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Animal Welfare 2015, 24: 497-506
ISSN 0962-7286
doi: 10.7120/09627286.24.4.497

Investigating the role of coat colour, age, sex, and breed on outcomes for dogs at two animal shelters in the United States

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Abstract

The popular press frequently reports that coat colour bias negatively impacts shelter adoption rates for black domestic dogs. This phenomenon, commonly called 'black dog syndrome' (BDS), reportedly increases the likelihood of euthanasia for black dogs and negatively affects the length of black dogs' time to adoption. While organisations may focus on BDS and ways to promote black dogs, it is possible that the influences of other important factors, such as sex, age and breed, may be overlooked. To evaluate the veracity of BDS and examine the impact of various phenotypic traits on shelter outcomes, we analysed four years of intake and outcome data from two animal shelters in the Pacific Northwestern United States. Results indicated that the average length of availability for adoption (LOA) for black dogs was not significantly longer than that for other coloured dogs, nor was the rate of euthanasia of black dogs significantly higher than average. On the other hand, age and breed group were consistent predictors of shelter outcomes across the two shelters. Older dogs tended to have longer LOA and to be euthanised at rates higher than expected. Bully breeds had significantly longer LOA in both shelters and, compared to other breeds, were euthanised at higher than expected rates. The methods implemented in this study could be utilised by other shelters to inform intake and marketing strategies.

Keywords: *animal shelter, animal welfare, black dog syndrome, domestic dog, euthanasia, length of availability*

Introduction

Many anecdotal reports suggest that black domestic dogs (*Canis familiaris*) face low adoption rates due to their coat colour. The existence of this phenomenon, frequently referred to as 'black dog syndrome' (BDS), has been bolstered in popular media. The supposed impact of BDS is that black dogs stay longer in shelters before being adopted and are more likely to be euthanised (Leonard 2011; Allman 2012). News reports regularly quote animal shelter personnel and spokespeople from various humane organisations who state that it is harder to place black dogs compared to other coloured dogs. The predominant theories cited by reporters regarding what contributes to BDS consist of adopters discriminating against black dogs due to negative preconceptions about these dogs' expected temperaments, adopters finding black dogs less interesting due to the ordinariness of a black coat, and the difficulty of skillfully photographing black animals to promote them to potential adopters (see, for example, the following news reports: Friedman 2009; Keith 2009; Sørensen 2012; Edwards 2013; LaRue 2014; Waldman 2014). While some of these factors may affect adoption decisions, black dogs may also have poorer shelter outcomes if more black dogs enter the shelter system than dogs of any other colour.

Some reports appear to support the concept of BDS. In a 2009 survey of animal rescues and shelters conducted by Petfinder, 54.2% of respondents said large, black dogs were more difficult to place than other dogs (Keith 2009). Despite frequent media attention and regular discussion within the animal shelter industry about BDS, findings from scientific studies that have examined how dogs' phenotypic characteristics affect adoptions and human preferences have been mixed. A study of the adoption records of more than 4,000 dogs at a Sacramento, California county shelter reported that black and brindle dogs had the least likelihood of being adopted, and dogs of these colours that were not adopted were, indeed, being euthanised (Lepper *et al* 2002). Conversely, DeLeeuw (2010) concluded that having a black coat was only weakly associated with lower adoption rates, and a study of factors influencing dog adoptions reported that length of stay (LOS) was not significantly associated with colour, age, or sex (Protopopova *et al* 2012). Furthermore, Diesel *et al* (2007) reported that although black dogs had significantly lower rates of adoption than did dogs with grey or merle, yellow or golden, or liver and white coats, their outcomes were no worse than dogs with brown/brindle, tri/mixed, or black and white coats. Brown *et al* (2013) examined the effect of physical characteristics

on the average LOS of dogs at two animal shelters in New York State and found that breed group and age impacted LOS but coat colour did not.

Preferences for some coat colours and biases against others seem plausible. After all, colour has been shown to influence decision-making across cultures and in many different sectors, from the auto industry to school supplies (Grossman & Wisenblit 1999; Madden *et al* 2000). In a study designed to identify the meanings that people in East Asia, Europe, North America and South America associate with different colours, black was significantly linked with the terms 'sad' and 'stale' across cultures (Madden *et al* 2000). Such associations lend credence to the idea that black dogs might seem dull or ordinary to adopters, possibly increasing these dogs' chances of being overshadowed by dogs of other coat colours. In China, however, the colour black is also associated with being dependable and trustworthy (Jacobs *et al* 1991), which are traits frequently ascribed to companion dogs (Hart 1995). Thus, findings regarding the popularity of dogs of particular coat colours are not necessarily generalisable across cultures.

Research into the role of physical appearance on human perceptions of dog personalities has revealed conflicting results regarding coat colour. In a study conducted by Fratkin and Baker (2013), participants viewed two images that were identical other than the dog was black in one picture and yellow in the other. Participants rated the dogs on five personality traits. The black dog was rated as significantly less agreeable, less conscientious, and less emotionally stable than the yellow dog. In another study, Goleman *et al* (2014) found that although respondents to their questionnaire preferred black-coated dogs, these same participants, in response to questions regarding the appearance of aggressive and dangerous animals, selected large, black dogs as representatives of those traits. A preliminary study of the impact of size and colour on human response to dogs in public found that passersby changed their path more frequently when confronted by dark dogs than by pale-coloured dogs, regardless of size (Blecker *et al* 2013). Such results appear to support the notion that humans view black dogs more negatively than dogs of other colours.

Other studies, however, have not concluded that black dogs are viewed more negatively than other dogs. Woodward *et al* (2012) found perceptions of black dogs to be more positive than those of white dogs. In Woodward *et al*'s (2012) study, participants viewed four images: a white standard poodle, a white toy poodle, a black standard poodle, and a black toy poodle. Participants rated the large dogs as significantly more dominant than the small dogs, but they ranked the black poodles as friendlier and less dominant than their white counterparts. Woodward *et al* (2012) also reported results from a second experiment in which they used images of different breeds and found that the black Labrador retriever was consistently ranked as friendlier and less hostile than most other dogs in the study, including a brindle boxer, a sable-coloured German shepherd, and a brown pit bull. Unfortunately, it is difficult to ascertain whether these results are related to coat colour, breed, or both.

The contradictory findings regarding the causes, implications, and even existence of BDS highlight that additional research into factors affecting shelter dog outcomes is needed. Prior studies have tended not to report the likelihood of black versus non-black dogs being euthanised. Additionally, there has been limited discussion of the proportion of black-coated dogs that enter the shelter compared to dogs of other coat colours. Furthermore, questions remain about whether black dogs entering a shelter tend to be of a particular breed, and whether breed differences impact the fate of black dogs.

The aim of this study was to determine whether coat colour has a significant impact on an adopted dog's average length of availability for adoption (LOA) in a shelter and on a dog's potential for euthanasia. Whereas a number of previous studies of domestic dog adoption rates have focused on single organisations over one-year periods (Lepper *et al* 2002; Diesel *et al* 2007; DeLeeuw 2010; Leonard 2011), the current study focused on four years of shelter data collected from two private, non-profit animal shelters located in the Pacific Northwestern United States. Both shelters used the same data collection and reporting methods and the same database software. The shelters' intake policies differed, however. One shelter was classified as 'selective intake', meaning that the decision to admit dogs to the shelter was impacted by factors such as space availability at the shelter and a dog's breed, age, coat colour, medical needs, and temperament. The other shelter was classified as 'open admission' and therefore accepted all dogs, regardless of dogs' physical characteristics or behavioural or medical conditions. Because the open admission shelter did not turn away any dogs, this shelter had a lower live release rate than the selective intake facility.

Anticipating that factors other than coat colour would impact dogs' LOA and likelihood of being euthanised, we also examined main effects of sex, age, and breed group on LOA and likelihood of euthanasia. Additionally, we examined whether factors such as sex, age, coat colour, and breed group were associated with whether dogs were classified as healthy or unhealthy-untreatable upon intake.

Materials and methods

Participants

Two private, non-profit animal shelters located approximately 15 miles apart in the Pacific Northwest region of the United States provided four years of adoption and euthanasia statistics for this study. Each shelter also provided intake status, age, sex, coat colour, and breed information for each dog that entered its facility from the period of 1st January 2009 to 31st December 2012. Both shelters utilised the Shelter Buddy® database software in conjunction with the Asilomar Accords guidelines (Armstrong *et al* 2004) for collecting and recording shelter data.

Shelter A is a large, private, non-profit organisation located in a metropolitan area. This organisation built a new state-of-the-art shelter facility about 15 years ago. The current facility can house more than 100 dogs and includes an on-site veterinary hospital that provides care to the shelter

https://doi.org/10.7120/09627286.24.4.497 Published online by Cambridge University Press

animals. In 2011, this shelter reported a live release rate of 99% for dogs. The shelter follows internal selective intake guidelines that determine which dogs the shelter will accept based on breed, age, coat colour, medical needs, and temperament. More than half of the dogs which enter this shelter are acquired through transfers from other rescue organisations; roughly 30% of the dogs come into the shelter via owner surrender; and 7% enter the shelter as strays. The remaining percentage of dogs entering the shelter comes from humane officer surrenders and legal cases, such as court-ordered owner relinquishment.

Shelter B is located nearby, though in a smaller metropolitan area. It is also a private, non-profit organisation. The shelter was renovated within the past five years and has the capacity to house nearly 60 dogs. The organisation reported a live release rate of approximately 85% for dogs in 2011. The shelter operates under an 'open admission' policy that does not discriminate intake based on age, breed, coat colour, health, or temperament. The shelter receives more than 60% of its dogs through owner surrender or as strays brought in from the public. The remaining 40% of dogs are acquired through transfer programmes with other shelter organisations, including partnerships with county agencies.

Measures and procedures

The information included in this study was retrieved from each participating shelter's Shelter Buddy® database software. The data acquired included animal-specific information, such as the animal identification number, incoming and outgoing dates, outgoing status (ie adopted, transferred out, euthanised, etc), intake status, change of status (ie available for adoption, hospitalised, awaiting intake exam, etc), breed, colour, age, and sex. Of the 27,288 records obtained for this study, 16,692 (61%) met the criteria described below and were included in the final data set. To be included in analyses, the records must have had both an incoming and outgoing date between 1st January 2009, and 31st December 2012. Only those dogs that entered the shelter as potential residents were included in analyses; dogs that were listed as dead on arrival, euthanasia-request, or returned to owner were excluded from the analyses. In addition, because previous studies have reported that dogs younger than one year old have significantly shorter LOS (Brown *et al* 2013) and significantly greater rehoming rates (Diesel *et al* 2007) compared to dogs older than one year, dogs under one year of age were excluded from analyses. Dogs 13 years and older were also excluded from analyses due to the small number of individuals in this age category. Roughly 700 dogs with missing or incomplete coat colour or age information were also excluded; five dogs at Shelter B whose sex was unknown were removed from analyses that included sex as a variable. As some dogs were adopted and returned more than once, duplicate records existed in the initial data set. For these instances, only the record with the earliest intake and outgoing status dates were included in analyses.

Information about the intake status of dogs in this study is defined by Asilomar Accords terms (Armstrong *et al* 2004), which shelters assigned to dogs upon shelter admission. Only those dogs with a status of healthy or unhealthy-untreatable were included in health-related analyses.

Rather than calculating a dog's entire length of stay, which would have included time spent on stray hold or otherwise unavailable for adoption, we calculated LOA for each dog. We defined LOA as the number of days that passed between when a dog first became available for adoption and the dog's adoption date. Thus, dogs that were euthanised or transferred to other organisations were not included in LOA calculations. LOA provides a more accurate indicator of adopters' preferences than LOS, although LOS and LOA were strongly correlated (Shelter A: $r = 0.84$, n = 10,137; $P < 0.001$; Shelter B: $r = 0.75$, n = 3,662; $P < 0.001$). Analyses regarding LOA included the following four age categories: 1–3 years; 4–6 years; 7–9 years; and 10–12 years. Detailed records for some dogs at both shelters were missing, making it impossible to calculate LOA for those individuals. In total, we were able to calculate LOA for 10,137 dogs at Shelter A and 3,662 dogs at Shelter B.

Coat colour was categorised using information from the shelter data. The shelter software allowed for the inclusion of both primary and secondary coat colour descriptions. Coat colour names were not specifically defined within either shelter and, as a result, there were more than 100 different coat colours listed in the data. For consistency and accuracy, coat colours were reduced to nine standard options: black, brindle, brown, grey, red, tan, white, yellow, and multicolour. For the purposes of this study, coat colour was defined as solid colour (black, brown, grey, red, tan, white, or yellow) for dogs with only a primary colour listed. Any dog with the description of brindle as primary or secondary colour was defined as brindle. Dogs with both a primary and secondary colour listed (but not brindle) were defined as having a multicolour coat.

The shelter software also allowed for primary and secondary breed descriptions. For analyses, all breed determinations were made using the primary breed or breed mix listed, whether or not a secondary breed was listed. The dogs were then further categorised using the American Kennel Club (AKC) breed groups: herding, hound, non-sporting, sporting, terrier, toy, and working. Closer inspection of the data revealed that 8% of terriers in Shelter A were identified as pit bull type (ie labeled as American bully, American pit bull terrier, American Staffordshire terrier, or Staffordshire bull terrier), whereas 59% of terriers in Shelter B were identified as such. Thus, a bully breed category was added, and bully breeds were considered separately from the other terrier breeds. For breeds not recognised by the AKC, categorisations were determined based on the commonly accepted purpose of the breed (Table 1; see supplementary material to papers published in *Animal Welfare* on the UFAW website: http://www.ufaw.org.uk/the-ufaw-journal/supplementary-material).

Shelter management provided written consent prior to releasing the records for analysis. Study procedures were approved by the Canisius College Institutional Review Board.

Table 2 Number of dogs from Shelter A belonging to each breed group by coat colour category.

	Black	Brindle	Brown	Grey	Red	Tan	White	Yellow	Multicolour	Total
Bully	4	28	0	0	5	6	3	2	58	**106**
Herding	62	67	35	1	27	34	19	26	1,285	**1,556**
Hound	47	36	29	0	109	44	2	6	668	**941**
Non-sporting	55	23	6	6	26	50	174	49	286	**675**
Sporting	624	44	141	10	63	36	11	283	672	**1,884**
Terrier	65	13	32	31	16	128	114	74	953	**1,426**
Toy	178	58	152	37	136	372	284	155	1,648	**3,020**
Working	25	45	7	22	10	11	27	11	371	**529**
Total	**1,060**	**314**	**402**	**107**	**392**	**681**	**634**	**606**	**5,941**	**10,137**

Table 3 Number of dogs from Shelter B belonging to each breed group by coat colour category.

	Black	Brindle	Brown	Grey	Red	Tan	White	Yellow	Multicolour	Total
Bully	1	24	4	6	4	5	0	0	99	**143**
Herding	19	24	5	0	9	3	4	9	352	**425**
Hound	8	20	10	2	41	5	1	6	368	**461**
Non-sporting	11	12	3	3	3	6	35	9	94	**176**
Sporting	275	11	61	7	37	14	5	157	274	**841**
Terrier	14	8	6	9	2	18	18	18	203	**296**
Toy	51	24	62	17	53	135	79	56	569	**1,046**
Working	9	35	2	5	10	12	6	6	189	**274**
Total	**388**	**158**	**153**	**49**	**159**	**198**	**148**	**261**	**2,148**	**3,662**

Data analysis

An alpha level of 0.05 was used for all statistical tests, which were performed using SPSS® software. The distribution of the LOA variable was positively skewed, so LOA was log-transformed [log(x + 1)] to normalise the data prior to statistical analyses. We ran independent samples *t*-tests to compare LOA between the two shelters and Chi-squared tests to compare euthanasia rates at the two shelters. To test for main effects of sex, age group, colour, and breed group on LOA, we used general linear modeling. Main effects were further tested using Bonferroni *post hoc* tests. Interactions between variables were not investigated because of the highly variable number of dogs belonging to the numerous categories that would have resulted from creating two-way interaction terms. Illustrating this point, Tables 2 and 3 show the number of dogs belonging to each colour within each breed group. Chi-squared analyses were utilised to evaluate relationships between the likelihood a dog was euthanised and age, sex, coat colour, and breed group. Chi-squared analyses were also run to determine whether the likelihood a dog was classified as healthy was related to age, sex, coat colour, or breed group. To determine which cell or cells produced the statistically significant difference, the residuals between the observed and expected frequencies were converted to *z*-scores.

Results

Of the 15,285 records obtained from Shelter A, 10,695 (70%) met criteria described above and were considered usable. Among the usable records, 10,137 dogs (95%) were adopted and 196 (2%) were euthanised. The remaining 3% of dogs were transferred to other organisations. Less than 1% of dogs died (ie were not euthanised) in the shelter's care. The mean (± SD) LOA at Shelter A was 7.15 (13.91) days.

Shelter B included a total data set of 12,003 records, of which 5,997 (50%) were deemed usable per the study criteria. Of the dogs in the Shelter B sample, 3,662 (61%) were adopted, 1,307 (22%) were euthanised, and 17%

https://doi.org/10.7120/09627286.24.4.497 Published online by Cambridge University Press

Table 4 Intake data for each age group and average LOA of adopted dogs by age group.

Age group	Shelter A			Shelter B		
	Number of intakes (%)	Mean (± SD) LOA (days)	n	Number of intakes (%)	Mean (± SD) LOA (days)	n
1–3 years	6,778 (63.4%)	5.55 (± 11.41)	6,488	3,319 (55.3%)	8.62 (± 18.20)	2,095
4–6 years	2,558 (23.9%)	8.21 (± 14.51)	2,420	1,545 (25.8%)	11.78 (± 18.77)	947
7–9 years	974 (9.1%)	12.27 (± 19.90)	905	759 (12.7%)	14.31 (± 22.41)	456
10–12 years	385 (3.6%)	17.09 (± 23.26)	324	374 (6.2%)	15.05 (± 17.71)	164

Numbers in parentheses represent the percentage of dogs taken in that belonged to each age group.

Table 5 Intake data for each coat colour and average LOA of adopted dogs by coat colour.

Coat colour	Shelter A			Shelter B		
	Number of intakes (%)	Mean (± SD) LOA (days)	n	Number of intakes (%)	Mean (± SD) LOA (days)	n
Black	1,111 (10.4%)	6.52 (± 13.16)	1,060	591 (9.9%)	9.04 (± 15.45)	388
Brindle	331 (3.1%)	9.81 (± 17.30)	314	358 (6.0%)	10.54 (± 15.48)	158
Brown	425 (4.0%)	7.76 (± 14.17)	402	229 (3.8%)	9.59 (± 13.16)	153
Grey	112 (1.0%)	6.51 (± 8.90)	107	74 (1.2%)	10.41 (± 18.68)	49
Red	414 (4.0%)	7.60 (± 12.10)	392	269 (4.5%)	9.21 (± 13.04)	159
Tan	719 (6.7%)	8.41 (± 18.90)	681	290 (4.8%)	9.03 (± 13.40)	198
White	687 (6.4%)	7.25 (± 16.10)	634	239 (4.0%)	6.24 (± 7.80)	148
Yellow	637 (6.0%)	6.00 (± 12.95)	606	381 (6.4%)	6.57 (± 11.47)	261
Multicolour	6,259 (58.5%)	7.03 (± 13.14)	5,941	3,566 (59.5%)	11.72 (± 21.96)	2,148

Numbers in parentheses represent the percentage of dogs taken in that belonged to each coat colour.

were transferred to other organisations. Less than 1% of dogs died in the shelter's care. The mean (± SD) LOA at Shelter B was 10.44 (10.93) days.

Average LOA differed significantly between Shelter A and Shelter B, $t_{13,797} = -14.32$; $P < 0.001$, as did rates of euthanasia, $\chi^2(1, n = 15{,}189) = 1{,}868.64$; $P < 0.001$. Fewer dogs than expected by chance were euthanised at Shelter A ($z = -24.7$), and more dogs than expected by chance were euthanised at Shelter B ($z = 33.0$). Given these rather substantial differences between shelters, data from each shelter were analysed separately.

Intake

Forty-three percent of dogs taken into both Shelter A and Shelter B were female. The numbers of dogs at each shelter which belonged to each age group, coat colour category, and breed group and the percentage of dogs falling within each of those categories are included in Tables 4–6.

Length of availability for adoption

Shelter A

Sex, age group, coat colour, and breed group were entered as between-subjects factors in a general linear model assessing their impacts on LOA. All variables impacted LOA (sex: $F_{1,10,117} = 44.92$; $P < 0.001$; age group: $F_{3,\ 10,117} = 194.75$; $P < 0.001$; coat colour: $F_{8,10,117} = 3.76$; $P = 0.001$; breed group: $F_{7,\ 10,117} = 30.05$; $P < 0.001$). Females had a shorter LOA than males. Younger age groups consistently had significantly shorter LOA than older age groups (for all; $P < 0.001$).

Comparisons across the nine coat colours revealed that yellow dogs had the shortest LOA, followed by grey dogs and black dogs, although none of these differences were significant (Figure 1). Brindle dogs had the longest LOA. Black dogs had a significantly shorter LOA than brindle dogs and tan dogs (for both; $P < 0.01$), as did yellow dogs (for both; $P < 0.01$). Both white dogs and multicolour dogs had a shorter LOA than brindle dogs (for both; $P < 0.05$).

Table 6 Intake data for each breed group and average LOA of adopted dogs by breed group.

Breed	Shelter A			Shelter B		
	Number of intakes (%)	Mean (± SD) LOA (days)	n	Number of intakes (%)	Mean (± SD) LOA (days)	n
Bully	133 (1.2%)	27.13 (± 31.67)	106	654 (10.9%)	32.48 (± 33.42)	143
Herding	1,622 (15.2%)	7.24 (± 15.57)	1,556	792 (13.2%)	9.94 (± 14.99)	425
Hound	989 (9.2%)	7.63 (± 14.43)	941	603 (10.1%)	13.50 (± 24.81)	461
Non-sporting	764 (7.1%)	9.01 (± 17.56)	675	334 (5.6%)	8.07 (± 14.58)	176
Sporting	1,970 (18.4%)	6.71 (± 13.70)	1,884	1,224 (20.4%)	9.30 (± 15.42)	841
Terrier	1,487 (13.9%)	5.67 (± 10.99)	1,426	443 (7.4%)	7.94 (± 12.58)	296
Toy	3,133 (29.3%)	6.49 (± 10.85)	3,020	1,426 (23.8%)	7.88 (± 16.21)	1,046
Working	597 (5.6%)	9.10 (± 16.52)	529	521 (8.7%)	11.98 (± 23.06)	274

Numbers in parentheses represent the percentage of dogs taken in that belonged to each breed group.

Terriers and toy breeds had the shortest LOA, and bully and working breeds the longest (Figure 2). Dogs belonging to the bully group had a significantly longer LOA than dogs in all other breed groups ($P < 0.001$). Working breeds had significantly longer LOA than herding, sporting, terrier, and toy breeds (for all; $P < 0.05$), and non-sporting breeds had significantly longer LOA than sporting and terrier breeds (for both; $P < 0.05$). Hounds and toy breeds had significantly longer LOA than sporting breeds (for both; $P = 0.01$).

Shelter B

When sex, age group, coat colour, and breed group were entered as between subjects factors in a general linear model, significant main effects were found for each of the variables (sex: $F_{1, 3,642} = 8.62$; $P = 0.004$; age group: $F_{3, 3,642} = 47.83$; $P < 0.001$; coat colour: $F_{8, 3,642} = 4.35$; $P < 0.001$; breed group: $F_{7, 3,642} = 35.44$; $P < 0.001$). Females had a shorter LOA than males. Dogs aged 1–3 years had a significantly shorter LOA than dogs in all other age groups (for all; $P < 0.001$). Dogs aged 4–6 years and 7–9 years had significantly shorter LOA than dogs in the 10–12 years age group (for both; $P < 0.05$).

White dogs had the shortest average LOA, followed by yellow dogs and black dogs (Figure 1). Brindle dogs and multicolour dogs had the longest LOA. LOA for black dogs did not differ significantly from LOA for dogs belonging to any of the other colour groups. Brindle, brown, tan and multicolour dogs had significantly longer LOA than yellow dogs (for all; $P < 0.05$), and multicolour dogs had significantly longer LOA than white dogs ($P = 0.02$).

Terrier and toy breeds had the shortest LOA, and bully, hound, and working dogs the longest. Dogs belonging to the bully group had significantly longer LOA than dogs belonging to any other group (for all; $P < 0.001$; Figure 2). Hound breeds and working breeds had significantly longer LOA than non-sporting, sporting, terrier, and toy breeds (for all; $P < 0.05$).

Likelihood of euthanasia

Shelter A

Because the euthanasia rate at Shelter A was only 2%, it is apparent that Shelter A does not generally place a time limit on dogs' stays at the facility and instead holds dogs until they are adopted. Thus, the impacts of sex, age, coat colour, and breed group on likelihood of euthanasia were not investigated for this shelter.

Shelter B

Sex had a significant impact on the likelihood of euthanasia, $\chi^2(1, n = 5,993) = 11.92$; $P = 0.001$. Males were more likely than expected to be euthanised ($z = 2.0$), and females were less likely than expected to be euthanised ($z = –2.3$). Age group also had a significant impact on the chances a dog would be euthanised, $\chi^2(3, n = 5,997) = 62.16$; $P < 0.001$. Dogs in the 10–12 years group were more likely than expected to be euthanised ($z = 6.7$).

A Chi-squared analysis of all nine coat colours also yielded a significant result, $\chi^2(8, n = 5,997) = 95.28$; $P < 0.001$. Fewer dogs with white coats were euthanised than expected ($z = –3.1$), whereas more brindle dogs were euthanised than expected ($z = 7.1$).

A significant difference was found in euthanasia rates between breed groups, $\chi^2(7, n = 5,997) = 1,141.63$; $P < 0.001$. Fewer than expected hound dogs, terriers, and toy dogs were euthanised (hound: $z = –5.6$; terrier: $z = –4.6$; toy: $z = –11.2$), whereas more than expected bully breeds were euthanised ($z = 26.7$).

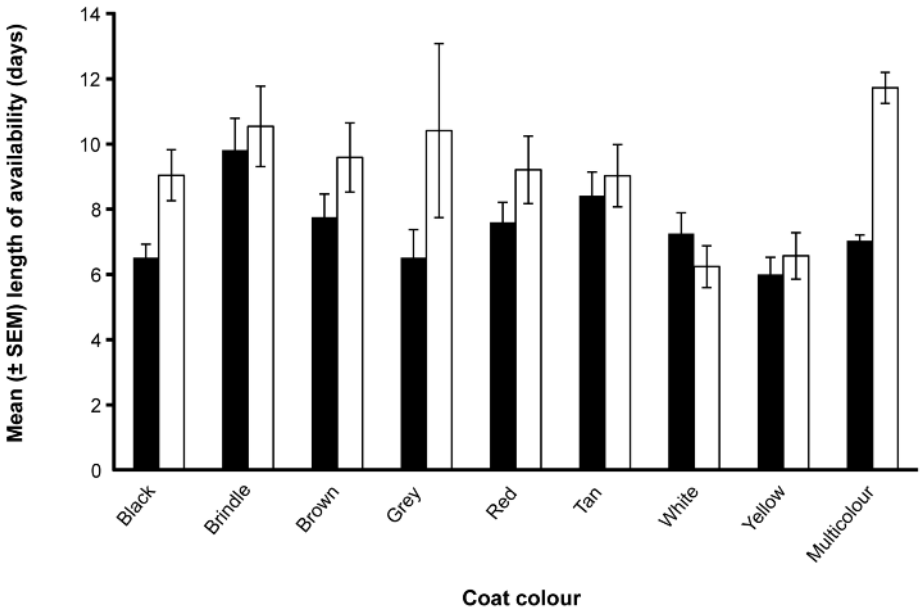
Intake status

Shelter A

Intake status did not differ significantly for males and females, $\chi^2(1, n = 5,508) = 0.09$; $P = 0.77$, but it did across age groups, $\chi^2(3, n = 5,508) = 264.93$; $P < 0.001$. Fewer than expected dogs in the 1–3 years group were classified

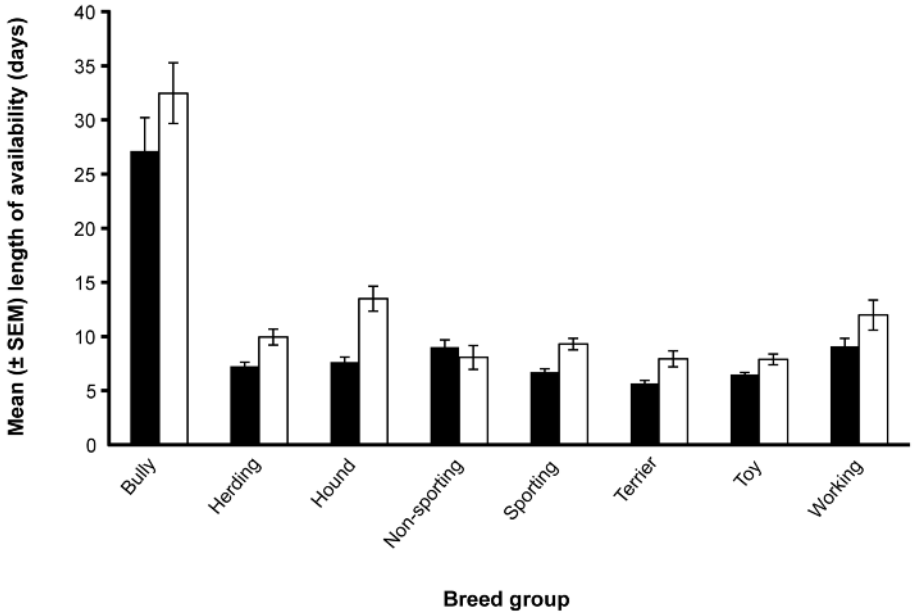
https://doi.org/10.7120/09627286.24.4.497 Published online by Cambridge University Press

Figure 1



Average length of availability (LOA) for dogs belonging to each coat colour category. Black bars represent Shelter A dogs, and white bars represent Shelter B dogs.

Figure 2



Average length of availability (LOA) for dogs belonging to each breed group category. Black bars represent Shelter A dogs, and white bars represent Shelter B dogs.

as unhealthy-untreatable (z = –6.5), and more than expected dogs in all other age groups were classified as unhealthy-untreatable (4–6 years: z = 4.1; 7–9 years: z = 4.0; 10–12 years: z = 13.2).

When intake status was compared across all nine coat colours, there was a significant relationship between coat colour and intake status, $\chi^2(8, n = 5{,}508) = 43.35$; $P < 0.001$. Tan dogs were more likely than expected to be classified as unhealthy-untreatable (z = 4.9), and multicolour dogs were less likely than expected to be classified as unhealthy-untreatable (z = –2.7).

There was also a significant difference among the intake statuses of the eight breed groups, $\chi^2(7, n = 5{,}508) = 220.29$; $P < 0.001$. Bully, non-sporting, and working dogs were

more likely than expected to be classified as unhealthy-untreatable (bully: $z = 6.5$; non-sporting: $z = 11.0$; working: $z = 4.3$), and herding, terrier, and toy dogs were less likely than expected to be classified as unhealthy-untreatable (herding: $z = –3.4$; terrier: $z = –2.9$; toy: $z = –2.1$).

Shelter B

The sex of a dog was not significantly related to its intake status assessment, $\chi^2(1, n = 4,209) = 0.27$; $P = 0.60$. Dogs of varying age groups differed significantly in likelihoods of being classified as healthy or unhealthy-untreatable, $\chi^2(3, n = 4,210) = 105.89$; $P < 0.001$. Dogs in the 1–3 years group were less likely than expected to be classified as unhealthy-untreatable ($z = –3.0$), and dogs in the 10–12 years age group were more likely than expected to be classified as unhealthy-untreatable ($z = 9.5$). There was no association between intake status and coat colour, $\chi^2(8, n = 4,210) = 4.46$; $P = 0.81$. Breed group, however, had a significant impact on intake status, $\chi^2(7, n = 4,210) = 30.84$; $P < 0.001$. Bully breeds were more likely than expected to be classified as unhealthy-untreatable ($z = 4.2$), whereas toy breeds were less likely than expected to be classified as unhealthy-untreatable ($z = –2.0$).

Discussion

Findings from this study revealed that the commonly cited implications of BDS — particularly long shelter stays and higher risk of euthanasia — were not a reality at either the selective intake shelter or the open intake shelter we examined. Differences in study methodologies may, at least in part, explain why some studies have reported that black dogs have a harder time getting adopted yet other studies have not. For instance, Keith's (2009) report that more than half of respondents to a Petfinder survey indicated that black dogs tend to be hard to place for adoption was based on survey participants' perceptions rather than on actual numbers provided by shelters' databases. Discrepancies across studies regarding the impact that black coat colour has on adoption outcomes may also be influenced by regional or cultural differences regarding coat colour preferences, by the possibility that black dogs at some shelters may be more likely to belong to particular breeds, ages, or size categories than black dogs at other shelters, and by shelters' marketing strategies. Related to the latter point, recent news reports and shelter marketing tactics that suggest that black dogs do have a harder time getting adopted may have increased adopter interest in black dogs.

Age and breed group were more consistent predictors of shelter outcomes than coat colour in the current study. Black dogs did not face significantly longer shelter stays prior to adoption than dogs of other colours at either shelter. Dogs with brindle coats at Shelter A, however, had the longest LOA, which was significantly longer than the LOA of dogs of some other colours, including black dogs. At Shelter B, brindle dogs and multicolour dogs had the longest LOA, although brindle dogs' LOA was only significantly longer than the LOA of yellow dogs and multicolour dogs' LOA was only significantly longer than the LOA of yellow dogs and white dogs. Results from this study also indicated that black dogs were not at greater risk of euthanasia compared to dogs of other colours.

To determine whether dogs of certain coat colours were more likely to enter a shelter in unhealthy-untreatable states, we included analyses that focused on the intake status of dogs. Not surprisingly, given the results of LOA and euthanasia analyses, black dogs were not more likely than expected to be evaluated as unhealthy-untreatable.

Previous research has found that factors other than coat colour, such as age and breed or breed group, are better predictors of LOS (Lepper *et al* 2002; Protopopova *et al* 2012; Brown *et al* 2013), and the current study's results support these findings. In general, younger dogs had shorter lengths of stay and lower euthanasia rates than older dogs and were less likely to be classified as unhealthy-untreatable. Bully breeds in this study had the longest waits prior to adoption, were euthanised at higher than expected rates, and were more likely than expected to be labeled as unhealthy-untreatable. A recent study conducted on shelter outcomes at two selective intake shelters in New York, however, did not find that bully breeds have significantly longer LOS than dogs belonging to other breed groups (Brown *et al* 2013). Brown *et al*'s (2013) findings, combined with conclusions drawn from the present study, lend credence to the idea that shelter outcomes are best evaluated on a shelter-by-shelter basis.

That dogs belonging to certain breed groups were more likely than dogs of other breed groups to be labeled as unhealthy-untreatable suggests that dogs of certain breed groups may be predisposed to certain health- or behaviour-related concerns. Alternatively, shelters may label dogs belonging to particularly hard-to-adopt breeds as unhealthy-untreatable to reduce the negative impact these dogs would otherwise have on their adoption statistics. Thus, it would be useful to explore why dogs of certain breed groups may have higher chances of being deemed unhealthy-untreatable. Regarding behavioural concerns, analyses of shelter assessments indicate that pit bull-type dogs are more likely than the average dog to fail shelters' behavioural assessments due to aggression-related concerns (Bollen & Horowitz 2008), yet other studies have concluded that pit bull-type dogs do not score higher than average on assessments of stranger-directed aggression (Vas *et al* 2005; Duffy *et al* 2008). Furthermore, while a recent review of breed-related behavioural differences did find some between-breed differences, the authors concluded that substantial within-breed variation also exists (Mehrkam & Wynne 2014). Thus, it is crucial that dogs, regardless of breed group, be assessed as individuals.

Given that adoption and euthanasia patterns regarding coat colour, breed group, sex, and age differed between two shelters that likely draw upon the same set of prospective adopters, specific differences between Shelter A and Shelter B might have a greater influence on adoption and euthanasia rates than adopter preferences. For instance, Shelter A staff members used intake guidelines to determine which dogs they accepted and so could consider factors such as a dog's breed, age, coat colour, medical needs, and temperament when making intake decisions.

https://doi.org/10.7120/09627286.24.4.497 Published online by Cambridge University Press

Thus, it is possible that this shelter, compared to Shelter B, simply took in fewer dogs that may have been more difficult to place. In addition, if Shelter A was full, it did not accept new dogs and therefore did not have to euthanise dogs due to space constraints. Meanwhile, Shelter B had an open admission policy and accepted a larger proportion of stray dogs. As a result, this shelter may at times have accepted more dogs than it could reasonably accommodate, potentially resulting in increased instances of euthanasia of long-term — but otherwise healthy — dogs. Because this shelter did not limit intake of dogs by sex, age, breed, coat colour, or any other factor, it may have taken in more dogs that tend to be difficult to rehome. These differences between shelter-intake policies may explain why Shelter A had both a shorter average LOA and lower euthanasia rates than Shelter B. Of note, although black dogs comprised about 10% of both shelters' populations, bully breeds comprised 1% of Shelter A's population and 11% of Shelter B's population. Furthermore, data from both shelters indicated they had difficulty keeping LOA short and euthanasia rates low for bully breeds.

This study provides insight regarding the ways in which phenotypic variables may influence LOA or likelihood of euthanasia. Unfortunately, we did not have the data necessary to examine other potentially important variables, including reasons why dogs were relinquished, dogs' spay/neuter statuses upon intake, dogs' sizes, or dogs' behavioural traits. Analysis of these factors would provide additional information regarding which characteristics are most predictive of dogs' risks of being relinquished and their shelter-based outcomes. The utility of looking at such variables was exemplified in a recent study by Weiss *et al* (2014) which built upon the finding that large dogs tend to have poorer shelter outcomes. Weiss *et al* (2014) took an in-depth look into reasons why large dogs are relinquished and used their findings to propose interventions that might reduce relinquishment rates. An additional variable worth investigating would be the marketing strategies shelters use to promote dogs of various ages, sexes, colours, and breeds. The favourable adoption statistics for black dogs in the two shelters studied could, after all, correspond to successful marketing techniques employed by these organisations.

Although four years of data were obtained from two shelters, the sample was still small considering there are more than 13,000 community animal shelters in the United States that accept approximately 3.9 million dogs each year (American Society for the Prevention of Cruelty to Animals 2014). The shelters in this study are located near one another, so differences could not be attributed to possible geographical or cultural influences on LOA or likelihood of euthanasia. Additionally, because findings revealed that the shelters differed significantly regarding LOA and rates of euthanasia, it is important to recognise that the results from any single shelter are not likely to generalise to shelters with very different policies or procedures.

Animal welfare implications

While the impetus for this study was to examine the impact of black coat colour on LOA and likelihood of euthanasia, results indicated that it is a different coat colour — brindle — that is associated with increased likelihood of euthanasia and increased LOA. Lepper *et al* (2002) reported similar outcomes for brindle dogs, although Brown *et al* (2013) did not. Age and breed group had more consistent effects on LOA and euthanasia rates in this study than did coat colour, and bully breeds had consistently poor outcomes across both shelters. Findings from this study may provide shelters with insight regarding how best to use limited resources to market animals whose physical characteristics may place them at risk for euthanasia. Shelters may also benefit from applying some of the methods we utilised in this study to take a closer look at their own adoption- and euthanasia-related trends. Doing so may help them make informed changes that could potentially increase adoption success and reduce euthanasia rates within their organisations. Such information might even help shelters determine if interventions geared toward owners of specific groups of dogs might contribute to a reduction in the number of dogs entering their facilities.

Acknowledgements

We would like to thank Malini Suchak, Enya van Poucke and two anonymous reviewers for their feedback on earlier versions of this paper. We also thank the shelter management and staff members who provided access to their data.

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