

ESTIMATION OF GENETIC PARAMETERS FOR BEHAVIORAL ASSESSMENT SCORES
IN LABRADOR RETRIEVERS, GERMAN SHEPHERD DOGS, AND GOLDEN
RETRIEVERS

by

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Abstract

Among working dogs, the role of a guide dog ranks as one of the most noble and useful occupations and thus was recognized early as a category of working dogs worthy of focused research. Behavior issues top the list of most common reasons for rejecting dogs from working as guides. The objective of this study was to estimate genetic parameters for each of the 101 questions and 12 subscale factors measured by the Canine Behavioral Assessment and Research Questionnaire (C-BARQ). The C-BARQ is a standardized questionnaire that contains seven behavioral categories: training and obedience, aggression, fear and anxiety, separation-related behavior, excitability, attachment and attention-seeking, and a miscellaneous category. These categories and questions allow the evaluator to describe any dog's behavior. For this study, questionnaire responses were obtained on 3,149 and 3,348 Labrador Retrievers (LR) from Guiding Eyes for the Blind (GEB) and 989 and 1,187 Labrador Retrievers, 608 and 692 Golden Retrievers (GR), and 966 and 1,348 German Shepherd Dogs (GSD) from The Seeing Eye, Inc. (TSE) at 6- and 12-months of age, respectively. The estimates of heritability and standard errors from TSE dogs indicate that there is much genetic variation that could be exploited in selection against "Familiar dog-directed aggression/fear" (0.27 ± 0.12) of GR at 6-months, "Chasing" (0.22 ± 0.10) of GR at 6-months, and "Nonsocial fear" (0.27 ± 0.09) of GR at 12-months or in selection for improved "Trainability" of LR (0.46 ± 0.07), GSD (0.47 ± 0.07), and GR (0.20 ± 0.08) at 12-months. In general, the remaining factors and most of the 101 questions were found to be lowly heritable (< 0.10). These estimates are useful to understand more about the nature of behavioral traits leading to the production of successful working guides.

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Dedication

I lovingly dedicate this thesis to my little brother "Butch," who I know watched over me every step of the way.

Chapter 1 - Introduction

Obtaining an adequate number of high-quality dogs suitable for breeding or training to work as guides for blind people is a constant challenge for many guide dog schools. Many schools now maintain their own breeding colonies to ensure the availability of an adequate number of high-quality dogs with predictable traits to meet their needs. The most effective way to use information about the traits in a population, to produce predictable stock and to improve it over time, is to apply the time proven principles of population genetics and quantitative genetics to manage the population over successive generations.

Over the past three decades, advances in computing power have enabled the study of genetic complexity in more animals and in greater detail than ever before. Researchers can now predict changes in quantitative genetic traits in future generations by using complex statistical models that take into account all the animals in the pedigree. Several traits can be studied simultaneously and relationships among traits can be established. Most parameters of behavior are complex combinations of genetic and environmental influences. With sufficient data on each of many animals in an extended pedigree, it is possible to assess the extent to which these traits are heritable. Furthermore, researchers can also forecast the likely results of selection in the future, which enables comparisons of the possible results of different breeder selection strategies.

One of many issues facing guide dog organizations is that there is no single perfect "type" of guide dog. Because substantial variation exists among the people who use guide dogs, there must also be variation among the dogs available for matching with their blind masters. This means that guide dog schools are not breeding for one specific kind of "super dog", as show breeders predominantly desire. Rather, it is essential to have dogs with varying degrees of characteristics such as breed, temperament, size, and energy to enable guide dog schools to properly match dogs with blind people who are equally varying in the needs and desires they require of the dog who will literally live with them 24 hours per day.

This task of finding the "right" dog for each client is one of the hardest jobs faced by the training staff of a guide dog school. The trainer has to assign the dog to the client/handler early on in the training course as they have a short period of time with the clients and dogs together to determine if they have made a successful match. It is very difficult to switch a pair late in the

training period as bonding between the client and dog will already have begun to take place. Each trainer works with a small group of clients and dogs at the same time and therefore has potential to create confusion for the dog when reassigning them with a different client, but having to remain around their original handler. It is also important that the dog's temperament matches the home environment of the client. For example, it would be unwise to pair a high energy large dog with a short elderly client who doesn't often leave their home.

The criteria used in the breeder selection process at guide dog organizations are crucial to the success of working guides. A potential tool for this selection process is known as the Canine Behavioral Assessment and Research Questionnaire (C-BARQ, 2012). The C-BARQ was developed by researchers at the Center for the Interaction of Animals and Society of the University of Pennsylvania and designed to provide standardized evaluations of canine behavior and temperament. The information the C-BARQ provides may be useful to guide dog schools as a way to learn more about the nature of optimal behavioral traits leading to the production of dogs that are more successful in their ability to work as guides.

While this canine behavioral assessment instrument has been extensively tested for reliability and validity, prior to this study a comprehensive genetic analysis of the C-BARQ had not been completed. Thus, the objectives of this research are to estimate the magnitude of heritability for each of the 101 questions and each of the 12 subscale factors, as well as exploration of breeding strategy implications based on the results obtained. The heritability estimates can then be used to predict response to selective breeding.

The Guide Dog Service Industry

Guiding Eyes for the Blind (GEB) Headquarters and Training Center is located in Yorktown Heights, NY and the Canine Development Center (Breeding Center) is located in Patterson, NY. GEB is an internationally accredited guide dog school with a mission to provide greater independence, dignity, and new horizons of opportunity to the visually impaired. Their selective breeding program began in the mid-1960s and the organization continually strives to genetically improve the health and working ability of its guide dogs.

The Seeing Eye, Inc. (TSE), located in Morristown, N.J., was founded in 1929 and is the oldest existing guide dog school in the world. It is an internationally accredited provider of guide dogs and owns the trademark for and is technically the only source for a SEEING EYE ®

dog. TSE is a national philanthropic organization and a leader of research in canine genetics, breeding, disease control, and behavior. Their overall mission is to enhance the independence, dignity, and self-confidence of blind people through the use of Seeing Eye[®] dogs.

The ultimate goal of the Breeding Manager and Geneticist of both these guide dog schools is to increase the number of high-quality dogs available for training while minimizing the number of unusable dogs produced by their respective breeding programs.

Chapter 2 - Literature Review

Canine Behavior

Numerous genetic studies of aspects of canine behavior have been performed in the last century (Humphrey and Warner, 1934; Scott and Fuller, 1965; Goddard and Beilharz, 1982, 1982/83; Knol, et al. 1988; Wilsson, 1997a,b,1998), but the majority of studies were aimed towards understanding the genetics of canine physical traits (Willis, 1995). Over the past decade, the number of canine behavior studies has grown, especially in the development of behavioral assessments to measure aspects of canine temperament. Due to their practical impact on society, many of these studies have focused on working dogs, but that trend is changing to include new studies that focus on genetic aspects of canine behaviors (American Kennel Club-Canine Health Foundation (AKC-CHF), 1991, 2003, 2007, 2009; Morris Animal Foundation (MAF), 2008).

Assessments of Working and Companion Dog Behavior

Among working dogs, the role of a guide dog ranks as one of the most noble and useful occupations (Willis, 1995) and thus was recognized early as a category of working dogs worthy of focused research. Behavior issues are the most common reasons for rejecting dogs from working as guides (Goddard and Beilharz, 1982, 1982/83).

Knol et al. (1988) described the expectations of a guide dog as eager to perform tasks while not easily distracted, remaining calm, and displaying controlled responses to stimuli. These same authors characterized a guide dog's behavior as possessing an alert stability, while the dog must not ever chase or become too excitable when greeting people or in the presence of other tempting environmental stimuli. The dog must refrain from barking excessively, as well as whining or howling when receiving auditory stimuli that often leads to such behavior. These authors also distinguished the guide dog as needing an overall focus on both the handler as well as its general work environment while also keeping an acceptable pull at the harness handle and adjusting speed accordingly. Maintaining a reliable relieving schedule and defecating on

command, enjoying grooming by the owner, and accepting examination and treatments by veterinarians are also necessary for good guide work (Knol et al., 1988).

A working guide dog encounters various situations and stimuli, and excessive fear to any of these situations would cause it to fail from the program. Goddard and Beilharz (1984a) conducted a factor analysis of fearfulness in 102 potential guide dogs because fearfulness is the most common reason for release from the guide dog program. Four breeds, Labrador Retriever, German Shepherd Dog, Boxer, and Kelpie, and their crosses were used in the study. One person carried out the testing procedures at 12 weeks, 4-, 6-, and 12-months of age while the dogs were with their puppy raisers. At 6- and 12-months of age, they tested the reaction of each dog to 4 stimuli, recording 6 responses related to fearfulness: approach, avoidance, nature of contact, posture, tail position, and startle reaction. The dogs were tested once again, when they began training, between the ages of 12-18 months. The results suggested that adult fearfulness could be somewhat accurately predicted from fearfulness observed at 3 months of age, but they also noted that accuracy of prediction improved with age.

Other common behavioral reasons for releasing dogs from working as guides for the blind include high distraction, high activity, and excitability (Baillie, 1972; Guide Dogs for the Blind, 1975; Scott and Beilfelt, 1976; Goddard and Beilharz, 1982, 1982/83). Goddard and Beilharz (1984a, 1984b) examined the relationship of fearfulness to, and the effects of sex, age, and experience on exploration and activity in the same 102 potential guides. They found a correlation of high visual and auditory exploration, but no correlation with olfactory exploration. They also noted that between 6- and 12-months of age, the dogs declined in activity level and unwanted exploration. Additionally, they documented a sex effect; females were shown to have a higher activity level during inhibitory training and a higher level of olfactory exploration than males. Their studies suggest that decreasing fearfulness will decrease auditory and visual exploration but will have little effect on activity.

Goddard and Beilharz (1984a, 1984b, 1986) reported that their ability to predict adult fearfulness improved with accumulating new information as a dog increased in age. Their study subjected the same 102 dogs to a series of behavioral tests between the ages of 4 weeks and 6 months old, with the overall aim to find a reliable method of predicting adult behavior from observations made at younger ages. Their objective was to develop a reliable puppy test that would identify puppies at a young age that would be most suitable for work as guides and to help

select breeding stock. Their results suggested that genetic selection against fearfulness would be more accurate if carried out in adult dogs rather than in young dogs. This finding confirms the concept that development of canine behavior passes through critical periods (Scott and Fuller, 1965), so accurate selection of replacement breeders needs to be based on observations made after closing of the fearfulness critical period.

Wilsson and Sundgren (1997a) analyzed test results of 1,310 German Shepherd Dogs and 797 Labrador Retrievers from the Swedish Dog Training Centre (SDTC) that ranged in age from 15-20 months. The researchers evaluated behavior tests previously used at SDTC, and examined whether or not test results could be used to select dogs for more than one type of service work, i.e. police dogs, guide dogs, narcotic dogs, or protection dogs. One experienced person conducted all tests which involved scoring 10 different behavior characteristics based on the dog's reactions in 7 different test situations. A factor analysis revealed 4 factors for both breeds: Factor 1 included the characteristics of courage, nerve stability, and hardness; Factor 2 was made up of temperament and ability to cooperate; Factor 3 by affability (German Shepherd Dogs) and sharpness and defense drive (Labrador Retrievers); and Factor 4 by sharpness, prey drive, and defense drive (German Shepherd Dogs) and affability (Labrador Retrievers). Their results indicate that a subjective evaluation of complex behavioral parameters can be used as a tool for selection of dogs appropriate for service work. They also suggest that the use and correct interpretation of a behavior test can be enhanced by adjusting the results for breed and planned service category.

Goodloe and Borchelt (1998) sought to identify factors that could be used both to describe dogs and to predict future behavior in companion dogs. The researchers identified 22 factors representing temperament traits with variation among companion dogs. These 22 factors were obtained through an exploratory principal component analysis of 127 descriptions of behavior across 2,018 owner responses. Among the 22 factors, 4 were related to aggression, 3 related to play, and 3 described vocal behavior. The framework set forth provides fodder for the development of behavioral profiles which could be tested for their ability to predict future behavior and their suitability for fastidious homes or lifestyles.

Because inter-rater agreement, test-retest reliability, internal consistency, and convergent validity have been determined by various techniques across canine temperament studies reported in the literature, a meta-analysis was done to consolidate results related to these measurements

(Jones and Gosling, 2005). The findings of the analysis generally supported the reliability and validity of canine temperament tests, but they also concluded that there is a continuing need for more studies examining discriminate validity. Furthermore, they noted that the distinction between temperament and personality needs to be consistently maintained in the literature.

Taylor and Mills (2006) encourage a scientific approach to the development, conduct, and evaluation of temperament tests for adult companion dogs. Five key factors are posited and explained in detail: purpose, standardization, reliability, validity, and practicality. A number of authors have noted that reports of methodology, reliability, and validity are sparse in the literature (Hsu and Serpell, 2003; Marston and Bennett, 2003; Jones and Gosling, 2005; Taylor and Mills, 2006). The Canine Behavioral Assessment and Research Questionnaire (C-BARQ) is, however, one tool for assessing aspects of canine temperament developed to address each of these key factors. The rigorous approach used in developing the C-BARQ lends credibility to the descriptions of behavior it provides regarding individual dogs. These individual dog descriptions are beginning to be used by both working dog agencies, TSE and GEB, to decide which dogs are suitable as working dogs. Animal shelter agencies are also using the C-BARQ as a tool for assessing the adaptability of companion dogs.

Assessing the Validation of C-BARQ

Serpell and Hsu (2001) described the development and validation of a novel questionnaire method for assessing behavior and temperament on a total of 1,097 1-year-old prospective guide dogs, recruited from TSE. This simple 40-item behavioral questionnaire used a series of five-point, semantic differential-type rating scales. This approach allowed volunteer puppy-raisers to provide a quantitative assessment of their dog's typical response to a variety of common environmental events and stimuli. The scores were subjected to factor analysis which identified eight common factors: stranger-directed fear/aggression, non-social fear, energy level, owner-directed aggression, chasing, trainability, attachment, and dog-directed fear/aggression. These eight factors were then validated against TSE's own criteria for rejecting dogs for behavioral reasons resulting in construct validity of the puppy raisers' questionnaire assessments of their dogs. Findings indicated that the 40-item behavioral questionnaire provided a useful and accurate means of predicting the suitability of dogs for working as guides, however, the instrument was quite specific to the TSE population.

Hsu and Serpell (2003) described the development and validation of a 68-item questionnaire for assessing behavior and temperament traits on a total of 1,851 pet dogs. Pet owners scored their dogs on a five-point frequency scale and a semantic differential-type rating scale. Data from the completed questionnaires were then subjected to factor analysis which identified eleven factors from 68 of the original questionnaire items. This suggested that such methods can provide a valid and reliable method of assessing behavior and temperament traits in dogs.

The C-BARQ was validated in two separate, but similar studies (Serpell and Hsu, 2001; Hsu and Serpell, 2003) confirming that the questionnaire factors and the behavior and temperament traits they represent were stable and consistent among different populations of dogs. These authors (Serpell and Hsu, 2001) also evaluated the overall construct validity of the C-BARQ, which was deemed valid as well as capable of discriminating among dogs that succeed in training for work as guide dogs versus dogs that fail training due to behavior.

C-BARQ

Serpell and Hsu (2005) found an overall lack of statistically significant sex differences and a highly significant breed difference in trainability, among 1,563 dogs of eleven common breeds measured by the C-BARQ. These results indicated that subsequent selection for more specialized and interactive working skills may have heightened their trainability in some breeds as compared with other breeds. In other words, these findings suggest that there is prospect for improving trainability in most breeds of dog.

Liinamo et al. (2007) were the first to genetically study a portion of C-BARQ traits. The authors sought to identify if any aggression-related questions and factors, measured by the C-BARQ, exhibited significant genetic variation in a population of Dutch Golden Retrievers. Among the 27 C-BARQ questions they examined, estimates were found to be highly heritable for 13 questions, moderately heritable for four questions and lowly heritable for seven questions. All four subscale factor estimates were highly heritable. Standard errors were not obtained for the highly heritable traits, thus reliability could not be calculated. For future quantitative genetic studies the authors advised acquiring data from a larger population size and avoiding selective sampling of dogs, which were two limitations of this study.

Duffy, Hsu and Serpell (2008) performed a study that surveyed the owners of more than 30 breeds of dogs using the C-BARQ. They found large and consistent differences among dog breeds in the prevalence and severity of different forms of aggressive behavior directed at different targets (strangers, owners, or other dogs), and the degree to which aggression was associated with fear. The value in the results of this study may help elucidate the causes of aggression and potentially help reduce the prevalence of aggressive behavior in dogs.

More recently, van den Berg et al. (2010) conducted an evaluation of the C-BARQ as a measure of stranger-directed aggression in 1000 dogs of three common breeds (German Shepherd Dog, Golden Retriever and Labrador Retriever). They concluded that the subscale consisting of 10 items could be used to quantify stranger-directed aggression in the three breeds. The scores of different dogs can also be compared meaningfully regardless of the dogs' sex, breed or neutering status.

Genetics of Behavior

Importance of Heritability

Setting priorities for genetic improvement and choosing the best selection strategy depends on the program objectives and evaluation method. The selection index and best linear unbiased prediction (BLUP) have been shown to be successful tools for obtaining genetic improvement. Specifically, in livestock species, including dairy, beef and swine production, BLUP-based selection programs have been highly successful (Muir and Aggrey, 2003). In any animal breeding program, accurate heritability estimates are imperative for applying the appropriate genetic influence to the traits being considered for improvement and for estimation of correct breeding values (Jain and Sadana, 2000).

Heritability is an important parameter that can be defined as the proportion of phenotypic variation that is attributable to genetic variation among individuals in a population (Bourdon, 2000). Heritability can be used to evaluate animals and to predict response to selective breeding. A breeder's goal is to increase the number of desirable alleles present in the resulting offspring of a breeding pair and thus select the superior individuals of that generation to reproduce. Over time, this selection process will increase the number of desirable alleles in the population. Larger estimates of heritability imply that more of the observed variation in a trait is controlled

by genetic effects than by the environmental effects, and with larger estimates of heritability, it is easier to improve a trait through selection.

Genetics and Selection in Dogs

Today, many studies suggest that genetic variation exists in a large number of behavioral traits among various breeds of dogs (Mackenzie et al., 1986, Wilsson and Sundgren, 1997a,b,1998; Ruefenacht et al., 2002; Strandberg et al., 2005; van der Waaij et al., 2006, 2008). Other studies have documented that a genetic component is involved in the expression of other canine traits, i.e. canine hip dysplasia (Leighton et al., 1977; Mäki et al., 2000; Zhiwu et al., 2009). In these studies, heritability estimates varied from moderate to highly heritable. It was concluded that selection efforts within breeding programs should result in improved hip-quality by selecting against canine hip dysplasia. Steady genetic improvement has been achieved through selection based on phenotypic hip scores at Guiding Eyes for the Blind (Jane Russenberger, personal communications, July 23, 2006) and The Seeing Eye, Inc.(Leighton, 1997). This demonstrates that genetic selection in dogs can lead to genetic improvement similar to that documented in livestock species, thus a valid canine behavior assessment tool could enable organizations to genetically improve aspects of behavior in the dogs.

There are many genetic and environmental factors that affect the suitability of dogs as guides for the blind. Goddard and Beilharz (1982) considered these factors when analyzing the records of 929 Labrador Retrievers and 102 dogs of other breeds. The dogs came from the Royal Guide Dogs for the Blind Association, Victoria, Australia, and were placed with puppy raisers at 6-12 weeks of age. Least-squares analysis was used to estimate heritability using the LSMLGP (Harvey, 1968) computer program. The model included year, sire, dam, sex, between-litter residual after fitting year, sex and dam and within-litter (individual) error. Heritabilities and standard errors were estimated for success (0.44 ± 0.13), fear (0.46 ± 0.13), dog distraction (0.09 ± 0.08), and excitability (0.09 ± 0.08). Their results suggested that fearfulness is the most heritable component of success and selection for less fearful dogs should yield measurable results.

Goddard and Beilharz (1982/83) studied 10 behavioral traits that affect the suitability of dogs as guides for the blind using the same method as described in Goddard and Beilharz (1982). The traits included nervousness, suspicion, concentration, willingness, distraction, dog

distraction, nose distraction, sound shy, hearing sensitivity, and body sensitivity. Their model included year, sex, sire, dam, residual between-litter variation (not explained by the other sources), and within-litter error. Heritability and genetic correlations were estimated from trainers' scores of 249 Labrador Retrievers bred by the Royal Guide Dogs for the Blind Association. The moderately heritable traits were concentration (0.28), willingness (0.22), dog distraction (0.27), and body sensitivity (0.33) and the only highly heritable trait was nervousness (0.58). No unfavorable correlations between traits were discovered and the authors suggest future selection could result in an overall improvement in the dogs.

Wilsson and Sundgren (1997b) investigated the potential to predict adult usefulness by way of a puppy test at 8-weeks of age in 1,235 German Shepherd puppies. The majority of these puppies were tested again at 15-20 months old using the same method as Wilsson and Sundgren (1997a). Their model included gender, parity, litter size, weight at 50 days, and error. The moderately heritable traits include yelp (0.22 ± 0.08), shriek (0.24 ± 0.09), contact I (0.21 ± 0.08), fetch (0.21 ± 0.08), retrieve (0.20 ± 0.08), large ball (0.27 ± 0.09), and objects visited (0.27 ± 0.09). The highly heritable traits include tug of war (0.48 ± 0.11), activity (0.53 ± 0.13), and contact II (0.42 ± 0.10). Although their results suggest that a portion of observed variation in puppy behavior could be explained by hereditary factors, measurements of these factors in 8-week-old puppies failed to work as predictors of their adult behavior.

Wilsson and Sundgren (1998) used the same material from Wilsson and Sundgren (1997a, 1997b) to estimate heritability with regards to a behavior test for selecting dogs for either service or for breeding. A factor analysis yielded four factors that explained 75 percent of the variation. These included: (1) mental stability, (2) willingness to please, (3) affability (ardor for Labrador Retrievers), and (4) ardor (affability for Labrador Retrievers). Estimates of heritability and standard errors for these factors include: Factor 1 (0.25 ± 0.06) and (0.29 ± 0.09), Factor 2 (0.24 ± 0.06) and (0.20 ± 0.08), Factor 3 (0.32 ± 0.07) and (0.15 ± 0.07), and Factor 4 (0.17 ± 0.06) and (0.22 ± 0.08) for German Shepherds and Labrador Retrievers, respectively. Heritability and standard errors were reported for 9 individual behavioral traits including courage, sharpness, defense drive, prey drive, nerve stability, temperament, hardness, affability, and ability to cooperate. For German Shepherds, the moderately heritable traits were courage (0.26 ± 0.06), defense drive (0.20 ± 0.06), prey drive (0.31 ± 0.07), nerve stability (0.25 ± 0.06), affability (0.37 ± 0.08), and ability to cooperate (0.28 ± 0.07), while the remaining traits were

lowly heritable ranging from (0.13 ± 0.05) to (0.15 ± 0.05) . For the Labrador Retrievers, the moderately heritable traits were courage (0.28 ± 0.09) , defense drive (0.22 ± 0.08) , hardiness (0.20 ± 0.08) , and ability to cooperate (0.35 ± 0.09) , while the remaining traits were lowly heritable ranging from (0.05 ± 0.07) to (0.17 ± 0.08) . Their results also showed that the German Shepherds bred by the SDTC had higher index values in comparison to privately bred dogs, which demonstrates the importance of a purpose driven breeding program weighted on service dog traits.

Strandberg, et al. (2005) studied genetic variation of behavioral traits on 5,956 German Shepherd Dogs to test whether there is a maternal and/or litter influence on these traits. Data were collected from the Swedish Dog Mentality Assessment. Heritability estimates from a single-trait direct animal model on 4 personality traits included: playfulness (0.26), chase-proneness (0.18), curiosity/fearlessness (0.32), and aggressiveness (0.20). Their results suggest that there is substantial genetic variation to exploit for genetic improvement, the mother has rather little influence (both genetically and environmentally), and the litter effect seems to have a larger influence than the mother on these personality traits.

Van der Waaij et al. (2006) studied genetic variation in eight behavioral traits, namely: courage, defense drive, prey drive, nerve stability, temperament, cooperation, affability, and gun shyness in German Shepherds and Labrador Retrievers. Heritability and genetic and phenotypic correlations were estimated between the traits considered in their analysis. Among the German Shepherds, moderately heritable traits were cooperation and gun shyness at (0.21 ± 0.04) and (0.30 ± 0.06) , respectively and the highly heritable trait was affability (0.91 ± 0.02) . Of the Labrador Retrievers, the moderately heritable traits included defense drive (0.24 ± 0.04) , prey drive (0.33 ± 0.05) , nerve stability (0.20 ± 0.04) , temperament (0.21 ± 0.04) , and cooperation (0.28 ± 0.05) and gun shyness was highly heritable at (0.75 ± 0.06) . They concluded that their measured traits could be improved by selection.

van der Waaij et al. (2008) estimated genetic parameters on 2,757 German Shepherd Dogs and 1,813 Labrador Retrievers of Swedish behavior test results. Sex and age had the largest influence on the 10 traits measured. Among German Shepherds, the moderately heritable traits were prey drive (0.23 ± 0.05) , affability (0.38 ± 0.06) , and gun shyness (0.22 ± 0.09) , while the rest of the traits were lowly heritable ranging from (0.14 ± 0.03) to (0.19 ± 0.04) . Among Labrador Retrievers, the moderately heritable traits included defense drive (0.21 ± 0.06) , prey

drive (0.32 ± 0.06), and cooperation (0.25 ± 0.06). The only highly heritable trait was gun shyness (0.56 ± 0.09). The rest of the traits were lowly heritable ranging from (0.03 ± 0.03) to (0.18 ± 0.05). Most of the genetic correlations were positive with the exception of some correlations with cooperation, which were negative. Their conclusions were: (1) estimating breeding values would be a good solution to incorporate into selection decisions, and (2) genetic parameters should be estimated separately by breed.

Within my study, earlier research is extended in three distinct ways to improve the depth and breadth of genetic improvement strategies. First, comprehensive data from two populations of guide dogs were used in genetic analyses to obtain comparisons both within and across samples. Second, heritability was estimated for all 101 questions and 12 subscale factors that comprise the C-BARQ across three breeds and two time-points of evaluation. Finally, we addressed the potential impact of the heritability estimates as they relate to the selection decisions of guide dog organizations.

Chapter 3 - Estimation of genetic parameters for behavioral assessment scores in Labrador Retrievers, German Shepherd Dogs, and Golden Retrievers

Introduction

To keep pace with increasingly more complex working environments where guide dogs are asked to assist their blind masters, guide dog breeding programs must constantly improve the working ability and general health of the puppies they produce. Behavior issues are the most common reasons for rejecting dogs from working as guides (Goddard and Beilharz, 1982, 1982/83). Breeder selection criteria are crucial to the production of genetic improvement in successive generations used to identify young replacements. Many research studies have focused on aspects of health in working dogs (Willis, 1995), but new studies are focusing on genetic aspects of dog behaviors in both pets and working dogs (American Kennel Club-Canine Health Foundation (AKC-CHF), 1991, 2003, 2007, 2009; Morris Animal Foundation (MAF), 2008).

A validated and widely used tool for describing aspects of behavior in dogs is the Canine Behavioral Assessment and Research Questionnaire (C-BARQ, 2012; Serpell and Hsu, 2001; Hsu and Serpell, 2003). Developed by animal behaviorists at the University of Pennsylvania, the C-BARQ was designed to provide accurate and reliable standardized evaluations of certain aspects of canine behavior. Information provided by the C-BARQ may be useful to guide dog schools by elucidating the nature of optimal behavioral traits in successful working guide dogs, and it could lead to the production of dogs that are more capable in their ability to work as guides.

The C-BARQ was validated in two separate, but similar studies (Serpell and Hsu, 2001; Hsu and Serpell, 2003) confirming that the questionnaire factors and the behavior and temperament traits they represent were stable and consistent among different populations of dogs. These authors (Serpell and Hsu, 2001) also evaluated the overall construct validity of the C-BARQ, which was deemed valid as well as capable of discriminating among dogs that succeed in training versus dogs that fail training for behavioral reasons. Complete details describing the

process used to validate the C-BARQ and assess its reliability have been reported (Serpell and Hsu, 2001, 2005; Hsu and Serpell, 2003).

While the C-BARQ has been extensively tested for reliability and validity, no comprehensive genetic analysis of the C-BARQ has yet been reported. It remains to be determined which, if any, of the 101 questions and 12 subscales that comprise the C-BARQ describe sufficient genetic variation among dogs in each population to support using these measurements to obtain genetic improvement. If heritability estimates for some components are at least 20%, then perhaps some of the questionnaire results could be incorporated into a genetic selection process by calculating estimated breeding values. This process, applied over successive generations of selection, could improve the quality of guide dogs produced by these purpose-driven breeding programs. Thus, the objectives of this research are to estimate heritability of each of the 101 questions and of 12 subscale factors and to explore breeding strategy implications based on the results obtained.

Materials and Methods

Data

Data and pedigree information for this study were obtained from C-BARQ records at two guide dog breeding organizations: Guiding Eyes for the Blind (GEB), Patterson, N.Y. and The Seeing Eye, Inc. (TSE), Morristown, N.J. Heritability is a parameter specific to the population from which the data were collected and the two populations are not genetically connected, so analyses were done separately for each organization. C-BARQ scores were available on puppies at 6- and 12-months of age by both GEB and TSE. The C-BARQ questionnaires were completed by the puppy raiser families, who as volunteer families, raise these puppies in home environments from about 7-8 weeks of age until they return to the school to begin training at 14-18 months of age.

It is the job of the puppy raiser family to nurture and care for their puppy by providing hours of patient teaching. The family also offers exposure to numerous socialization opportunities. Puppy-raisers are asked to fill out the C-BARQ online when the puppy is 6- and 12-months old. The C-BARQ is filled out by the lead training member of the household that spends the most time with the puppy. He/she is asked to rate his/her dog's typical response to a range of commonly encountered events, situations, and environmental stimuli (Serpell Hsu,

2001, 2005; Hsu and Serpell, 2003). It is the intent of the puppy-raising period to produce puppies that can be returned to the guide dog school as well-socialized young adult dogs with good house manners and social skills. Once returned to the training center, they are assigned to a guide dog instructor, who works with that dog for at least 4-5 months, until it is comfortable with all aspects of guide work. The dog is tested to determine if it responds safely and reliably to all work situations it encounters while guiding a blind-folded, sighted person.

The 101 questions that comprise the C-BARQ are grouped into 7 behavioral categories: (1) training and obedience, (2) aggression, (3) fear and anxiety, (4) separation-related behavior, (5) excitability, (6) attachment and attention-seeking, and (7) a miscellaneous category. These categories and the questions therein were designed to elicit from the evaluator a description of the dog's behavior during the 2-3 months prior to the day on which the questionnaire was answered (Serpell and Hsu, 2001, 2005; Hsu and Serpell, 2003).

C-BARQ data from GEB were collected from 2003 to 2010 on Labrador Retrievers at 6- (3,149 dogs) and 12-months of age (3,348 dogs). C-BARQ data from TSE were collected from 2002 to 2010 on 989 and 1,187 Labrador Retrievers, 608 and 692 Golden Retrievers, and 966 and 1,348 German Shepherd Dogs at 6- and 12-months of age, respectively. The pedigree datasets provided by both schools included more than 5 generations of ancestors (GEB: n = 14,584 animals, TSE: n = 15,141 animals). Ancestors in the pedigree file were born from 1957 to 2010 (GEB) and 1963 to 2010 (TSE).

Statistical Analysis

Genetic Parameters.

To determine which fixed effects should be included in the models to estimate genetic parameters, the GLM procedure (PROC GLM) in SAS was used (Release 9.2, SAS Institute Inc., Cary, NC). Fixed effects included in the model were statistically significant ($P < 0.05$). Variance components for estimation of heritability were calculated using a multiple-trait derivative-free restricted maximum likelihood (MTDFREML) procedure (Boldman et al., 1995) where the mixed linear model was defined as: $y = X\beta + Zu + e$, where y = vector of observations, X = incidence matrix relating fixed effects (β), of sex and year-season, to y , Z = incidence matrix relating random direct additive genetic effects (u) to y , and e = vector of residual error effects.

Fixed effects were sex and year-season, where seasons were defined by calendar quarter. All analyses were carried out separately for each breed and agency.

The variance structure for the models can be described as: $\text{Var}(a) = \sigma_a^2 A$, where A = additive genetic relationship matrix and $\text{Var}(e) = \sigma_e^2 I$. Narrow-sense heritability was defined as $h^2 = \sigma_a^2 / \sigma_p^2$. Maximum likelihood estimates were obtained by minimizing the variance of the logarithmic value of the likelihood function. A value of 10^{-9} was used for the convergence criterion in the iterative process. In practice, the log of the likelihood function is minimized using the estimates from a previous estimation of the model as starting values. This ensured convergence was not incorrectly obtained merely at local maximum sites.

Results

Heritability

Labrador Retrievers. Descriptive statistics of the data are presented in Table 1 (GEB) and Table 2 (TSE). Estimates of heritability and standard errors for GEB and TSE 6- and 12-month Labrador Retrievers are in Table 3.

Among GEB LR questions, the estimates of heritability (≥ 0.10) include: Question 18 "When mailmen or other delivery workers approach your home" (0.12 ± 0.03 ; 12-month) from the Aggression category, Question 59 "Barking" (0.11 ± 0.03 ; 6-month) and (0.12 ± 0.03 ; 12-month) from the Separation-related behavior category, Question 65 "When doorbell rings" (0.11 ± 0.03 ; 12-month) from the Excitability category, and from the Miscellaneous category: Question 76 "Chases birds if given the chance" (0.11 ± 0.03 ; 12-month), Question 77 "Chases squirrels, rabbits, etc. if given the chance" (0.12 ± 0.03 ; 6- and 12-month), Question 81 "Chews inappropriate objects" (0.12 ± 0.03 ; 12-month), Question 84 "Steals food" ($0.14 \pm .03$; 12-month), Question 93 "Active, energetic, always on the go" ($0.11 \pm .03$; 6-month), Question 96 "Chases own tail/hind end" ($0.11 \pm .03$; 6-month) and ($0.16 \pm .04$; 12-month), and Question 100 "Licks people or objects excessively" (0.12 ± 0.03 ; 12-month). The heritability of the remaining C-BARQ questions were all below 0.10 with 77 percent of them not significantly different from zero ($P > 0.05$). Among GEB LR subscale factors, the Chasing (0.15 ± 0.04 ; 12-month) and Pain Sensitivity (0.10 ± 0.03 ; 12-month) subscale factors were lowly heritable, while the remaining subscale factor estimates of heritability were all below 0.10 with 50 percent of them not significantly different from zero ($P > 0.05$).

TSE LR data had one moderately heritable trait from the Miscellaneous category on Question 88 "Urinating when approached, petted, handled or picked up" (0.26 ± 0.07 ; 6-month) and (0.20 ± 0.06 ; 12-month). Among 12-month responses in the Trainability category, two questions were highly heritable: Question 5 "Slow to respond to correction or punishment; thick-skinned" (0.41 ± 0.07) and Question 6 "Slow to learn new tricks or tasks" (0.67 ± 0.05). The Trainability subscale factor was also highly heritable (0.46 ± 0.07). Stranger-directed aggression (0.15 ± 0.04 ; 6-month), Pain Sensitivity (0.10 ± 0.05 ; 12-month) and Attachment/attention-seeking (0.13 ± 0.05) are the lowly (≥ 0.10 , < 0.20) heritable subscale factors. The remaining subscale factors yielded heritability estimates below 0.10 and were not significantly different from zero ($P > 0.05$). The remaining C-BARQ questions yielded heritability estimates below 0.20 with 96 percent (6-month) and 83 percent (12-month) of them not significantly different from zero ($P > 0.05$).

The Pain sensitivity subscale factor and two questions from the Miscellaneous category: Question 81 "Chews inappropriate objects" and Question 96 "Chases own tail/hind end" remained consistently lowly (≥ 0.10 , < 0.20) heritable across both GEB and TSE LR populations at 12-months. There were no other commonalities found between the two LR populations.

German Shepherd Dogs. Descriptive statistics of the data are presented in Table 4. Estimates of heritability and standard errors for TSE 6- and 12-month German Shepherd Dogs are in Table 5.

Among TSE GSD 6-month data, the estimates of heritability ranged no higher than 0.18 (Question 59 "Barking" from Separation-related behavior category and Question 80 "eats own or other animals' droppings or feces" both from the Miscellaneous category). Nonsocial Fear (0.12 ± 0.07) was the only lowly (≥ 0.10 , < 0.20) heritable subscale factor in the 6-month GSD data. All other estimates of heritability were smaller than 0.20 and 100% of the subscale factors and 94 percent of the questions were not significantly different from zero ($P > 0.05$).

Among TSE GSD 12-month data, Question 31 "Family member taking items stolen by dog" (0.39 ± 0.10) from the Aggression category was found to be moderately heritable. The highly heritable traits include: Question 5 "Slow to respond to correction or punishment; thick-skinned" (0.51 ± 0.07), Question 6 "Slow to learn new tricks or tasks" (0.59 ± 0.05) from the Trainability category, Question 51 "When stepped over by a member of the household" (0.53 ± 0.08) from the Fear and Anxiety category, and the Trainability (0.47 ± 0.07) subscale factor.

The lowly heritable subscale factors that may be worth exploring include: Stranger-directed aggression (0.18 ± 0.07), Pain Sensitivity (0.14 ± 0.06), Owner-directed aggression (0.12 ± 0.06), and Dog-directed aggression/fear (0.10 ± 0.06). All other estimates of heritability were smaller than 0.20 and 67 percent of the subscale factors and 83 percent of the questions were not significantly different from zero ($P > 0.05$).

Golden Retrievers. Descriptive statistics of the data are presented in Table 6. Estimates of heritability and standard errors for TSE 6- and 12-month Golden Retrievers are in Table 5.

Among the TSE GR 6-month data, the moderately heritable traits include: Question 51 "When stepped over by a member of the household" (0.23 ± 0.10) of the Fear and Anxiety category, and Familiar dog-directed aggression (0.27 ± 0.12) and Chasing (0.22 ± 0.10) subscale factors. All other estimates of heritability were smaller than 0.20 and 75 percent of the subscale factors and 94 percent of the questions were not significantly different from zero ($P > 0.05$).

Among TSE GR 12-month data, the moderately heritable traits include: Question 5 "Slow to respond to correction or punishment; thick-skinned" (0.30 ± 0.09) of the Trainability category, Question 38 "In response to sudden or loud noises" (0.29 ± 0.09) of the Fear and Anxiety category, and the Trainability (0.20 ± 0.08) and Nonsocial Fear (0.27 ± 0.09) subscale factors. Question 6 "Slow to learn new tricks or tasks" (0.48 ± 0.09) of the Trainability category was the only highly heritable trait. All other estimates of heritability were smaller than 0.20 and 75 percent of the subscale factors and 89 percent of the questions were not significantly different from zero ($P > 0.05$).

Discussion

When comparing variance component and heritability estimates between the two agencies (GEB vs. TSE), there were some interesting differences. It was almost uniformly the case that variance components estimated from TSE data were from 1.5 to 40 times larger than the respective components estimated from the GEB data. One possible explanation for these differences may be attributed to differing origins of their breeding colonies. Among the TSE LR population, Cole et al. (2004) reported no founders identified as most-influential ancestors, however, some males were retained in the population as sires for several generations. Those sires were without limitation on number of litters produced and were found to be the origin of

most of the lines seen in the pedigree today (Cole et al., 2004). There was also a constant increase in effective founder numbers seen in TSE LR population that had contributed to an increase in heterozygosity (Cole et al., 2004). Furthermore, since at least 1994, TSE has limited the number of litters a male can produce (8-10 litters/sire) to help maintain genetic diversity by limiting the rate of increase in inbreeding. Among the GEB LR population, it is speculated that the two main lines of origin were unrelated, however, the founders may have had a substantial degree of inbreeding. GEB's founders were rather uniform in numerous aspects of their behavior, thus this uniformity might have led to the production of descendants that are themselves more uniform than was the case in TSE's breeding colony.

A second possible explanation for the larger variance components found at TSE may lie with differing strategies used by the two agencies with respect to the size of paternal half-sib families they produced. For example, during the last 15 years covered by the data summarized in this study, GEB produced 20 half-sib families of 100 or more pups each, in contrast to TSE, which produced none. With large genetic contributions made by a few select sires at GEB, it is conceivable that this practice resulted in lower genetic variation within the GEB population.

The possibility that average levels of inbreeding differed between the two agencies was also examined as a possible explanation for the larger variance component estimates found at TSE. This inbreeding effect was not supported by the data, however, because the TSE population was found to be more inbred than the GEB population (9.9% vs. 4.5%, respectively).

The contemporary group effect in the GEB model was found to be statistically significant ($P < 0.05$) for 9/12 (6-month) and 8/12 (12-month) subscale factors and 47/101 (6-month) and 54/101 (12-month) questions.

It is possible that the traits with larger (0.38 - 0.97) environmental variances may be attributed to a low inter-rater reliability across puppy-raisers (i.e. Chasing, Excitability, Attention/attachment seeking for 6- and 12-month LR for both TSE and GEB; Chasing, Pain Sensitivity, Excitability, Attention/attachment-seeking for TSE GSD 6- and 12-month; Chasing, Excitability, and Attention/attachment-seeking for TSE GR 6- and 12-month). During the development of C-BARQ, Hsu and Serpell (2003) could not examine 4 subscale factors for validity including: (1) Chasing, (2) Pain Sensitivity, (3) Excitability, and (4) Trainability due to a lack of information on dogs with diagnosed behavior problems related to the factors. As mentioned, Chasing, Pain Sensitivity and Excitability are 3 of the 4 subscale factors that

exhibited higher environmental variances. The subscale factor Familiar dog aggression has also been added, since Hsu and Serpell (2003), to improve the reliability of some already existing factors, but thus remains to be validated. These validations are necessary before final conclusions can be drawn from the genetic parameters found within our study. The fact that the Trainability subscale factor was found to be highly heritable suggests that this factor could be considered for incorporation into the breeder selection process.

Traits with moderate to high estimates of heritability were observed predominantly at the 12-month time point across all breeds. The subscale factors with low (≤ 0.10) heritabilities include: Stranger-directed fear, Separation-related problems and Excitability across all breeds and both time points. Heritability estimates for the majority of traits did not differ significantly from zero ($P > 0.05$).

Linnamo et al. (2007) showed comparatively high heritabilities in a study based on identical C-BARQ questions of the Aggression category and the four Aggression-related subscale factors. The Familiar dog-directed aggression (0.27 ± 0.12 ; 6-month) subscale factor heritability estimate was smaller than the estimate of 0.45 presented by Liinamo et al. (2007). Among the Aggression category the lowly ($\geq 0.10, < 0.20$) heritable questions include: Question 18 "When mailmen or other delivery workers approach your home" (0.11 ± 0.07 ; 12-month), Question 29 "When barked, growled, or lunged at by another unfamiliar dog" (0.13 ± 0.08 ; 6-month and 0.16 ± 0.08 ; 12-month), and Question 34 "When approached while eating by another familiar household dog" (0.13 ± 0.08 ; 6-month) and are quite different from the estimates of 0.03 ± 0.06 , 0.23 ± 0.16 and 0.71 ± 0.39 , respectively, also presented by Liinamo et al. (2007). Among the aggression-related subscale factors, the Stranger-directed aggression (0.00 ± 0.05 ; 6-month and 0.04 ± 0.05 ; 12-month), Owner-directed aggression (0.10 ± 0.07 ; 6-month and 0.00 ± 0.03 ; 12-month) and Dog-directed aggression (0.02 ± 0.07 ; 6-month and 0.18 ± 0.09 ; 12-month) heritability estimates were substantially smaller at both time points than the estimates of 0.87, 0.82 and 0.43, respectively, presented by Liinamo et al. (2007). Unfortunately, Liinamo et al. (2007) were unable to obtain standard errors for the highly heritable estimates of the C-BARQ factors and thus their precision is unknown. Differences between this study and that of Liinamo et al. (2007) may be largely due to our consideration of a closed colony of GR guide dogs that have been selected away from aggression for many years, whereas Liinamo et al. (2007) considered a population of Dutch Golden Retrievers that were recruited to the project for

exhibiting aggressive behavior or being related to an aggressive dog, having a small data set (115-264 observations), and did not include any fixed effects in addition to the general mean. Willis (1995) states that there is a tendency to find similar results for the same trait in different populations although it is not necessarily applicable to all populations due to their genetic diversity.

Goddard and Beilharz (1984a, 1984b, 1986) suggest that genetic selection against fearfulness would be more accurate if carried out in adult dogs rather than in young dogs. This finding confirms the concept that development of canine behavior passes through critical periods (Scott and Fuller, 1965), so accurate selection of replacement breeders needs to be based on observations made after closing of the fearfulness critical period. Willson and Sundgren (1997a) reported that the effect of age is insignificant within the age interval of 15-20 months. The purpose of the 6-month time point was to allow the pups to develop, but without long exposure to the environment to mask the underlying genetic control. Overall, C-BARQ heritability estimates exhibited substantial variation between the two age points and should be considered as an area in need of future research.

Goddard and Beilharz (1982) conducted a genetic analysis of guide dog behaviors in 929 LR and 102 dogs of other breeds (mostly GR) and found the heritability and standard error of Excitability (0.09 ± 0.08) not significantly different from zero, which is similar to our finding of the C-BARQ Excitability subscale factor (0.01 ± 0.04 to 0.08 ± 0.05 ; across LR, GR, and both time points). It should be pointed out that the "Excitability" trait in the study of Goddard and Beilharz (1982) is defined as "high activity" whereas the C-BARQ Excitability trait is a factor extracted from 6 questions (63-68) related to a tendency to react strongly to potentially exciting or arousing events, such as going for walks or car trips, door bells, arrival of visitors, and the owner arriving home. With regards to this, there is a great need to develop a common language in describing temperament traits of the canine to allow for future comparisons (Goodloe and Borchelt, 1998).

Conclusion

Heritability estimates of the C-BARQ questions and subscales obtained in the present study suggest that there is substantial genetic variation that could be used in selecting against

Familiar dog-directed aggression of TSE GR at 6-months, Chasing of TSE GR at 6-months, and Nonsocial fear of TSE GR at 12-months or in selection for improved Trainability of TSE LR, GSD, and GR at 12-months. However, validation of the Familiar dog-directed aggression, Chasing, Trainability, and Pain Sensitivity subscale factors should be done before these subscale factor EBVs are added as an information source in the breeder selection process. Heritability values obtained from the current study can be used as a guideline to approximate the outcome of various selection decisions (Willis, 1995). Furthermore, some of the subscale factors identified as being moderate or highly heritable might also prove useful for predicting which puppies may be at risk of failing from the guide dog program.

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Chapter 4 - Tables

Table 1. Number of observations (N), mean, and standard deviation (SD) of the traits considered in the Guiding Eyes for the Blind (GEB) Labrador Retriever (LR) analysis.

Variable	GEB LR 6-Month			GEB LR 12-Month		
	N	Mean	SD	N	Mean	SD
Stranger-directed aggression	2505	0.04	0.14	2896	0.07	0.18
Owner-directed aggression	2763	0.06	0.17	3070	0.04	0.12
Dog-directed aggression/fear	2031	0.21	0.30	2509	0.22	0.33
Familiar dog-directed aggression	2063	0.13	0.30	2323	0.11	0.29
Trainability	2886	2.42	0.29	3165	2.48	0.28
Chasing	1975	1.23	0.87	2531	1.22	0.90
Stranger-directed fear	3049	0.04	0.18	3283	0.05	0.20
Nonsocial fear	2296	0.40	0.41	2960	0.36	0.40
Separation-related problems	2954	0.30	0.33	3187	0.25	0.31
Pain Sensitivity	2521	0.43	0.52	2816	0.45	0.53
Excitability	2644	1.24	0.68	2945	1.40	0.74
Attachment/attention-seeking	2756	1.64	0.68	3069	1.76	0.71
Section 1: Training and obedience						
1	3069	2.75	0.72	3295	2.85	0.69
2	3142	3.21	0.58	3343	3.33	0.58
3	3103	2.80	0.73	3329	3.06	0.68
4	3144	2.94	0.69	3336	3.08	0.66
5	3034	1.34	0.95	3276	1.29	0.96
6	3120	0.92	0.83	3312	0.89	0.81
7	3145	2.26	0.80	3336	2.16	0.83
8	3121	3.09	0.86	3314	3.18	0.86
Section 2: Aggression						
9	3075	0.16	0.51	3299	0.07	0.31
10	3138	0.03	0.20	3328	0.04	0.21
11	3099	0.02	0.18	3307	0.02	0.16
12	2897	0.04	0.21	3192	0.06	0.28
13	3139	0.09	0.35	3331	0.06	0.29
14	3075	0.09	0.34	3294	0.05	0.26
15	3118	0.04	0.23	3319	0.06	0.29
16	3113	0.03	0.22	3312	0.04	0.23
17	3128	0.02	0.18	3335	0.01	0.16
18	2928	0.07	0.31	3238	0.13	0.39

Variable	GEB LR 6-Month			GEB LR 12-Month		
	N	Mean	SD	N	Mean	SD
19	2988	0.03	0.21	3243	0.02	0.19
20	2944	0.09	0.33	3212	0.16	0.43
21	3131	0.03	0.21	3330	0.02	0.15
22	2823	0.08	0.30	3117	0.12	0.37
23	2978	0.12	0.40	3257	0.16	0.45
24	2972	0.11	0.38	3253	0.14	0.42
25	3074	0.08	0.33	3307	0.05	0.27
26	2632	0.12	0.40	3018	0.13	0.40
27	2966	0.23	0.52	3236	0.29	0.59
28	3124	0.04	0.23	3326	0.05	0.25
29	2667	0.32	0.63	3010	0.34	0.66
30	3117	0.01	0.13	3330	0.01	0.08
31	3077	0.07	0.32	3269	0.04	0.23
32	2313	0.28	0.63	2519	0.19	0.52
33	2270	0.04	0.23	2512	0.04	0.24
34	2125	0.06	0.30	2380	0.08	0.34
35	2295	0.17	0.46	2505	0.15	0.45
Section 3: Fear & Anxiety						
36	3118	0.06	0.28	3318	0.08	0.31
37	3073	0.04	0.22	3300	0.04	0.23
38	3138	0.69	0.77	3334	0.66	0.80
39	3124	0.03	0.19	3326	0.04	0.22
40	3141	0.04	0.23	3334	0.05	0.26
41	2796	0.52	0.72	3163	0.37	0.63
42	3110	0.35	0.58	3321	0.32	0.57
43	2801	0.28	0.59	3046	0.36	0.67
44	2583	0.21	0.52	3166	0.21	0.53
45	3071	0.24	0.55	3270	0.23	0.54
46	3036	0.11	0.37	3268	0.13	0.41
47	3108	0.47	0.67	3299	0.45	0.67
48	3098	0.25	0.53	3306	0.24	0.52
49	2875	0.89	1.08	3122	0.89	1.07
50	3035	0.38	0.70	3266	0.41	0.73
51	3114	0.04	0.23	3326	0.05	0.23
52	3068	0.18	0.50	3305	0.18	0.48
53	2537	0.09	0.34	2934	0.09	0.33
54	2652	0.66	0.86	2960	0.59	0.81
Section 4: Separation-related behavior						
55	3111	0.03	0.21	3291	0.03	0.22

Variable	GEB LR 6-Month			GEB LR 12-Month		
	N	Mean	SD	N	Mean	SD
56	3102	0.06	0.30	3287	0.08	0.35
57	3113	0.22	0.57	3294	0.25	0.61
58	3126	0.89	0.93	3303	0.66	0.87
59	3130	0.83	0.91	3311	0.59	0.84
60	3093	0.15	0.50	3292	0.07	0.34
61	3041	0.33	0.70	3269	0.33	0.72
62	3099	0.02	0.15	3283	0.03	0.20
Section 5: Excitability						
63	3141	1.58	0.99	3326	1.67	1.00
64	3139	1.69	0.92	3336	1.64	0.94
65	2677	0.84	0.91	2989	1.12	1.00
66	3133	0.92	0.88	3333	1.12	0.96
67	3099	0.73	0.86	3311	0.95	0.95
68	3115	1.75	1.07	3309	1.87	1.08
Section 6: Attachment & Attention-seeking						
69	3050	1.96	1.20	3257	2.09	1.22
70	3092	2.53	1.00	3324	2.61	0.99
71	3129	2.48	0.95	3329	2.58	0.96
72	3138	1.51	1.11	3332	1.69	1.09
73	3059	0.47	0.83	3283	0.58	0.91
74	2928	0.97	1.07	3190	1.09	1.14
Section 7: Miscellaneous						
75	2301	1.83	1.27	2768	1.69	1.24
76	2707	1.32	1.19	3068	1.31	1.20
77	2611	1.53	1.23	3004	1.59	1.25
78	2541	0.70	0.97	2898	0.75	0.97
79	2870	0.17	0.53	3162	0.23	0.61
80	3034	0.56	0.96	3274	0.64	1.00
81	3134	1.50	1.04	3326	1.17	1.02
82	3082	0.59	0.89	3304	0.46	0.80
83	3123	0.58	0.85	3321	0.59	0.84
84	3056	0.54	0.87	3284	0.52	0.85
85	3129	0.46	0.76	3326	0.32	0.69
86	3137	1.35	0.99	3327	1.22	0.97
87	3123	0.04	0.25	3318	0.04	0.24
88	3137	0.03	0.22	3324	0.02	0.17
89	3126	0.11	0.38	3324	0.04	0.23
90	3123	0.07	0.31	3317	0.03	0.21
91	3135	0.62	0.82	3332	0.56	0.82

Variable	GEB LR 6-Month			GEB LR 12-Month		
	N	Mean	SD	N	Mean	SD
92	3133	2.28	0.92	3322	2.09	0.96
93	3133	2.08	1.02	3322	2.02	1.03
94	3003	0.24	0.57	3251	0.25	0.58
95	2975	0.16	0.53	3236	0.16	0.52
96	3108	1.03	0.94	3314	0.79	0.90
97	2903	0.41	0.74	3176	0.32	0.68
98	3129	0.51	0.80	3319	0.41	0.74
99	3129	0.32	0.62	3324	0.37	0.65
100	3131	0.73	0.97	3319	0.62	0.92
101	2864	0.14	0.53	3041	0.17	0.60

Table 2. Number of observations (N), mean, and standard deviation (SD) of the traits considered in the TSE Seeing Eye, Inc. (TSE) Labrador Retriever (LR) analysis.

Trait	TSE LR 6-Month			TSE LR 12-Month		
	N	Mean	SD	N	Mean	SD
Stranger-directed aggression	743	0.05	0.22	1037	0.06	0.20
Owner-directed aggression	844	0.10	0.22	1048	0.08	0.19
Dog-directed aggression/fear	481	0.22	0.33	764	0.26	0.41
Familiar dog-directed aggression	621	0.16	0.34	820	0.13	0.32
Trainability	940	2.73	0.45	1125	2.78	0.45
Chasing	513	0.99	0.83	835	0.96	0.88
Stranger-directed fear	977	0.04	0.17	1171	0.05	0.22
Nonsocial fear	624	0.36	0.41	1003	0.30	0.39
Separation-related problems	890	0.36	0.35	1122	0.32	0.35
Pain Sensitivity	744	0.34	0.45	997	0.42	0.54
Excitability	799	1.58	0.78	1029	1.74	0.79
Attachment/attention-seeking	840	1.58	0.69	1086	1.75	0.71
Section 1: Training and obedience						
1	971	2.67	0.77	1171	2.73	0.83
2	988	3.20	0.63	1183	3.34	0.58
3	984	2.75	0.80	1177	3.01	0.70
4	988	2.98	0.76	1182	3.17	0.70
5	986	2.61	1.03	1180	2.38	1.18
6	984	2.85	0.81	1168	2.55	1.17
7	989	1.82	0.87	1186	1.99	0.85
8	972	2.98	0.94	1175	3.02	0.99
Section 2: Aggression						
9	985	0.29	0.68	1180	0.15	0.47
10	986	0.06	0.35	1186	0.05	0.30
11	980	0.07	0.36	1181	0.04	0.27
12	908	0.04	0.25	1147	0.05	0.29
13	986	0.11	0.41	1186	0.10	0.38
14	971	0.16	0.47	1170	0.14	0.49
15	978	0.05	0.28	1183	0.05	0.28
16	970	0.04	0.27	1182	0.05	0.28
17	976	0.02	0.19	1180	0.02	0.14
18	903	0.06	0.26	1139	0.10	0.35
19	894	0.06	0.31	1106	0.03	0.21
20	937	0.08	0.31	1151	0.16	0.45
21	985	0.06	0.33	1186	0.04	0.26
22	873	0.07	0.30	1108	0.13	0.41

Trait	TSE LR 6-Month			TSE LR 12-Month		
	N	Mean	SD	N	Mean	SD
23	896	0.15	0.49	1139	0.25	0.62
24	888	0.12	0.45	1134	0.19	0.56
25	964	0.12	0.42	1176	0.09	0.35
26	768	0.15	0.49	1012	0.17	0.49
27	907	0.33	0.66	1143	0.34	0.69
28	980	0.07	0.32	1184	0.07	0.32
29	736	0.27	0.63	988	0.42	0.77
30	978	0.02	0.17	1179	0.01	0.10
31	970	0.16	0.52	1154	0.13	0.45
32	695	0.35	0.71	869	0.27	0.64
33	688	0.06	0.31	878	0.04	0.24
34	634	0.09	0.39	838	0.07	0.34
35	694	0.20	0.55	879	0.17	0.47
Section 3: Fear & Anxiety						
36	983	0.04	0.24	1176	0.07	0.31
37	980	0.04	0.24	1178	0.04	0.28
38	984	0.74	0.90	1186	0.63	0.88
39	986	0.03	0.19	1186	0.03	0.22
40	989	0.04	0.20	1186	0.05	0.27
41	759	0.42	0.73	1061	0.26	0.57
42	963	0.19	0.46	1178	0.20	0.48
43	984	0.23	0.52	1175	0.33	0.66
44	816	0.26	0.61	1123	0.21	0.57
45	953	0.24	0.56	1174	0.26	0.61
46	931	0.11	0.37	1165	0.16	0.50
47	985	0.48	0.74	1182	0.40	0.70
48	948	0.13	0.39	1170	0.14	0.40
49	772	0.68	0.92	1024	0.76	1.06
50	964	0.41	0.71	1165	0.50	0.85
51	984	0.03	0.17	1176	0.04	0.23
52	961	0.10	0.38	1169	0.13	0.44
53	721	0.09	0.37	981	0.11	0.41
54	705	0.67	0.92	1008	0.55	0.83
Section 4: Separation-related behavior						
55	967	0.05	0.25	1171	0.05	0.28
56	961	0.07	0.33	1168	0.08	0.38
57	970	0.25	0.59	1168	0.30	0.68
58	979	1.11	0.99	1181	0.95	1.00
59	977	0.74	0.90	1179	0.55	0.81

Trait	TSE LR 6-Month			TSE LR 12-Month		
	N	Mean	SD	N	Mean	SD
60	970	0.15	0.50	1168	0.13	0.43
61	943	0.58	0.91	1160	0.48	0.84
62	955	0.07	0.36	1160	0.12	0.45
Section 5: Excitability						
63	986	1.94	1.05	1185	1.94	1.02
64	986	2.10	1.03	1186	2.02	1.00
65	806	1.08	1.07	1036	1.33	1.11
66	986	1.25	1.02	1187	1.52	1.06
67	988	1.05	1.00	1184	1.36	1.06
68	987	2.16	1.11	1183	2.28	1.07
Section 6: Attachment & Attention-seeking						
69	978	1.73	1.25	1175	1.85	1.27
70	968	2.36	1.07	1174	2.49	1.05
71	986	2.51	1.01	1186	2.60	0.98
72	987	1.57	1.11	1186	1.70	1.08
73	940	0.41	0.80	1165	0.59	0.94
74	890	1.07	1.14	1115	1.26	1.21
Section 7: Miscellaneous						
75	663	1.68	1.26	935	1.47	1.27
76	792	0.90	1.07	1064	0.91	1.11
77	773	1.22	1.16	1065	1.22	1.21
78	803	0.90	1.05	1027	0.91	1.12
79	854	0.13	0.48	1088	0.11	0.42
80	934	0.66	1.01	1153	0.70	1.06
81	981	1.86	1.04	1181	1.56	1.08
82	943	0.60	0.88	1169	0.57	0.90
83	982	0.75	0.95	1177	0.71	0.92
84	947	0.73	0.99	1169	0.71	0.95
85	985	0.47	0.84	1181	0.31	0.68
86	988	1.69	1.02	1186	1.59	1.03
87	973	0.06	0.33	1176	0.06	0.33
88	981	0.29	0.66	1183	0.13	0.42
89	977	0.23	0.58	1182	0.06	0.31
90	978	0.13	0.43	1176	0.05	0.26
91	988	0.82	0.88	1184	0.78	0.90
92	988	2.60	0.89	1185	2.46	0.93
93	988	2.44	0.96	1185	2.41	1.00
94	871	0.25	0.56	1121	0.25	0.57
95	862	0.16	0.52	1121	0.17	0.56

Trait	TSE LR 6-Month			TSE LR 12-Month		
	N	Mean	SD	N	Mean	SD
96	963	1.01	0.97	1169	0.70	0.88
97	798	0.43	0.79	1056	0.32	0.71
98	969	0.50	0.81	1180	0.44	0.79
99	972	0.40	0.71	1176	0.48	0.77
100	980	0.87	1.01	1183	0.78	0.97
101	873	0.27	0.71	1065	0.28	0.75

Table 3. Heritability (h²) and standard errors (SE) of the traits considered in the analysis for Guiding Eyes for the Blind (GEB) and The Seeing Eye, Inc. (TSE) Labrador Retrievers (LR) at 6- and 12-months of age.

Trait	GEB LR 6-Month		GEB LR 12-Month		TSE LR 6-Month		TSE LR 12-Month		
	h ²	SE	h ²	SE	h ²	SE	h ²	SE	
Stranger-directed aggression	0.01	0.02	0.09	0.03	0.13	0.07	0.09	0.05	
Owner-directed aggression	0.05	0.02	0.03	0.02	0.07	0.04	0.08	0.05	
Dog-directed aggression/fear	0.05	0.03	0.00	0.02	0.05	0.06	0.03	0.04	
Familiar dog-directed aggression	0.02	0.02	0.01	0.02	0.00	0.04	0.05	0.04	
Trainability	0.01	0.02	0.01	0.01	0.09	0.05	0.46	0.07	
Chasing	0.09	0.04	0.15	0.04	0.04	0.06	0.07	0.04	
Stranger-directed fear	0.04	0.02	0.01	0.01	0.00	0.03	0.02	0.02	
Nonsocial fear	0.06	0.03	0.08	0.03	0.01	0.03	0.07	0.04	
Separation-related problems	0.09	0.03	0.06	0.02	0.06	0.04	0.08	0.04	
Pain Sensitivity	0.03	0.02	0.10	0.03	0.07	0.05	0.10	0.05	
Excitability	0.02	0.02	0.05	0.02	0.04	0.04	0.08	0.05	
Attachment/attention-seeking	0.03	0.02	0.07	0.03	0.03	0.03	0.13	0.05	
Section 1: Training and obedience									
1	0.05	0.02	0.06	0.03	0.07	0.04	0.08	0.04	
2	0.01	0.02	0.01	0.01	0.11	0.05	0.09	0.04	
3	0.00	0.01	0.01	0.01	0.01	0.03	0.08	0.04	
4	0.04	0.02	0.01	0.01	0.07	0.04	0.09	0.04	

	GEB LR 6-Month			GEB LR 12-Month			TSE LR 6-Month			TSE LR 12-Month	
Trait	h ²	SE		h ²	SE		h ²	SE		h ²	SE
5	0.05	0.02		0.01	0.01		0.02	0.03		0.41	0.07
6	0.00	0.01		0.01	0.01		0.01	0.03		0.67	0.05
7	0.05	0.02		0.01	0.01		0.03	0.03		0.04	0.03
8	0.04	0.02		0.01	0.01		0.03	0.03		0.04	0.03
Section 2: Aggression											
9	0.04	0.02		0.01	0.01		0.03	0.03		0.00	0.02
10	0.00	0.01		0.00	0.01		0.07	0.04		0.04	0.03
11	0.00	0.01		0.00	0.02		0.06	0.04		0.04	0.03
12	0.01	0.01		0.03	0.02		0.04	0.04		0.00	0.02
13	0.02	0.02		0.00	0.01		0.03	0.03		0.00	0.02
14	0.03	0.02		0.02	0.01		0.06	0.04		0.04	0.03
15	0.00	0.01		0.03	0.02		0.06	0.04		0.03	0.03
16	0.01	0.01		0.02	0.02		0.07	0.05		0.02	0.03
17	0.03	0.02		0.07	0.03		0.00	0.02		0.01	0.02
18	0.01	0.01		0.12	0.03		0.03	0.03		0.06	0.04
19	0.01	0.02		0.01	0.02		0.00	0.03		0.04	0.03
20	0.05	0.02		0.08	0.03		0.10	0.05		0.01	0.02
21	0.03	0.02		0.00	0.01		0.05	0.04		0.06	0.03
22	0.03	0.02		0.06	0.03		0.10	0.05		0.04	0.04
23	0.03	0.02		0.02	0.02		0.00	0.02		0.05	0.04

Trait	GEB LR 6-Month		GEB LR 12-Month		TSE LR 6-Month		TSE LR 12-Month		
	h ²	SE	h ²	SE	h ²	SE	h ²	SE	
24	0.00	0.01	0.01	0.01	0.10	0.05	0.05	0.03	
25	0.02	0.02	0.01	0.01	0.01	0.02	0.00	0.02	
26	0.00	0.02	0.00	0.01	0.00	0.03	0.01	0.03	
27	0.00	0.01	0.04	0.02	0.03	0.03	0.01	0.02	
28	0.00	0.01	0.01	0.01	0.01	0.03	0.05	0.03	
29	0.00	0.02	0.00	0.01	0.01	0.03	0.04	0.04	
30	0.01	0.02	0.01	0.01	0.00	0.02	0.05	0.03	
31	0.07	0.03	0.02	0.02	0.06	0.04	0.02	0.02	
32	0.05	0.03	0.00	0.02	0.00	0.03	0.04	0.04	
33	0.00	0.02	0.02	0.02	0.02	0.03	0.00	0.02	
34	0.02	0.02	0.02	0.02	0.04	0.04	0.00	0.03	
35	0.00	0.02	0.00	0.01	0.01	0.03	0.01	0.03	
Section 3: Fear & Anxiety									
36	0.02	0.02	0.01	0.01	0.00	0.02	0.01	0.02	
37	0.02	0.02	0.01	0.01	0.00	0.03	0.02	0.02	
38	0.06	0.02	0.07	0.02	0.04	0.03	0.16	0.06	
39	0.03	0.02	0.00	0.01	0.00	0.02	0.02	0.02	
40	0.03	0.02	0.00	0.01	0.00	0.02	0.03	0.03	
41	0.03	0.02	0.04	0.02	0.04	0.04	0.00	0.02	
42	0.04	0.02	0.01	0.01	0.00	0.02	0.03	0.03	

Trait	GEB LR 6-Month		GEB LR 12-Month		TSE LR 6-Month		TSE LR 12-Month	
	h ²	SE	h ²	SE	h ²	SE	h ²	SE
43	0.04	0.02	0.04	0.02	0.03	0.03	0.07	0.04
44	0.04	0.02	0.03	0.02	0.00	0.03	0.00	0.02
45	0.05	0.02	0.01	0.01	0.03	0.03	0.04	0.03
46	0.02	0.02	0.00	0.01	0.03	0.03	0.03	0.03
47	0.02	0.02	0.03	0.02	0.03	0.03	0.06	0.03
48	0.04	0.02	0.03	0.02	0.00	0.03	0.00	0.02
49	0.02	0.02	0.06	0.02	0.02	0.03	0.03	0.03
50	0.00	0.01	0.04	0.02	0.04	0.04	0.06	0.04
51	0.02	0.02	0.00	0.01	0.01	0.03	0.12	0.06
52	0.01	0.02	0.08	0.03	0.00	0.02	0.01	0.02
53	0.04	0.03	0.00	0.01	0.03	0.04	0.03	0.03
54	0.05	0.02	0.01	0.01	0.02	0.04	0.06	0.04
Section 4: Separation-related behavior								
55	0.03	0.02	0.00	0.01	0.00	0.02	0.00	0.02
56	0.00	0.01	0.01	0.01	0.04	0.03	0.00	0.02
57	0.01	0.01	0.01	0.01	0.00	0.02	0.02	0.03
58	0.08	0.02	0.08	0.02	0.05	0.03	0.13	0.05
59	0.11	0.03	0.12	0.03	0.09	0.05	0.06	0.04
60	0.04	0.02	0.02	0.02	0.03	0.03	0.03	0.02
61	0.03	0.02	0.02	0.02	0.05	0.04	0.04	0.03

Trait	GEB LR 6-Month		GEB LR 12-Month		TSE LR 6-Month		TSE LR 12-Month		
	h ²	SE	h ²	SE	h ²	SE	h ²	SE	
62	0.01	0.01	0.01	0.01	0.00	0.02	0.04	0.03	
Section 5: Excitability									
63	0.03	0.02	0.05	0.02	0.10	0.05	0.10	0.05	
64	0.03	0.02	0.00	0.01	0.07	0.04	0.05	0.03	
65	0.04	0.02	0.11	0.03	0.00	0.03	0.07	0.04	
66	0.01	0.01	0.05	0.02	0.02	0.03	0.10	0.04	
67	0.02	0.02	0.06	0.02	0.07	0.04	0.09	0.04	
68	0.04	0.02	0.05	0.02	0.09	0.05	0.07	0.04	
Section 6: Attachment & Attention-seeking									
69	0.03	0.02	0.04	0.02	0.03	0.03	0.03	0.03	
70	0.07	0.02	0.07	0.03	0.01	0.02	0.02	0.03	
71	0.03	0.02	0.04	0.02	0.02	0.03	0.10	0.05	
72	0.02	0.02	0.04	0.02	0.01	0.02	0.10	0.05	
73	0.04	0.02	0.06	0.02	0.04	0.03	0.09	0.04	
74	0.04	0.02	0.07	0.03	0.00	0.03	0.01	0.02	
Section 7: Miscellaneous									
75	0.08	0.03	0.08	0.03	0.00	0.04	0.04	0.03	
76	0.08	0.03	0.11	0.03	0.03	0.04	0.07	0.04	
77	0.12	0.04	0.12	0.03	0.07	0.05	0.07	0.04	
78	0.04	0.02	0.06	0.02	0.04	0.04	0.05	0.04	

Trait	GEB LR 6-Month		GEB LR 12-Month		TSE LR 6-Month		TSE LR 12-Month	
	h ²	SE	h ²	SE	h ²	SE	h ²	SE
79	0.03	0.02	0.07	0.03	0.08	0.04	0.02	0.03
80	0.04	0.02	0.00	0.01	0.08	0.05	0.04	0.03
81	0.06	0.02	0.12	0.03	0.02	0.03	0.10	0.04
82	0.06	0.02	0.03	0.02	0.02	0.03	0.03	0.03
83	0.03	0.02	0.06	0.02	0.02	0.03	0.00	0.02
84	0.08	0.03	0.14	0.03	0.04	0.03	0.05	0.04
85	0.09	0.03	0.09	0.03	0.18	0.06	0.13	0.05
86	0.07	0.02	0.07	0.02	0.07	0.04	0.16	0.06
87	0.00	0.01	0.00	0.01	0.06	0.04	0.00	0.02
88	0.03	0.02	0.00	0.01	0.26	0.07	0.20	0.06
89	0.01	0.01	0.03	0.02	0.02	0.03	0.00	0.02
90	0.02	0.02	0.00	0.01	0.04	0.03	0.01	0.02
91	0.05	0.02	0.04	0.02	0.09	0.05	0.06	0.04
92	0.04	0.02	0.03	0.02	0.00	0.02	0.07	0.04
93	0.11	0.03	0.08	0.03	0.00	0.03	0.05	0.03
94	0.00	0.01	0.00	0.01	0.02	0.03	0.01	0.02
95	0.00	0.01	0.02	0.02	0.00	0.03	0.04	0.03
96	0.11	0.03	0.16	0.04	0.01	0.02	0.11	0.05
97	0.03	0.02	0.01	0.01	0.00	0.03	0.16	0.06
98	0.04	0.02	0.05	0.02	0.12	0.05	0.17	0.06

Trait	GEB LR 6-Month		GEB LR 12-Month		TSE LR 6-Month		TSE LR 12-Month	
	h^2	SE	h^2	SE	h^2	SE	h^2	SE
99	0.00	0.01	0.00	0.01	0.00	0.03	0.03	0.03
100	0.09	0.03	0.12	0.03	0.02	0.03	0.08	0.04
101	0.00	0.02	0.00	0.01	0.00	0.03	0.00	0.02

Table 4. Number of observations (N), mean, and standard deviation (SD) of the traits considered in the The Seeing Eye, Inc. (TSE) German Shepherd Dog (GSD) analysis.

Trait	TSE GSD 6-Month			TSE GSD 12-Month		
	N	Mean	SD	N	Mean	SD
Stranger-directed aggression	708	0.16	0.30	917	0.24	0.36
Owner-directed aggression	849	0.10	0.21	1018	0.07	0.18
Dog-directed aggression/fear	456	0.35	0.43	671	0.44	0.52
Familiar dog-directed aggression	674	0.28	0.47	815	0.38	0.57
Trainability	909	2.79	0.44	1069	2.84	0.48
Chasing	546	1.40	0.98	810	1.39	0.96
Stranger-directed fear	946	0.06	0.22	1090	0.09	0.27
Nonsocial fear	634	0.42	0.43	964	0.39	0.42
Separation-related problems	856	0.47	0.41	994	0.49	0.46
Pain Sensitivity	762	0.64	0.65	939	0.68	0.69
Excitability	818	1.64	0.74	1006	1.86	0.77
Attachment/attention-seeking	879	1.65	0.69	1042	1.86	0.70
Section 1: Training and obedience						
1	956	2.70	0.81	1096	2.86	0.82
2	964	3.17	0.63	1110	3.26	0.59
3	953	2.62	0.79	1108	2.88	0.73
4	963	3.10	0.77	1111	3.27	0.71
5	959	2.76	1.01	1108	2.55	1.22
6	958	3.06	0.80	1102	2.70	1.21
7	963	1.96	0.86	1109	2.12	0.85
8	942	2.91	1.02	1099	3.05	1.06
Section 2: Aggression						
9	960	0.20	0.57	1100	0.10	0.40
10	959	0.11	0.38	1104	0.13	0.41
11	957	0.08	0.31	1099	0.08	0.36
12	863	0.19	0.52	1073	0.33	0.67
13	964	0.11	0.37	1107	0.09	0.35
14	930	0.26	0.60	1090	0.20	0.55
15	946	0.15	0.44	1105	0.22	0.56
16	951	0.11	0.38	1100	0.13	0.41
17	961	0.03	0.21	1105	0.03	0.22
18	882	0.27	0.56	1067	0.47	0.70
19	928	0.06	0.29	1087	0.03	0.21
20	896	0.33	0.61	1044	0.51	0.72

Trait	TSE GSD 6-Month			TSE GSD 12-Month		
	N	Mean	SD	N	Mean	SD
21	960	0.06	0.31	1106	0.05	0.25
22	832	0.30	0.61	996	0.42	0.69
23	862	0.37	0.69	1062	0.55	0.84
24	871	0.32	0.64	1059	0.46	0.80
25	945	0.05	0.27	1099	0.04	0.24
26	713	0.27	0.60	903	0.37	0.72
27	907	0.50	0.79	1079	0.67	0.91
28	957	0.11	0.39	1107	0.17	0.47
29	728	0.61	0.88	902	0.80	1.00
30	950	0.02	0.19	1099	0.01	0.11
31	944	0.09	0.39	1086	0.08	0.36
32	732	0.47	0.82	854	0.48	0.82
33	728	0.11	0.42	858	0.20	0.60
34	693	0.27	0.65	828	0.40	0.77
35	735	0.31	0.63	859	0.45	0.77
Section 3: Fear & Anxiety						
36	955	0.09	0.36	1098	0.10	0.39
37	953	0.05	0.26	1097	0.08	0.35
38	960	0.75	0.88	1109	0.67	0.89
39	960	0.05	0.26	1107	0.11	0.38
40	961	0.05	0.26	1108	0.08	0.33
41	790	0.53	0.79	1018	0.38	0.70
42	942	0.35	0.61	1100	0.33	0.60
43	950	0.53	0.78	1094	0.64	0.89
44	773	0.23	0.61	1072	0.20	0.55
45	938	0.38	0.75	1097	0.32	0.63
46	920	0.23	0.62	1089	0.21	0.54
47	957	0.67	0.79	1102	0.60	0.79
48	926	0.19	0.46	1093	0.20	0.50
49	800	1.04	1.15	975	1.04	1.18
50	926	0.78	1.03	1077	0.78	1.03
51	952	0.04	0.26	1099	0.08	0.36
52	934	0.23	0.60	1086	0.25	0.62
53	695	0.14	0.47	897	0.21	0.57
54	733	0.82	1.00	910	0.74	0.93
Section 4: Separation-related behavior						
55	940	0.06	0.30	1080	0.07	0.32
56	933	0.07	0.35	1079	0.07	0.33
57	951	0.42	0.78	1085	0.60	0.95

Trait	TSE GSD 6-Month			TSE GSD 12-Month		
	N	Mean	SD	N	Mean	SD
58	958	1.41	1.10	1098	1.27	1.15
59	957	1.07	1.01	1096	1.00	1.00
60	942	0.22	0.61	1081	0.23	0.63
61	925	0.53	0.84	1066	0.48	0.84
62	913	0.15	0.51	1054	0.40	0.78
Section 5: Excitability						
63	963	2.25	1.05	1108	2.36	1.04
64	959	1.89	1.00	1107	1.81	0.99
65	826	1.36	1.09	1010	1.72	1.15
66	957	1.33	1.09	1107	1.66	1.12
67	957	0.98	0.99	1108	1.43	1.15
68	960	1.98	1.07	1106	2.14	1.09
Section 6: Attachment & Attention-seeking						
69	951	2.10	1.24	1097	2.42	1.22
70	952	2.52	1.05	1104	2.68	1.00
71	960	2.21	1.04	1109	2.37	1.05
72	961	1.34	1.05	1108	1.65	1.11
73	936	0.51	0.89	1088	0.70	1.05
74	908	1.27	1.19	1073	1.37	1.21
Section 7: Miscellaneous						
75	680	2.04	1.33	898	2.00	1.34
76	834	1.29	1.23	1008	1.23	1.20
77	783	1.60	1.25	990	1.72	1.27
78	789	0.85	1.02	993	0.90	1.01
79	851	0.19	0.54	1026	0.17	0.49
80	938	1.29	1.18	1087	1.17	1.12
81	957	1.49	0.93	1104	1.12	0.90
82	935	0.49	0.82	1077	0.38	0.71
83	955	0.48	0.78	1104	0.50	0.74
84	932	0.79	0.96	1087	0.69	0.89
85	958	0.47	0.77	1102	0.37	0.74
86	960	1.52	1.00	1106	1.45	1.01
87	956	0.04	0.23	1100	0.02	0.19
88	958	0.13	0.46	1103	0.02	0.15
89	953	0.28	0.65	1100	0.10	0.41
90	950	0.18	0.53	1097	0.10	0.38
91	956	0.70	0.85	1104	0.70	0.88
92	960	2.39	0.91	1106	2.21	0.94
93	959	2.23	1.00	1108	2.25	1.03

Trait	TSE GSD 6-Month			TSE GSD 12-Month		
	N	Mean	SD	N	Mean	SD
94	888	0.26	0.58	1040	0.26	0.61
95	880	0.20	0.61	1044	0.20	0.58
96	946	0.93	0.98	1086	0.63	0.89
97	785	0.42	0.78	987	0.33	0.73
98	951	0.74	0.92	1095	0.86	1.00
99	938	0.39	0.70	1090	0.42	0.72
100	950	0.67	0.92	1098	0.65	0.93
101	835	0.23	0.68	988	0.25	0.74

Table 5. Heritability (h²) and standard errors (SE) of the traits considered in the analysis for The Seeing Eye, Inc. (TSE) German Shepherd Dogs (GSD) and Golden Retrievers (GR) at 6- and 12-months of age.

Trait	TSE GSD 6-Month		TSE GSD 12-Month		TSE GR 6-Month		TSE GR 12-Month	
	h ²	SE	h ²	SE	h ²	SE	h ²	SE
Stranger-directed aggression	0.00	0.03	0.18	0.07	0.00	0.05	0.04	0.05
Owner-directed aggression	0.03	0.04	0.12	0.06	0.10	0.07	0.00	0.03
Dog-directed aggression/fear	0.03	0.06	0.10	0.06	0.02	0.07	0.18	0.09
Familiar dog-directed aggression	0.00	0.04	0.03	0.04	0.27	0.12	0.02	0.04
Trainability	0.03	0.03	0.47	0.07	0.12	0.07	0.20	0.08
Chasing	0.06	0.06	0.07	0.05	0.22	0.10	0.16	0.08
Stranger-directed fear	0.00	0.03	0.08	0.05	0.00	0.03	0.08	0.05
Nonsocial fear	0.12	0.07	0.04	0.04	0.19	0.08	0.27	0.09
Separation-related problems	0.08	0.05	0.03	0.03	0.02	0.04	0.07	0.05
Pain Sensitivity	0.04	0.04	0.14	0.06	0.06	0.05	0.09	0.06
Excitability	0.03	0.03	0.05	0.04	0.01	0.04	0.05	0.04
Attachment/attention-seeking	0.06	0.04	0.08	0.04	0.10	0.07	0.10	0.06
Section 1: Training and obedience								
1	0.06	0.04	0.17	0.06	0.10	0.06	0.04	0.04
2	0.06	0.04	0.12	0.05	0.02	0.04	0.12	0.06

	TSE GSD 6-Month		TSE GSD 12-Month		TSE GR 6-Month		TSE GR 12-Month	
Trait	h ²	SE	h ²	SE	h ²	SE	h ²	SE
3	0.04	0.03	0.07	0.04	0.02	0.04	0.00	0.03
4	0.00	0.03	0.03	0.03	0.11	0.06	0.01	0.02
5	0.01	0.02	0.51	0.07	0.03	0.04	0.30	0.09
6	0.01	0.02	0.59	0.05	0.03	0.04	0.48	0.09
7	0.01	0.03	0.00	0.02	0.09	0.05	0.08	0.05
8	0.03	0.04	0.01	0.03	0.11	0.07	0.09	0.05
Section 2: Aggression								
9	0.01	0.03	0.05	0.04	0.00	0.03	0.00	0.03
10	0.00	0.02	0.02	0.03	0.00	0.03	0.02	0.03
11	0.01	0.03	0.00	0.02	0.00	0.03	0.01	0.03
12	0.06	0.05	0.06	0.04	0.01	0.03	0.01	0.03
13	0.01	0.03	0.06	0.04	0.07	0.05	0.00	0.03
14	0.04	0.04	0.01	0.03	0.00	0.04	0.00	0.03
15	0.00	0.03	0.05	0.04	0.07	0.06	0.00	0.03
16	0.00	0.03	0.04	0.04	0.00	0.04	0.00	0.03
17	0.00	0.03	0.01	0.03	0.00	0.03	0.00	0.02
18	0.12	0.06	0.12	0.05	0.02	0.04	0.11	0.07
19	0.00	0.03	0.01	0.03	0.04	0.04	0.00	0.02
20	0.00	0.03	0.17	0.07	0.00	0.03	0.08	0.06
21	0.00	0.02	0.00	0.03	0.03	0.04	0.00	0.04

Trait	TSE GSD 6-Month		TSE GSD 12-Month		TSE GR 6-Month		TSE GR 12-Month	
	h ²	SE	h ²	SE	h ²	SE	h ²	SE
22	0.01	0.03	0.13	0.06	0.03	0.04	0.01	0.03
23	0.03	0.04	0.11	0.05	0.01	0.04	0.06	0.05
24	0.06	0.04	0.07	0.04	0.00	0.03	0.00	0.03
25	0.05	0.04	0.00	0.02	0.00	0.04	0.00	0.02
26	0.07	0.05	0.12	0.06	0.00	0.04	0.03	0.05
27	0.02	0.03	0.04	0.03	0.06	0.05	0.06	0.04
28	0.03	0.04	0.06	0.04	0.01	0.03	0.00	0.03
29	0.06	0.05	0.05	0.04	0.13	0.08	0.16	0.08
30	0.00	0.03	0.01	0.03	0.05	0.05	0.01	0.03
31	0.00	0.03	0.39	0.10	0.06	0.05	0.03	0.04
32	0.00	0.03	0.00	0.03	0.07	0.07	0.07	0.06
33	0.00	0.04	0.00	0.03	0.06	0.06	0.00	0.04
34	0.07	0.05	0.06	0.05	0.13	0.08	0.03	0.04
35	0.00	0.03	0.02	0.03	0.02	0.04	0.02	0.03
Section 3: Fear and Anxiety								
36	0.00	0.03	0.00	0.02	0.00	0.03	0.05	0.04
37	0.00	0.03	0.07	0.04	0.00	0.03	0.05	0.04
38	0.07	0.04	0.03	0.03	0.19	0.08	0.29	0.09
39	0.01	0.03	0.09	0.05	0.01	0.03	0.06	0.04
40	0.01	0.03	0.05	0.04	0.00	0.03	0.04	0.03

Trait	TSE GSD 6-Month		TSE GSD 12-Month		TSE GR 6-Month		TSE GR 12-Month	
	h ²	SE	h ²	SE	h ²	SE	h ²	SE
41	0.08	0.05	0.03	0.03	0.14	0.07	0.16	0.07
42	0.04	0.04	0.01	0.02	0.08	0.05	0.08	0.05
43	0.00	0.03	0.01	0.03	0.03	0.04	0.09	0.05
44	0.03	0.04	0.04	0.04	0.06	0.05	0.09	0.05
45	0.00	0.03	0.05	0.04	0.08	0.06	0.09	0.05
46	0.07	0.05	0.04	0.03	0.05	0.05	0.00	0.03
47	0.09	0.04	0.02	0.03	0.17	0.07	0.08	0.05
48	0.04	0.03	0.05	0.04	0.06	0.04	0.11	0.06
49	0.00	0.04	0.09	0.05	0.02	0.04	0.05	0.05
50	0.01	0.03	0.09	0.05	0.11	0.06	0.05	0.04
51	0.00	0.03	0.53	0.08	0.23	0.10	0.01	0.03
52	0.05	0.04	0.03	0.03	0.00	0.02	0.15	0.08
53	0.01	0.03	0.08	0.05	0.08	0.07	0.06	0.05
54	0.00	0.04	0.02	0.03	0.09	0.07	0.04	0.04
Section 4: Separation-related behavior								
55	0.00	0.03	0.00	0.03	0.00	0.04	0.02	0.03
56	0.06	0.04	0.01	0.03	0.00	0.04	0.04	0.04
57	0.02	0.03	0.04	0.03	0.03	0.04	0.07	0.05
58	0.05	0.04	0.04	0.03	0.04	0.04	0.10	0.06
59	0.18	0.07	0.02	0.03	0.17	0.07	0.14	0.06

Trait	TSE GSD 6-Month		TSE GSD 12-Month		TSE GR 6-Month		TSE GR 12-Month	
	h ²	SE	h ²	SE	h ²	SE	h ²	SE
60	0.15	0.07	0.01	0.03	0.02	0.04	0.01	0.03
61	0.02	0.03	0.04	0.03	0.02	0.03	0.03	0.04
62	0.01	0.03	0.00	0.03	0.02	0.04	0.01	0.03
Section 5: Excitability								
63	0.06	0.04	0.07	0.04	0.03	0.04	0.10	0.05
64	0.04	0.04	0.03	0.03	0.01	0.03	0.03	0.04
65	0.07	0.05	0.08	0.04	0.09	0.07	0.08	0.06
66	0.00	0.03	0.02	0.03	0.00	0.03	0.00	0.03
67	0.03	0.03	0.05	0.04	0.02	0.04	0.05	0.04
68	0.08	0.04	0.06	0.04	0.04	0.05	0.08	0.05
Section 6: Attachment and Attention-seeking								
69	0.03	0.03	0.07	0.04	0.02	0.04	0.02	0.03
70	0.00	0.03	0.02	0.03	0.08	0.06	0.01	0.02
71	0.07	0.05	0.06	0.04	0.02	0.03	0.04	0.04
72	0.05	0.04	0.10	0.05	0.01	0.03	0.12	0.05
73	0.00	0.03	0.02	0.03	0.04	0.04	0.05	0.04
74	0.04	0.04	0.01	0.02	0.04	0.05	0.06	0.05
Section 7: Miscellaneous								
75	0.12	0.06	0.01	0.03	0.10	0.07	0.10	0.06
76	0.01	0.03	0.04	0.04	0.13	0.07	0.10	0.06

Trait	TSE GSD 6-Month		TSE GSD 12-Month		TSE GR 6-Month		TSE GR 12-Month	
	h ²	SE	h ²	SE	h ²	SE	h ²	SE
77	0.06	0.05	0.14	0.06	0.17	0.08	0.06	0.05
78	0.10	0.05	0.04	0.03	0.08	0.06	0.08	0.05
79	0.00	0.03	0.06	0.04	0.00	0.04	0.04	0.04
80	0.18	0.07	0.11	0.05	0.06	0.06	0.03	0.04
81	0.07	0.04	0.01	0.02	0.01	0.04	0.03	0.04
82	0.04	0.04	0.02	0.03	0.03	0.04	0.14	0.07
83	0.04	0.03	0.02	0.02	0.07	0.05	0.00	0.03
84	0.00	0.03	0.03	0.03	0.13	0.07	0.09	0.05
85	0.00	0.02	0.03	0.03	0.05	0.05	0.03	0.04
86	0.09	0.04	0.15	0.06	0.17	0.08	0.17	0.07
87	0.00	0.03	0.00	0.03	0.01	0.04	0.00	0.03
88	0.11	0.05	0.03	0.03	0.15	0.08	0.10	0.06
89	0.09	0.05	0.00	0.02	0.17	0.09	0.02	0.03
90	0.03	0.03	0.02	0.03	0.03	0.04	0.02	0.03
91	0.07	0.05	0.12	0.05	0.04	0.05	0.05	0.04
92	0.08	0.05	0.03	0.03	0.02	0.03	0.07	0.05
93	0.07	0.04	0.08	0.04	0.00	0.03	0.02	0.03
94	0.00	0.03	0.05	0.04	0.01	0.03	0.06	0.05
95	0.00	0.03	0.00	0.03	0.13	0.07	0.04	0.03
96	0.16	0.06	0.09	0.05	0.10	0.06	0.09	0.05

Trait	TSE GSD 6-Month		TSE GSD 12-Month		TSE GR 6-Month		TSE GR 12-Month	
	h^2	SE	h^2	SE	h^2	SE	h^2	SE
97	0.07	0.05	0.13	0.06	0.09	0.06	0.16	0.07
98	0.04	0.04	0.08	0.04	0.12	0.06	0.15	0.06
99	0.01	0.03	0.00	0.02	0.04	0.04	0.17	0.07
100	0.04	0.03	0.13	0.05	0.11	0.07	0.05	0.04
101	0.00	0.03	0.02	0.03	0.02	0.04	0.01	0.03

Table 6. Number of observations (N), mean, and standard deviation (SD) of the traits considered in the The Seeing Eye, Inc. (TSE) Golden Retriever (GR) analysis.

Trait	TSE GR 6-Month			TSE GR 12-Month		
	N	Mean	SD	N	Mean	SD
Stranger-directed aggression	448	0.06	0.18	601	0.09	0.22
Owner-directed aggression	544	0.08	0.18	646	0.07	0.19
Dog-directed aggression/fear	287	0.22	0.34	448	0.24	0.36
Familiar dog-directed aggression	428	0.15	0.29	514	0.18	0.38
Trainability	575	2.76	0.44	653	2.79	0.44
Chasing	350	1.33	0.91	491	1.34	0.89
Stranger-directed fear	598	0.03	0.20	681	0.05	0.25
Nonsocial fear	384	0.61	0.59	583	0.56	0.57
Separation-related problems	554	0.37	0.36	643	0.34	0.35
Pain Sensitivity	470	0.35	0.45	557	0.36	0.48
Excitability	499	1.77	0.71	604	1.95	0.78
Attachment/attention-seeking	535	1.61	0.65	638	1.82	0.70
Section 1: Training and obedience						
1	595	2.81	0.73	683	2.91	0.78
2	607	3.21	0.62	690	3.36	0.57
3	602	2.66	0.80	685	2.82	0.75
4	607	3.02	0.74	689	3.16	0.71
5	604	2.68	0.98	683	2.52	1.13
6	603	2.89	0.83	682	2.60	1.09
7	608	1.81	0.83	689	1.96	0.84
8	604	3.01	0.96	684	3.05	0.96
Section 2: Aggression						
9	607	0.20	0.58	685	0.13	0.49
10	606	0.06	0.29	691	0.04	0.25
11	603	0.06	0.34	689	0.03	0.24
12	544	0.05	0.22	662	0.06	0.28
13	608	0.13	0.40	691	0.10	0.38
14	603	0.12	0.39	687	0.09	0.37
15	603	0.05	0.26	691	0.06	0.29
16	599	0.05	0.25	685	0.04	0.24
17	607	0.04	0.24	688	0.02	0.22
18	549	0.11	0.35	674	0.16	0.42
19	567	0.05	0.24	674	0.03	0.24
20	558	0.12	0.36	672	0.24	0.52

Trait	TSE GR 6-Month			TSE GR 12-Month		
	N	Mean	SD	N	Mean	SD
21	608	0.04	0.25	691	0.03	0.23
22	530	0.10	0.36	639	0.19	0.48
23	554	0.12	0.41	659	0.19	0.53
24	553	0.09	0.38	661	0.12	0.41
25	594	0.05	0.22	684	0.05	0.26
26	451	0.13	0.46	602	0.14	0.43
27	572	0.33	0.65	672	0.40	0.74
28	608	0.06	0.29	690	0.06	0.30
29	467	0.25	0.59	563	0.42	0.78
30	604	0.01	0.12	689	0.01	0.14
31	601	0.15	0.47	680	0.13	0.47
32	458	0.29	0.65	542	0.29	0.70
33	461	0.04	0.27	538	0.04	0.23
34	437	0.12	0.41	526	0.13	0.43
35	462	0.19	0.48	538	0.26	0.59
Section 3: Fear & Anxiety						
36	603	0.05	0.30	685	0.06	0.33
37	601	0.04	0.27	685	0.05	0.32
38	603	1.01	0.99	690	0.92	0.98
39	607	0.03	0.25	689	0.05	0.32
40	608	0.02	0.21	689	0.04	0.25
41	485	0.87	0.97	613	0.62	0.90
42	599	0.47	0.74	689	0.48	0.77
43	598	0.24	0.54	678	0.32	0.66
44	484	0.41	0.75	661	0.41	0.82
45	593	0.25	0.62	683	0.27	0.61
46	586	0.10	0.39	677	0.13	0.42
47	606	0.81	0.93	686	0.68	0.87
48	593	0.27	0.56	685	0.28	0.58
49	485	0.67	0.92	569	0.67	0.96
50	597	0.48	0.77	682	0.41	0.74
51	604	0.04	0.26	687	0.04	0.22
52	586	0.07	0.31	682	0.08	0.30
53	432	0.09	0.37	591	0.12	0.41
54	435	0.74	0.96	557	0.62	0.86
Section 4: Separation-related behavior						
55	592	0.07	0.31	677	0.06	0.28
56	589	0.12	0.49	677	0.15	0.51
57	595	0.29	0.68	681	0.34	0.71

Trait	TSE GR 6-Month			TSE GR 12-Month		
	N	Mean	SD	N	Mean	SD
58	603	1.07	0.99	687	0.87	0.99
59	604	0.92	0.97	685	0.68	0.92
60	593	0.10	0.40	678	0.06	0.31
61	583	0.46	0.78	674	0.41	0.79
62	592	0.14	0.52	669	0.28	0.66
Section 5: Excitability						
63	607	2.25	1.01	689	2.36	1.03
64	608	2.12	0.94	691	2.02	0.97
65	502	1.39	1.11	609	1.66	1.17
66	607	1.42	1.03	692	1.62	1.13
67	607	1.02	1.03	691	1.34	1.12
68	607	2.49	1.05	690	2.66	1.04
Section 6: Attachment & Attention-seeking						
69	593	1.66	1.19	685	1.80	1.22
70	602	2.45	1.02	690	2.54	1.03
71	605	2.47	0.96	690	2.57	0.92
72	606	1.49	1.05	689	1.87	1.07
73	584	0.44	0.80	675	0.70	1.01
74	565	1.22	1.18	654	1.48	1.26
Section 7: Miscellaneous						
75	429	1.79	1.24	542	1.62	1.23
76	522	1.48	1.22	635	1.51	1.21
77	509	1.74	1.21	636	1.81	1.20
78	486	0.82	0.93	624	0.94	1.05
79	536	0.24	0.60	634	0.26	0.59
80	582	0.63	0.97	672	0.51	0.86
81	603	1.64	1.04	691	1.48	1.04
82	589	0.70	0.93	684	0.68	0.93
83	603	0.67	0.86	688	0.61	0.83
84	578	0.69	0.93	677	0.73	0.93
85	604	0.33	0.68	690	0.18	0.50
86	608	1.56	1.00	690	1.60	1.05
87	598	0.03	0.20	687	0.06	0.30
88	602	0.32	0.67	689	0.20	0.54
89	602	0.19	0.51	686	0.07	0.31
90	603	0.13	0.42	685	0.05	0.23
91	606	0.75	0.88	688	0.86	0.98
92	608	2.54	0.89	690	2.50	0.88
93	607	2.33	0.92	691	2.33	0.98

Trait	TSE GR 6-Month			TSE GR 12-Month		
	N	Mean	SD	N	Mean	SD
94	560	0.27	0.61	652	0.29	0.65
95	547	0.24	0.65	649	0.19	0.56
96	600	1.15	1.01	681	1.00	1.06
97	488	0.56	0.91	629	0.51	0.89
98	604	0.58	0.84	686	0.60	0.84
99	597	0.40	0.68	686	0.51	0.76
100	605	0.76	0.95	689	0.68	0.93
101	531	0.28	0.73	618	0.37	0.86

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Appendix A - C-BARQ

ID Code:

Canine Behavioral Assessment & Research Questionnaire (C-BARQ)

The following questions are designed to allow you to describe how your dog has been behaving in the recent past (i.e. during the last few months). Please try to answer all of the questions. Only leave a question blank if you cannot answer it for some reason (for instance, if you have never observed the dog in the situation described).

SECTION 1: Training and obedience

Some dogs are more obedient and trainable than others. By checking the appropriate boxes, please indicate how trainable or obedient your dog has been in each of the following situations in the recent past:

	Never	Seldom	Sometimes	Usually	Always
1. When off the leash, returns immediately when called.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Obeys the "sit" command immediately.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Obeys the "stay" command immediately.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Seems to attend/listen closely to everything you say or do.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Slow to respond to correction or punishment; 'thick-skinned'.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Slow to learn new tricks or tasks.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Easily distracted by interesting sights, sounds or smells.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Will 'fetch' or attempt to fetch sticks, balls, or objects.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 2: Aggression

Some dogs display aggressive behavior from time to time. Typical signs of moderate aggression in dogs include barking, growling and baring teeth. More serious aggression generally includes snapping, lunging, biting, or attempting to bite.

By circling or underlining a number on the following 5-point scales (0= No aggression, 4= Serious aggression), please indicate your own dog's recent tendency to display aggressive behavior in each of the following contexts:

9. When verbally corrected or punished (scolded, shouted at, etc) by you or a household member.

<u>No aggression:</u> No visible signs of aggression	0.....1.....2.....3.....4	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
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10. When approached directly by an unfamiliar **adult** while being walked/exercised on a leash.

<u>No aggression:</u> No visible signs of aggression	0.....1.....2.....3.....4	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
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11. When approached directly by an unfamiliar **child** while being walked/exercised on a leash.

<u>No aggression:</u> No visible signs of aggression	0.....1.....2.....3.....4	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
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12. Toward unfamiliar persons approaching the dog while s/he is in your car (at the gas station for example).

<u>No aggression:</u> No visible signs of aggression	0.....1.....2.....3.....4	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
--	---------------------------	--	--

13. When toys, bones or other objects are taken away by a household member.

<u>No aggression:</u> No visible signs of aggression	0.....1.....2.....3.....4	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
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14. When bathed or groomed by a household member.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

15. When an unfamiliar person approaches you or another member of your family at home.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

16. When unfamiliar persons approach you or another member of your family away from your home.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

17. When approached directly by a household member while s/he (the dog) is eating.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

18. When mailmen or other delivery workers approach your home.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

19. When his/her food is taken away by a household member.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

20. When strangers walk past your home while your dog is outside or in the yard.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

21. When an unfamiliar person tries to touch or pet the dog.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....	1.....2.....3.....4	

22. When joggers, cyclists, rollerbladers or skateboarders pass your home while your dog is outside or in the yard.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....	1.....2.....3.....4	

23. When approached directly by an unfamiliar **male** dog while being walked/exercised on a leash.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....	1.....2.....3.....4	

24. When approached directly by an unfamiliar **female** dog while being walked/exercised on a leash.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....	1.....2.....3.....4	

25. When stared at directly by a member of the household.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....	1.....2.....3.....4	

26. Toward unfamiliar dogs visiting your home.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....	1.....2.....3.....4	

27. Toward cats, squirrels or other small animals entering your yard.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....	1.....2.....3.....4	

28. Toward unfamiliar persons visiting your home.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

29. When barked, growled, or lunged at by another (unfamiliar) dog.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

30. When stepped over by a member of the household.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

31. When you or a household member retrieves food or objects stolen by the dog.

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

32. Towards another (familiar) dog in your household (leave blank if no other dogs).

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

33. When approached at a favorite resting/sleeping place by another (familiar) household dog (leave blank if no other dogs).

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

34. When approached while eating by another (familiar) household dog (leave blank if no other dogs).

<u>No aggression:</u> No visible signs of aggression	<u>Moderate aggression:</u> growling/barking—baring teeth	<u>Serious aggression:</u> Snaps, bites or attempts to bite.
0.....1.....2.....3.....4		

35. When approached while playing with/chewing a favorite toy, bone, object, etc., by another (familiar) household dog (leave blank if no other dogs).

<p><u>No aggression:</u> No visible signs of aggression</p>	<p><u>Moderate aggression:</u> growling/barking—baring teeth</p>	<p><u>Serious aggression:</u> Snaps, bites or attempts to bite.</p>
<p>0.....</p>	<p>1.....2.....3.....4</p>	<p>4</p>

Are there any other situations in which your dog is sometimes aggressive? If so, please describe briefly:

SECTION 3: Fear and Anxiety

Dogs sometimes show signs of anxiety or fear when exposed to particular sounds, objects, persons or situations. Typical signs of mild to moderate fear include: avoiding eye contact, avoidance of the feared object; crouching or cringing with tail lowered or tucked between the legs; whimpering or whining, freezing, and shaking or trembling. Extreme fear is characterized by exaggerated cowering, and/or vigorous attempts to escape, retreat or hide from the feared object, person or situation.

Using the following 5-point scales (0=No fear, 4=Extreme fear), please indicate your own dog's recent tendency to display fearful behavior in each of the following circumstances:

36. When approached directly by an unfamiliar **adult** while away from your home.

<p><u>No fear/anxiety:</u> No visible signs of fear</p>	<p><u>Mild—Moderate fear/anxiety</u></p>	<p><u>Extreme fear:</u> cowers; retreats or hides, etc.</p>
<p>0.....</p>	<p>1.....2.....3.....4</p>	<p>4</p>

37. When approached directly by an unfamiliar **child** while away from your home.

<p><u>No fear/anxiety:</u> No visible signs of fear</p>	<p><u>Mild—Moderate fear/anxiety</u></p>	<p><u>Extreme fear:</u> cowers; retreats or hides, etc.</p>
<p>0.....</p>	<p>1.....2.....3.....4</p>	<p>4</p>

38. In response to sudden or loud noises (e.g. vacuum cleaner, car backfire, road drills, objects being dropped, etc.).

<p><u>No fear/anxiety:</u> No visible signs of fear</p>	<p><u>Mild—Moderate fear/anxiety</u></p>	<p><u>Extreme fear:</u> cowers; retreats or hides, etc.</p>
<p>0.....</p>	<p>1.....2.....3.....4</p>	<p>4</p>

39. When unfamiliar persons visit your home.

<u>No fear/anxiety:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild—Moderate fear/anxiety</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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40. When an unfamiliar person tries to touch or pet the dog.

<u>No fear/anxiety:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild—Moderate fear/anxiety</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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41. In heavy traffic

<u>No fear:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild— Moderate fear</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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42. In response to strange or unfamiliar objects on or near the sidewalk (e.g. plastic trash bags, leaves, litter, flags flapping, etc.

<u>No fear:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild— Moderate fear</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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43. When examined/treated by a veterinarian.

<u>No fear/anxiety:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild—Moderate fear/anxiety</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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44. During thunderstorms, firework displays, or similar events.

<u>No fear/anxiety:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild—Moderate fear/anxiety</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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45. When approached directly by an unfamiliar dog of the same or larger size.

<u>No fear/anxiety:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild—Moderate fear/anxiety</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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46. When approached directly by an unfamiliar dog of a smaller size.

<u>No fear/anxiety:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild—Moderate fear/anxiety</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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47. When first exposed to unfamiliar situations (e.g. first car trip, first time in elevator, first visit to veterinarian, etc.)

<u>No fear:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild— Moderate fear</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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48. In response to wind or wind-blown objects.

<u>No fear:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild— Moderate fear</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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49. When having nails clipped by a household member.

<u>No fear:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild— Moderate fear</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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50. When groomed or bathed by a household member.

<u>No fear:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild— Moderate fear</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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51. When stepped over by a member of the household.

<u>No fear/anxiety:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild—Moderate fear/anxiety</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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52. When having his/her feet toweled by a member of the household.

<u>No fear/anxiety:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild—Moderate fear/anxiety</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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53. When unfamiliar dogs visit your home.

<u>No fear:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild— Moderate fear</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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54. When barked, growled, or lunged at by an unfamiliar dog.

<u>No fear/anxiety:</u> No visible signs of fear	0.....1.....2.....3.....4	<u>Mild—Moderate fear/anxiety</u>	<u>Extreme fear:</u> cowers; retreats or hides, etc.
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SECTION 4: Separation-related behavior.

Some dogs show signs of anxiety or abnormal behavior when left alone, even for relatively short periods of time. Thinking back over the recent past, how often has your dog shown each of the following signs of separation-related behavior when left, or about to be left, on its own (check appropriate boxes):

	Never	Seldom	Sometimes	Usually	Always
55. Shaking, shivering or trembling.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56. Excessive salivation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57. Restlessness/agitation/pacing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58. Whining.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
59. Barking.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
60. Howling.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
61. Chewing/scratching at doors, floor, windows, curtains, etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
62. Loss of appetite.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Are there any other situations in which your dog is fearful or anxious? If so, please describe:

SECTION 5: Excitability

Some dogs show relatively little reaction to sudden or potentially exciting events and disturbances in their environment, while others become highly excited at the slightest novelty. Signs of mild to moderate excitability include increased alertness, movement toward the source of novelty, and brief episodes of barking. Extreme excitability is characterized by a general tendency to over-react. The excitable dog barks or yelps

hysterically at the slightest disturbance, rushes towards and around any source of excitement, and is difficult to calm down.

Using the following 5-point scales (0=Calm, 4=Extremely excitable), please indicate your own dog's recent tendency to become excitable in each of the following circumstances:

63. When you or other members of the household come home after a brief absence.

<u>Calm</u> : little or no special reaction	0.....	<u>Mild—Moderate excitability</u>	1.....	2.....	3.....	4	<u>Extremely excitable</u> : over-reacts, hard to calm down.
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64. When playing with you or other members of your household.

<u>Calm</u> : little or no special reaction	0.....	<u>Mild—Moderate excitability</u>	1.....	2.....	3.....	4	<u>Extremely excitable</u> : over-reacts, hard to calm down.
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65. When doorbell rings.

<u>Calm</u> : little or no special reaction	0.....	<u>Mild—Moderate excitability</u>	1.....	2.....	3.....	4	<u>Extremely excitable</u> : over-reacts, hard to calm down.
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66. Just before being taken for a walk.

<u>Calm</u> : little or no special reaction	0.....	<u>Mild—Moderate excitability</u>	1.....	2.....	3.....	4	<u>Extremely excitable</u> : over-reacts, hard to calm down.
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67. Just before being taken on a car trip.

<u>Calm</u> : little or no special reaction	0.....	<u>Mild—Moderate excitability</u>	1.....	2.....	3.....	4	<u>Extremely excitable</u> : over-reacts, hard to calm down.
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68. When visitors arrive at your home.

<u>Calm</u> : little or no special reaction	0.....	<u>Mild—Moderate excitability</u>	1.....	2.....	3.....	4	<u>Extremely excitable</u> : over-reacts, hard to calm down.
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Are there any other situations in which your dog sometimes becomes over-excited? If so, please describe briefly:

SECTION 6: Attachment and Attention-seeking.

Most dogs are strongly attached to their people, and some demand a great deal of attention and affection from them. Thinking back over the recent past, how often has your dog shown each of the following signs of attachment or attention-seeking.

	Never	Seldom	Sometimes	Usually	Always
69. Displays a strong attachment for one particular member of the household.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
70. Tends to follow you (or other members of household) about the house, from room to room.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
71. Tends to sit close to, or in contact with, you (or others) when you are sitting down.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
72. Tends to nudge, nuzzle or paw you (or others) for attention when you are sitting down.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
73. Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another person.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
74. Becomes agitated (whines, jumps up, tries to intervene) when you show affection for another dog or animal.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 7: Miscellaneous

Dogs display a wide range of miscellaneous behavior problems in addition to those already covered by this questionnaire. Thinking back over the recent past, please indicate how often your dog has shown any of the following behaviors:

	Never	Seldom	Sometimes	Usually	Always
75. Chases or would chase cats given the opportunity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
76. Chases or would chase birds given the opportunity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
77. Chases or would chase squirrels, rabbits and other small animals given the opportunity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
78. Escapes or would escape from home or yard given the chance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

79. Rolls in animal droppings or other 'smelly' substances.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
80. Eats own or other animals' droppings or feces.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
81. Chews inappropriate objects.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
82. 'Mounts' objects, furniture, or people.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
83. Begg persistently for food when people are eating.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
84. Steals food.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
85. Nervous or frightened on stairs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
86. Pulls excessively hard when on the leash.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
87. Urinates against objects/ furnishings in your home.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
88. Urinates when approached, petted, handled or picked up.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
89. Urinates when left alone at night, or during the daytime.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Never	Seldom	Sometimes	Usually	Always
90. Defecates when left alone at night, or during the daytime.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
91. Hyperactive, restless, has trouble settling down.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
92. Playful, puppyish, boisterous.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
93. Active, energetic, always on the go.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
94. Stares intently at nothing visible.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
95. Snaps at (invisible) flies.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

96. Chases own tail/hind end.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
97. Chases/follows shadows, light spots, etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
98. Barks persistently when alarmed or excited.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
99. Licks him/herself excessively.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
100. Licks people or objects excessively.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101. Displays other bizarre, strange, or repetitive behavior(s) *	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

* Please describe: _____
