

Assessment of Canine Temperament in Relation to Breed Groups

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Abstract

Breed specific legislations (BSL), are laws that discriminate against dogs of specific breeds and breed groups. BSL similar to human racial profiling is based upon the premise that certain breed types are more dangerous to humans because of genetic temperament predispositions. The American Pit Bull Terrier and the American Staffordshire Terrier are the breeds most targeted by BSL. In the current study, the temperaments of over 25,000 dogs, of various breeds, have been evaluated including 1136 dogs from the pit bull group and 469 American Pit Bull Terriers. Using results of a rigorous pass-fail temperament test, designed to evaluate characteristics such as human aggression, these analyses statistically evaluated the proportion of dogs categorized by breed groups (e.g. sporting, pit bull, hound, toy, terrier) passing. Interestingly, results show that the pit bull group had a significantly higher passing proportion ($p < 0.05$) than all other pure breed groups, except the Sporting and Terrier groups. These groups however, did not have a statistically higher passing proportion ($p = 0.78$) than the pit bull group. This study has provided data to indicate the classification of dog breed groups with respect to their inherent temperament, as part of BSL, may lack scientific credibility. Breed stereotyping, like racial profiling, ignores the complex environmental factors that contribute to canine temperament and behavior.

Introduction

“Pit bull and pit bull type dogs, including any dog that possesses physical characteristics of pit bull and pit bull-type breeds” is a common phrase found in much current legislation. This language is both vague and open to interpretation. The term “pit bull” is an unofficial breed group, usually encompasses between 4 and 10 individual, pure breeds of dog, including the American Pit Bull Terrier and American Staffordshire Terrier among others. Thus, in most previously reported statistics related to dog bites and deaths (Sacks et al., 1989; Sacks et al., 1996a; Sacks et al., 1996b) pit bull-types including dogs of questionable genetic background have been grouped together by the nondescript term “pit bull”. In these publications, these compiled groups of breeds, termed “pit bulls”, were compared statistically against individual breeds. In addition, the authors of these studies have noted within the publications that their statistics could not be normalized using the population of dogs in question. These facts invalidate the results of these studies in relation to the noted pit bull group, from any reasonable epidemiological or public health perspective.

Ultimately, by creatively grouping many pure breeds of dog under a non-precise term “pit bull”, such analyses artificially created larger populations of animals promoting bias in the results of these studies (CDC, 1997; CDC, 2003; AVMA, 2001).

It has been documented that there is little usefulness in using BSL as an attempt to protect a community’s citizens from dog attacks/bites (CDC, 1997; CDC, 2003; AVMA, 2001). BSL is based on the assumption that there are genetic differences among breeds with regard to their temperament that make them inherently dangerous. However, the genetic make-up of an individual dog, of any breed, is only one of many components that may enhance a dogs relative potential to be aggressive toward humans. This presents us with the scientific question “Are the breeds and breed groups most often targeted by BSL lacking stability of temperament as postulated by breed specific legislation?” If not, perhaps the true problem with any dangerous dog, of any breed, is more likely that of environment, nurture, and careless ownership, which are not addressed by BSL.

If we seek to define temperament across entire breeds or breed groups the testing of a sufficiently large percentage of the population must be performed. In the current study, we present the results of the largest defined and uniform temperament test performed on canines (over 25,000 dogs representing pure breeds and mixed breeds) that were derived from across the United States, as part of the American Temperament Testing Societies (ATTS) Temperament Test. Here we have provided new and novel analyses of these data in relation to breed groups including the legislatively created "pit bull" (pit bull group). In addition, an analysis of the single breed most often associated with the non-descript term "pit bull" (the American Pit Bull Terrier) is compared against all other breed groups.

Materials and Methods

Animals

In the current study, the temperaments of 25,726 dogs, of various breeds, have been evaluated including 1136 dogs from the pit bull group and 469 American Pit Bull Terriers. All dogs were at least 18 months old. The majority of dogs tested can be characterized as healthy, well fed, and well-cared for dogs. Public notices of temperament tests were typically posted and promoted in a variety of ways, which included posting notices at local dog clubs, shelters, pet stores, internet message boards, mailing lists where exposure to dog owners was expected to be highest. Inclusion in the temperament tests was voluntary and dogs were only required to be over the age of 18 months to participate. Over the course of this study tests were held in all 48 continuous states except North Dakota, South Dakota and Vermont. The states in which higher numbers of tests have been held included California, Michigan, Florida, Georgia, Missouri, and Illinois. The diverse regional distribution across the United States contributed no bias to the analyses presented ($p = 0.22$ data not shown).

Breed Groups:

For statistical analyses of the data, the breeds were placed into "breed groups". The groupings of the breeds are shown in the supplemental table at the end of the document and are consistent with the classification schemes of both the United Kennel

Club (UKC; www.ukcdogs.com) and the American Kennel Club (AKC; www.akc.org).

Temperament test

Three separate and extensively trained Licensed Testers oversaw each Temperament Test including secondary oversight by a Chief Tester. All Testers undergo a lengthy apprenticeship prior to being allowed to evaluate actual tests. In short, the Tester goes through three levels - an Apprentice Tester, Provisional Tester, Licensed Tester and Chief Tester. A Chief Tester oversaw all levels of Tester training and evaluated Licensed Testers pass fail scores and sub-test evaluations of each dog for accuracy and consistency. For each level (Apprentice, Provisional), the Tester must evaluate at least 60 dogs, as well as acted as a station worker for each of the sub-tests described below. Before certification as a Licensed Tester is complete, both a written and video scored exam must also be passed. Only Licensed Testers results were counted while Apprentice and Provisional evaluations if performed during a temperament test were used for training purposes only.

The Temperament Test was broken up into individual categories that evaluate specific temperament-based characteristics. Each Category was further broken up into sub-tests. Each sub-test was evaluated on a rigorous pass, or fail, scoring system. Failure of any sub-test resulted in a failure of the entire temperament test.

During the temperament test each dog was presented on a loose six-foot (6') lead. The handlers, which were typically the owners of the dogs, were not allowed to talk to the dog, give commands, or give corrections. One of the 3 Licensed Testers guided the handlers through the course after a brief explanation at the beginning while the other 2 Licensed Testers observed. The specific courses, because of different geographic locations, availability of resources, and weather conditions were slightly variable, though all key aspects of each sub-test were maintained uniformly for all subjects and test situations.

As noted previously, dogs were tested with a set of behavioral categories that were divided into individual sub-tests. All sub-tests were designed to individually measure various aspects of temperament. As noted, if any of the individual sub-tests were failed, then the entire test was considered failed. To obtain a passing score on the

temperament test, all sub-tests must have been completed successfully. Failure of a sub-test was recognized when a dog shows unprovoked aggression, panic without immediate recovery (within 5 seconds), or exhibited strong avoidance behavior. These behaviors as part of temperament tests have been defined extensively in the literature (Slabbert and Odendaal, 1999; Seksel et al., 1999; Svartberg, 2002; Ruefenacht et al., 2002; van den Berg et al., 2003; Fuchs et al., 2005). The 5 categories and 10 sub-tests are as follows:

Category 1: Behavior toward strangers.

The objective of this behavioral category was to measure the dog's reaction to strangers in a non-threatening situation. No fearful or aggressive behavior is permitted in this category.

Sub-test 1: Neutral stranger

This sub-test evaluated the dog's reaction to non-interactive or passive socialization and measured potential aggression. In this test, a neutral normal-acting person, who was also a stranger to the dog, approached the handler, shook hands with the handler, and engaged the handler in a brief conversation. The stranger must ignore the dog.

Sub-test 2: Friendly stranger

This sub-test evaluates the affects of interactive social interaction with a stranger and measured the dogs potential for nervousness or non-social behavior. In this test, a person, who was a stranger to the dog, approached happily and briskly, ignored the owner, and directed their attention immediately at the dog. The stranger spoke, in a friendly voice, to the dog then reached down to pet the dog.

Category 2: Reaction to Auditory Stimuli.

The objective of this category was to provide a measure of the dog's reaction to auditory stimuli. In this test careful evaluation of fearful reaction were made by each Licensed Tester. In general, the dog should not break away from the handler nor hit the end of the 6' lead before recovery and investigative behavior. In other words, as an extreme example, the dog may hunch or tense momentarily or even appear startled but must recover within 5 seconds. Dogs could also seek to investigate the source of the sound. Aggressive behavior in any form was not permitted.

Sub-test 3: Hidden Noise

This sub-test evaluated the dog's response to a hidden, sudden, and loud noise and measures the dog's ability to recover from sudden unknown sounds. In this sub-test, the handler and the dog approached a hidden assistant who loudly rattled a metal bucket filled with rocks and set this bucket in the path of the dog.

Sub-test 4: Gunshots

This sub-test evaluated the dog's ability to recover from a sudden and loud noise. In this sub-test, the handler stopped at a designated marker with his/her back towards a well-hidden assistant. The assistant fired three shots using a .22 caliber starter pistol (SHOT-PAUSE-SHOT-SHOT).

Category 3: Reaction to Sudden Visual Stimulus.

The objective of this category was to provide a measure of the dog's reaction to a sudden visual stimulus. In this test careful evaluation of fearful reactions were made by each Licensed Tester. In general, the dog should not break away from the handler nor hit the end of the 6' lead before recovery and investigative behavior. In other words, the dog may hunch momentarily or appear startled but was required to recover within 5 seconds and evaluate the source of the sound. Fear reactions beyond this or lack of recover within 5 seconds was considered a failure. Aggressive behavior in any form was not permitted.

Sub-test 5: Umbrella

This sub-test evaluated the dog's reaction to sudden motion and a strange object and measures the dog's visual responsiveness. In this sub-test, the handler and dog approached an assistant sitting in a chair holding a closed umbrella parallel to the ground at a 90 degree angle to the dog and handler. When the dog was five feet from the assistant, the umbrella was opened suddenly. The handler's focus was required to remain on the umbrella, not on the dog.

Category 4: Tactile Stimuli.

The objective of this category was to measure the dog's reaction to unusual footing, its ability to recover from the fear of unusual footing, and to measure its investigative behavior to the unusual footing.

Sub-test 6: Plastic Footing

In this sub-test, both the handler and the dog were required to walk the entire length of a 15-foot by 6-foot clear plastic strip. The dog can appear uncomfortable or can notice the obstacle but must continue walking. If the dog avoided the surface or sought to escape across or back on the surface, it was considered a failure.

Sub-test 7: Wire Footing

In this sub-test, the handler walked beside the obstacle rather than on it, as in sub-test 6. The dog was required to walk the entire length of a 12-foot by 3-foot unfolded exercise pen (X-Pen). X-Pens were typically 12-gauge wire panels with 1 x 2 inch weave. Similar to above, if the dog avoided the surface or sought to escape across or back on the surface, it was considered a failure.

Category 5: Self-Protective and Aggressive Behavior.

The objective of this category was to collectively evaluate the dog's capacity to recognize an unusual situation, its threshold to provocation, its protective instincts, and its propensity to realize when a situation became a threat. The stranger was never closer than 10 feet from the dog. This was roughly measured as being 18 feet from the handler with consideration for the length of the leash and the handlers arm reach.

Sub-test 8: Non-Threatening Stranger

This sub-test evaluated the dog's reaction to a non-threatening stranger that was dressed in unusual clothing. The purpose of this sub-test was to test the dog's alertness to an unusual situation. The handler and dog team stopped at a designated marker as instructed by the Tester. The strangely dressed stranger crossed the path 38 feet in front of the team. The dog could take notice of the stranger but could not react with more than curiosity. Any aggressive behavior or fearful behavior was considered a failure.

Sub-test 9: Threatening Stranger

This sub-test evaluated the same situation as above but evaluated the dog's ability to recognize when an unusual situation turned into a provocation. Picking up at the end of sub-test 9, the strangely dressed stranger suddenly advanced

10 feet (from 38 feet to 28 feet) towards the stationary handler in a threatening manner (defined as a fast tense marching with arms above head and eyes glaring at the dog). The dog could take notice of the stranger and was allowed to respond in a protective manner only (defined as placing themselves in front of the handler) but could not act fearful or aggressive.

Sub-test 10: Aggressive Stranger

This sub-test evaluated the dog's protective instincts and aggression restraint. By necessity, this test was judged subjectively only in relation to the breed's standard requirements for temperament and in relation to a dogs training in protection or sports such as Schutzhund, only if such protection training was indicated by the handler at the beginning of the Temperament Test. Thus, guardian breeds such as the German Shepherd could act with controlled aggression (defined as barking warningly), while breeds that are not categorized by breed standards (UKC or AKC) as guardians, or that were not trained for protection (e.g. Schutzhund), could not. In this sub-test, the weird stranger again advanced to within 10 feet of the dog in a wilder and more aggressive manner (defined as above but with arms waving and loud vocalizations of anger). The dog could move to a protective position in front of the owner. The dog could not show fear or act overtly or with uncontrolled aggressive behavior (wildly lunging and aggressively barking and growling) regardless of breed or training. Breeds such as the American Pit Bull Terrier, which is not defined as a guardian breed, and whose standard specifically states that human aggression is not part of the breed standard, could not show any aggressive behavior only protective behavior. If undue or overt aggression or fear were displayed by any dog this sub-test was failed.

Statistics**Sample size**

To determine if the sample size in this study was large enough to generalize across the entire United States' population of dogs, a Sample size analyses was conducted using infinity as the expected population size. To be conservative a maximum allowable difference of 0.01, confidence of 0.99, and population proportion of 0.5 were used. This resulted in a required sample size of 16,588 dogs (Thompson, 1992). Thus, with over 25,000 dogs tested, we had a sample size that could easily be

generalized across all dogs in the United States, even if there were an infinite number of dogs (Thompson, 1992).

Significant differences between proportions were analyzed using the following equations:

Our null hypothesis was: $H_o : p_1 = p_2$ Which means the proportion of dogs passing the temperament test in a given group were not significantly different to the proportion of dogs passing the temperament test in the second group)

To test for the null by comparing proportions, we compute the z statistic:
$$z = \frac{\hat{p}_1 - \hat{p}_2}{s_p(D)}$$

Where
$$s_p(D) = \sqrt{\hat{p}(1 - \hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$$

And
$$\hat{p} = \frac{X_1 + X_2}{n_1 + n_2}$$

In terms of a standard normal random variable Z (derived from the standard Z-table), the P-value for a test of H_o against $H_a : p_1 > p_2 \Leftrightarrow P(Z \geq z)$
 $H_a : p_1 < p_2 \Leftrightarrow P(Z \leq z)$
 $H_a : p_1 \neq p_2 \Leftrightarrow P(|Z| \geq |z|)$

In all cases, we utilized a comparison of proportion of dogs passing the temperament test to determine if p_1 was statistically greater or less than p_2 . In addition, to prevent type I error, Bonferroni correction was made to results in order to keep the overall experiment error rate to 5%.

Results

A total of 206 different breeds were evaluated using the American Temperament Test Society evaluation. The total number of dogs evaluated in this study was 25,726, the total number of dogs passing the test 20,848, and the total failing the test 4,878. The average percentage of all dogs passing was 81.71%. To illustrate the power and significance of the statistical evaluation presented here, the sampling distribution of the proportions p_1 - p_2 are approximately normal as long as the proportions of dogs passing in each group are not too close to 1.0 or 0.0, and the sample sizes are not

too small. In our case, the sample size was extremely large (actual over twice the suggested sample size calculations generated for a population of infinite size) and the proportion did not approach 0.0 or 1.0 for any of the groups analyzed, thereby validating the choice of statistical models. The raw data is summarized in Table 1.

Table 1. The number of dogs in each breed group evaluated (n), passed all sub-tests of the temperament test (X), failed at least one sub-test, and the percentage of dogs that passed the temperament test.

group	Total dogs tested (n)	Total dogs passed (X)	Total dogs failed	Percentage passing
Sporting	3181	2719	462	85.48%
Pit Bull	1136	960	176	84.50%
Mixed	680	579	101	85.10%
APBT	469	391	78	83.40%
Terrier	1860	1526	334	82.04%
Working	9111	7341	1770	80.57%
Herding	7885	6319	1566	80.14%
Toy	529	421	108	79.60%
Hound	1379	1062	317	77.01%
All	25726	20848	4878	81.04%

The results of statistical analysis for the breed groupings are provided in Table 2. The group that had the highest proportion of breed groups passing the temperament test was the sporting group (85.48%), followed by the pit bull group (84.50%). The groups that failed, with the lowest proportion of dogs passing the temperament test, were the toy (79.01%) and hound groups (77.01%). The groups were compared to determine if there was a significant difference in the proportion of dogs from each group that passed the temperament test. It was found that there were no significant differences between the proportion of dogs passing in the two groups with the highest passing percentages (sporting group and the pit bull group). Both of these breed groups performed significantly better ($p > 0.05$) than all other groups. The toy and hound group passed at significantly lower rates ($p < 0.05$) than all other groups. Following Bonferroni correction the pit bull group still maintained a significantly higher passing percentage than all pure breed groups except Sporting and Terrier (Bonferroni corrected $p < 0.05$).

Table 2. Results of the statistical z-test with bonferroni correction.

Comparisons	z value	B p value	Bon ferroni	Conclusion
PBG vs. Toy	2.48	< 0.00	S	PBG higher pass
PBG vs. Working	3.18	< 0.00	S	PBG higher
PBG vs. Sporting	-0.79	0.78	NS	No difference
PBG vs. Herding	3.48	< 0.00	S	PBG higher pass
PBG vs. Terrier	1.74	0.04	NS	No difference
PBG vs. Hound	4.71	< 0.001	S	PBG higher pass
PBG vs. Mixed	-0.36	0.64	NS	No difference
Toy vs. Work	-0.55	0.71	NS	No difference
Toy vs. Sport*	-3.47	< 0.00	S	Toy lower pass
Toy vs. Herding	-0.30	0.62	NS	No difference
Toy vs. Terrier	-1.28	0.90	NS	No difference
Toy vs. Hound	1.20	0.11	NS	No difference
Toy vs. Mixed*	-2.53	0.00	S	Toy lower pass
Work vs. Sport*	-6.17	< 0.00	S	Work lower pass
Work vs. Herding	0.70	0.23	NS	No difference
Work vs. Terrier	-1.46	0.92	NS	No difference
Work vs. Hound	3.08	0.00	S	Work higher pass
Work vs. Mix*	-2.9	0.00	S	Work lower pass
Sport vs. Herding	6.56	< 0.00	S	Sport higher pass
Sport vs. Terrier	3.22	< 0.00	S	Sport higher pass
Sport vs. Hound	6.97	< 0.00	S	Sport higher passing
Sport vs. Mix	0.22	0.41	NS	No difference
Herd vs. Terrier*	-1.86	0.03	NS	No difference
Herd vs. Hound	2.66	0.00	S	Herd higher pass
Herd vs. Mix*	-3.16	< 0.00	S	Herd lower pass
Terrier vs. Hound	3.53	< 0.00	S	Terriers higher pass
Terrier vs. Mix*	-1.83	0.03	NS	No difference
Hounds vs. Mix*	-4.31	< 0.00	S	Hounds lower pass

PBG= pit bull group; S = significant after bonferonni correction; NS not significant after bonferonni correction; B p-value = bonferronni corrected p-value.

In addition to comparison of breed groups the American Pit Bull Terrier as a single breed was considered separately. The American Pit Bull Terrier is the breed that, because the phrase “pit bull” as part of its name, has been most readily associated with the seemingly catchall category of “pit bull and pit bull type” in relation to BSL. As a pure breed analyzed on its own merit, the American Pit Bull Terrier evaluations showed there was no significant difference even with the group with highest proportion of dogs passing (Sporting Group). As noted the sporting group contains some of the more publicly accepted (as dogs of stable or good temperament) including Golden Retrievers and Labrador Retrievers. More notably, the American Pit Bull Terriers showed significantly higher proportion of dogs passing the test than hounds, herding, working, and toy groups (Table 3).

Table 3. This table provides the results of the z-test and the significance of the test against the null hypothesis.

Comparisons	z value	p value	Conclusion
APBT vs. Toy	1.5324	0.0627	APBT higher pass rate
APBT vs. Work	1.4965	0.0673	APBT higher pass rate
APBT vs. Sport	-1.2	0.8849	No difference
APBT vs. Herding	1.709	0.0437	APBT higher pass rate
APBT vs. Terrier	0.6725	0.2506	No difference
APBT vs. Hound	2.9	0.0019	APBT higher pass rate
APBT vs. Mixed	-0.817	0.793	No difference
PBG vs. APBT	0.5682	0.285	No difference

Discussion

Murphy (1997) published a manuscript that defined categories of temperament in dogs. Murphy (1997) used a similar temperament test to that described here but focused on a total of 89 dogs, which were primarily Golden Retrievers. The American Kennel Club (2005) established the Canine Good Citizen test and title, which has a slightly less stringent testing procedure, to establish criteria for determining a dog to be a “good member of society”. Most publications that evaluate the temperament of dogs have utilized temperament tests and definitions of behavior that are similar to the temperament test described here (Slabbert and Odendaal, 1999; Seksel et al., 1999; Svartberg, 2002; Rufenacht et al., 2002; van den Berg, Schilder and Knol, 2003; Fuchs et al., 2005). As part of the current study the number of animals

evaluated and the evaluation of breeds within groups minimized potential extraneous bias such as founder effects, sex effects, age effects, and breed representation effects. Observer bias is minimized by standardized training of judges, requiring agreement among 3 separate licensed Testers, and by utilizing a pass fail testing structure with defined behavioral requirements.

Here we provide a concise definition of temperament as, an individual's exhibited, predictable, and measurable behavior patterns displayed in response to environmental stimuli. In higher vertebrate animals temperament is predominantly influenced by age, sex, socialization, health, and genetics. The concept of temperament must be focused on the individual dog and if we seek to encompass entire families, breeds, breed groups, or species this concept must by necessity become more and more general and broadly encompassing. This is the failure of BSL as a logical solution to ownership problems because the vast majority of pit bulls and APBT are shown to be of good temperament. Plomin et al. (1990) remarked that behavioral differences exist not only between species but also between individuals of the same species. As an example that is easy to digest, we can assume for instance that almost all Golden Retrievers are friendly toward humans. However, Golden Retrievers can be raised in such a way to make them aggressive toward humans (Edwards, 1991; Knol et al., 1998; van den Berg et al., 2003; Kwant, 2004).

In support of the current data, a study by Böttjer (2003) evaluated aggressive behaviour of 347 dogs belonging to the American Staffordshire Terrier, Bullterrier, Staffordshire Bullterrier, Rottweiler, Doberman Pincher breeds, and a catchall pit bull group. Only 3.75% of the dogs failed the Temperament Test and were therefore noted as having dangerous aggressive behaviour (not toward humans) towards other dogs. The assessment of the breeds groups showed that neither the pit bull group, nor the American Staffordshire Terrier, displayed a significant difference between the single breeds and breed types. The results of the Böttjer study, like the current study, showed that the BSL assumptions based upon inherent differences in "dangerousness" across entire breeds was not justified.

The Center for Disease Control and Prevention (CDC, 1997; CDC, 2003) has indicated that BSL has no merit. They indicate that "Dangerous dog laws", which focus on individual dogs, regardless of

breed, that have exhibited harmful behavior (e.g., unprovoked attacks on persons or animals) are both logical and enforceable without violating the rights of citizens or declaring individual animals guilty even though the majority are of sound temperament. The CDC indicates that the most logical approach is to place primary responsibility for a dog's behavior on the owner, rather than the dogs breed. The CDC indicates that legislation and programs focused on ownership responsibility as well as owner and child education are the keys to a safer canine population. The American Veterinary Medical Association (2001) Task Force on Canine Aggression and Human-Canine Interactions also state that Breed Specific Legislation has no merit and that targeting those individual dogs, of any breed, that commit acts of aggression, directly addresses the problem.

Conclusion

Previously published bite statistics when groups are compared to individual breeds are unrepresentative as corroborated by the Centers for Disease Control and Prevention and the American Veterinary Medical Association (CDC, 1997; CDC, 2003; AVMA, 2005). The current study has statistically shown, based on a defined temperament test, that the classification of dog breeds and dog breed types (breed groups), with respect to their aggressiveness toward humans is not supported scientifically. The complex and contributing conditions related to the upbringing of individual dogs are not considered by BSL and such laws unfairly target the vast majority of individual dogs, which are temperamentally stable. The temperaments of animals are fundamentally and universally acknowledged to be influenced by age, sex, early socialization, early nutrition, training, health and genetics, while BSL only takes one of these factors into account.

Citations

1. ATTS (2005) American Temperament Testing Society, from <http://www.atts.org>
2. AVMA (2001) American Veterinary Medical Association Task Force on Canine Aggression and Human-Canine Interactions. *A community approach to dog bite prevention*. J. Am. Vet. Med. Assoc. 218, 1732-1749.
3. Böttjer, A. (2003) Intraspecific aggressive behaviour of five breeds of dogs and the pitbull-type during the Temperament-Testing according to the guidelines of the

- Dangerous Animals Act of Lower Saxony, Germany (GefTVO) of 05.07.2000. PhD thesis. Hannover: Tierärztliche Hochschule.
4. California Considers Allowing Breed-Specific Laws. (2005, June 24). AKC News from http://www.akc.org/news/index.cfm?article_id=2543
 5. CDC Center for Disease Control and Prevention, (1997). Dog-Bite-Related Fatalities—United States, 1995-1996 Morbid Mortal Week Rep., 46 (21), 463.
 6. CDC Center for Disease Control and Prevention, 2003. Nonfatal Dog Bite—Related Injuries Treated in Hospital Emergency Departments - United States. Morbid Mortal Week Rep. 52, (26), 605-610.
 7. CGC. Canine Good Citizen Program, 2005. American Kennel Club. from <http://www.akc.org>
 8. Dog Lovers Don Red and Black Ribbons for Breed Ban Awareness Campaign (2000, August 28). National Animal Interest Alliance from <http://www.naiaonline.org/body/articles/archives/pressrelease836.htm>
 9. Edwards, R. A., 1991. Aggression in golden retrievers. Vet. Rec. 128, (17), 410.
 10. Fuchs, T., Gaillard, C., Gebhardt-Henrich, S., Ruefenacht, S., Steiger, A., 2005. External factors and reproducibility of the behaviour test in German shepherd dogs in Switzerland. Appl. Anim. Behav. Sci. 94, (4), 287-301.
 11. Knol, B. W., Roozendaal, C., van den Boogaard, L., Bouw, J., 1998. The suitability of dogs as guide dogs for the blind: criteria and testing procedures. Vet. Q. 10, 198–204.
 12. Kwant, L., 2004. Aggressive behavior in Golden Retrievers: researching the scope of the problem. Tijdschr Diergeneeskd. 129 (18), 597-598.
 13. Marmer, L., 1984. The new breed of municipal dog control laws: are they constitutional? Univ. Cincinnati Law Rev. 53, 1067–1081.
 14. Murphy, J. A., 1995. Assessment of the temperament of potential guide dogs. Anthrozoos. 8, 224–228.
 15. Murphy, J. A., 1997. Describing categories of temperament in potential guide dogs for the blind. Appl. Anim. Behav. Sci. 58, 163-178.
 16. Plomin, R., De Fries, J. C., McClearn, G. E., 1990. Behavioural Genetics: A Primer. W.H. Freeman, New York, 32
 17. Ruefenacht, S., Gebhardt-Henrich, S., Miyake, T., Gaillard, C., 2002. A behaviour test on German Shepherd dogs: heritability of seven different traits. Appl. Anim. Behav. Sci. 79, 113-132
 18. Sacks, J. J., Kresnow, M., Houston, B., 1996a. Dog bites: how big a problem? Injury Prev. 2, 52 -54
 19. Sacks, J. J., Lockwood, R., Hornreich, J., & Sattin, R. W., 1996b. Fatal dog attacks, 1989-1994. Pediatrics. 97, 891-895
 20. Sacks, J. J., Sattin, R. W., Bonzo, S. E., 1989. Dog bite-related fatalities from 1979 through 1988. JAMA. 262, 489-492.
 21. Seksel, K., Mazurski, E. J., Taylor, A., 1999. Puppy socialization programs: short and long term behavioural effects. Appl. Anim. Behav. Sci. 62 (4), 335–349.
 22. Slabbert, J. M. Odendaal, J. S. J., 1999. Early prediction of adult police dog efficiency—a longitudinal study. Appl. Anim. Behav. Sci. 64 (4), 269-288
 23. Svartberg, K., 2002. Shyness–boldness predicts performance in working dogs Appl. Anim. Behav. Sci. 79(2),157-174
 24. Thompson S. K., 1992. Sampling: New York, Wiley
 25. van den Berg L., Schilder, M. B., Knol, B. W., 2003. Behavior genetics of canine aggression: behavioral phenotyping of golden retrievers by means of an aggression test. Behav. Genet. 33(5):469-83.

Supplemental Table. This table provides the groupings of breeds used for statistical analyses.

APBT Group	American Pit Bull Terrier
Pit Bull Group	Bull Terrier, BullDoggue, American Bulldog, Boston Terrier, Staffordshire Bull Terrier, American Staffordshire Terrier, and American Pit Bull Terrier.
Hound Group	Afghan Hound, American Foxhound, Basenji, Basset Hound, Beagle, Black and Tan Coonhound, Bloodhound, Bluetick Coonhound, Borzoi, Dachshund (Miniature Longhaired), Dachshund (Miniature Smooth), Dachshund (Miniature Wirehaired), Dachshund (Standard Longhaired), Dachshund (Standard Smooth), Dachshund (Standard Wirehaired), English Foxhound, Greyhound, Ibizan Hound, Irish Wolfhound, Norwegian Elkhound, Otterhound, Petit Basset Griffon Vendeen, Pharaoh Hound, Rhodesian Ridgeback, Saluki, Scottish Deerhound.
Terrier Group	Airedale Terrier, American Pit Bull Terrier, American Staffordshire Terrier, American Tunnel Terrier, Australian Terrier, Bedlington Terrier, Border Terrier, Bull Terrier, Cairn Terrier, Dandie Dinmont Terrier, Irish Terrier, Kerry Blue Terrier, Lakeland Terrier, Manchester Terrier, Miniature Bull Terrier, Miniature Schnauzer, Norfolk Terrier, Norwich Terrier, Parson Russell Terrier, Scottish Terrier, Sealyham Terrier, Skye Terrier, Smooth Fox Terrier, Soft Coated Wheaten Terrier, Staffordshire Bull Terrier, Welsh Terrier, West Highland White Terrier, Wire Fox Terrier.
Herding Group	Australian Cattle Dog, Australian Kelpie, Australian Shepherd, Bearded Collie, Belgian Laekenois, Belgian Malinois, Belgian Sheepdog, Belgian Tervuren, Border Collie, Bouvier Des Flanders, Briard, Canaan Dog, Collie, Cardigan Welsh Corgi, German Shepherd Dog, Giant Schnauzer, Catahoula Leopard Dog, Old English Sheepdog, Pembroke Welsh Corgi, Puli, Shetland Sheepdog, Standard Schnauzer, Texas Heeler, Pembroke Welsh Corgi, Shiloh Shepherd, Swedish Vallhund, Welsh Sheepdog
Sporting Group	American Water Spaniel, Brittany Spaniel, Boykin Spaniel, Chesapeake Bay Retriever, Clumber Spaniel, Cocker Spaniel, Curly-Coated Retriever, English Cocker Spaniel, English Setter, English Springer Spaniel, Field Spaniel, Flat-Coated Retriever, German Shorthaired Pointer, German Wirehaired Pointer, Golden Retriever, Gordon Setter, Irish Setter, Irish Water Spaniel, Labrador Retriever, Nova Scotia Duck Tolling Retriever, Pointer, Portuguese Water Dog, Spinone Italiano, Sussex Spaniel, Tibetan Spaniel, Vizsla, Weimaraner, Welsh Springer Spaniel, Standard Poodle.
Working Group	Rottweiler, Doberman Pinscher, Akbash Dog, Akita, Alaskan Malamute, Anatolian Shepherd Dog, Bernese Mountain Dog, Boxer, Bullmastiff, Dogo Argentino, Dogue De Bordeaux, Estrala Mountain Dog, Giant Schnauzer, Great Dane, Great Pyrenees, Greater Swiss Mountain dog, Kuvasz, Leonberger, Mastiff, Neapolitan Mastiff, Newfoundland, Polski Owczarek Nizinny, Portuguese Water Dog, Presa Canario, Saint Bernard, Samoyed, Siberian Husky, Standard Schnauzer, Tosa
Toy Group	Miniature Poodle, Miniature Pinscher, Toy Poodle, Manchester Terrier, Cavalier King Charles Spaniel, Shih Tzu, Pug, Yorkshire Terrier, Chihuahua, Pomeranian, Chinese Crested Dog, Silky Terrier, Pekingese, Toy Manchester Terrier, Tibetan Terrier, Brussels Griffon, Toy Fox terrier, Havanaese, Japanese Chin.
Mixed	All dogs that were not identified as pure bred.