003; Bennett and Rohlf, 2007).

Some of the differences in reported findings may clearly be accounted for by methodological differences between studies. For example, there are often distinct differences in owner reports between questionnaires containing objective (e.g., "Does your dog withdraw when unfamiliar people approach?") or more subjective (e.g., "Is your dog fearful of other dogs?") types of questions. However, these mixed findings may also be indicative that more subtle aspects of owner behavior may interact with global effects of owner attitude or training. For example, the consistency, or otherwise, of an owner's behavior toward his or her dog within a single context is also related to the occurrence of undesirable behaviors (Cullinan et al., 2004). In addition, the effect of an "anthropomorphic attitude" is likely to be complex; such an attitude can lead to owners both under- and overestimating the cognitive abilities of their pets (Bradshaw and Casey, 2007).

Previous studies have reported an association between reduced prevalence of undesirable behaviors in pet dogs and attendance at obedience training classes (Clark and Boyer, 1993; Jagoe and Serpell, 1996) or engagement with any form of training (Kobelt et al., 2003; Bennett and Rohlf, 2007). In addition, Hiby et al (2004) found significantly fewer behavior problems in dogs that had been trained using rewards only, as compared with dogs that had been trained using some form of punishment only, or a combination of both. The potential negative effects on behavior of using aversive training techniques have also been identified in other studies (Schilder et al., 2004).

Given that the majority of pet dogs receive at least some form of basic training to make them manageable companions, and that there is some indication that the methods used may relate to the prevalence of undesirable behaviors, the aim of this study was to investigate further the relationship between types of training methods, attendance at different categories of training classes, and the occurrence of potentially undesirable behaviors in domestic dogs.

Materials and methods

A convenience sample of dog owners was recruited for this survey. Dog owners out walking their dogs, or visiting a veterinary hospital in several different locations in the United Kingdom (Shropshire, Somerset, and Leicestershire) were asked to complete a standard questionnaire. The questionnaire obtained basic demographic data about the dog and owner, information about the type of training conducted with the dog (e.g., training carried out informally at home or attendance at training classes such as puppy socialization, agility, obedience, or show handling), and the specific training techniques used (e.g., sound distraction, verbal praise, shutting away, telling off). In addition, the questionnaire asked owners the frequency with which their dog showed 36 behaviors that are commonly perceived to be undesirable, on a scale of 0 to 4, where 0 was "never" and 4 was "frequently." The individual behaviors were described as objectively as possible (e.g., "Does your dog not come back when called on a walk?" or "Does your dog chew or destroy items when you are out of the house?") to avoid differences in owner perception of more subjective concepts, such as "disobedience" or "anxiety." Where one of these behaviors occurred in their dog, respondents were also asked to rate whether they perceived the behavior to be a problem.

A total of 250 questionnaires were given out, and 192 completed questionnaires were returned. Sixty-seven percent of respondents were female. The age of the owner ranged from under 20 years to over 60, with the majority of participants falling into the 41-60 category. Most of the dogs in the sample lived in households with 2 adults (71% of households), and there were no children in 43% of the households. The total number of dogs in the sample households ranged from 1 to 5 dogs. Thirty-eight percent of dogs lived in a house with 1 other dog, 6.8% lived with 2 other dogs, 2% lived with 3, and 2% lived with 4 other dogs. Single-dog households made up the remaining 52% of the sample. Most respondents had owned dogs before their current dog, with first-time dog owners making up just 15% of the sample.

The dogs included in the survey ranged in age from 1 to 15 years, with a median age of 5 years. The ratio of male to female dogs in the survey was roughly equal, with 52% males and 48% females. Fifty-eight percent of the males and 63% of the females were neutered. Purebred dogs dominated the sample population, with only 19% of respondents owning cross-breeds. All of the kennel club breed groups were represented in the sample. Gun dogs were the largest group with 35% of the dogs being gun dog breeds. The next largest group was the pastoral breeds (18%), followed by terriers (12%), hounds (8%), toy breeds (3%), and breeds from the utility group (2%).

The majority of dogs (71%) were acquired by the current owner within the first 3 months of the dogs' lives. Dogs acquired by their current owner at ages over 3 months were obtained predominantly from either a private home or from a re-homing center. Most dogs (72%) were acquired by the owners from the person who bred the dog, 20% of owners got their dogs from re-homing centers, and 2% of owners bred the dogs themselves. Finally, 6% of owners acquired their dogs from other sources, such as pet shops, family, and friends.

Data analysis

All statistical analyses were conducted using SPSS version 12 for Windows. Because there is a wide range of different methods currently in use in dog training, the types of training methods used by owners were combined into categories prior to analysis to reduce the number of variables for comparison. These categories were: "positive reinforcement," "negative reinforcement," and "positive punishment," as defined in Table 1. The 4-point scale for the frequency of each behavior was reduced to a 0/1 score to indicate whether the behavior occurred at all, for the purposes of analysis. The undesirable behavior variables were also combined. In this case, the variables were combined in 2 different ways. First, scores to detect the effect of any underlying "temperament" or "behavioral strategy" existing across contexts were created by summating the contexts in which 3 common behavioral responses (aggression, avoidance, and attention seeking) were shown and then dividing by number of contexts measured for each. Second, the presence or absence of any behavioral response within specific contexts (e.g., being left alone by the owner) or toward specific targets (e.g., reaction to other dogs outside the household) was calculated. A "control score" was also developed from the mean number of contexts in which dogs showed goal-directed behaviors that are generally inhibited through effective training techniques (e.g., not coming back when called). The individual undesirable behaviors contributing to each category are listed in Table 2. Nonparametric tests were used for the analysis, as the data were not normally distributed. Relationships between behavioral scores and contextual categories were compared with attendance at training classes and the use of different training methods using Spearman rank correlations, Mann-Whitney U tests, chi-square tests, and Kruskal-Wallis tests.

Results

Training classes

According to owner reports, most of the dogs (88%) in the survey had received some form of training while with their current owner. Most popular among respondents was training the dog at home rather than in formal dog-training classes, with 58% of owners reporting that they trained their dogs in this way. General obedience classes were attended by 40% of owners, and 27% attended puppy socialization classes. Agility or flyball classes were attended by 12% of owners, and 5% of dogs were taken to handling or showing classes.

Table 1 Categorization of training techniques

Category of training type	Definition of category	Training methods included in each category and percentage of respondents using each method	
Positive reinforcement	Target behavior is increased subsequent to the presentation of a (presumably subjectively pleasant) stimulus	Verbal praise	96
		Reward with food treats	84
		Stroking or petting	83
		Play	68
		Clicker training (conditioned positive reinforcement)	16
Negative reinforcement	Target behavior is increased subsequent to the removal of a (presumably subjectively aversive) stimulus	Withdrawal of attention ("time out")	45
		Withholding food rewards	10
		Physical restraint (e.g., holding still or pushing into position)	12
Positive punishment	Target behavior is decreased subsequent to the presentation of a (presumably subjectively aversive) stimulus	Verbal telling off	64
		Physical correction (e.g., scruff, shake, or smack)	37
		Nonverbal sound "distraction"	5

Table 2 Categorization of undesirable behaviors

Category of undesirable behavior	Individual behaviors included
Attention-seeking score	Chew items when owner present only (derived from "chew or destroy items when owner out" and "chew or destroy items when owner in")
	Jump up at owner
	Paw at owner
	Wake up owner during the night (excluding dogs over 10 years of age, for whom this behavior may reflect cognitive dysfunction [Landesburg et al., 1997])
	Follow owner around the house
	Steal objects in front of the owner
	Mouth at hands or clothes
	Mount people (excluding dogs under 18 months of age, where the primary motivation for this behavior may be sexual)
Fear (avoidance) score	Avoid or hide from familiar people
	Avoid or hide from unfamiliar people
	Avoid or hide from dogs when out of the house
	Fear response to loud noises
Aggression score	Aggression toward familiar people
	Aggression toward unfamiliar people
	Aggression toward dog(s) in the household
	Aggression toward dogs when out of the house
	Aggression associated with feeding
Control problems score	Pull on the lead
	Chase things (bikes, cars, joggers, etc.)
	Steal food
	Not come back when called
Separation problem	Chew or destroy items when owner out of the house only (derived from "chew or destroy items when owner out" and "chew or destroy items when owner in")
	Bark or howl when owner out of the house only (derived from "bark or howl when owner present" and "bark or howl when owner out")
	House-soil when owner out of the house only (derived from "house-soil when owner present" and "house-soil when owner out")
Reaction to dog(s) within household	Aggression toward dog(s) in the household
Reaction to dog(s) outside the household	Aggression toward dogs when out of the house
	Avoid or hide from dogs when out of the house
Reaction to family members	Aggression toward familiar people
	Avoid or hide from familiar people
Reaction to unfamiliar people	Aggression toward unfamiliar people
	Avoid or hide from unfamiliar people
	Overexcitable with unfamiliar people
Reaction to being told off	Show aggression when told off
	Spin or whirl when told off
	Become overexcitable when told off
Compulsive behavior	Repeatedly spin or whirl for no apparent reason
	Repeatedly lick at one part of the body
	Eat excessively and vomit

Training methods

Owners used a wide range of different training methods. The 3 most frequently used training methods (rewarding the dog's behavior with verbal praise, food treats, or physical contact) involved positive reinforcement (Table 1). When the individual training methods were combined into categories (Table 1), 16% used only positive reinforcement, 12% used a combination of positive reinforcement and negative reinforcement, 32% used a combination of positive reinforcement and positive punishment, and the remaining 40% used a combination of all categories. Seventy-two percent of owners used some form of positive punishment.

Undesirable behaviors

The mean number of potentially undesirable behaviors per dog was 11.3 (range 0-29). Only 3 dogs were reported to show none of the behaviors listed. The 10 most commonly reported individual undesirable behaviors are

Table 3 The most frequently reported undesirable behaviors

Reported Behavior	Percentage of dogs exhibiting the behavior
Jumping up at owners	78
Pawing or demanding attention (other than jumping up)	75
Excitable with visitors	74
Pulling on the lead	69
Following the owner around the house	65
Fearful response to noise	55
Barking or whining while the owner is in the house	49
Excitable when out of the house	48
Aggression to other dogs when out on a walk	47
Not coming back when called on a walk	39

shown in Table 3. When combined into categories, the mean "aggression score" across all dogs was 0.22, the mean "fear (avoidance) score" was 0.27, the mean "attention-seeking score" was 0.39, and the mean "control" score was 0.43. Sixty-five dogs (34%) showed a behavioral response in the context of being left alone (i.e., separation-related behavior); 15% (n = 28) showed an undesirable behavioral response to other dogs within the household; 99 dogs (52%) showed an undesirable response to dogs outside the household; 25 (13%) showed an undesirable response toward family members; 153 (80%) showed an undesirable response to unfamiliar people; and 13% of dogs (n = 25) showed an undesirable response when told off.

When owners whose dog showed a potentially undesirable behavior were asked whether they considered the behavior that their dog displayed to be a "problem," 76 % of owners considered the expression of at least 1 potentially undesirable behavior by their dog to be problematic to them. The most common behaviors considered a problem by owners whose dogs showed them (Table 4) were different from those occurring most commonly in the population, although there was a significant positive correlation between owners rating an undesirable behavior as occurring "frequently" and considering it to be "problematic" (Spearman's rho = 0.462, n = 192, $P < 0.01$).

Eighteen percent of owners had sought help for undesirable behaviors. Of these, 32% had asked a vet for advice, 9% a vet nurse, 26% an animal behaviorist, 47% a dog trainer, and 9% a friend or relative. Help had also been sought from rescue centers, breeders, and books. Owners were found to be most likely to seek advice from someone if they were experiencing control problems with their dog, aggression to unfamiliar dogs, aggression to unfamiliar people, and jumping up.

Relationship between training classes attended and occurrence of undesirable behaviors

In this study, attendance at any type of training class did not significantly affect the total number of undesirable behaviors shown by dogs. However, attendance at puppy socialization classes was associated with reduced reaction to dogs from outside the household ($\chi^2 = 6.843$, df = 1, $P < 0.01$). An association was also found between owners doing informal training at home and not attending any training classes, with an increased aggression score (Mann-Whitney U, $z = -1.974$, $P < 0.05$). Interestingly, the control problem score did not appear to be affected by attendance at any type of training class.

Table 4 Behaviors most commonly considered to be problems by owners whose dogs showed them

Behavior	Percentage of owners who consider behavior a problem	Percentage of dogs exhibiting behavior
Aggression toward members of the family	56	8
House soil when owner is in the house	53	16
Chew/destroy things when the owner is out	51	32
Steal food	50	38
Chase things (e.g., cars, bikes, people)	48	23
Undesirable response to unfamiliar people	47	28
Aggression when told off	47	8
Aggression to other dogs when out on walk	46	47
House soil while owner is out of the house	46	21
Aggression to other dogs in same household	43	15

Relationship between training methods used and occurrence of undesirable behaviors

A significant relationship was found between categories of training methods used by owners and the total number of undesirable behaviors shown by dogs (Kruskal-Wallis $\chi^2 = 12.865$, df = 3, $P < 0.01$) (Figure 1). When individual categories of undesirable behavior were investigated, types of training method used were also significantly associated with attention-seeking score (Kruskal-Wallis $\chi^2 = 12.705$, df = 3, $P < 0.01$); fear (avoidance) score (Kruskal-Wallis $\chi^2 = 8.55$, df = 3, $P < 0.05$); and aggression score (Kruskal-Wallis $\chi^2 = 10.884$, df = 3, $P < 0.05$) (Figure 2). In all these cases, use of positive reinforcement alone was associated with the lowest mean scores (attention-seeking score 0.33; fear (avoidance) score 0.18; aggression score 0.1). The highest mean attention-seeking score (0.49) was found in dogs whose owners used a combination of positive reinforcement and negative reinforcement. The highest mean avoidance score (0.31) was found in dogs whose owners used a combination of all categories of training method. Owners using a combination of positive reinforcement and positive punishment had dogs with the highest mean aggression score (0.27). Control problem score, separation-related behaviors, compulsive behaviors, and undesirable response to family members or dogs within the household were not significantly associated with category of training method. However, undesirable response to dogs outside the household ($\chi^2 = 9.155$, df = 3, $P < 0.05$) and undesirable response to unfamiliar people ($\chi^2 = 8.647$, df =, $P < 0.05$) were associated with category of training method (Figure 3).

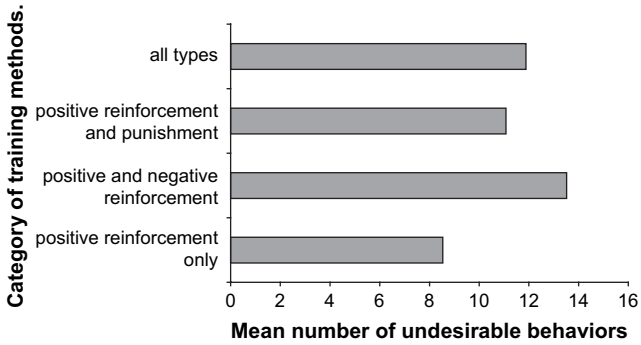

Figure 1 Relationship between category of training used by owners and mean number of undesirable behaviors shown by dogs.

When training method categories were reduced to whether owners used any positive punishment methods or not, the aggression score was significantly higher in those owners who had used punishment (Mann-Whitney U, $z = -2.608$, $P < 0.01$), as was the avoidance score (Mann-Whitney U, $z = -2.719$, $P < 0.01$) (Figure 4). No relationship was found with the attention-seeking score or control problems. There was also a trend for dogs whose owners used punishment to show more reaction toward other dogs outside of the household. Unsurprisingly, an undesirable response to being told off was significantly associated with the use of positive punishment (Mann-Whitney U, Z = −2.043, $P < 0.05$).

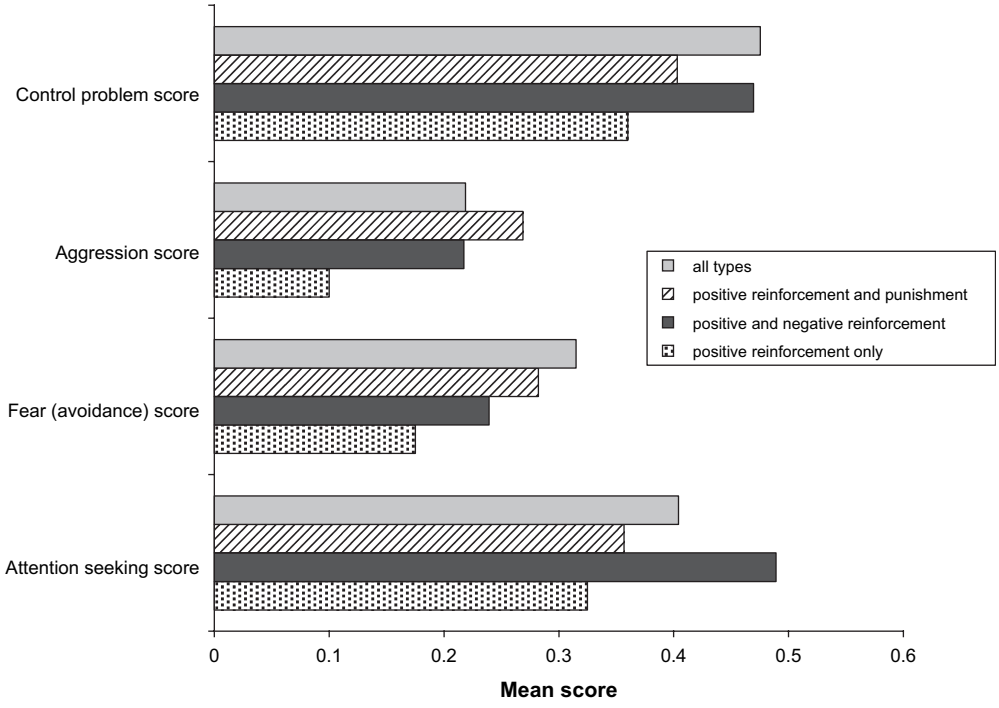

Figure 2 Relationship between category of training used by owners and undesirable behavior scores in dogs.

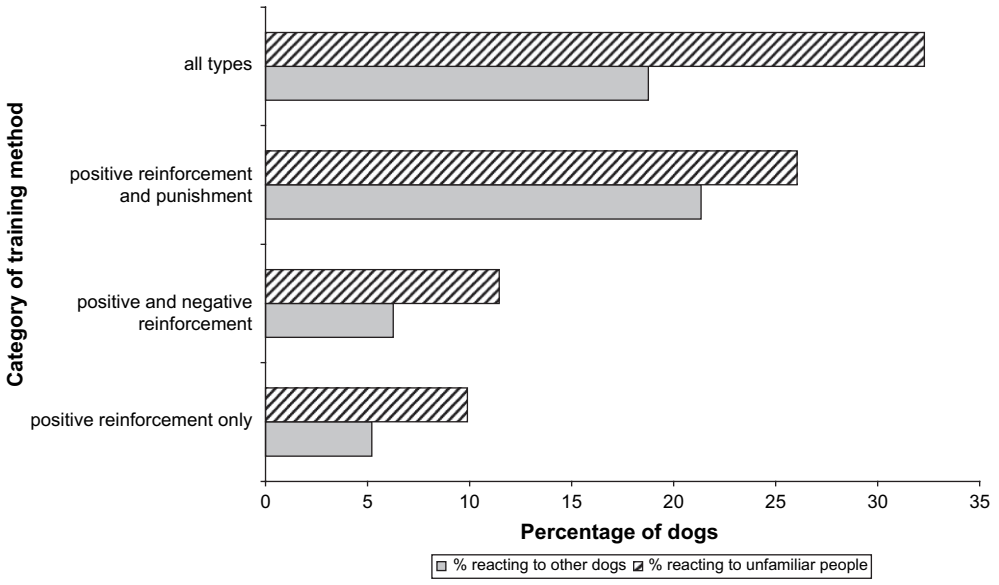

Figure 3 Percentage of dogs showing an undesirable response to unfamiliar people and dogs outside the house in different categories of training method used by owners.

Other influences on occurrence of undesirable behaviors

Age of dog

A significant, although weak, negative correlation was found between dog age and total number of undesirable behaviors (Spearman's rho -0.235, $P = 0.01$). When compared with the different categories of behavior, dog age was found to be significantly negatively correlated with attention-seeking score (Spearman's rho -0.389, $P < 0.01$), but not fear (avoidance) score or aggression score. Younger dogs were more likely to show separation-related behaviors (Mann-Whitney U, $Z = -2.691$, $P < 0.05$) and control problems (Spearman's rho -0.293, $P < 0.01$). However, older dogs were more likely to show an undesirable reaction to other dogs outside the home (Mann-Whitney U, $Z = -2.356$, $P < 0.05$), and unfamiliar people (Mann-Whitney U, $Z = -2.279$, $P < 0.05$).

Breed of dog

No significant effect of breed type was found on total number of undesirable behaviors, control problem score, avoidance score, or attention-seeking score. The number of dogs in the utility (n = 4) and toy (n = 5) breed groups were too low to allow for further analysis.

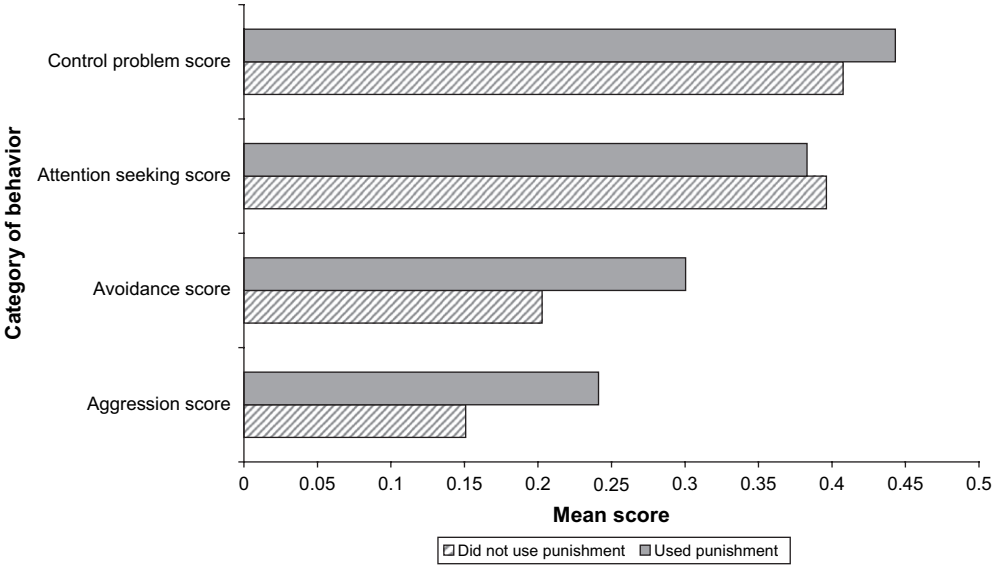

Figure 4 Effect of whether owners used any positive punishment methods at all on undesirable behavior scores in dogs.

Sex of dog

Neither neuter status nor gender of dogs had a significant effect on either total number of undesirable behaviors or any category of undesirable behavior.

Origin of dog

The total number of undesirable behaviors shown by dogs was significantly lower in those that had come from a breeder than those from a rescue shelter or bred by the owner themselves (Kruskal-Wallis $\chi^2 = 8.95$, df = 3, $P < 0.05$). Although origin had no effect on aggression, fear (avoidance), and attention-seeking scores, the occurrence of separation-related behavior was higher in dogs from a rescue shelter (Kruskal-Wallis $\chi^2 = 10.31$, df = 3, $P < 0.05$)

Previous experience of owners

Whether the respondents had owned a dog previously had no significant effect on total number of undesirable behaviors or any of the behavior scores.

Number of children in the household

The number of children in households had no significant effect on total number of undesirable behaviors or any of the undesirable behavior scores. The mean number of children in the household was significantly lower, however, where dogs showed separation-related behavior (Mann-Whitney U, $z = -2.291$, $P < 0.05$). In addition, stealing food was increased with increasing number of children in the household.

Discussion

Although the sample in this study was an opportunity sample of only those pets who are taken for walks or to the veterinary hospital, a recent epidemiological survey of 1278 households in the United Kingdom suggests that a large proportion of general dog owners take their dogs for walks or to the veterinarian's office, with the 279 respondents reporting that 97% (n = 271) of dogs (including young puppies) were taken for walks more than once a week and 84% (n = 234) of dogs had visited the veterinary surgery in the past year (Westbrook et al., in press). The sample of dog owners in this study does not differ significantly from previous surveys of the general dog-owning population in the United Kingdom (Bradshaw et al., 2002) in terms of owner sex or age, or the age, origin, sex, and neuter status of the dogs. The large proportion of females who completed the questionnaire in this and previous studies may be attributed to the fact that the main owner of the dog was asked to complete the survey and it is possible that more females than males consider themselves to be the primary owners of the dog. The method of sampling may also have resulted in this female owner bias. Questionnaires were distributed during working hours, as well as outside of working hours, and if females were more likely to be out walking the dog or visiting the veterinary surgery during working hours, then this may account for the difference. In terms of the breeds of dogs, a large proportion (81%) of dogs in the sample were purebred, slightly higher than found in larger scale surveys (e.g., Bradshaw et al., 2002). This survey was carried out in a limited number of geographical locations, and the high proportion of pedigreed dogs is possibly a result of socioeconomic factors in the areas in which questionnaires were distributed.

The proportion of potentially undesirable behaviors found in this sample of dogs (98%) is similar to that found in previous studies (Kobelt et al., 2003) and almost identical to the 97.2% found by Hiby and colleagues (2004). The number of dogs displaying signs of separation-related behavior (34%) and noise phobia (55%) are also similar to those found in previous studies (Bradshaw et al., 2002; Blackwell et al., 2006a&b). Clearly not all of the potentially undesirable behaviors were considered as "problems" by owners; the most common undesirable behaviors were those associated with attention seeking (shown by 94% of dogs) that are frequently tolerated, and sometimes even encouraged, by owners. The types of behaviors that owners reported as being a problem to them, such as aggression directed toward family members, house soiling, and destruction, are more representative of cases seen in clinical populations (e.g., http://www.apbc.org.uk). As also suggested with domestic cats (Casey and Bradshaw, 2001), it may be that owners tend to primarily seek advice where their pet's behavior is a "problem" and affects their lifestyle. Interestingly, however, in this study owners reported actually seeking advice for control problems with their dog, aggression toward unfamiliar dogs, aggression toward unfamiliar people, and jumping up more than any other undesirable behaviors. These problems occur outside the house or involve people from outside the family; it is possible that owners are embarrassed by behaviors that occur in a more public arena, and this is also a factor in seeking advice.

Previous authors have found a link between obedience training and a reduction in reported behavior problems (Clark and Boyer, 1993; Jagoe and Serpell, 1996; Bennett and Rohlf, 2007). However, in the study reported here, attendance at obedience classes appeared to have no effect on the occurrence of undesirable behaviors, even for "control" behaviors, such as not coming back when called and pulling on the lead, that are commonly addressed by such classes. It is unclear why this is the case, although the fact that only 15% of owners were first-time dog owners may have influenced this finding. In addition, it is possible that more experienced owners may have attended training classes with previous dogs and applied the techniques learned to their current pet. In addition, the availability of information from books, magazines, and the Internet may make training techniques accessible to owners without attending formal classes. Attending puppy socialization classes was associated with reduced reaction to dogs from outside the household. Attendance at puppy socialization

classes may provide increased opportunities for social interaction, facilitating the development of appropriate social communication with unfamiliar dogs.

Most owners reported using some kind of positive reinforcement when interacting with their dogs, particularly verbal praise and stroking. However, only 16% of owners use purely positive reinforcements in their training, similar to that found by Hiby and colleagues (2004). When combinations of training category used were compared with undesirable behaviors, the use of positive reinforcement alone was significantly associated with a lower number of undesirable behaviors, as also found by Hiby and colleagues (2004). These results, therefore, confirm the finding that the use of punishment-based techniques when training dogs is associated with a higher number of undesirable behaviors, although this is obviously not necessarily a causal link. It is possible that increased undesirable behaviors occur through dogs associating punishment either with the person carrying it out, or the context in which it occurs, rather than (as is intended) their own behavioral response. This inadvertent learning can lead to fear or anxiety developing in association with the handler or context. Alternatively, it may be simply that owners of dogs that show a larger number of undesirable behaviors are more likely to resort to using punishment.

The use of training methods involving positive reinforcement only were also significantly associated with a lower attention-seeking score, aggression score, and fear (avoidance) score, but not control problem score. This finding tends to support the hypothesis that punishment-based training techniques are related to the development of undesirable behavioral traits, since it would be expected that punishment in response to the occurrence of undesirable behaviors would apply to control problems as much as other behavioral responses. The highest mean attention-seeking score was found in dogs whose owners use a combination of positive reinforcement and negative reinforcement. This finding is consistent with what might be expected, since the variable reinforcement of attention-seeking responses is likely to make them more persistent over time. However, since the most prevalent technique used within the "negative reinforcement" category was "shutting away," it is also possible that owners resort to this technique in response to attention-seeking behaviors from their dogs. The highest aggression score was found in those dogs whose owners used a combination of positive reinforcement and positive punishment. This finding may support the hypothesis that aggressive responses in dogs can develop as a result of "conflict," or anxiety about an uncertain response to their behaviors from inconsistent owners (Cullinan et al., 2004). Alternatively, again, the findings may reflect the types of responses that owners try in response to aggressive behaviors in their dogs.

When the contexts in which undesirable behaviors occurred were compared with category of training method used by owners, only an undesirable response to unfamiliar people and to dogs from outside the household were significantly associated with training type. In both cases, the use of positive reinforcement alone, or in combination with negative reinforcement, was significantly associated with a lower reporting of undesirable response, compared to where owners used methods involving positive punishment. The finding supports that of Roll and Unshelm (1997), who found a link between punishment-based training and dog–dog aggression. This result may suggest that the use of punishment techniques in this context increases behaviors associated with anxiety. However, since this is a correlational finding, this result may have also arisen because owners whose dogs show these behaviors are more likely to resort to punishment.

Factors other than training methods were also found to influence undesirable behaviors. As has been found in other studies (e.g., Bradshaw et al., 2002), younger dogs were more likely to show a higher number of undesirable behaviors. When examined in more detail, young dogs appeared to have higher attention-seeking scores and were more likely to have control problems and show separation-related behavior. It makes sense for young dogs to show more attention-seeking behaviors and control problems, since behavioral inhibition is generally greater in adults than juveniles. This is the case because the immediate behavioral response to emotions in young animals becomes increasingly inhibited by pathways from higher cortical centers as the latter develop with age and experience (Panksepp, 2003). An older population of dogs may also partially represent a "residual population" of animals who have not been relinquished or euthanized for their behavior, and/or whose owners have learned to tolerate or live with their undesirable behaviors. In contrast, an undesirable response to unfamiliar people and dogs outside the household was higher in older dogs. Since these behaviors often become reinforced over time, either because they are "successful" in resolving the situation for the individual, or because of the owner's response, an increase with age is not unexpected.

There was no real effect of breed type on undesirable behavior shown. The gender of dogs was also unrelated to measures of undesirable behavior, as found in other studies (e.g., Bradshaw et al., 2002; Bennett and Rohlf, 2007). Neuter status was also not significant in the study reported here, in contrast to Bennett and Rohlf (2007), who found that owners rated "anxiety/destructiveness" and "nervousness" differently for neutered and entire dogs. This difference may be accounted for by methodological differences, as Bennett and Rohlf (2007) measured owner perceptions rather than specific behaviors.

The origin of dogs appeared to have a significant effect on undesirable behaviors in this study, in contrast to Bradshaw and colleagues (2002). The number of undesirable behaviors was lower in dogs from a breeder than those from rescue centers. This may be a reflection of the numbers relinquished to rescue centers for behavior problems (Bailey, 1992; Miller et al., 1996; Patronek et al., 1996;

Serpell, 1996; Salman et al., 1998, 2000; Scarlett et al., 1999; New et al., 2000; Marston and Bennett, 2003; Shore et al., 2003; Mondelli et al., 2004; Shore, 2005). In particular, the occurrence of separation-related behavior was higher in dogs from a rescue center. This result supports findings from some other studies (Guthrie, 1999), but not others (Bradshaw et al., 2002), where the population included a larger proportion of dogs obtained from re-homing centers.

In contrast to other studies (Jagoe and Serpell, 1996; Kobelt et al., 2003; Bennett and Rohlf, 2007), but in agreement with Borchelt and Voith (1982), no relationship was found between first-time dog ownership and the occurrence of potentially undesirable behaviors. This finding may be related to the relatively small proportion (15%) of respondents in this study who were first-time dog owners.

The number of children in households had no significant effect on total number of undesirable behaviors or any of the undesirable behavior scores, in contrast to Kobelt and colleagues (1993), who reported a link between the presence of children in a household and the occurrence of "overexcitability" of dogs. The mean number of children in the household was significantly lower, however, where dogs showed separation-related behavior. This finding may be owing to dogs being less dependent on their owner's attention in households where parents' attention is directed toward children rather than dogs, or it may be that dogs living in households with children are less likely to be left alone. The increased food stealing with increasing numbers of children probably reflects the greater opportunity for successfully getting food from children, or the increased availability of discarded food in households that include children.

Conclusions

In conclusion, it seems that there is an association between a lower number of potentially undesirable behaviors reported in dogs trained without the use of punishment-based techniques. However, attendance at formal training classes appears to have little effect on the overall occurrence of undesirable behaviors in adult dogs.

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