

THE EFFECTIVENESS OF ENRICHMENT PROGRAMS FOR DOGS IN AN  
ANMIMAL SHELTER

A Dissertation

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EVALUATION OF THE EFFECTIVENESS OF ANIMAL SHELTER  
ENRICHMENT PROTOCOLS FOR DOGS

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Dogs (N = 108) in an animal shelter received one of four enrichment programs: twice daily walking alone (walking) or in combination with a daily food-dispensing toy (toy), a daily session of standardized human contact (petting), or daily obedience training (obedience). We evaluated the effects of enrichment on: a) cortisol concentrations intermittently sampled across approximately days 2-10 in the shelter; b) behavior during an in-shelter mock adoption session; c) adoptability; d) behaviors in the adoptive homes; and e) frequency of retention up to 6 months post-adoption.

Within enrichment groups, blood cortisol concentrations did not change from approximately day 2 to day 6 of residence in the shelter, but decreased significantly from approximately day 6 to day 10 only in dogs in the walking group. Among groups, changes in blood cortisol concentrations did not differ across sampling days.

During an in-shelter mock adoption session, there were no differences among groups in attention-seeking behaviors, time sitting or lying, or time to approach the mock adopters. Dogs in the petting and obedience groups performed more ambivalent behaviors during the session on approximately days 9-10 of residence in the shelter than did dogs in the walking group.

There were no differences in proportions of dogs adopted or on time to adoption among enrichment groups. However, more adopters of dogs in the toy and obedience groups selected their dogs because the dogs “did not bark” than did

adopters of dogs in the walking group. At 1 month post-adoption, dogs in the obedience group displayed “hyperactive” behaviors more frequently than dogs in the walking and toy groups. Furthermore, dogs in the walking and petting groups displayed more annoying barking at 1 month post-adoption than dogs in the toy group.

Seventeen percent of dogs were returned by 6 months post-adoption: four in the walking group, two in the toy group, one in the petting group, and four in the obedience group. The reasons for returning and the time to return did not vary among enrichment groups.

## BIOGRAPHICAL SKETCH

Dr. Perry was born and raised in Vermont where she developed a deep love for animals. After achieving her life-long dream of earning a doctorate degree in veterinary medicine from Cornell University, she joined a mixed practice in central New York. Unfortunately, 5 years into practice, she suffered disabling injuries in a motor vehicle accident. During her recovery, she attended classes on computer programming and database management at Finger Lakes Community College. Her passion for animal behavior, however, led her back to Cornell to study under Dr. Katherine A. Houpt in veterinary behavior. While working under Dr. Houpt, she became an instructor for a farm animal behavior course and lecturer for various courses and conferences in animal behavior and welfare. Despite ongoing health issues, she pursued a Ph.D. program at Cornell in epidemiology under the mentorship of Dr. Janet M. Scarlett focusing on improving the behavior and welfare of dogs in animal shelters.

To Bailey, who enriched my life more than I can express!

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CHAPTER 1  
THE EPIDEMIOLOGY OF UNWANTED DOGS AND FACTORS INFLUENCING  
THEIR WELFARE IN ANIMAL SHELTERS

## **1.1. Introduction**

There is an estimated 77.5 million dogs in the US (APPA 2010-2011 Owner's Survey), owned by approximately 46.3 million households. Unfortunately, millions of these dogs are surrendered to US shelters every year, and about half of them are euthanized (Patronek and Glickman, 1994; Patronek et al., 1995; New et al., 2000).

In the 1970s, many animal-welfare groups actively began to promote sterilization of dogs as a means to reduce shelter euthanasias. As a result of these efforts and those of veterinarians, the proportion of dogs entering shelters has shifted from being primarily litters of puppies to being predominantly young-adult dogs between 6 and 24 months of age—a large proportion of whom are relinquished because of behavior problems (Miller et al., 1996; Patronek et al., 1996; DiGiacomo et al., 1998; Salman et al., 1998; New et al., 2000; Salman et al., 2000).

Furthermore, beginning in the late 1980s and continuing today, there has been significant growth in the numbers of “adoption-guarantee” shelters (often referred to as “no-kill” shelters), which euthanize animals only for serious medical or behavioral issues. The rise of the “no-kill movement” has led many shelters (both traditional and adoption-guarantee) to keep dogs in the shelter for a longer time than was done in previous decades to improve dogs' chances of adoption. Many dogs entering the shelter have perceived behavioral problems, which may decrease their likelihood of adoption (Wells and Hepper, 1992; Lepper et al., 2002; Marston et al., 2005a; Diesel et al., 2007), and potentially increase their length of stay in the shelter.

To confound the problem, research indicates that the stress of confinement in a shelter can be detrimental to a dog's mental well-being (Dess et al., 1983; Garnier et al., 1990; Beerda et al., 1996; Hennessy et al., 2001; Palestrini et al., 2005) and can result in the development or exacerbation of problem behaviors (Mertens and Unshelm, 1996; Beerda et al., 1999a; Beerda et al., 1999b; Beerda et al., 2000).

Because behavior problems are a leading cause of relinquishment and return of a dog to a shelter, it is imperative to investigate ways to mitigate the stressfulness of the shelter and improve dogs' in-shelter and post-adoptive behaviors. Several researchers have examined the effects of providing different types of enrichment strategies for kennel dogs (e.g., social contact, toys, or sensory stimulation) on dogs' behavior (Wells, 2004b). Although results are promising, the lasting benefits of these strategies (in the adoptive homes) remain to be elucidated.

This review addresses the reasons dogs are relinquished to shelters, what influences their adoptability, and which factors affect their retention in their adoptive homes. In addition, the physiological and behavioral evaluation of stress in dogs is discussed, as well as methods used (including enrichment strategies) to improve dogs' behavior and well-being while in the shelter.

## **1.2. Relinquishment of Dogs to Shelters**

The staggering number of dogs surrendered to shelters each year in the US has prompted many investigators to examine factors influencing owners' decision to relinquish their dogs. In one case-control study, interviews were conducted with 285 households relinquishing a dog to a shelter in Indiana (case households) and 748 households (randomly selected from the same community) that owned at least 1 dog at the time of the interview (control households) to determine factors associated with relinquishment (Patronek et al., 1996).

The median age of relinquished dogs was younger than that of household dogs (2.3 years versus 5.2 years, respectively), and dogs who were  $\geq 6$  months old (especially 1-2 year olds) when acquired or who were adopted from a shelter or purchased from a private owner or breeder for  $\leq$  \$100 were more likely to be surrendered. Furthermore, dogs who were sexually intact or mixed-breed had greater

odds of relinquishment than dogs who were neutered or purebred. Dogs who received little or no veterinary care after adoption or who were more work than expected by their owners also were more likely to be relinquished. Behavior problems (especially house soiling, destructive chewing, excessive activity, and aggression) were associated with increased odds of relinquishment: the more frequent the undesirable behavior, the greater the odds of being surrendered. Moreover, the odds of relinquishing a dog was increased for households that did not participate in obedience classes following adoption and for dogs who spent most of their time in crates, basements, garages, or confined in a yard.

The investigators controlled for potential confounding variables in a multivariable logistic-regression model and selected case and control households from the same county (which increased homogeneity of the dogs). The authors emphasized, however, that interpretation of their results should be done with caution because causal relationships are difficult to prove with a retrospective study design. Nonetheless, educational programs for dog owners concerning the importance of neutering, seeking veterinary care, attending obedience training, and addressing behavior problems should be implemented by shelters, veterinarians, and animal advocates as a means of decreasing the risk of relinquishment of dogs to animal shelters.

Factors relating to an owner's decision to surrender a pet also were investigated in an Ohio shelter (Miller et al., 1996). Analysis of 56 shelter-intake questionnaires showed that 54% of relinquishing owners originally had obtained their dog from a private owner; 23% had obtained their dog from a shelter. Sixty-seven percent of dogs were  $\leq 2$  years old at the time of relinquishment. Considering this age group, it is not surprising that the reason most commonly reported (by 30% of relinquishing owners) for surrendering a dog was the dog's behavior—especially hyperactivity, house soiling, biting, chewing, fearfulness, and barking (which was

more of a problem in households with children than in households without children).

Given that most behaviors reported as reasons for relinquishment were normal canine behaviors, the authors concluded that owners (and subsequently their dogs) would benefit greatly from education on normal canine development and behavior, and from counseling regarding realistic expectations of their dogs. Furthermore, within the limitations of that study—descriptive and lacking in statistical analyses—the results provide additional evidence for the premise that behavior problems are key factors in an owner’s decision to relinquish a dog.

Results of interviews of 38 persons surrendering an animal to a private shelter in Massachusetts also confirmed those of other studies. The most common reason cited for surrendering a pet was the pet’s behavior (by 32% of respondents), followed by medical and housing issues (DiGiacomo et al., 1998). Although the study used a qualitative approach (and the data were not analyzed statistically), a common theme emerged from the interviews: owners tolerated issues with their pet for a long time before relinquishing them. Thus, in agreement with the conclusions of Miller et al. (1996), relinquishment of some dogs might be prevented if shelters offered comprehensive behavioral counseling and support services to all pet owners.

The National Council on Pet Population Study and Policy conducted a large multi-centered study (the Shelter Survey) examining the characteristics of dogs and of people relinquishing them to 12 animal shelters in four regions of the US (Salman et al., 1998). Owners surrendering 3,676 dogs were interviewed regarding demographics, dog characteristics, and reasons for relinquishment.

The most frequent reasons cited for relinquishing a dog were behavior problems, housing concerns, and lifestyle issues; the primary sources of relinquished dogs were friends and shelters (Salman et al., 1998). Twenty-four percent of dogs were relinquished specifically for euthanasia, primarily due to old age, illness, or

severe behavior problems (e.g., aggression); the latter group comprised 16% of all euthanasias. Moreover, the median age of dogs relinquished explicitly for euthanasia was considerably greater than that of dogs relinquished for adoption (10.4 years. vs. 1.2 years) (Kass et al., 2001).

The most common single reason reported in the Shelter Survey for relinquishing dogs was moving (New et al., 1999). Most dogs relinquished for this reason (n = 330) were < 2 years old, intact, obtained from friends at no cost, and had lived with their owners for < 2 years before being surrendered. In fact, 34% of dogs were owned for < 7 months. Problem behaviors were reported to occur frequently in this group of dogs at least some of the time during the month prior to relinquishment; specifically, 57% of dogs were hyperactive, 39% excessively noisy, 34% fearful, and 33% destructive, and 26% of dogs had house-soiled.

When reasons for relinquishment were combined, the third-most common category of relinquishment of dogs in the Shelter Survey was health and personal issues (HPIs) (Scarlett et al., 1999). The top reasons cited in this category included no time for the dog, personal problems, allergies, and conflicts between a child and the dog. Furthermore, > 70% of owners citing lack of time for their dogs owned dogs who were  $\leq$  2 years old; almost 70% of dogs had been owned for < 1 year at the time they were relinquished. Twenty-eight percent of people with HPIs also cited non-aggressive behavior problems as an additional reason for relinquishing their dogs, followed by housing issues (21%) and inappropriate expectations (14%). Furthermore, > 50% of households citing HPIs had added at least one dog to their home (in addition to the relinquished dog) during the year prior to surrendering their dog; those dogs were obtained most frequently from a friend or shelter.

The most common category of reported reasons for relinquishment of dogs in the Shelter Survey was behavior problems (Salman et al., 2000). At least one behavior

reason was given by 40% of owners surrendering their dog, with 27% citing behavior as the only reason. The investigators combined reasons for surrendering dogs into “behavior only”, “mixed” (behavioral and non-behavioral), and “non-behavior only” categories. Within the “behavior only” category, the modal age group was 1 to 2 years and the modal length of ownership was < 3 months. The most commonly cited behaviors in this category were aggression, escaping, and destructiveness. When mixed reasons were given for relinquishment, house soiling was the most frequently reported problematic behavior. This implies that house soiling by itself was not always a strong determinant of relinquishment—but when combined with other reasons, might have lowered the threshold for surrendering a dog.

The relative proportion of relinquished dogs was highest in the “behavior only” category when at least one other dog lived in the home. Moreover, the percentage of surrendered dogs from households reporting the addition of at least one other dog in the year prior to relinquishment also was highest in the “behavior only” category—especially if that dog had been obtained from a shelter. In fact, of the dogs relinquished for behavior problems, 39% had been acquired from a shelter.

It is of interest that the proportion of dogs who knew some basic commands when acquired was highest in the “behavior only” relinquishment category, whereas the proportion of dogs taught obedience commands by a family member after acquisition was lowest in that category. The authors suggested that owner expectations might have been higher for dogs already trained; therefore, the owners were less tolerant of subsequent behavior problems.

Data from the Shelter Survey (which included interviews of 2,092 people surrendering 2,631 dogs) were compared to data collected from questionnaires completed by 3,434 US households owning 5,807 dogs (Household Survey) to assess factors associated with relinquishment (New et al., 2000). Dogs were at increased



odds of relinquishment if they were intact, < 2 years old, mixed-breed, owned for < 1 year, or obtained at little or no cost or from a shelter or friend. Moreover, dogs who had house-soiled or were fearful, frequently destructive, or overly active were more likely to be surrendered. Dogs also were at increased odds of relinquishment if they had bitten a person during the month prior to being surrendered.

The authors reported that approximately half of the comparison households were selected because they had at least one dog leave the home during the previous year. The remaining comparison households either had added at least one dog or had no change in the number of dogs during the same time period. Because the comparison population was skewed toward households reporting a pet leaving during the year of the survey, it might not have been representative of the general population of US dog-owning households. Furthermore, the Shelter Survey was carried out by personal interviews whereas the Household Survey was conducted through mailed questionnaires. Although both instruments were standardized, answers could have been different between the two styles. For instance, persons completing a questionnaire were less able to ask for clarification of questions that they might have found confusing. Likewise, investigators conducting interviews were not exempt from error in recording responses. Despite those concerns, the results of this study were consistent with other published studies—young, mixed breed dogs with behavior problems have increased odds (risk) of relinquishment.

Although the aforementioned Regional Shelter Study surveyed a large number of people surrendering their pet(s), the shelters were not selected randomly; thus, the results might not generalize well to other shelters. Moreover, “adoption-guarantee” shelters were excluded from the study. Shelter personnel have long believed that people under-report behavior problems to open-admission shelters, fearing that their animal might be euthanized. There is a lack of data comparing characteristics of

people surrendering pets to a traditional, open-admission shelter to characteristics of people relinquishing animals to “adoption-guarantee” shelters. If people surrendering their animals to a shelter known to perform euthanasia for space differed from people surrendering animals to “adoption-guarantee” shelters, the results of the Regional Shelter Survey could have been biased. Furthermore, because the owners might differ, so might their dogs. Although causal inferences cannot be made from the descriptive results, the significant associations found are nonetheless important in understanding issues that lead to relinquishment of dogs to shelters.

Although behavior problems have been reported frequently as a major reason for relinquishing dogs to shelters in the US, they accounted for only a small percentage of relinquishments (10%) in a study in the Czech Republic; moving (19%), housing (14%), and personal issues (19%) were cited more frequently (Němcová and Novák, 2003). A large study in Australia ( $n = 20,729$ ) also reported that owner-related factors (with moving cited most frequently within this category) were more commonly provided (by 32% of relinquishers) as the motive for surrendering dogs (Marston et al., 2004; Marston et al., 2005b). Behavior issues (including escaping, hyperactivity, and barking, aggression, and issues with other pets) accounted for only 16% of reasons. However, behavior problems accounted for 59% of euthanasias within the shelter.

The authors of the Australian study found significant differences in admission characteristics of dogs, length of stay, and outcomes among the three study shelters and, therefore, emphasized that their results should not be generalized to other shelters. Moreover, records were not standardized among the three shelters, which could have resulted in misclassified or omitted data. Indeed, the authors noted that some records were incomplete concerning reasons for relinquishment, returns, or euthanasia. Those issues and differences in reasons for relinquishment (as compared

to US shelters) complicate the generalizability of the results to other shelters, particularly in the US. As suggested by the authors, it is important for shelter staff to collect data to investigate properly factors relating to adoption and relinquishment of dogs within their own shelter.

Many studies of pet relinquishment rely upon information provided by owners at the time of surrendering their pets. The accuracy of this information, however, might be questionable. This issue was addressed in a study of people relinquishing dogs to a shelter in Sacramento, California (Segurson et al., 2005). A behavioral questionnaire was administered to 54 owners when surrendering their dog, half of whom were told that information from the questionnaire would be used for adoption purposes (non-confidential) and half of whom were told that the information would remain confidential. Comparison of responses between the two groups showed that significantly more owners in the confidential group reported their dogs as having owner-directed aggression and stranger-directed fear than owners in the non-confidential group.

The investigators also collected questionnaires from 784 clients of the University of Pennsylvania Veterinary Hospital who had completed the behavioral questionnaire for their dog during a visit to the hospital within the previous 3 years. Questionnaire scores of client-owned dogs were compared to those of relinquished dogs in the confidential group (which were believed to be more accurate than responses from the non-confidential group). Using prevalence odds ratios (POR) to evaluate associations between relationship to a pet (client-owned versus confidentially-relinquished) and behavioral problems, dogs relinquished to shelters were more likely to have owner-directed aggression (POR = 11), stranger-directed aggression (POR = 4), stranger-directed fear (POR = 4), dog-directed aggression or fear (POR = 4), non-social fear (POR = 3), and separation-related behavior (POR = 5).

The authors attributed the differences in cited behaviors between the confidential and non-confidential groups to bias in reporting by the owners in the latter group—they might have been less likely to report behaviors that could have reduced their dog’s chances of being adopted. However, because the confidential group and client-owned dogs were from separate populations in different geographical areas and were not randomly selected, those results should be replicated using a representative sample of owned and relinquished dogs in the US. Nevertheless, aggression, fearful, and separation-related behaviors appear to be important risk factors for relinquishment of dogs to shelters.

The issue of inaccuracies in owner-supplied information also was addressed by researchers in the UK who compared reports of dogs’ behavior given by their owners at the time of relinquishment (to one of five shelters) with reports of the dogs’ behavior by their adoptive owners (Stephen and Ledger, 2007). A 20-item questionnaire using 5-point rating scales relating to common behavior problems was completed by 163 owners surrendering their dogs (QA) and by 99 adopters of those dogs at 2 and 6 weeks post-adoption (QB and QC, respectively). Additionally, 284 second and 262 third questionnaires were mailed to new owners of dogs for whom a first questionnaire was not received. In total, there were 56 dogs for whom both QA and QB were returned, 40 dogs with both QA and QC returned, and 191 dogs with both QB and QC returned. Behavior rating scale measures were compared among all three questionnaires using Spearman rank correlation coefficients.

Overall, only nine of the 20 behaviors were correlated between reports by relinquishing owners and new adopters. Those behaviors included anxiety and aggression toward the veterinarian, separation-related anxiety, sexual mounting, stealing food, and aggression to strangers and unfamiliar dogs. Moreover, adoptive owners reported better attentiveness by their dogs when asking them to ‘sit’ and ‘stay’,

and less furniture chewing, food stealing, and excessive vocalization at 2- and 6-weeks post-adoption than did relinquishing owners. When examining the changes in behaviors reported in the adoptive homes, dogs displayed more aggression towards strangers and someone reaching out to them, and more food stealing at 6 weeks than at 2 weeks following adoption.

The authors addressed the possibility of discrepancy in reported behaviors between relinquishing and adoptive homes, and between adoptive homes at 2 and 6 weeks post-adoption as being due to inaccurate reporting by the owners, an invalid questionnaire (i.e., inaccurate tool for measuring dog behavior), or inconsistent behavior of the dog in the two homes. With regard to inaccurate reporting, three out of the four reported aggressive behaviors were well correlated between previous and adoptive homes, suggesting that relinquishing owners accurately reported aggression (which is believed to be under-reported by owners surrendering their dogs to ensure that their dogs are not euthanized). In addition, the Spearman rank correlation coefficients between QB and QC (adoptive homes) were moderate (0.4 to 0.7) to high (0.7 to 0.9) for all behavior ratings, thereby lending support for the test-retest repeatability of the questionnaire; however, validity was not assessed. Thus, it is still possible that the questionnaire inaccurately measured the dogs' behavior. Inconsistency in dogs' behaviors between homes could have been due to differences in characteristics of the owners and households, experiences of the dog while in the shelter, or the unfamiliarity of the new home. From the results of that study it is difficult to determine the reason for the discrepancy in dogs' behaviors between homes and within the same home over time, but it is probably due to a combination of inaccurate reporting and an invalid questionnaire as well as inconsistency in dogs' behaviors.

All studies to date emphasize the importance of behavior, either by itself or in

combination with other factors (relocating, HPIs), in an owner's decision to relinquish a dog. The recurring theme is that young, mixed-breed dogs with perceived behavior problems are at the greatest risk of being surrendered to a shelter. There is no evidence that owners report problems that dogs do not have. Hence, although relinquishing owners often underreport their dogs' behavior problems, the information they provide is probably indicative of the dogs' behavior and should be considered in conjunction with shelter staff evaluations when assessing the suitability of dogs for adoption. As recommended by several investigators, shelters should focus resources on education of dog owners regarding recognition and management of normal dog behavior, obedience training, addressing common behavior problems, and the importance of neutering and seeking veterinary care. Such efforts could help to promote realistic expectations of owning a dog, and thereby reduce the number of dogs entering shelters.

### **1.3. Behavioral Testing**

Once a dog enters a shelter, he or she is evaluated medically. In addition, many shelters conduct formal behavioral evaluations or temperament tests of dogs to assess behaviorally whether the dog is suitable for adoption. Results of those assessments are used to prevent adoption of aggressive dogs and to help match dogs with potential owners (Bollen and Horowitz, 2008). Although behavioral evaluations are increasingly common in shelters, few studies have critically evaluated the quality of these tests. This review addresses behavioral tests for shelter dogs only.

Comprehensive reviews of canine behavioral and temperament tests have been reported elsewhere (Jones and Gosling, 2005; Diederich and Giffroy, 2006; Taylor and Mills, 2006).

Criteria for assessing the quality and usefulness of a behavioral test include its

reproducibility, validity, and feasibility (Taylor and Mills, 2006). Reproducibility is the extent to which the test results are consistent when replicated (i.e., the results have little or no random error). The most basic measures of reproducibility are intra- and inter-observer repeatability (the consistency of results when the test is repeated by a single or multiple observers) and test-retest repeatability (in which the same test is applied to the same dog after a prescribed interval of time and the results are compared). Reproducibility of a test can be enhanced by standardizing the testing procedure and by training the people who will be performing the evaluations. Moreover, some authors consider it to be a prerequisite for establishing test validity: if the test results cannot be duplicated, it is unlikely that test will be valid (Jones and Gosling, 2005). A potential problem with assessing reproducibility of behavioral evaluations, however, is habituation by the dogs to the testing procedure (and possibly to the evaluator). Temperament traits by definition are relatively consistent over time under similar situations (Diederich and Giffroy, 2006) and, therefore, should not change. In-shelter behavioral assessments, however, do not necessarily evaluate temperament per se—but rather evaluate the dog’s reactions to a controlled series of tests designed to mimic real-life circumstances (Bollen and Horowitz, 2008). Nonetheless, if a behavioral evaluation cannot produce consistent results, it is not useful.

The quality of a behavioral test is also measured by its validity, defined as the degree to which the test measures the behavioral trait(s) it intends to measure. Validity is often described in terms of three aspects: content, construct, and criterion validity (Taylor and Mills, 2006). Content validity is the degree to which the components of the test (i.e., the subtests) measure all facets of the behavioral trait being evaluated. For example, testing components aimed at assessing fearful behavior would need to encompass all behavioral responses indicative of fear (e.g.,

cowering, flattening of ears, retreating, etc.). Assessing content validity often relies on subjective evaluation of the behaviors that comprise the corresponding behavioral trait, either by the researchers or by experts in the field (Diederich, et al., 2006).

Construct validity is the degree to which the components of the test measure the “broad construct” (or conceptualization) of the behavioral trait being assessed. This type of validity is often evaluated using data reduction techniques and then looking at the relationship between factors (Taylor and Mills, 2006). *Convergent validity* is the extent to which related factors or measures are correlated, and *discriminant validity* is the extent to which unrelated factors are not correlated. For example, items corresponding to aggression (lunging, growling, snapping) should be correlated with each other but not correlated with items relating to sociability (time spent in proximity to the observer, solicitous behavior).

Criterion validity is the extent to which components of a test (i.e., scores) are associated with a “gold standard” (external criterion). With respect to behavioral assessments for which there typically is no gold standard, this can be assessed by evaluating concurrent validity, i.e., the degree to which a behavioral measure varies (concurrently) with a more established measure of the same behavioral trait. Criterion validity also can be examined through predictive validity (whether the behavioral measure correlates with future behavior), which is often determined by (adoptive) owner reports of their dog’s behavior. Some investigators analyze the predictive power of a test in terms of sensitivity and specificity. *Sensitivity* is the probability that an aggressive dog (disease-positive) will display aggression during the evaluation (test-positive), whereas *specificity* is the probability that a non-aggressive dog (disease-negative) will not show aggression during the evaluation (test-negative) (Taylor and Mills, 2006). Alternatively, some investigators evaluate the performance of the behavior test in terms of predictive values. The probability that a dog identified



by the test as aggressive (test-positive) is indeed aggressive (disease-positive) is the *positive predictive value* (PPV) of the test (the number of true positives divided by the number of test positives); the probability that a dog identified by the test as non-aggressive (test-negative) is indeed non-aggressive (disease-negative) is the *negative predictive value* (NPV) of the test (the number of true negatives divided by the number of test negatives). However, the predictive values of a test are highly dependent upon the prevalence of the behavior in question. For example, as the prevalence of a behavior decreases, the PPV of the test also decreases and the NPV increases. Thus, NPV and PPV are inappropriate measures of a test's validity given that prevalence greatly affects those values.

A more versatile measure of the test's performance is the likelihood ratio (LR), which is the likelihood of a given test result in a dog with the trait compared to the likelihood of the same result in a dog without the trait. The LR is typically defined in terms of a positive or negative test result. Using aggression as an example, the LR of a positive test (LR+) is the likelihood of an aggressive dog showing aggression during the test (true positive) compared to the likelihood of a non-aggressive dog showing aggression during the test (false positive). Likewise, the LR of a negative test (LR-) is the likelihood of an aggressive dog not showing aggression during the test (false negative) compared to the likelihood of a non-aggressive dog not showing aggression during the test (true negative).

No matter what the quality of test, it must be practical in the shelter setting. Tests must be standardized and refined for use by shelter staff to make them easy to perform. Many of the behavioral tests evaluated in the literature are prohibitively long, requiring an hour or more per dog. A test that is too lengthy or complicated will be difficult to implement and interpret; thus, its use in a shelter will be limited at best.

Remarkably few studies have addressed the reproducibility of behavioral tests

for pet dogs. One exception is a study that evaluated the “temperament” of 74 pair-housed dogs in an animal shelter in Italy using standard ethological techniques (De Palma et al., 2005). Dogs were observed in each of three different scenarios: 1) inside the cage with another dog; 2) alone with an observer in an open space within the shelter; and 3) during behavior testing of dogs’ reactions to the observer during various interactions in an open space within the shelter (as an assessment of the dog’s independence from humans). All occurrences of dogs’ behaviors in each testing scenario were recorded (on a check sheet) using an ethogram consisting of 110 (in the cage), 115 (in an open space within the shelter), and 25 (in an open space within the shelter while interacting with an observer) behavior patterns. In addition, dogs were walked outside the shelter and assigned to one of five classes of fearful behavior (very calm, calm, timorous, fearful, or very fearful) based on their reaction to the novel (outdoor) environment. Furthermore, fecal cortisol metabolites were analyzed on three consecutive days for all dogs.

Principal component analysis of the data identified 5 factors that accounted for 56% of the variability in the observations: “subordination/aggressiveness”, “intra-specific dominance-activity”, “anxiety-sociability towards dogs”, “playfulness”, and “sociability towards humans”. When analyzing individual scores, dogs who scored high on “intra-specific dominance-activity” also scored high in the behavior tests on independence from humans (during the third testing scenario;  $p = 0.02$ ). It is of interest that dogs who were confident and independent within the shelter (familiar environment) showed fear outside the shelter (novel environment). Fecal cortisol metabolite concentrations, however, were not significantly correlated with factor scores or with fear reactions to the novel (outdoor) environment. Because behavioral observations were performed by three people, inter-observer repeatability was analyzed with Kendall’s kappa coefficient: agreement among all three observers was

high (ranging from 0.82 to 0.89).

Overall, the authors acknowledged that the dogs' behaviors were highly variable, due in part to the lack of homogeneity in breed and life history. Nevertheless, they suggested that ethological methods could be used to characterize the temperament of shelter dogs because they would be easier to implement than standardized behavioral evaluations. However, the authors did not assess other forms of reproducibility (intra-observer, test-retest) nor validity (including correlations with future behavior). Moreover, the ethogram for recording behaviors consisted of up to 115 behavior patterns—making it impractical for use in a shelter setting.

A later study evaluated inter- and intra-rater repeatability of staff assessments of shelter dogs' responses during a behavioral evaluation (Diesel et al., 2008a). Twenty dogs at a welfare charity in the UK (Dogs Trust) each were videotaped during a standardized behavioral evaluation (performed by one person) under three different conditions: when approached in their kennel by a person, during general handling and grooming, and when introduced to another dog. An assessment form was developed for the study containing six possible responses (each scored on an ordinal scale from 0 to 5) for each of the three testing scenarios. The form and videotapes (or DVDs) were sent to 17 Dogs Trust rehoming centers in the UK where 40 staff members, who were involved in behavioral testing, scored the behaviors of the dogs from the recordings using the standardized assessment form. Two months later, 18 of those staff members evaluated the dogs' behavior again using the same video recording and assessment form.

In general, there was a moderate level of agreement (calculated using a weighted kappa statistic) between staff members, except for some behaviors with a high degree of subjectiveness ("indifferent" response during approach) or low prevalence ("fear-aggressive" and "pushy-aggressive" responses during general

handling and grooming). The latter was expected because the kappa statistic is affected by the prevalence of the attribute—if prevalence is very low, chance agreement is increased and kappa values are reduced. Hence, low values of kappa might not necessarily reflect low levels of agreement for behaviors with low prevalence (Feinstein and Cicchetti, 1990; Sim and Wright, 2005). The inter-rater repeatability increased for most responses when only data from those staff members with formal training in dog behavior or at least 8 years of experience in the field were included in the analyses. Furthermore, the intra-rater repeatability was generally moderate to high for most responses (except ‘nervous’ response to other dogs) indicating that staff members were consistent in their evaluations.

The results of the study indicated that formal training in dog behavior and standardization of evaluation protocols can improve repeatability of staff’s assessments of dogs’ behaviors. However, the behavioral test itself was not evaluated. Therefore, standardization of the evaluation procedure and assessment of its repeatability and validity is needed.

The validity of a behavioral evaluation for shelter dogs was assessed in a study in The Netherlands (van der Borg et al., 1991). A set of 21 subtests was used to evaluate problem-related behaviors (aggression, fear, obedience, separation anxiety, and miscellaneous behaviors) of 72 dogs in one of five animal shelters. Following the behavior test, the shelter staff person attending the dog was interviewed regarding the dog’s behavioral characteristics using a standardized questionnaire. Then at 1-2 months following adoption, telephone interviews were conducted with adoptive owners regarding their experiences with their dogs (in relation to potential behavior problems) using another standardized questionnaire. Test results and staff assessments were compared to the experiences of the new owners (with regards to their dogs’

behaviors) to evaluate the validity of the behavior test and staff opinions in predicting post-adoption behavior problems.

The authors calculated sensitivity (the probability that a test correctly identified a dog with the behavioral trait in question) and negative predictive values (NPV, the probability that the dog did not have the trait given that the test result was negative) as measures of test validity. Overall, the staff were moderately good at predicting lack of car-related problems, “disobedience”, and inter-dog aggression given the prevalence of those behaviors in the study (NPV = 0.81, 0.80, 0.82, respectively)—but the sensitivity of their assessments for those traits was poor (0.23, 0.47, 0.36, respectively). In general, however, the behavior test was much better at predicting lack of problem behaviors than was staff opinion. Lack of aggression towards adult humans and dogs and lack of separation anxiety were predicted well by the behavioral tests (NPV = 0.85, 0.95, 0.92, respectively); the sensitivity of the behavior test also was moderately good for those behaviors (0.82, 0.86, 0.83, respectively). The NPV of the behavioral test also was moderately high for disobedience, pulling on the leash, and car-related problems (NPV = 0.91, 0.84, 0.83, respectively), but the sensitivity was moderate to poor (0.84, 0.89, 0.46, respectively).

The authors used sensitivity and NPV as measures of validity for the behavioral tests and staff opinions, stating incorrectly, however, that the sensitivity of a test is dependent upon prevalence whereas negative predictive value is not, and that a low prevalence might give a lower NPV (and a lower percentage of false positives). In fact, sensitivity and specificity of a test are measures of its accuracy and are not usually influenced by prevalence. Predictive values, however, depend heavily upon prevalence. Hence, behaviors with low prevalence would not affect the sensitivity of a test, but would increase its negative predictive values, making the latter a poor measure of test validity. The authors also did not address the test’s reproducibility nor

did they assess the validity or repeatability of the questionnaire instrument. In addition, the testing procedure took 1½ hours per dog to complete (a time constraint that is not feasible in most animal shelters). However, the authors stated that the test was being modified for use in shelters and would be evaluated further.

A later study (Christensen et al., 2007) evaluated the ability of a modified version of the Assess-a-Pet™ procedure (Sternberg, 2003) in preventing the adoption of aggressive dogs from an animal shelter in the US. Of 66 dogs who passed the evaluation and were subsequently adopted, 71% were reported to exhibit behaviors consistent with aggression within 13 months of adoption: 41% displayed lunging, growling, snapping, or biting; the remaining 30% exhibited barking. Territorial aggression was exhibited by 52% of dogs, predatory aggression by 14%, inter-dog aggression by 17%, owner-directed aggression by 5%, resource guarding (food, rawhides, toys) towards people by 5%, and resource guarding towards other animals by 6% of dogs. However, only 6% of adopted dogs ever snapped at or bit another animal or person. Although the authors did not explicitly evaluate the validity of the test, their results suggest that temperament testing is an imperfect vehicle for identifying all types of aggression in dogs in an animal shelter despite using standardized methods. This is especially true for certain types of aggression (territorial, predatory, and intra-specific) that are not evaluated with the Assess-a-Pet™ procedure. Although the test was not assessed for reproducibility, it was in frequent use at the study shelter (supporting its feasibility).

The effectiveness of the Assess-a-Pet™ procedure (Sternberg, 2002) also was examined for identifying aggression and predicting post-adoption behavior problems in 2,017 dogs surrendered to a New England animal shelter (Bollen and Horowitz, 2008). Standardized evaluations were performed on each dog (between 48 and 96 hours after admission to the shelter) during which their reactions to each of nine

testing components were recorded. Overall, dogs failed the entire test if they showed serious aggression during any part of the test or if they failed  $\geq 3$  sections; these dogs were not placed for adoption. Dogs who failed only the sociability section of the evaluation were labeled as “unsocial”, and dogs who showed mild aggression during one or two components were labeled as “borderline”. Dogs passing all components without showing any behavior of concern were deemed “no-issue” dogs. All “unsocial”, “borderline”, and “no-issue” dogs were placed for adoption. To determine the usefulness of the behavioral evaluation in predicting future behavior, information was obtained via questionnaires from owners 6 months after adoption regarding their dogs’ behavior in situations similar to those of the testing components.

The authors found that the odds of failing the behavior evaluation were significantly higher for “high-risk” (pit bull, rottweiler, husky, and chow) versus “low-risk” (all others) breeds (OR = 3.0), and for male versus female dogs (OR = 1.7). Furthermore, the best predictor of past aggression (based on the behavioral history) was failure of the behavioral evaluation (OR = 11.8). For dogs passing the evaluation, “unsocial” dogs had greater odds of having non-aggressive behavior problems (barking, digging, escaping, jumping, destruction, chewing, separation anxiety, and fearful behavior) at 6 months post-adoption (OR = 3.7), whereas “borderline” dogs had greater odds of being returned to the shelter because of aggression (OR = 2.3). Moreover, adolescent dogs (7-18 months) had 2.4-times greater odds of being returned for non-aggressive behavior problems than were dogs < 6 months old.

Multinomial logistic regression models were generated to assess the association between the results of the behavioral evaluation and dog demographics (sex, age, breed) and the behavioral history. Using the new owner’s report of the dog’s behavior as the “gold standard”, the model based on the behavioral evaluation alone had moderately high sensitivity, but low specificity (0.83 and 0.67, respectively)

for predicting past aggression. Models based on the behavior evaluation combined with demographic variables (sex, age, and breed) had moderately high specificity (0.89 to 0.89) but only poor to moderate sensitivity (0.46 to 0.53).

The investigators clearly defined the components of their evaluation, used a standardized form to record each dog's response during the test, and eliminated inter-observer variation by having only one person (KSB) perform the evaluations. However, they did not assess the repeatability of the test nor did they assess the validity or reproducibility of the post-adoption questionnaire. Furthermore, although the length of time required (approximately 45 minutes) might be prohibitive for some shelters, the applicability of the evaluation is generally feasible.

In summary, a quality behavioral assessment should be both reproducible and valid. However, there are scarce data evaluating either of those criteria of assessments used in shelters. A behavioral test must produce consistent results (i.e., with minimal random error) else the validity of the test (the degree to which the test measures the behavioral traits it purports to measure) could be affected by inconsistency among test evaluators, dogs, or testing locations (Taylor and Mills, 2006).

Behavioral assessments are a snapshot of a dog's behaviors at a particular time under a specific circumstance. Repeating this scenario is difficult because the dog learns from each testing experience and, therefore, his or her behavior may be modified in future tests. Moreover, it is impossible for the shelter setting (in which evaluations are performed) to mimic completely real-world situations. For example, detection of aggression towards children or (most) territorial aggression cannot be assessed at all (Bollen and Horowitz, 2008). Therefore, it is not surprising that the few studies examining the repeatability and validity of behavioral evaluations used to screen shelter dogs prior to adoption have yielded inconsistent and generally mediocre results. No evaluation is perfect in identifying all aggression (the primary behavior of



concern to shelters); but combined with owner reports and staff assessments, the results appear to be useful in preventing the adoption of some aggressive dogs. Although the evaluations studied are standardized and simple to follow, many of them take 30-45 minutes or more per dog to complete. All require training of the persons performing the assessments and the quality of assessment can vary widely among assessors. Furthermore, in some locations, knowledgeable and effective trainers are difficult to find.

Additional research into the effectiveness of behavioral evaluations addressing both the repeatability and validity of the testing procedure is greatly needed. Nevertheless, even though behavioral tests have not been evaluated appropriately, they are valuable because they are preventing a high proportion of egregiously aggressive animals from being adopted, even though false negatives—aggressive animals that pass the evaluation—do occur.

#### **1.4. Adoption**

Dogs admitted to shelters who are deemed healthy and who pass the behavioral assessment (if performed) are then offered to the public for adoption. Some dogs are adopted very quickly while others remain in the shelter for several days to months (unless they are euthanized for space). Many investigators have evaluated factors that influence pet selection in hopes of finding ways to promote the adoptability of all dogs.

The association between characteristics of dogs and their subsequent successful adoption from a shelter in Lansing, Michigan was evaluated in a retrospective cohort study (Posage et al., 1998). Based on data from intake questionnaires, dogs were categorized by size, breed group (using AKC classifications), coat color, and reasons for relinquishment. Of 1,468 dogs entering the

shelter, 1,072 (73%) were successfully adopted, i.e., not returned by the end of the study (2 months after the last adoption). Small dogs (< 35 lb. and < 15 in. tall) and those in the hound, terrier, non-sporting, and toy breed groups were more likely to be adopted successfully than were large dogs or those in other breed groups (although some breed-group classifications might have been inaccurate due to the variation in staff members' ability to recognize breeds). Dogs with white, gray, or gold coat colors also were more likely to be adopted successfully than dogs with black, brown, or multicolored coats; dogs who lived outdoors prior to relinquishment were less likely to be adopted than dogs who had lived indoors. A multiple logistic-regression model using variables which were significantly associated with adoption by chi-square analysis (coat color, health, size, sex, breed, and outdoor status) explained only a small percentage of the variance in adoption success ( $R^2 = 0.048$ ), which the authors partly attributed to the success of the shelter in selecting dogs to be offered for adoption (i.e., those who were preferred).

It is surprising that behavior problems reported by previous owners (house soiling, chewing, and aggression toward people or animals) were not associated with adoption. It is possible that owners relinquishing dogs underreported problem behaviors to improve their dogs' chances of being adopted (see Segurson et al., 2005). In addition, potential adopters might not have witnessed behavior problems reported by previous owners and, therefore, might not have placed as much importance on those issues when selecting a dog.

Although several factors were associated with successful adoption, the authors cautioned against applying their findings to dogs in other animal shelters and emphasized the importance of shelter managers systematically reviewing characteristics of preferred (adopted) dogs in their shelters. This would allow staff to identify dogs at risk of not being adopted and to direct their efforts on promoting those

particular dogs—especially in shelters that euthanize animals for space.

A later retrospective cohort study also investigated factors influencing adoption of dogs from a US animal shelter (Lepper et al., 2002). In that study, however, the proportion of dogs adopted was much lower; only 26% of 4,813 available dogs were adopted over a 9-month period. A multivariable logistic-regression model indicated that as a dog's age increased, the odds of adoption decreased. Furthermore, neutered dogs were more likely to be adopted than were intact dogs. Coat color also influenced the odds of being adopted: using black and tan as the reference color, brindle dogs had the lowest odds and red dogs had the highest odds of being adopted. In addition, purebred dogs had greater odds of being adopted than did mixed breeds. In particular, non-hunting breeds less than 16" tall, giant companion breeds, ratters, and cocker spaniels were more likely to be adopted whereas Staffordshire terriers and fighting breeds were least likely to be adopted. Using stray dogs as the reference group (who accounted for 67% of dogs available for adoption), dogs relinquished because of behavior problems had much lower odds of being adopted (OR = 0.06).

The study identified several variables that were predictors of adoption, but focused only on one geographical region (Sacramento, California). Public preferences might vary in other areas of the country (Posage et al. 1998). For instance, larger dogs might be preferred in rural areas due to greater space available for them. Examining factors influencing adoption of dogs in other geographical regions would improve the generalizability of the results. Nevertheless, as the authors stated, shelters should obtain information regarding adopters' preferences (for particular characteristics of dogs) to help promote types of dogs who might be otherwise overlooked.

Investigators in Northern Ireland distributed a questionnaire to a random sample of members of the general public (n = 89) regarding factors that might

influence their selection of a dog for adoption (Wells and Hepper, 1992). Most respondents (76%) selected temperament as the most important factor influencing selection of a dog, whereas other factors were cited less frequently (size, sex, appearance, and age by 11%, 7%, 4%, and 2% of respondents, respectively). Moreover, the vast majority of people preferred owner-relinquished (85%) over stray dogs (15%).

The public also preferred blonde versus black dogs, and dogs with long versus short hair. In addition, dogs at the front of the cage, not barking, and with a toy present in the cage were deemed more desirable. Participants made those selections, however, by viewing pairs of photographs of dogs with each characteristic. Other important traits (such as friendliness or lack of fear) that might influence selection cannot be ascertained in photographs. Likewise, longhaired and blonde dogs come in a variety of shapes and sizes, making application of those results to other “real” dogs difficult. Examining characteristics of dogs who were actually adopted would have provided more accurate information regarding adopters’ preferences.

In a pilot study in the Czech Republic, investigators collected data via questionnaires (n = 125) from people adopting dogs from either of two shelters (Němcová and Novák, 2003). Overall, the most important factors influencing selection of a specific dog were the dog’s appearance, personality, and size. Those traits, however, were not defined in the paper, with the exception of personality (described as “quiet, suitable for kids”, “alert, suitable for guarding”, and “friendly”). Moreover, specific preferences for traits were not given. For example, the authors did not state which attributes of a dog’s appearance adopters preferred. Nonetheless, the greatest proportion of dogs adopted were 2-4 months old. In addition, mixed-breed dogs (especially those that were housed in groups) were more likely to be adopted than purebred dogs. Future studies should explicitly define the variables investigated

in order to ascertain adopters' preferences more accurately.

In an Australian study, 62 owners were interviewed 1 month after adopting a dog from either of two shelters (Marston et al., 2005a). Overall, selection of a dog was influenced mainly by the dog's behavior (in the shelter), size, and appearance. Desired behavioral attributes included calmness, use of "soft eye contact", friendliness, and reacting well to children or an existing pet. However, specific details regarding the definition of those attributes were not provided. Furthermore, the authors used a convenience sample, which might have introduced bias because participants were self-selected. Although it is difficult to draw any conclusions from the results of the study, the results are similar to those found by other investigators.

Factors affecting time until adoption of dogs ( $n = 11,663$ ) from several shelters in the UK were analyzed in a retrospective cohort study (Diesel et al., 2007). Overall, the median time to adoption was 28 days. Survival analysis indicated that purebred dogs were adopted sooner than were mixed-breed dogs, and dogs in the gundog and utility breed groups were adopted more quickly than were hounds; pastoral (herding) breeds had the slowest time to adoption. Small dogs had a faster time to adoption than did medium or large dogs, and females were re-homed more quickly than were males. Furthermore, dogs < 1 year old were adopted sooner than older dogs and dogs with grey/merle, yellow/golden, or liver and white coat colors were re-homed more quickly than dogs with other coat colors.

The authors noted that misclassification bias might have resulted from the staff's subjective assessment of the age or breed variables. Furthermore, the database used by the re-homing centers did not allow staff to record behavior problems that arose while dogs were at the shelter. Because dogs' behavior influences their chances of adoption (Wells and Hepper, 1992; Lepper et al., 2002; Marston et al., 2005a), omitting this variable might have influenced the results. Nonetheless, the study

identified several factors that might affect how quickly a dog is adopted. Although those factors cannot be altered (gender, age, coat color), the public's perception of them might be enhanced through education and counseling.

### **1.5. Interventions Influencing Adoption**

Other researchers have investigated ways to enhance the adoptability of dogs. In a study of 120 stray dogs admitted to a shelter in Northern Ireland (Wells and Hepper, 2000a), three different environmental conditions were evaluated separately: social stimulation (walking in front of the dog's kennel every 10 minutes throughout the day), toy provision, and changing the location of the bed in the kennel. The incidence of adoption during a 1-month period of social stimulation was compared to the incidence of adoption during a 1-month period exactly 1 year prior (control period). Likewise, adoptions were compared between 1-month periods when dogs either had a toy suspended at the front of their cages or had their beds moved to the front of the kennel to adoptions made during the same months 1 year previously (control periods). The incidence of dogs adopted during each of the environmental conditions (social stimulation, toy, bed) was significantly greater than the incidence of dogs adopted during the control periods (1 year prior). Although those results are promising, it is possible that other factors (e.g., characteristics of dogs and adopters, adoption counseling, or shelter staff) influenced adoptions. Future studies should use a concurrent control group to help control for potential confounding factors, and to allow for more direct comparisons of incidences of adoption.

In Italy, the law prohibits euthanasia of shelter dogs unless they are severely ill or a danger to people, which results in many dogs remaining in Italian shelters for the majority of their lives. To enhance adoption of dogs, many animal shelters in Italy implement a Temporary Adoption Program (TAP). The TAP is a "non-traditional"

type of adoption that allows people to spend time with a particular dog (such as going for a walk outside the shelter or taking the dog home for a day) without being required to adopt him/her. One study examined the influence of TAPs, different management factors (number of dogs per pen), and animal- and owner-related characteristics on adoptability of dogs in an Italian shelter (Normando et al., 2006). Upon entering the shelter, dogs without behavior or health issues were available for “conventional” adoption for the first 3 months. Those dogs remaining in the shelter after 3 months were then “randomly” assigned to either a standard TAP group (n = 238) or a “not available for any TAP” group (control, n = 293); the latter dogs still could be adopted in the traditional manner. Older dogs were preferentially included in the standard TAP group in an effort to promote their adoptability (resulting in a non-random assignment). Of the dogs in the “not available for any TAP” group, 110 were included in a “Trials” group. Those dogs had been selected for adoption and were allowed to go home for a few days with their potential adopters for a trial period.

Any dogs with behavior or health issues were assigned to one of three Special Temporary Adoption Programs (Special TAPs). Special TAP A (n = 92) included dogs who were aggressive, fearful, excessively active, or displayed other behavior problems; Special TAP A2 (n = 17) included dogs with chronic illnesses; and Special TAP B (n = 13) included dogs who were walked outside by volunteers members of the shelter staff. The latter group was similar to the standard TAP group except that the temporary adopter was a shelter volunteer. Persons adopting a dog in the Special TAP A group first were interviewed by the shelter staff and then counseled (pre- and post-adoption) on management of dogs with behavior problems. They also were required to participate in a dog behavior course and post-adoption training classes. Persons adopting a dog in the Special TAP A2 group received counseling on management of dogs with chronic illnesses.

Dogs in the Special TAP A2 and Special TAP B groups were not included in the final analyses due to small sample sizes in each group. Analysis of the remaining dogs (n = 733) revealed that dogs  $\leq$  6 months old were adopted more quickly than were older dogs (average length of stay of 1.4 and 6.4 months, respectively). In addition, dogs with behavior problems had longer lengths of stay than dogs without behavior problems (12 and 5.1 months, respectively). Furthermore, dogs who were adopted by a TAP-adopter were returned less frequently than dogs adopted by a stranger.

Overall, the study demonstrated that although age was the major determinant of adoption of dogs from this shelter, TAPs decreased the proportion of dogs returned. The effects of implementing similar programs (akin to fostering programs but without the need to take the dog home) on the adoption success of dogs in shelters in the US should be investigated.

A recent clinical trial evaluated the effects of obedience training and environmental alterations on adoptability of dogs in an Indiana animal shelter (Luescher and Medlock, 2009). One hundred eighty shelter dogs were randomly assigned as pairs to either a treatment (training) or a control group. Training (which started when dogs were made available for adoption) consisted of daily 20-minute sessions during which dogs were taught to wear a head halter, come to the front of the kennel, walk on lead, sit on command, and not jump up on people. In addition to the training, each week of the study was alternated randomly as being an environmental modification or a control week. Environmental modification included providing dogs (in both groups) with blankets and toys, using colored cage cards (instead of white), and placing artificial plants above the pens.

Of the 180 dogs available for adoption, 116 (64%) were adopted and followed for at least 1 year. Dogs in the training group were adopted 1.4 times more often than



control (untrained) dogs ( $p = 0.007$ ). Moreover, dogs who were labeled as being “good with other dogs” had greater odds of being adopted. Environmental modification, however, did not have any impact on adoption.

Although 64% of the dogs were adopted, there was no significant difference in length of stay for adopted and un-adopted dogs (9.3 days, S.E. = 3.0 versus 6.6 days, S.E. = 1.5, respectively). The latter group consisted of dogs who were euthanized (32%), went to a rescue organization (2%), returned to their owners (1%), or died (0.5%). Allowing dogs to remain available for adoption for a longer period of time (rather than euthanizing them for space) might have affected the proportion of dogs adopted from each group. Nevertheless, it is important to note that only one dog was returned out of all the dogs involved in the study. The results of that study are promising and suggest that similar training programs should be investigated in other shelters.

## **1.6. Returns**

Promoting adoption of dogs from a shelter is only part of the process of successful rehoming. Dogs also must be integrated properly into their adoptive homes and form a bond with their new owners. The development of this bond may be influenced by the dogs’ behavior (Helms and Bain, 2009). A study in the UK examined the relationship between the behavior of adopted dogs and their owners’ level of attachment (Serpell, 1996). In a questionnaire survey (using 3-point rating scales), owners were asked to rate their attachment to their dog and their perceptions of their dog’s behavior 1 year after adoption ( $n = 37$ ). When adopted dogs’ actual behaviors were compared with their owners’ ratings of what they considered ‘ideal’ behaviors, adopted dogs tended to show more nervousness/fear, affection, separation-related distress, hyperactivity, and lack of obedience than ‘ideal’ dogs. Neither ideal

conceptions nor actual ratings of dogs, however, were associated with owner attachment levels; however, dogs who were rated as more intelligent tended to have more-attached owners. Nonetheless, discrepancies between ideal and actual ratings were consistently greater in the “moderately attached” group (n = 19) versus the “very attached” group (n = 65) of owners—implying that the former were less satisfied with their dogs’ behaviors than the latter. Although the study used a convenience sample, had few respondents in the “moderately attached” group, and used a limited set of questions to assess the dogs’ behavior, the results emphasized the importance of the relationship between dogs’ behavior and the strength of the bond between dogs and their owners.

A later study examined post-adoption behaviors, owner’s satisfaction with their new pets, and retention. Adopters of pets from PETsMART’s Luv-A-Pet locations, the 1999 Adopt-a-thon, or an animal shelter in New Mexico or Arizona were followed for 2 weeks, 6 and 12 months after adoption (n = 698, 490, and 343, respectively) (Neidhart and Boyd, 2002). Overall, only 23% of owners claimed their dog exhibited problem behaviors (most commonly: house soiling, chewing, digging, escaping, aggression and problems with people). It is therefore not surprising that 86% of adopters were satisfied with their dog (average rating of 3.8 on a 4-point scale). However, by 1 year post-adoption, 20% of pet owners (of cats and dogs) no longer owned their pet (49% of these animals had been returned to the shelter, 25% had died, 13% were given away, 11% ran away, and 2% were disposed for “miscellaneous” reasons). The authors did not distinguish between dogs and cats in those percentages except mentioning that attrition was similar between the two species. The most common reasons cited for dogs not remaining in the home were problems getting along with others (36%), behavior problems (e.g., destructiveness and house soiling) (28%), and death (15%). Attrition also was higher for animals who

were > 1 year old when adopted, were adopted as a companion for a child, or were adopted into a household with an annual income < \$35,000.

The authors concluded that a pet's personality and behavior were important factors in whether or not a pet remained in the home. However, it was not clear whether all people adopting an animal from one of the three locations (PETsMART Charities, Animal Humane Association of New Mexico, or Arizona Humane Society) were included in the study, or only a sample of adopters. Because the issue of random assignment was not addressed in the report, it is impossible to determine whether the study population was representative of the US pet-adopting population—which prevents generalizing the results to dogs in other shelters. Nonetheless, the results are in agreement with other studies with respect to behavior being a determinant of whether a dog is returned to the shelter or retained in the home.

Because a dog's behavior can influence an owner's level of satisfaction and attachment with him/her (Serpell, 1996; Helms and Bain, 2009), it is important to investigate post-adoption behaviors and their relationship with an owner's decision to return a dog to a shelter. Adopters of animals from the Michigan Humane Society were surveyed at 1 week ( $n = 1,298$ ) and 1 month ( $n = 1,216$ ) post-adoption regarding health and behavior problems of their adopted dogs (Lord et al., 2008). At 1-week post-adoption, 92% of owners rated their dog's behavior as good or excellent even though 63% reported that their dog exhibited at least 1 problem behavior. The most common behavior problem cited was house-soiling (particularly in dogs  $\leq 1$  year old); the second-most common was digging, chewing, or scratching objects. Not surprisingly, dogs with behavior problems were less likely to be considered "adjusting well" to their new homes than dogs without behavior problems. Moreover, dogs with behavior problems when left alone were more likely to be destructive than dogs without behavior problems when left alone.

At 1-month post-adoption, the most common behavior problem (reported by 68% of dog owners) was chewing, digging, or scratching at objects; house-soiling was the second-most common behavior problem cited. However, only 13% of dog owners took their dog to obedience class; 79% of these dogs were  $\leq 1$  year old when adopted. Furthermore, dogs taken to obedience class were more likely to have had at least one behavior problem than dogs not taken to class—suggesting that owners of dogs with behavior problems were more likely to enroll them in obedience training (possibly as a means of correcting the behavior) than owners of dogs without problem behaviors.

As noted by those authors, generalizing the results to dogs in other shelters must be done with caution because the study focused on one geographical area. However, the results of such a large study still provide valuable information regarding concerns many adopters have about their new pets. Addressing house soiling, destructive behavior, and anxiety while dogs are still in the shelter and providing counseling and education programs for adopters could enhance owner attachment to their dogs and help ensure that dogs remain in their new homes.

Other investigators have reported that dogs adopted from animal shelters frequently display problem behaviors following adoption. In one study in Northern Ireland, 68% of adopters ( $n = 556$ ) stated that their dog displayed problematic behaviors within the first month following adoption (Wells and Hepper, 2000b). Male dogs were reported to display more behavior problems than were females (especially conspecific inter-male aggression, roaming, and sexual problems), and dogs obtained as strays were reported to roam more than dogs who were previously owned. Adopters also claimed that puppies exhibited fewer problem behaviors than older dogs, and that juvenile dogs displayed more excessive barking and activity than puppies or adults. Arguably the most striking finding was that 90% of dogs returned to the shelter exhibited problem behaviors (compared to behavior problems in 67% of

dogs not returned). Moreover, 30% of dogs who showed aggression toward humans were returned. Those latter findings again underscore the importance of behavior in the fate of a dog adopted from a shelter.

Behavior problems also were reported to occur at least some of the time during the first month post-adoption in dogs adopted from one of two Australian shelters, and included (in order of decreasing frequency) pulling on the leash, hyperactivity, mouthing, destruction, generalized fear, separation anxiety, and house soiling (Marston et al., 2005a). Furthermore, by one month post-adoption, 13% of the dogs were returned. Reasons given by owners for returning their dogs included poor selection, escaping behavior, separation-related problems, aggression toward animals, chasing wildlife, and mouthing behavior. Additionally, 50% of destructive dogs, 40% of dogs who escaped, and 25% of dogs who were mouthy or displayed anxiety or separation-related behavior were returned. In an earlier study of three Australian shelters, however, only 7% of adopted dogs were returned (Marston et al., 2004; Marston et al., 2005b). Reasons for returning a dog in that study included owner-related factors (moving), dog-related factors (size and health), behavior problems, and problems with an existing pet in 26%, 22%, 22%, and 13%, respectively. Despite the difference in proportions of dogs returned, both studies confirmed that perceived behavior problems were an important factor in an owner's decision to keep or surrender their dog.

Data from return-intake questionnaires ( $n = 307$ ) were examined to evaluate specific reasons for returning dogs to an animal shelter in Italy (Mondelli et al., 2004). Throughout a 6-year period, 86% of 3,281 available dogs were adopted, of whom 15% ( $n = 431$ ) were returned. Overall, 41% of the returned dogs were returned within the first week after adoption. The number of days that dogs remained with persons living in an apartment was less than the number of days dogs remained with adopters living

in a house before being returned. In addition, adopters with previous dog experience returned dogs more frequently because of behavioral issues than those without dog experience. Although more female than male dogs were adopted, more males were returned; 60% of the returned dogs were between 6 months and 2 years old. The most frequently reported reasons for returning dogs were behavior problems (39%), aggressiveness toward people (15%), and management problems (e.g., not having time or space for the dog) (34%), health or personal issues (6%), and housing issues (5%). Because behavior problems were a major reason for returning a dog, the authors suggested (in agreement with other studies) that shelters should implement educational programs for potential adopters regarding dog ownership (particularly of dogs with known behavioral issues) and provide access to post-adoption counseling and support services (such as a behavioral hotline) and obedience training classes.

A later study evaluated reasons for returning pets within 2 years of adoption to a US Midwestern shelter through telephone interviews with 78 relinquishing owners (Shore, 2005). The mean age of all animals returned to the shelter was 16.3 months (SD = 16.2 months); 51% were < 12 months old. Additionally, 54% of the returns occurred within the first 2 weeks after adoption. When asked what led owners to return their pet, behavior problems were cited by 37% of respondents (including house soiling, escaping, destructiveness, separation anxiety, and aggression toward humans). Moreover, 11% of returned animals did not get along with other pets in the household and 11% were not good with children. The study was qualitative and did not separate dog from cat data in the results; hence it is difficult to extrapolate the findings to dogs in other shelters. Nonetheless, the findings are in agreement with those of other studies regarding the impact of a dog's behavior on the success (or failure) of adoption and the importance of sound adoption counseling for new owners.

Researchers in the UK examined factors influencing retention of dogs adopted

from 14 rehoming centers in the UK in a prospective cohort study (Diesel et al., 2008b). Questionnaires were sent to owners at 6 to 8 weeks post-adoption (n = 4500) regarding post-adoption behavior and health issues. A random sample of these owners (n = 700) was contacted by telephone at 6 months post-adoption to inquire whether they still owned their adopted dog: 15% of dogs had been returned to the shelter, 39% within the first 2 weeks. Median time to return was 27 days (95% CI: 23, 22).

A multivariable logistic regression model indicated that compared to dogs without behavior problems, dogs with behavior problems had higher odds of return—particularly if the dog was aggressive and the owners had not sought behavioral advice (OR = 11.1 if owners did not seek advice, and OR = 5.6 if owners did seek advice). Dogs who were destructive also were more likely to be returned than dogs without behavioral problems (OR = 2.1 whether or not owners sought advice). Furthermore, large dogs (> 25 kg) had higher odds of being returned than smaller dogs (OR = 2.1), and adopters finding their dogs more work than expected were more likely to return their dogs than adopters finding their dogs less work than expected (OR = 9.9). Adopters < 25 years of age also were more likely to return their dogs than were older adopters (OR = 2.9). In addition, dogs who lived in households with children < 13 years old had greater odds of being returned than did dogs who lived in homes without children (OR = 1.8). Owners who let their dogs sleep on a family member's bed were less likely to return their dogs than owners who did not allow their dogs to sleep on a bed (OR = 0.6). Additionally, owners taking their dogs to obedience classes were less likely to return their dogs than owners who did not attend obedience classes (OR = 0.3).

The study elucidated several factors influencing the return of dogs to a shelter, namely behavior problems and other dog- and owner-related issues. The results again reiterate the common theme that providing owners with pre-adoption counseling

regarding dog ownership and post-adoption behavioral support might help reduce the proportions of dogs returned to shelters.

A sensitive period of development has been identified in dogs (occurring between 3 and 14 weeks of age) during which experiences are believed to affect their behavior later in life (Freedman et al., 1961; Serpell and Jagoe, 1995). Therefore, it seems plausible that providing puppies with positive early learning experiences should help promote positive behaviors later in life. One study explored the effects of puppy-socialization classes on subsequent retention of dogs (Duxbury et al., 2003).

Questionnaires were mailed (at least 1 year after adoption) to owners of 248 dogs from 54 litters adopted from a humane society in Minnesota. Dogs were included in the study if they had been adopted between the ages of 5 and 10 weeks and had belonged to litters from which at least two puppies had been enrolled in the humane-society puppy-socialization classes between 7 and 12 weeks of age, and from which at least two puppies had not been enrolled in classes. Scores for early handling and responses to obedience commands were calculated from questionnaire data for each dog.

Three groups of dogs were considered for analyses: Group 1 only participated in classes at the humane society; Group 2 did not participate in any puppy classes; Group 3 participated in puppy classes elsewhere. Univariable analyses found that dogs who had received the most handling as puppies or who responded consistently to obedience commands were more likely to be retained in their adoptive homes than dogs who received little handling as puppies or did not respond consistently to commands. In multivariable logistic regression models, dogs in Group 1 (humane society puppy classes) were found to have greater odds of being in their adoptive homes at the time the questionnaire was completed than dogs in Groups 2 or 3 (OR = 3.1). Female dogs also were more likely to be retained than male dogs (OR = 4.2). In addition, higher odds of retention were reported for dogs who slept on or near the



owner's bed (OR = 10.1) or lived in homes without children < 6 years old (OR = 0.1). Dogs who wore head collars frequently or occasionally as puppies also were more likely to be retained than dogs who did not wear head collars as puppies (OR = 3.8). However, head collars were promoted by the humane society's puppy classes, which could confound the results (dogs in humane-society classes had higher retention, dogs with head collars had higher retention)—yet all dogs in Groups 2 and 3 who wore head collars were retained.

The age of dogs at the time of completion of the questionnaires in this study ranged from 1 to 6.5 years. This could pose difficulties in the owner's recall of their dogs' experiences as puppies. Selection bias also might have occurred if owners who no longer owned their dog were less likely to return the questionnaire. Furthermore, the owners' decision to attend socialization classes might have been influenced by factors (such as moving, household income, or commitment to the puppy) that affected retention of dogs. The investigators did not control for those potential confounders in their analyses, although they did adjust for the effects of litter. Nonetheless, the results support the premise that early experiences can affect a dog's behavior later in life (Freedman et al., 1961; Serpell and Jagoe, 1995). Thus, enrolling puppies in obedience classes early in life might promote well-mannered puppies and enhance the human-dog bond, thereby leading to better retention of dogs in their adoptive homes.

Because many studies have cited house soiling as a common behavior problem in dogs following adoption and as a common reason for surrendering a dog to a shelter (Miller et al., 1996; Patronek et al., 1996; New et al., 1999; Salman et al., 2000; Neidhart and Boyd, 2002; Marston et al., 2005a; Shore, 2005; Lord et al., 2008), investigators in Ohio studied the effectiveness of pre-adoption counseling of owners on post-adoption house-training success (Herron et al., 2007). At the time of adoption, new owners were randomly allocated (in blocks) to receive either a 5-minute

counseling session regarding house-training techniques (n = 54), or not (n = 59). At 1 month following adoption, significantly more owners who had received counseling considered their dogs to be house-trained than did owners who had not received counseling (98.1% vs. 86.4%).

Although the authors excluded dogs < 6 months old and dogs who (previously) had been in foster care, the possibility still exists that some of the dogs were house trained prior to being relinquished to the shelter. However, dogs were randomly assigned to treatment groups, which minimized the likelihood that previously trained dogs were disproportionately assigned to the counseled group. Because house soiling is one of the most commonly cited reasons for relinquishing a dog, counseling owners at the time of adoption regarding house-training techniques would be a simple way for shelters to help reduce the number of dogs returned for that reason.

### **1.7. Summary of Studies of Relinquishment, Adoption, and Returns**

In conclusion, it is clear from the preceding studies that young adult dogs with behavior problems are at increased risk of relinquishment to shelters. Once adopted, this same category of dogs also is at risk of return. Moreover, the estimated 1.6 million dogs who are euthanized in shelters each year (Bartlett et al., 2005)—many with behavior problems—emphasize the importance of addressing behavior issues to prevent unnecessary deaths.

Although potential adopters state that a dog's behavior is important in their decision to adopt, studies have shown that other dog characteristics (e.g., age, sex, coat color, and size) are more likely to be associated with adoptability. Because the attachment between owners and their dogs is affected by their dogs' behavior (Serpell, 1996; Helms and Bain, 2009), shelters should educate potential adopters regarding the importance of taking behavior into account when selecting a dog, and use the results

of behavioral assessments to assist in that selection. Moreover, there exists a great need for improving the behavior of shelter dogs (in the shelter and after adoption) in order to promote and maintain the human-dog bond. The question remains whether or not this can be done within the (physical, monetary, and time) constraints of a shelter.

### **1.8. Stress**

Evidence suggests that dogs relinquished to shelters experience psychological stress (Dess et al., 1983; Garnier et al., 1990; Beerda et al., 1996; Palestrini et al., 2005). This is not surprising considering that within the shelter, dogs typically are housed alone in an unfamiliar, unpredictable, excessively noisy, barren, and inescapable (uncontrollable) environment (Hennessy et al., 2001). Physiologically, such conditions result in hypothalamic-pituitary-adrenal (HPA) axis activation as measured by elevated circulating cortisol concentrations (Hennessy et al., 1997).

As described earlier (Section 1.2), dogs with behavior problems are at increased risk of being surrendered to shelters. The stress of confinement in a kennel, however, promotes development or exacerbation of problem behaviors in dogs (Mertens and Unshelm, 1996; Beerda et al., 1999a; Beerda et al., 1999b; Beerda et al., 2000). Thus, the cycle is continued: dogs with unacceptable behaviors are relinquished to shelters where the stress of confinement promotes the development of more undesirable behaviors. Therefore, strategies that diminish the stressfulness of the shelter environment are a crucial part of improving the welfare of dogs within the shelter, and potentially the behavior (and retention) of dogs in their adoptive homes.

Endocrinologist Hans Selye first adopted the term “stress” in the 1930s when describing “the nonspecific response of the body to any demand made upon it” (Selye, 1936). Since then, the definition has gone through various modifications and interpretations. Broom and Johnson (1993) defined stress as “an environmental effect

on an individual which overtaxes its control systems and reduces its fitness or appears likely to do so”, whereas Mormède et al. (2007) defined it as “a general term used to describe environmental factors sollicitating adaptation mechanisms and the responses to these challenges”. Regardless of the definition, there is a consensus that the stress response involves activation of two major neuroendocrine systems: the sympathetic adrenal medulla (SAM) system and the HPA axis. The SAM system is the “fight or flight” response to acute stressors resulting in a rapid increase of circulating catecholamines (epinephrine and norepinephrine). Assessing the SAM system, however, is problematic because catecholamine concentrations (and subsequent physiological responses, e.g., increased heart rate) are easily affected by handling or the blood sampling procedure (Beerda et al., 1997)—catecholamine concentrations rise and fall rapidly (half-life of ~2 minutes) in response to sympathetic nervous system stimulation (Shaw et al., 1987). Consequently, many researchers evaluate the (longer term) stress response by measuring cortisol (as a product of HPA activity), which increases within minutes of a stressful event and has a longer half-life ~104 minutes (Thomasson and Steenburg, 1965). Moreover, cortisol has been shown to be a sensitive (although not necessarily specific) indicator of psychological stress in dogs (von Holst, 1998; Hennessy et al., 2001; Mormède et al., 2007).

Acute activation of the HPA axis predictably results in a measurable increase in circulating cortisol. With maintained activation, however, the HPA axis response is not as straightforward. Cortisol concentrations often decrease despite repeated exposure to the same stressors, whereas responsiveness to subsequent aversive (novel) stimuli might be exaggerated. In those situations, dynamic testing (via stimulation or inhibition) would be necessary to reveal dysregulation of the HPA axis (Mormède et al., 2007). Dogs also adopt a behavioral response to stress in an effort to cope with the situation. This response depends not only on the stressor itself, but also on the dog’s

appraisal of that perceived stressor. That appraisal is influenced by the dog's genetics, ontogeny, and learning (Veissier and Boissy, 2007), making behavioral responses highly variable and interpretation of them difficult at best.

Although there are numerous studies evaluating stress in dogs, there is a lack of consensus regarding methodology. The sources of subjects have included shelter, laboratory, military, police, and guide dogs. Length of confinement has ranged from a few days to several years, and has consisted of individual or group housing, indoor or outdoor conditions, or any combination of these. In addition, numerous behavioral and/or physiological observations and measurements have been made in dogs while undisturbed or when 'challenged' with various stimuli (social, novel, sound, visual, physical, etc.). The following review focuses primarily on behavioral and physiological stress responses of kennel dogs, although studies on pet dogs are included where pertinent.

### **1.9. Acute Stressors**

The predictability and controllability of a stressor (and not just the stressor itself) have pronounced effects on the magnitude of the stress response (Bassett and Buchanan-Smith, 2007). This influence was demonstrated in a study of 18 dogs exposed to foot shocks (Dess et al., 1983). Dogs were randomly assigned in pairs to either predictable or unpredictable shock conditions; within each pair, dogs were randomly assigned as the "master" (who could terminate shocks) or "yoked" (who could not terminate shocks) dog. On the first day of the study, all dogs were habituated to being yoked to each other in pairs while restrained in a hammock. On the second and third days, dogs were placed in the hammocks (yoked in pairs) and administered a series of foot shocks. For two pairs of dogs, shocks were predicted by a 5-second tone, and for other two pairs of dogs, shocks were not predicted. Moreover, one dog in each pair

(the “master” dog) could terminate the shock by pressing a panel. On the fourth day, all dogs were tested individually by administering signaled (by a 10-second flashing light) foot shocks. On each day, blood samples for cortisol determinations were collected immediately before sessions began and immediately after they ended. There were two replications of the study. During the first replication, two sessions of 50 shocks each (7-mA, for up to 15 seconds) were administered; during the second replication, dogs received two sessions of 40 shocks each (5-mA, for up to 5 seconds).

The researchers found that during the stress-induction phase, dogs without control over the shocks (yoked dogs) had greater increases in plasma cortisol than dogs who were able to terminate the shock. Moreover, dogs who had received signaled shocks during the induction phase had lower cortisol concentrations during the test phase than dogs who previously had received unpredictable shocks. The results of the study emphasize the importance of psychological factors (e.g., controllability and predictability) in modulating the adrenocortical response to stress. Although the dogs in the study were from a research colony, the findings are still relevant to dogs in animal shelters, whom typically lack control over their environment and experience frequent unpredictable stimuli (e.g., loud noise, interruptions by shelter staff or the public, etc.). Efforts to increase the controllability (e.g., through reward-based obedience training) and predictability (e.g., keeping all routine interactions on a regular schedule) of the shelter environment might help alleviate some of the psychological stress dogs experience while in the shelter.

Loud noise also has been shown to induce a stress response in dogs (Coppola et al., 2006a). One study assessed the effects of a sudden sound blast on behavioral and physiological responses of six laboratory dogs (Engeland et al., 1990). All dogs were housed in laboratory kennels for at least 2 weeks prior to testing and trained to stand quietly in a modified Pavlov sling for blood sampling (via adrenal venous and

femoral arterial cannulas). A 75 dB noise of 3 minutes duration was generated for each dog. Blood samples were collected continuously from 3 minutes prior until 10 minutes after the presentation of the noise; additional samples were collected at 12, 15, 20, and 30 minutes after the onset of the noise. Five additional dogs underwent only the blood sampling procedure (i.e., without presentation of the noise).

In response to the sound blast, dogs oriented toward the noise and showed generalized muscle contraction, panting, salivation, and piloerection, with a corresponding increase in heart rate and adrenal blood flow and pressure. In a subset of dogs ( $n = 4$ ), plasma cortisol was significantly elevated for 7 to 15 minutes after the onset of noise as compared to dogs not exposed to the noise. The effects of the blood sampling procedure alone did not affect any of the parameters (including cortisol concentrations) in the five dogs tested. However, the researchers used a small sample size and habituated the dogs to the testing conditions (which might have mitigated the cortisol response to the blood sampling procedure). Nevertheless, the results of the study indicate that noise can act as a stressor in dogs.

A later study also investigated noise as a stressor by presenting 16 dogs with varying levels (70, 78, and 87 dB) of sound in 18 blasts lasting 5, 10, or 15 seconds each (Beerda et al., 1997). One dog—inadvertently subjected to noise of 95 dB—showed an increase in tongue protruding, snout licking, paw lifting, and body shaking (compared to 30 minutes before noise presentation). Because the behavioral response of that dog occurred concurrently with an increase in heart rate and salivary cortisol concentrations, the authors suggested that those behaviors might be indicative of stress. Although behavioral responses of the other dogs (exposed to noise levels at  $\leq 87$  dB) were highly variable, they consistently displayed a lowered posture in response to the noise. However, cortisol concentrations did not increase in those dogs. The authors suggested that behavioral responses might be sensitive to noise stress, but

advised that measuring multiple stress parameters is necessary to aid in interpretation of the responses. Repeating the experiment with a greater number of dogs is not recommended because of the welfare implications of purposely subjecting dogs to that level of noise.

The results of the previous two studies (Engeland et al., 1990; Beerda et al., 1997) are of concern considering that dogs in shelters are frequently exposed to peak sound levels exceeding 100 dB (Sales et al., 1997). Thus, it can be assumed that shelter dogs experience profound stress and reduced welfare when exposed to loud noises. Means of decreasing noise levels in the shelter are greatly needed for the well-being of dogs, shelter workers, and people visiting the shelter.

Other startling or aversive stimuli also have been shown to induce a stress (i.e., fear) response in dogs. In one study, dogs responded to aversive or startling stimuli (including restraint and opening of an umbrella) during which the experimenter was present by performing more body shaking, crouching, and oral behaviors (e.g., lip licking, lip smacking, and swallowing) (Beerda et al., 1998). Dogs responded to stimuli that could not be anticipated (such as sudden sound blasts, electrical shocks, and a falling bag) by lowering their posture. Those dogs also tended to have increased salivary cortisol concentrations. However, the investigators did not find any correlations (Spearman rank) between behavior variables and cortisol concentrations, possibly because of low statistical power (due to a small sample size,  $n = 10$ ). Nonetheless, the authors suggested that body shaking, crouching, and oral behaviors might be indicative of moderate social stress because those behaviors were observed in the presence of the experimenter, whereas a low body posture might indicate intense acute stress since it was observed concurrently with an elevated cortisol response.

Because they wanted to identify a robust measurement of stress, the authors



did not control for potential confounding variables such as breed, sex, and age. They did, however, randomly select dogs from the kennel population. The dogs in the study were from an existing research colony and, therefore, were acclimated to confinement (unlike dogs in animal shelters); hence, the findings might not generalize well to dogs in animal shelters.

Another study evaluated behavior and cortisol concentrations of shelter dogs ( $n = 166$ ) in response to novel and threatening stimuli (Hennessy et al., 2001). The test (administered to dogs on their third day in the shelter) scored dogs' behaviors in 4 situations within a novel environment: 1) when placed alone in the novel environment; 2) in response to a person; 3) in reaction to a remote-controlled toy car; and 4) in response to an air horn blast. Blood samples for cortisol determinations also were collected from each dog on day 2 in the shelter and again on day 9 for any dog remaining in the shelter. In addition, questionnaires were mailed to adoptive owners at 2 weeks and 6 months post-adoption to collect data regarding problem behaviors of dogs in their new homes (including separation-related behavior, timidity, excitability, fearfulness, elimination, escaping, or destructive behavior, integration into the home, biting, and overall perceived problems). Behaviors in the first eight categories were answered on 5-point Likert scale; behaviors in the last two categories were answered yes or no. A mean score was calculated for each category; then a behavior problem index was generated separately for puppies and for juveniles and adults (with higher scores indicating more behavior problems).

Principal component analysis of behavioral responses to the test battery identified six factors that accounted for 69% of the variation in the data: locomotor activity, flight, sociability, timidity, solicitation, and wariness. No significant correlations were found between the six behavioral factors and cortisol concentrations on either day 2 or 9. Cortisol concentrations were, however, negatively correlated

with behavior problem indices of puppies at 6 months post-adoption—puppies with the lowest in-shelter cortisol concentrations on day 2 exhibited the most behavior problems at 6 months post-adoption. Only one correlation between individual factors and (future) behavior problem indices was found—puppies who were less wary of the toy car and air horn during the behavioral test had the most problematic behaviors at 2 weeks following adoption. No other correlations were found between individual factors and post-adoptive behaviors problem indices, suggesting that the test was not very good at predicting future behavior.

The authors found only one correlation between individual factors and (future) behavior problem indices (lack of wariness in puppies and behavior problems at 2 weeks post-adoption), indicating that the test had poor predictive (criterion) validity. Moreover, although the test was short (~10 minutes/dog) and did not require extensive training to conduct, the authors did not evaluate the test's repeatability. Nonetheless, the finding that boldness in puppies was associated with behavior problems at 2 weeks post-adoption should be explored further to help identify those dogs at risk of developing problematic behaviors.

Other researchers investigated behavioral and physiological measures of fear in laboratory dogs in response to novel and startling stimuli (King et al., 2003). One hundred eight dogs were exposed to a light/dark box (novel situation), an elevated plus maze (novel situation), a remote-controlled car (novel object), and an opening umbrella (startling stimulus). The light/dark box test (commonly used to assess anxiety in rodents) was adapted for use in dogs. During the test, the dog was placed in a dark, enclosed portion of a box (3 m x 1.5 m x 1.5 m). Time to enter and the total time within the light, open part of the box was recorded as well as the number of entries into the lit compartment and the number of transitions between the dark and light portions of the box. The elevated plus maze, commonly used to assess fear in

animals, consisted of a central square (1 m x 1 m) with four arms (each 3 m long x 1 m wide) forming a “plus” configuration. Two of the arms (closed arms) were surrounded by clear plexiglas walls whereas the other two arms of the maze were open except for 2 cm high edge strips (open arms). The entire apparatus was elevated 1.5 m off the floor. The dog was placed in the central square, and the time taken to enter and the total time within each arm, as well as number of transitions between different segments were recorded. Dogs’ latency to approach and number of approaches toward the remote-controlled toy car and umbrella were recorded, as well as their maximum withdrawal distance and time they remained within a specified distance from those objects.

In a principal-component analysis, three components of the behavioral responses were identified that accounted for 48% of the total variation: Component 1 was suggested to be a measure of a response to novelty, Component 2 a measure of exploration, and Component 3 a measure of response to startling stimuli. In addition, the dogs’ mean heart rate and salivary cortisol concentrations both increased following presentation of the startling stimulus ( $p \leq 0.001$  and  $p = 0.07$  respectively), which the authors interpreted as evidence that the behavioral responses to the stimulus might have been fear-related. The authors cautioned, however, that other motivational systems (e.g., locomotion) could have influenced the behavioral responses.

Those investigators examined the validity of their measures of fear in a later study (Ley et al., 2007) using a cross-over design. Twenty-four dogs were treated with either a placebo or an anxiolytic (clomipramine) for 6 weeks before testing in response to the light/dark box (novel situation), elevated plus maze (novel situation), remote-controlled car (novel object), and opening umbrella (startling stimulus). Dogs approached more quickly and spent more time near the remote-controlled car (Component 1, “novelty”) when receiving clomipramine than when receiving the

placebo. Moreover, there was a tendency for dogs receiving clomipramine (versus when receiving placebo) to approach more quickly and spend more time near the umbrella (Component 3, “fear of startling stimuli”). However, cortisol concentrations measured 10 minutes after the umbrella test were not significantly affected by treatment. Component 2, “exploration”, also was not affected by treatment—which was expected because exploratory behavior does not involve fear or anxiety. The authors concluded that their results, collectively with those of their previous study (King et al. 2003), indicated that dogs’ approach-avoidance behavior, i.e., further distance from and less time spent near the novel and startling stimuli, were measuring different aspects of fear. The practical use of those results to animal shelters, however, remains to be determined.

Behavioral and cortisol responses to various “challenging” stimuli were evaluated in 27 working dogs in the Belgian military to assess whether the dogs were chronically stressed (Haverbeke et al., 2008a). Plasma cortisol measurements and behavioral recordings (via videotape) were made on days 1, 3, 8, 15, 22, and 29. In addition, on days 8 and 29, dogs were exposed to a set of challenges: social (obedience training and protection work), visual (remote-activated toy car), and auditory (sound blast) stimuli. Behavioral responses were recorded only during the presentation of the visual and auditory challenges.

Cortisol concentrations were increased immediately following the first challenge on day 8 (compared to concentrations averaged across days 1, 3, and 8). However, concentrations following the second challenge on day 29 did not increase above concentrations measured prior to the challenge on the same day. Furthermore, dogs’ activity did not increase during the auditory stimulus as compared to their activity averaged over days 1, 3, 15, and 22 (control period). During the visual stimuli (on days 8 and 29), however, dogs were more active than during the control period

despite a decrease in pacing and manipulation of the environment. In addition, dogs showed more half-low postures during the visual-stimulus challenge on day 8 (but not on day 29) than during the control period.

The authors interpreted the higher postures and lack of increase in cortisol concentrations on day 29 (versus on day 8) as indicative of coping with the challenges, and suggested that although the dogs might have experienced diminished welfare, they were not chronically stressed. However, dogs were reported to spend a large percentage of their time (32%) engaged in stereotypic pacing during the control period. Hence, one would have to question the premise that those dogs were not experiencing some degree of stress.

Other researchers have examined more “natural” fear-inducing situations in dogs. Fourteen privately owned male collie dogs reported by their owners to be fearful or fearless of floors and gunshots were subjected to a novel flooring test (comprised of walking the dogs up stairs and across different types of flooring) and a gunshot test (Hydbring-Sandberg et al., 2004). In the floor test, the researchers scored the dogs on a scale from 1 to 4 according to their “hesitation to walk” (as a measure of immobility) and whether they “walked close to the wall” (as a measure of escape/avoidance); each dog was then classified as “floor fearful” or “floor fearless”. When exposed to a gunshot, the dogs’ “initial startle reaction” score was averaged with the dogs’ “degree of fear” score (both on a scale from 1 to 5) to classify each dog as “gun fearful” or “gun fearless”.

The researchers found that dogs who were behaviorally fearful of floors (“floor fearful”) had higher heart rates than dogs who were behaviorally fearless of floors (“floor fearless”); cortisol concentrations, however, did not differ between the two groups. Dogs who showed behavioral signs of fear in response to gunshots (“gun fearful”) had higher heart rates and cortisol concentrations than dogs who were not

fearful of guns (“gun fearless”). Moreover, heart rate and plasma cortisol concentrations remained significantly elevated in “gun fearful” dogs for up to 1 hour following the gunshot. Although heart rate increased significantly following the gunshot in “gun fearless” dogs, cortisol concentrations did not change.

Because behavioral signs of fear in dogs were associated with physiological changes indicative of stress (elevated heart rate and cortisol concentrations) in dogs fearful of gunshots, the authors concluded that behavioral measurements are useful in assessing fear and stress in dogs. However, although the authors described precisely each level of scoring for the hesitation to walk, walking close to the wall, and the startle reactions, they did not explain the behavioral and postural differences between the levels of fear (other than using “no fear, slight fear, obvious fear, very frightened, and terrified”). Without knowing which behaviors (such as crouching, trembling, or yelping) were used to determine the fearfulness score, the usefulness of this scoring is limited.

One of the most common fears reported in companion dogs is fear (or phobia) of thunderstorms. Physiological and behavioral reactivity to a simulated thunderstorm was evaluated in 19 thunderstorm-phobic pet dogs who were reported by their owners to show consistent behavioral changes (e.g., trembling, pacing, hiding, destructiveness, vocalizing) every time there was a storm (Dreschel and Granger, 2005). A 5-minute recording of a thunderstorm was played for dogs while their behaviors were observed. In addition, salivary cortisol concentrations were measured before, and 20 and 40 minutes after playing the recording. In response to the thunderstorm recording, dogs exhibited behavioral signs of fear (including pacing, whining, panting, and hiding). In addition, mean cortisol concentrations increased 207% above baseline values 20 minutes after the recording and remained elevated (150% above baseline) for 40 minutes post-recording. Compared to dogs living in

single-dog homes, dogs from multi-dog households had a smaller percent increase in cortisol above baseline at the 40-minute post-recording sampling. The owners' behavior, however, had no effect on the dogs' cortisol or behavioral responses. The authors acknowledged that the small sample size might have limited the power of the study; nonetheless, the results were highly significant. As they suggested, the impact of the presence of other dogs as a stress-modifying variable should be investigated further (particularly in research and shelter facilities).

### **1.10. In-Shelter Cortisol Concentrations**

Exposing dogs to known acute stressors is an effective way to assess physiological and behavioral measures of stress. Other investigators have measured shelter dogs' cortisol concentrations as a means of evaluating the stressfulness of the shelter environment. In one study, cortisol concentrations were analyzed (using a cross-sectional design) in dogs who had been in a shelter for varying lengths of time; 13 to 24 dogs were sampled on each day (Hennessy et al., 1997). Cortisol concentrations were highest in dogs sampled during the first 3 days in the shelter as compared to concentrations in dogs housed in the shelter for 10+ days. Using a longitudinal design, cortisol concentrations were analyzed in an additional 15 dogs on day 1 and again on day 4 or 5, and compared to concentrations of dogs kept as house pets ( $n = 17$ ). Cortisol concentrations were higher on day 1 than on day 4 or 5 in the shelter, and were higher in shelter dogs on day 1 than in pet dogs sampled in their homes. Although the baseline cortisol concentrations (i.e., before admission to the shelter) of the shelter dogs were unknown, the results suggest that dogs in an animal shelter experience stress as measured by elevated cortisol concentrations above those of pet dogs.

Because sampling blood involves subjecting dogs to a potentially aversive

procedure, many researchers have used less invasive techniques of evaluating cortisol. Urinary cortisol (from naturally voided urine samples) is a non-invasive alternative for assessment of circulating cortisol concentrations (Beerda et al., 1996). Furthermore, urine cortisol concentrations have been shown to reflect circulating cortisol concentrations over several hours preceding urine collection (Jones et al., 1990; Schatz and Palme, 2001). One study longitudinally examined urinary cortisol concentrations in a randomly selected sample of 81 dogs housed in an animal shelter in the UK (Stephen and Ledger, 2006). In general, urinary cortisol/creatinine (C/C) ratios peaked on day 17, after which they steadily decreased through day 31. However, a high degree of individual variability was noted in values on each sampling day. Thus, only dogs with complete data sets for days 2-10 were analyzed for changes in cortisol over time (n = 21). Cortisol peaked on day 2 in three dogs, on day 5 in five dogs, and on day 10 in seven dogs; cortisol decreased from day 2 to day 5 before increasing again on day 10 in six dogs. Urine cortisol concentrations measured in 20 of the same dogs in their adoptive homes 6 months after adoption were significantly lower than concentrations measured while in the shelter on all days except for day 31.

The difference in results between Hennessy et al. (1997) and Stephen and Ledger (2006) might be attributed to differences in dog populations (US versus the UK), shelter staff, sample type (blood versus urine), and management practices. In addition, dogs in the former study were from a more diverse background (owner-relinquished, strays, seized) than dogs in the latter study (owner-surrendered only). Nonetheless, it is evident from both reports that cortisol concentrations in dogs are significantly elevated (as compared to pet dogs) after admission to the shelter. The timing of the peak in cortisol concentration, however, is quite variable among individual dogs.



### **1.11. In-Shelter Behaviors**

In addition to physiological measures, many investigators have sought to identify behavioral indicators of stress (and welfare) in dogs by observing their behaviors in (confined) kennel environments. Researchers in Northern Ireland observed the behavior of dogs over 3 days in an animal shelter to determine whether time in the shelter affected their behavior (Wells and Hepper, 1992). In one trial, the time taken to eat a bowl of food was recorded for 10 stray and 10 unwanted (owner-relinquished) dogs. Both groups of dogs took longer to eat on day 1 than on either day 3 or day 5 suggesting that the dogs were more relaxed by days 3 and 5. In a second trial, an unfamiliar person approached the dogs (in their cages) and stood quietly for 5 minutes. Dogs were scored as “disinterested”, “inquisitive”, or “agitated”. Overall, dogs were significantly more relaxed over time in response to the same unfamiliar person suggesting that the dogs were more accustomed to the person (and possibly the shelter environment) by days 3 and 5. In a third trial, dogs were categorized as “ignorers”, “approachers”, or “responders” in response to ‘Kong Ball’ tossed into the kennel. Most dogs, however, ignored the toy on all three observation days, suggesting that the toy offered minimal or no enrichment.

A second part of the study evaluated the behavior of 10 dogs every 10 minutes over a 6-hour period on their first day in the shelter and again on their third and fifth days. Dogs were classified according to their activity (resting, sleeping, active, or sitting). Overall, dogs spent more time resting (than sleeping, being active, or sitting) on all 3 days (i.e., their behaviors did not change across days). Although the authors concluded that the dogs’ behavior was not adversely affected by a short time in a kennel, they observed a small number of dogs and only on their first, third, and fifth day in the shelter. Moreover, the dogs’ behavior prior to being kenneled was not known. Hence, it is difficult to draw any conclusions from those results regarding

dogs' behavior over time in the shelter.

Other investigators observed the behavior of 18 laboratory beagles under different social and spatial housing conditions (Hetts et al., 1992). Dogs were housed individually for 3 months in each of six different housing conditions (outdoor pen, outdoor run, indoor run without visual contact with other dogs, indoor standard cage, indoor standard cage with 30 minutes of forced treadmill exercise 5 days per week, and small indoor cage) in an 18-month cross-over design. Overall, dogs spent more time moving while in the pens and runs than while in the cages. In particular, dogs in the indoor run (social isolation) spent the most time moving and vocalizing and displayed the highest frequency (27% of observed time) of "bizarre movements" (which included whirling, pacing, circling, and leaping). Dogs in the smallest indoor cages self-groomed and manipulated the enclosure barriers more often (the latter of which the authors suggested was possibly due to restriction of movement) than did dogs in any other housing condition. The results suggest that social isolation (in the indoor run) as well as spatial restriction might adversely affect the psychological well-being of kennel dogs.

The prevalence of behaviors indicative of poor welfare were evaluated over a 6-week period in dogs in animal shelters (Stephen and Ledger, 2005). Dogs from seven shelters throughout the UK were observed during 4 to 10 sessions (of at least 20 minutes each) daily for 6 weeks. During the observation period, 15 behaviors indicative of poor welfare (including repetitive behaviors, panting, polydipsia, inappetence, vocalizations, escape/hiding attempts, and listlessness) were recorded as present or absent. Overall, the most commonly observed behavior was barking (in 24% of dogs), which increased progressively throughout the study. Repetitive behaviors (such as wall-bouncing, pacing, and circling) tended to develop later in the course of the study and increased in incidence over time whereas fear-based behaviors

(including hiding, attempting to escape, and inappetence) developed earlier and decreased over time. The authors noted marked individual variation in behaviors at different sampling periods despite the overall trends and large sample size ( $n = 148$ ). This variability was attributed in part to differences in age, gender, and breed, as well as to differences in design and management practices between shelters. Moreover, the dogs were from different backgrounds (owner-surrendered, stray, returned, abandoned, and seized dogs); stratifying the data (by source of dog) might have reduced some of the variability in the results. Nonetheless, the authors elucidated behaviors indicative of stress that could be used by shelters to identify dogs at risk of having compromised welfare.

### **1.12. Behavior and Cortisol Combined**

Dogs are social animals and, therefore, readily form bonds with conspecifics and humans; severance of those bonds (as when dogs are isolated) can result in distress for the dog. Consequently, the stress of separation from attachment figures (human and canine) has been studied in dogs under various social and housing situations.

In humans, the Ainsworth's Strange Situation (Ainsworth et al., 1978) procedure was designed to observe attachment relationships (and response to separation) between a caregiver and young children (between 9 and 18 months old). During the test, the child is observed while caregivers and strangers enter and leave the room. A modified version of this test was used to assess dogs' behavioral and physiological reactions to isolation in a novel environment (Palestrini et al., 2005). Seventeen pet dogs were placed in an unfamiliar environment, introduced to an unfamiliar person, and briefly separated from their owners (in various combinations) during eight testing episodes. Not surprisingly, dogs had higher heart rates when they were more active and vice versa. However, during episodes when they were isolated

from their owners, dogs vocalized more, spent more of their time staring (orienting) at the door, and were less active than during the control period—but had elevated heart rates. Although this was a small pilot study, the results strongly support the premise that dogs experience emotional stress when separated from an attachment figure in a novel environment—a situation similar to that of dogs relinquished to the shelter environment.

Other researchers evaluated the effects of separation from conspecifics and spatial restriction in laboratory beagles (Beerda et al., 1999a; Beerda et al., 1999b). Following 7 weeks of outdoor group housing, 15 Beagles (in 2 consecutive groups) were placed alone in restricted indoor housing for 6 weeks. Behavioral observations for each dog during both types of housing were made while undisturbed and while exposed to eight different challenges (when introduced into a novel “open field” environment, allowed to escape from their kennel, restrained, walked down an unfamiliar corridor, given a novel object, exposed to a loud noise, given food, and confronted with another dog).

Salivary cortisol concentrations were significantly elevated 20 minutes after transferring dogs from group to individual housing. Investigators noted, however, that the weather conditions for the two groups differed markedly during the outdoor housing condition. Cortisol concentrations tended to increase over 24 days of indoor housing in dogs who had been exposed to pleasant weather, and to decrease in dogs who had been exposed to poor weather while group-housed outside. Moreover, dogs in the poor-weather group responded to a sudden sound blast with a salivary cortisol response 3-times that of the dogs in the pleasant-weather group; however, after 5 weeks of individual housing, salivary cortisol response to noise in all dogs decreased significantly as compared to their response during group housing. The exaggerated cortisol response in dogs exposed to poor weather is indicative of HPA dysregulation,

which can occur in response to a novel aversive stimulus (sound blast) after repeated exposure to the same stressor (poor weather) (Mormède et al., 2007).

In response to indoor individual housing, dogs also showed changes in their behavior (including lower postures and increased frequencies of autogrooming, paw lifting, and vocalization), which the authors regarded as being associated with stress. In addition, some dogs exhibited coprophagy and repetitive manipulation (gnawing) of their kennel during individual housing; this was particularly evident in dogs from the pleasant-weather group. Urinary cortisol, however, was not significantly correlated with any of those behavioral measures.

Overall, the investigators interpreted the incidence of coprophagy and repetitive behaviors as well as increased levels of autogrooming, paw lifting, and vocalizing as behavioral indicators of chronic stress. However, due to the lack of correlations between salivary cortisol and behavioral responses, they warned against measuring only behavior when evaluating stress in dogs. They also suggested that dogs' prior experiences (e.g., to weather conditions) moderated their response to restrictive housing, and that although increased cortisol concentrations and HPA hyporesponsiveness to acute stimuli might occur in dogs under social and spatial restriction, lack of such responses does not exclude the existence of chronic stress. They cautioned, however, against extrapolation of their findings to field situations due to the relatively short period of induced stress (6 weeks), the homogeneity of the dogs (Beagle breed, mean age  $1.6 \pm 0.2$  years), and lack of correction for the number of parameters tested (which might have led to Type-I errors). Moreover, most shelter dogs probably do not come from (outdoor) group living. Hence, the results should be verified before extrapolating to dogs in shelter environments.

In a later study, researchers investigated chronic stress of kenneling by comparing behavioral and physiological parameters of dogs living for at least 1 year in

housing conditions of varying quality (Beerda et al. 2000). A control group (n = 24) was selected from dogs who had been living in private homes (enriched environment). The comparison groups included dogs who had been living under increasingly austere laboratory housing conditions (group II, n = 15; group III, n = 20; group IV, n = 13). The investigators found that urinary cortisol/creatinine (C/C) ratios were highest in the most austere group (which was assumed to be experiencing the highest level of chronic stress) and lowest in the most “enriched” group (pet dogs). The dogs under the most austere conditions also showed high incidences of paw lifting, nosing, and locomotor activities when undisturbed, and rarely displayed high postures. Furthermore, when startled by a slamming door or approached by a researcher, these dogs reacted with high incidences of circling, nosing, body shaking, yawning, ambivalent postures, and displacement behaviors, and frequently changed from one state of locomotion or posture to another.

Although increased paw lifting and behavioral arousal to mild stimuli were displayed by dogs presumed to have the highest degree of (chronic) stress, other behaviors observed (e.g., increased locomotion) were less specific to stress because they could have occurred in different contexts. As noted by the authors, the study examined many parameters simultaneously yet only adopted a comparison-wise alpha rate of  $p < 0.05$  as the level of significance. Although this was done to avoid missing any significant group effects, it is possible that some of their results occurred by chance.

Other researchers have looked at whether prior experience with kenneling would influence a dog’s response to confinement. In one study, dogs (n = 26) entering a shelter in the UK were categorized initially according to their presumed experience with kenneling: those with no known experience (owner-relinquished dogs) and those likely to have had kenneling experience in a shelter (returned and stray dogs) (Hiby et

al., 2006). Behavior and urinary C/C ratios were measured over 10 days. Overall, C/C ratios on the day after admission to the shelter were highly variable among dogs. A general trend, however, was found: on average, C/C ratios decreased in strays and returned dogs, and increased in owner-surrendered dogs throughout the study (days 1 through 10). With respect to behaviors, the frequency of drinking and duration of grooming increased whereas the duration of panting and paw-lifting decreased over time. In addition, dogs who showed an increase in urinary C/C ratios had higher median frequencies of walking or trotting, startling, and drinking throughout the study. Conversely, the reverse was found when observing individual dogs: dogs spent a relatively small percentage of time walking or trotting on days when they had the highest concentrations of morning urinary C/C ratios and vice-versa. Urinary C/C ratios are reflective of cortisol concentrations for the previous hours before the sample is collected (Jones et al., 1990). Because videotapes of the dogs' behaviors were made 20 minutes after urine had been collected, behaviors recorded would not necessarily be reflective of the behaviors that occurred during the preceding hours of sequestration of cortisol in the urinary bladder.

The authors concluded that dogs without previous kenneling experience (owner-surrendered) experienced greater stress in the shelter environment (as evident by their increasing C/C ratios) than dogs with previous kenneling experience (returns and strays). The assumption of previous kenneling experience, however, was not verified. Likewise, stray dogs were grouped with returned dogs without substantiating the assumption that those two groups of dogs were similar. The investigators used previous experience for grouping data for the analyses of C/C ratios, but subsequently regrouped the data according to the dogs' C/C ratio responses (i.e., whether their C/C ratios increased or decreased from day 1 through day 10) for the analyses of behaviors. Because only 69% of the owner-surrendered dogs had increasing C/C ratios and only

69% of the strays and returned dogs had decreasing C/C ratios, this re-categorization of dogs obscured the findings and limited the generalizability of the results to dogs in other shelters.

A later study also evaluated the effects of previous kennel experience on behavior and urinary cortisol concentrations of dogs (Rooney et al., 2007). A group of 1-year-old male Labrador Retrievers were studied before and after being transferred from a home environment to a novel kennel environment at a military training facility. Prior to the study, caretakers systematically habituated 16 dogs to kenneling; caretakers of 15 additional dogs did not habituate them to confinement. Urine was collected from each dog on 7 consecutive days starting 2 weeks prior to arrival at the training facility (baseline). On the day of arrival, C/C ratios increased in all dogs, but concentrations of non-habituated dogs were significantly higher than those of habituated dogs. By the tenth day in the facility, urinary C/C ratios had decreased in both groups; however, the concentrations were still elevated above baseline in the non-habituated dogs. Temporal trends in behaviors also were noted in all dogs: locomotion, vocalization, and paw-lifting decreased over time whereas auto-grooming and time spent in the indoor kennel increased. Between groups, there were no differences behaviorally between the habituated and non-habituated dogs on day 1, but by day 10, habituated dogs displayed a greater frequency of howling and a lower frequency of paw lifting. On average, habituated dogs also spent more time manipulating objects than did non-habituated dogs.

Among individual dogs, no significant correlations were observed between C/C ratios and behaviors. Nonetheless, the authors suggested that manipulation of objects (indicative of play) might be an indicator of good welfare because it was observed more frequently in habituated dogs (who also had lower cortisol concentrations), but noted that spontaneous behaviors might not have been the best



indicators of stress because of the great degree of individual variation. Even so, they cautioned against the exclusive use of cortisol (which can be elevated in non-stressful but arousing situations) in the evaluation of dogs' welfare.

The important finding of that study was that although confinement in a novel environment is stressful to dogs, the impact of the stress can be modified by the dog's previous experiences with kenneling. If shelters knew which dogs did not have prior kenneling experience (and therefore were more susceptible to experiencing stress in the shelter), they could preferentially place those dogs in foster care. Unfortunately, shelters do not always know the prior kenneling experience of dogs entering the shelter. Furthermore, the availability of foster homes in which to place dogs might be limited.

Studies evaluating stress in dogs have found a lot of variability—particularly in dogs' behavioral responses. A potential reason for this variability is differences in individuals' coping styles, defined as “a coherent set of behavioral and physiological stress responses which is consistent over time and which is characteristic to a certain group of individuals” (Koolhaas et al., 1999). Coping styles are influenced by genetics and learning, and can be classified as either reactive (passive) or proactive (active), depending on the behavioral strategy used in response to a perceived stressor. Animals with a reactive coping style tend to respond with inactivity (withdrawal) and low levels of aggression, whereas animals with a proactive coping style tend to display high levels of activity and aggression (fight or flight). Furthermore, animals in the reactive coping group tend to have high HPA axis reactivity to stressors (resulting in corticosteroid release); animals with proactive coping styles show little or no HPA axis reactivity.

In one study, coping strategies of working police dogs were examined in response to potential threats (Horváth et al., 2007). Sixty dogs (individually tethered

to a tree) were approached by a threatening stranger in three different scenarios (dog with muzzle, dog without muzzle, and dog tethered without muzzle but with handler present). Behaviors of the dogs were recorded during each scenario, and saliva samples were collected before and 20 minutes after each session for cortisol assays.

Using factor analysis, three behavioral factors were identified that accounted for 59% of the total variance: “fearfulness”, “aggressiveness”, and “ambivalence”. Using a hierarchical cluster analysis, dogs were classified into three groups based on their standardized factor scores: dogs in group 1 had the highest scores for factor “fearfulness”, dogs in group 2 for factor “aggressiveness”, and dogs in group 3 for factor “ambivalence”. Overall, cortisol concentrations increased from pre- to post-test in the fearful and ambivalent groups, but were moderated by the age of the dog: concentrations were higher post- versus pre-test in dogs 8-11 years old, but not in dogs 2-7 years old. Moreover, age was positively correlated with factors 1 and 3 (“fearfulness” and “ambivalence”, respectively), i.e., older dogs responded more fearfully and/or ambivalently to the threatening stranger than did younger dogs.

Those results support the idea that dogs adopt different coping styles in response to perceived stressors. Dogs in the fearful group behaved as animals with a reactive coping style—they displayed fearful (avoidance) behaviors and had elevated cortisol concentrations following the threats. Dogs in the aggressive group responded with a proactive strategy—they were more active and their cortisol concentrations did not increase post-test. Dogs in the ambivalent group, however, did not fit into either category—they displayed ambivalent behaviors and had elevated cortisol concentrations in response to the perceived threat. As suggested by the authors, this latter group of dogs might be at risk for experiencing stress because they are unable to choose a consistent coping strategy in a threatening social situation. Determining a way to assess coping styles of dogs in shelters quickly might help identify those dogs

who are less able to cope with the shelter environment so that strategies can be implemented to help reduce their stress.

### **1.13. Summary of Studies of Stress in Kenneled Dogs**

In conclusion, various aspects of the shelter environment (noise, novelty, isolation, unpredictability, lack of control) cause psychological stress in dogs. Unfortunately, there is a lot of individual variability in stress responses and measuring behavior is fraught with difficulties of standardization and objectiveness. Nevertheless, certain patterns have emerged: dogs in stressful situations have elevated cortisol concentrations (as compared to companion dogs) and display lowered postures and higher frequencies of oral behaviors (e.g., yawning, lip licking), vocalization, repetitive behaviors, and ambivalent behaviors (e.g., body or head shaking and paw lifting). To best assess the impact of stress on dogs in animal shelters (and any strategies used to reduce it), a combination of physiological and behavioral measures should be used.

### **1.14. Environmental Enrichment for Kenneled Dogs**

There is an increasing trend in animal shelters toward implementing programs aimed at improving (“enriching”) dogs’ environments as a means of alleviating some of the stress they experience while in the shelter. As is the case with use of the word “stress”, the term “enrichment” has been given different definitions depending on the author. Newberry (1995) defined enrichment as “an improvement in the biological functioning of captive animals resulting from modifications to their environment” (Newberry, 1995), whereas Shepherdson (1998) described it as “an animal husbandry principle that seeks to enhance the quality of captive animal care by providing the environmental stimuli necessary for optimal psychological and physiological well-

being” (Shepherdson, 1998; Tarou and Bashaw, 2007).

Enrichment allows animals to satisfy their ethological needs (Schipper et al., 2008), and has been shown to induce structural changes in the brain and enhance learning (van Praag et al., 2000). Dogs in a shelter typically are housed in a barren, isolated, stressful environment. Adding complexity to this environment through enrichment techniques may allow dogs to perform species-typical behaviors (e.g., social interaction, appetitive behavior), and/or result in a reduction of stress.

Various enrichment strategies used for shelter dogs include social contact (canine and human), physical enrichment (toys and cage alterations), and sensory stimulation (visual, olfactory, auditory, gustatory, and pheromonal stimulation). It should be noted that some forms of enrichment fall into more than one category (e.g., human contact provides social and sensory stimulation).

Mental stimulation is another form of enrichment that is often overlooked. Obedience training of shelter dogs is one means of providing mental enrichment. The effects of different methods of training (particularly with respect to the use of punishment) on dogs’ behavioral and physiological measures of stress have been examined by many researchers (Hiby et al., 2004; Lefebvre et al., 2007; Haverbeke et al., 2008b; Haverbeke et al., 2010), and a few studies have examined training methods on the quality of the dog-human relationship (Clark and Boyer, 1993; Lefebvre et al., 2007). However, there is a lack of data regarding obedience training as a form of enrichment for shelter dogs. Although Luescher and Medlock (2009) found that obedience training improved frequency of adoption of shelter dogs, they did not explicitly assess training as a form of enrichment. Reward-based obedience training provides dogs with mental stimulation through the use of operant conditioning—dogs learn that rewards are contingent upon their responses to obedience commands. Furthermore, dogs receive human social interaction, exercise, and gustatory

stimulation (if food rewards are used). Thus, it is reasonable to propose that reward-based obedience training would serve as enrichment for dogs in shelters. However, studies investigating the effectiveness of obedience training as an enrichment strategy for shelter dogs are greatly needed.

### **1.15. Social Contact – Canine**

Evidence suggesting that social contact among dogs ameliorates stress (Mertens and Unshelm, 1996) has prompted many behaviorists to recommend that sheltered dogs be housed in pairs or groups (Wells, 2004b). Several studies have examined the influence of social contact with conspecifics by comparing behavioral and physiological indicators of stress among dogs housed in different social conditions.

One study observed 194 individually- and group-housed dogs in two animal shelters and two commercial laboratories in the UK (Hubrecht et al., 1992). Using a focal animal technique, each dog's behavior was recorded continuously for two 30-minute sessions (one in the morning and one in the afternoon). Individually-housed dogs displayed repetitive behaviors more frequently (4-5% of the observed time) than group-housed dogs (1-2% of observed time). Furthermore, dogs housed in groups were more active and displayed a greater frequency of social and investigatory behaviors; dogs housed individually displayed more passive and non-social repetitive behaviors. In particular, individually-housed dogs were inactive 72-85% of the observed time whereas group-housed dogs were inactive 54-62% of the time.

As the authors noted, data collection, housing, and management practices were not standardized between sites. Moreover, the subjects differed in background, breed, and age. Nonetheless, the significant differences in activities found between dogs in different types of social housing support the premise that group-housing of dogs is preferable to single-housing, particularly in situations where human social contact is

limited.

The behavior of 18 laboratory beagles under different social and spatial housing conditions also were compared by researchers in the US (Hetts et al., 1992). After being housed individually for 3 months (see Section 1.11), six dogs were subsequently housed in pairs for 1 month each in outdoor pen and indoor run conditions. When housed in pairs in either housing condition, dogs spent more time sleeping and tended to spend less time vocalizing than when they had been housed individually. Moreover, the “bizarre movements” noted in dogs during the indoor run/socially isolated condition when housed individually were not seen when they were housed in pairs. Hence, those results suggest that social housing is beneficial to dogs, and may be more important than increased space to their mental well-being.

The former two studies appear contradictory: Hubrecht et al. (1992) found that dogs were more active when housed in groups, while dogs in the Hetts et al. (1992) study were least active when pair-housed. Dogs in the former study were from different animal shelters and laboratories whereas those in the latter were housed in a single laboratory. This discrepancy in populations (including potential differences in management and staff) confuses the comparisons of results, but could explain some of the differences found. Alternatively, the differences might be due to dogs in the former study being inactive but awake when housed alone and dogs in the latter study spending more time asleep when housed in pairs.

In a later study in Germany, shelter dogs housed in groups ( $n = 109$ ) were observed to bark less and display fewer behavior problems (including stereotypies) than dogs housed individually ( $n = 102$ ) (Mertens and Unshelm, 1996). In addition, group-housed dogs were adopted sooner and were returned less often than individually-housed dogs, and fewer owners of group-housed dogs complained of behavior problems within 4 weeks post-adoption than owners of dogs who were

housed individually. Differences in standard management practices, personnel, shelter environment, and dog populations between the two study shelters might have influenced the behavior of the dogs. Nonetheless, those results are promising and support the premise of the previous two studies that group-housing is beneficial to dogs' welfare and should be considered in shelters where feasible.

Increased opportunities for conspecific contact also affected the behavior of young (5-9 months old) beagle dogs ( $n = 48$ ) in laboratory housing in the UK (Hubrecht, 1993). Although dogs provided with additional conspecific contact for 2 months (by allowing them out of their pens to interact with each other for 1 hour each weekday) were more approachable (as assessed by a human-response test), those dogs also chewed items in their cage more frequently after the social contact and barked more throughout the course of the study as compared to dogs not provided extra social opportunities.

The results of the study might have been influenced by the ages of the dogs, which were between 5 and 9 months at the start of the study; dogs of this age group are still developing social skills and may respond differently to social contact with other dogs than would adult dogs. Furthermore, the dogs were already housed in pairs; thus, providing additional (canine) social opportunities might not have been as effective as it would have been if dogs had been housed singly.

Investigators in Ireland studied the effects of providing dogs in a rescue shelter with conspecific visual contact only (Wells and Hepper, 1998). Two hundred twelve dogs were housed in cages from which they could see other dogs in opposite cages; 195 dogs were housed across from empty cages. Dogs allowed visual contact with other dogs spent significantly more time at the front of their pens—presumably to see the other dogs—than dogs without such contact. There was no effect, however, on dog activity or vocalization. Nonetheless, as noted by the authors, allowing dogs to

see each other would encourage them to spend more time at the front of their kennels, which might promote their adoptability by making them more visible to the public. This would only be feasible, however, in shelters already designed to allow such contact.

Many of the previous studies used laboratory dogs as subjects, which are not necessarily comparable to dogs in animal shelters. The former are born and raised in laboratories and, therefore, are acclimated to confinement. Dogs in shelters, however, come from variable backgrounds and typically are not used to restrictive housing, particularly in the context of an animal shelter. In addition, with the exception of Hetts et al. (1992), the aforementioned studies were conducted in Europe. Management practices as well as the general dog population might differ significantly from those in (and across) the US.

Most shelters in the US house their dogs individually to minimize aggression and disease transmission. Implementing pair- or group-housing of dogs would require extensive training of staff members to be able to evaluate effectively which dogs are compatible. In the event of a disease outbreak, group housing would complicate efforts to control the infectious agent. The alternative approach of providing visual contact with other dogs would require re-designing existing shelters; this would be too costly and time-consuming for most shelters (Wells, 2004b).

#### **1.16. Social Contact – Human**

Because communal housing is impractical and epidemiologically unwise for many shelters, finding other means to enrich the environment of shelter dogs is a high priority. Research suggests that human contact is just as—or even more—important to the welfare of dogs as is conspecific contact (Tuber et al., 1996; Wells, 2004b).

In an early study, researchers demonstrated the beneficial effects of human



social contact on dogs' physiological and behavioral stress response (Lynch and McCarthy, 1967). Cardiac (heart rates) and motor responses (foot flexion) were measured in five mixed-breed dogs who had been conditioned to the pairing of a 480 c/s tone for 10 seconds and a 1-second moderate shock (intensity of 60 c/s varying 3-4 mA) to their forelegs occurring at the end of the tone presentation. Dogs were presented with the tone-shock sequence while alone in the experimental room, with a person standing next to them in the room, and while being petted by the person (gently behind the dogs' ears). In the first condition (alone in the experimental room), dogs responded to the tone-shock sequence with tachycardia and foot flexion. When receiving the tone-shock sequence in the presence of a person, dogs showed only mild tachycardia (but with foot flexion in response to the shock). While being petted, however, dogs' motor responses were suppressed, and the direction of their cardiac responses was changed—resulting in a relative bradycardia. Although the sample size in that study was small, the outcome measures were objective. The results clearly demonstrated the effectiveness of petting on mitigating the stress responses in dogs receiving conditioned foot shocks.

The presence of a familiar human also ameliorated the stress response of eight laboratory dogs to an unfamiliar environment (Tuber et al., 1996). Behavior and cortisol concentrations were evaluated while dogs were in their home kennel and when placed in a novel environment, with and without a littermate (with whom they had been housed for several years), or their (human) caretaker. Dogs' cortisol concentrations or behavior did not change when left alone in the home kennel in comparison to when their kennel mate was present (control session). When placed in a novel environment, the dogs' activity and cortisol concentrations significantly increased, even in the presence of their kennel mate. When tested in the novel environment in the presence of their human caretaker, however, the dogs'

glucocorticoid concentrations and activity did not increase. In addition, dogs solicited attention from their human caretaker more often than from their kennel mate while in the novel environment. Although the investigators used a small sample of dogs from a research laboratory, the results are pertinent to dogs in animal shelters inasmuch as the study emphasized both the stressful effects of social separation and the importance of human companionship to dogs over that of dog-dog companionship.

Additional studies also have confirmed the ability of human contact to moderate the stress response in dogs exposed to aversive stimuli. In one study, blood samples were collected from shelter dogs ( $n = 16$  pairs) after which half of the dogs were returned to their kennels while the remaining dogs were provided with human contact (petting and presenting food treats) (Hennessy et al., 1997). After 20 minutes, blood samples again were collected from all dogs. Although there was no effect of petting on cortisol concentrations (i.e., concentrations remained unchanged from pre- to post-interaction), dogs who were petted by a female investigator had significantly lower cortisol concentrations at the post-interaction sampling than dogs who were petted by a male investigator. The authors suggested that the female investigators might have been more effective in reducing cortisol concentrations because, in general, they had more experience with working with dogs.

That potential effect of gender of the human petter on cortisol responses in dogs ( $n = 74$ ) was further explored in a subsequent study (Hennessy et al., 1998). Men and women were trained using a standardized petting technique to reduce any style differences in their interactions with the dogs. In the first experiment, dogs had blood sampled and then were either returned to their cage (control) or were petted in a standardized fashion for 20 minutes after which a second blood sample was taken from all dogs. Analysis of pre- and post-treatment samples showed that cortisol concentrations increased in dogs who were not petted, but not in dogs who were petted

by either a man or a women. In the second experiment, 16 dogs were randomly assigned to either a control group in which blood was collected from the dogs after which they were returned to their cages, or an experimental group in which the dogs were petted for 20 minutes before blood was sampled. The researchers found that petting (in the experimental dogs) did not reduce cortisol concentrations below those of control dogs. In other words, 20 minutes of standardized human interaction was unable to mitigate the HPA response of dogs to the shelter environment. Although with a small sample size, the power of the second experiment was limited, the first experiment yielded promising results regarding the beneficial effects of human interaction on mitigating the stress response to aversive events (e.g., blood collection) that frequently occur in the shelter. Additional or longer sessions of human interaction, with or without other methods of environmental enrichment, might be necessary to reduce the stress response of dogs to the shelter environment per se.

The effects of human contact in moderating the stress response were shown to interact with the quality of diet that dogs received (Hennessy et al., 2002a; Hennessy et al., 2002b). Forty dogs were assigned to one of four groups in a factorial combination of two levels of human contact (with or without) and two levels of diet (premium or standard). Human contact consisted of 20 minutes/day of standardized petting and remedial obedience 5 days per week for 8 weeks; the premium diet included augmented levels of digestible protein, fat, calories, and animal-derived ingredients.

Plasma cortisol concentrations were significantly lower in all dogs on days 19, 33, and 60 (weeks 2, 4, and 8, respectively) than on day 3 (week 0) regardless of group assignment (diet or human interaction). In addition, cortisol concentrations of all dogs increased in response to a test battery of frightening stimuli in a novel environment (described in Hennessy et al. 2001) on day 3 and day 60. However, on day 60 (week

8), the increase in cortisol was less in dogs receiving human interaction than in dogs not receiving the interaction. In particular, the increase in cortisol concentrations in response to the test remained consistent from week 0 to week 8 in the human-interaction group but nearly doubled in the control group. Dogs receiving human interaction also showed less behavioral reactivity and non-directed licking in response to the test battery than did dogs not receiving the interaction. Furthermore, dogs fed the experimental (premium) diet made fewer escape attempts during the testing sessions, but only if they had received the human interaction sessions. Combined, those results emphasize the usefulness of cortisol in conjunction with behavioral measures in assessing stress responses in dogs, and support the premise that the HPA response becomes sensitized over time to the shelter environment (i.e., with continued exposure to stressors) as shown by the nearly doubling of cortisol concentrations in response to the test battery in the control group on day 60 (week 8). In light of the quality of the study design, the size of the differences between groups is unlikely to be spurious even though there were only 10 dogs in each group.

A subsequent study investigated the effects of a 3-week socialization and obedience program on HPA activity and behavior of shelter dogs (Hennessy et al., 2006). Twenty-six dogs either were enrolled in a socialization and training program at a local prison or remained in a control group at the animal shelter. After 3 weeks, compared to control dogs remaining at the shelter, socialized dogs showed significant improvement in response to obedience commands; in response to a novel situation, they displayed less reactivity (less vocalizing and jumping up on the researcher) but more yawning when presented with a remote-controlled toy car (threatening stimulus). Although plasma cortisol concentrations did not change from pretest to posttest, ACTH concentrations increased in both groups. In addition, ACTH and cortisol were positively correlated only during the posttest. The authors interpreted the

neuroendocrine response as indicative of HPA-axis dysregulation in response to prolonged confinement (i.e., stress). The program of socialization and obedience training had positive effects on the dogs' behavior (increased compliance to obedience commands and reduced behavioral reactivity in response to a threatening stimulus). Nonetheless, providing shelter dogs with 3 weeks of that type of program is not practical for most shelters.

A more reasonable program of human interaction (a single 45-minute session) also was shown to benefit shelter dogs (Coppola et al., 2006b). On their second day in an animal shelter, 48 dogs were provided with 45 minutes of playing, grooming, petting, and practicing basic obedience commands. Dogs who received the human contact sessions had lower cortisol concentrations on day 3 than dogs who did not receive extra contact (n = 44). In fact, the dogs not receiving the human contact had elevated cortisol levels on day 3 in comparison to day 2. The results of that study are promising, but must be investigated further to determine whether the benefits of human interaction persist beyond 1 day.

Short bouts of human interaction also were investigated in laboratory-housed beagles (Hubrecht, 1993). Dogs provided with a mere 30 seconds per day of additional handling and grooming for 2 months showed a decrease (by 90% of pre-treatment scores) in chewing of cage fixtures throughout the study. In addition, dogs receiving human contact were noted to be friendlier and more approachable to their handler or a stranger after 2 months (as were dogs receiving additional conspecific contact—see Section 1.15). The brief investment in time required is certainly within reason for shelter staff. Because the dogs in this study were between 5 and 9 months old, however, the results should be replicated with older dogs before concluding that 30 seconds per day of human interaction would have similar benefits in adult dogs.

### **1.17. Physical Enrichment**

Because providing human interaction takes time and personnel, other options of enriching the shelter environment for dogs need to be examined. Some researchers have attempted to enrich the environment of dogs by providing them with toys, but have had inconsistent success. In one study, group-housed laboratory beagles were provided with three different toys (rawhide, Gumabone chew, and plastic tubing) permanently suspended within their pens 10-15 cm off the floor by a spring (Hubrecht, 1993). After 2 months of continuous toy provision, the dogs were observed to spend less time inactive (a decrease of 20%) and chewing the cage furniture (a decrease of 85%), as well as less time interacting with their kennel mates—presumably in favor of manipulating the toys, with which they played for a large proportion of their day (24%). Considering that the dogs were between 5 and 9 months old (an age group that typically spends more time in object play than do older mature dogs), the amount of time they spent playing with the toys is not surprising.

Toys also were investigated as a form of enrichment for dogs in an animal shelter in Northern Ireland (Wells, 2004a). Dogs ( $n = 32$ ) were observed in response to receiving each of five non-treat dispensing toys (squeaky ball, non-squeaky ball, Nylabone® chew, tug rope, and Boomer ball) separately for 6 days. Overall, the dogs spent  $< 8\%$  of the observation time playing with the toys, with their interest decreasing from day 1 to days 3 and 5. Nonetheless, dogs who did interact with the toys tended to prefer ones that could be chewed (particularly the Nylabone®). The author suggested that dogs might have been too distracted by the shelter environment (from noise, interruptions from staff and visitors, etc.) to engage in play with the toys. The adult age of the dogs (mean age = 4.3 years) most likely contributed to their lack of interest.

Some researchers also have provided dogs with kennels or platforms within

their runs as a means of adding complexity to the environment. In a study by Hubrecht et al. (1992) [see Section 1.15], group-housed laboratory dogs provided with kennels within their pens, spent 35% of their time (on average) using the kennel for resting, playing, or to escape other dogs (thereby allowing dogs to exert some control over their surroundings). In a later study [see Sections 1.15, 1.16], Hubrecht (1993) constructed raised platforms in the pens of 12 laboratory dogs (from which the dogs could see other dogs in adjacent pens), and added a vertical board to the front of the bed board to convert the space underneath the platform into a kennel. Those dogs were observed to spend > 50% of their time using the platforms, but little time using the kennel underneath (0.2% of observed time). Although a control group was not evaluated for comparison, the platform provided another dimension (vertical space) and degree of complexity to the pen, thereby providing dogs with more options for utilizing space within their kennels.

Constructing platforms or providing kennel areas to the pens of shelter dogs would be impractical. However, other methods of manipulating the kennel environment have been investigated. Wells and Hepper (2000a) observed dogs behaviors after manipulating the position of their beds within the run and suspending a toy at the front of the cage. Although moving the bed to the front of the cage encouraged dogs to spend more time at that position, it had no effect on their activity or vocalization. Suspending a toy at the front of the cage also did not affect the dogs' behavior (the toys were largely ignored). Nevertheless, as noted in Section 1.5, the benefits of the manipulations were indirect: incidence of dogs adopted during those manipulations increased over the incidence of dogs adopted 1 year prior (control period). However, a later study failed to find any effect of providing blankets or toys in the runs of shelter dogs on frequency of adoption (Luescher and Medlock, 2009). Hence, it remains unclear which, if any, environmental manipulations are likely to

have the greatest benefit for shelter dogs.

### **1.18. Feeding Enrichment**

Because dogs explore their environments with their mouths, feeding enrichment (e.g., food-dispensing toys) is often recommended by behaviorists as a way to provide dogs with oral and mental stimulation. The effects of this type of enrichment were evaluated in a group of kenneled military dogs in the UK (Gaines et al., 2008). Eight dogs were given a food-stuffed Kong™ once daily for 4 months, whereas 14 dogs received a dog biscuit only. Handlers scored their dogs on 11 attributes pertaining to working ability, behavior, and overall health prior to the provision of enrichment and after the 4-month trial period. The only attribute that changed significantly was “ability to learn from being rewarded”, which increased in both groups (albeit slightly more in the enriched group).

Although the enrichment had no discernable effect on the dogs’ behavior, the authors suggested that it might be beneficial as a means of occupying the dogs’ time and providing a source of stimulation in an otherwise barren environment. Even so, their results should be repeated in light of the small sample size and the limited number of behaviors measured in the context of working ability.

The effects of food-dispensing toys also were evaluated in 17 laboratory dogs (Schipper et al., 2008). Behaviors of each dog were videotaped for 20 minutes per day during each of three 5-day trial phases, “pre-toy”, “toy”, and “post-toy”. During the “toy” trial, 8 dogs received a food-enrichment toy (Kong extreme™) containing a mixture of dog biscuits, pieces of bread, and “Kong peanut butter flavored filling paste™” twice daily; 9 control dogs received a sham-treatment, i.e., the same procedures were implemented without actually giving the dogs a food enrichment toy. Videotaped behaviors were scored as states (including 11 locomotion elements and 7



activity elements) or as events (including behaviors such as barking, yawning, paw lifting, stereotypies, and number of behavioral transitions).

Dogs receiving the food-filled Kong extreme™ toy spent 32% of the observed time (on average) interacting with the toy—this did not change during the 5 days of observations (indicating that the dogs did not habituate to the toys). Dogs also were more active than control dogs (as measured by less time inactive, more behavioral transitions, and more locomotor behavior)—but only when receiving the toys. However, a trial by treatment (toy) interaction was found: activity increased from the “pre-toy” to the “toy” trial in treatment (toy) group, but decreased in the control group. Likewise, time sitting decreased in the toy group but increased in the control group from the “pre-toy” to the “toy” trial. Although the ambient temperature might have influenced dogs’ behavior (because dogs had access to outdoors at all times and the temperature varied from 17 to 25°C), Pearson correlations between temperature and toy interaction were not significant. Nevertheless, the authors suggested that the true effect of the toy “could even have been greater than was actually observed” due to the increase in ambient temperature, which would have caused a decrease in activity. In either case, providing food-dispensing toys to dogs in shelters would be a practical way to enrich the shelter environment and stimulate appetitive (foraging) behaviors.

### **1.19. Sensory Stimulation**

As a non-verbal species, domestic dogs must rely on their senses to communicate and interact with conspecifics, interspecifics, and their environment. Thus, it seems quite reasonable that use of sensory stimulation might be a way to enrich the environment of kennelled dogs. Although music is not a “natural” (species-specific) auditory stimulus for dogs, studies showing that it can improve mood and behavior in humans has prompted evaluation of its effectiveness for dogs (Wells, 2009). Researchers in

Northern Ireland examined the effects of audio stimulation on dogs' behaviors in an animal shelter (Wells et al., 2002). Radio stations of human conversation and three types of music (classical, pop, and heavy metal) each were played for 4 hours for 50 shelter dogs. When exposed to classical music, dogs spent more time resting, less time standing, and more time quiet than when exposed the other types of stimulation. Exposure to heavy metal music, however, resulted in dogs spending more time barking. The authors concluded that exposure to classical music might enhance the welfare of shelter dogs by promoting behaviors indicative of relaxation (which also are considered desirable by potential adopters). Implementing the results in shelters, however, might not be feasible if a sound system was not already installed (a plugged-in radio could be exposed to water spray during kennel cleaning). Furthermore, adding sound to an already noisy environment potentially could be detrimental to the well-being of dogs (and persons in the shelter) (Newberry, 1995; Sales et al., 1997). Nevertheless, providing classical music might be an easy method of enrichment in some shelters where noise levels are not excessive.

Olfactory stimulation also has been used as a potential enrichment for shelter dogs. In one study, dogs (n = 55) were exposed to each of four odors (using oil burners) for a 4-hour period for 5 consecutive days, with 2 days of no odor in between each session (Graham et al., 2005a). Exposure to lavender and chamomile resulted in dogs showing more relaxed behaviors and less barking whereas exposure to rosemary and peppermint encouraged dogs to spend more time standing and moving (i.e., alert) and more time barking. Although those odors presumably have limited biological relevance to dogs, their effectiveness in promoting quiet, calm behavior is worth investigating further. However, alternative methods of providing olfactory enrichment should be utilized (such as via a collar impregnated with lavender or chamomile essential oils) due to the inherent dangers of using oil burners in a shelter environment.

Inanimate visual stimulation also appears to influence the behavior of dogs in shelters. Dogs presented with four types of visual images (without sound) on a television screen (blank screen, moving images of dogs, moving images of unfamiliar animal species, and moving images of humans) 4 hours per day for 5 days (2 days in between each stimulus presentation) spent very little time (11%) looking at the television screens (Graham et al., 2005b). During each of the experimental conditions, however, dogs spent less time vocalizing and moving than during the control condition (no visual stimulation), and spent more time at the front of their pens—particularly when images were of conspecifics. Displaying moving images of other dogs on a television screen could encourage dogs to spend more time in public view, which may be perceived as more desirable to potential adopters (Wells and Hepper, 1998). Unfortunately, providing televisions for dogs would be impractical in most shelters.

Dog appeasing pheromone (DAP) is a synthetic analog of a naturally occurring pheromone secreted from the intermammary sulcus by the lactating bitch. Puppies absorb DAP (through openings in the nasal cavity) into the vomeronasal organ, which then transmits signals to the amygdala and hypothalamus where it exerts its “appeasing” effect (Pageat and Gaultier, 2003). The synthetic analog of DAP is marketed in spray, impregnated collar, and room (plug-in) diffuser forms, and its benefits have been studied in various contexts. In a randomized, blind, placebo-controlled study, dogs in an animal shelter were housed in a kennel with an electrical diffuser of DAP ( $n = 37$ ) or a placebo ( $n = 17$ ) for 7 days (Tod et al., 2005). Overall, barking frequency and mean barking amplitude in response to a person walking by the kennel were significantly lower in dogs exposed to the DAP, but peak amplitude was not. Resting and sniffing behavior in response to a friendly stranger (extending his/her hand toward the dog) also was greater in dogs exposed to DAP.

Reducing barking would benefit not only the dogs but also the people in the

shelter. Use of a plug-in diffuser also would be easy to implement in a shelter setting—but possibly cost prohibitive (~\$30 per room per month). Nonetheless, as stated by the authors, the effects of using DAP in shelters (in conjunction with other enrichment programs) on dogs' behavior and welfare warrants further study.

Sensory stimulation appears to be a promising way to enrich the environments of dogs in animal shelters. Although some types of sensory enrichment might not be practical for some shelters (e.g., classical music, aroma therapy using oil burners, pheromonal therapy, inanimate visual stimulation), others are easy to implement (feeding enrichment, pheromone diffusers) and should be evaluated further to determine whether they are indeed effective in ameliorating the stress of the shelter environment and worth the time and money required to implement them.

## **1.20. Conclusion**

In summary, approximately 4 million dogs are surrendered to shelters annually in the US. Most of them are young adult, mixed-breed dogs with behavior problems. Unfortunately, once in the shelter, dogs are exposed to a myriad of stressors (e.g., noise, frequent disruptions, social isolation) that can induce or exacerbate existing problem behaviors. To improve welfare (by decreasing stress) and promote adoptability, many shelters have begun to implement enrichment programs. There are a few studies evaluating particular types of enrichments—but fewer comparing the effectiveness of different programs with one another. If shelters are going to allocate resources to providing these programs, it is important to evaluate which enrichments (if any) are more effective at improving welfare, promoting desirable behaviors, and increasing adoptability of dogs in the shelter. Furthermore, any residual effects of these programs on post-adoptive behavior and retention need to be assessed.

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CHAPTER 2  
THE EFFECTS OF ENVIRONMENTAL ENRICHMENT ON CORTISOL  
CONCENTRATIONS OF DOGS IN AN ANIMAL SHELTER

## **2.1. Introduction**

Millions of unwanted dogs are surrendered to animal shelters in the US every year (Patronek and Glickman, 1994; Patronek et al., 1995; New et al., 2000). Although shelters make every effort to ensure the health and safety of dogs in their care, many of these dogs experience fear and anxiety because of unfamiliar surroundings, social isolation, excessive noises, and unpredictable events in the shelter environment (Beerda et al., 1997; Hennessy et al., 1998; Hennessy et al., 2001). The resulting psychological stress induces a profound hypothalamic-pituitary-adrenal (HPA) system activation that results in a measurable increase in circulating cortisol (Beerda et al., 1996; Hennessy, 1997; Mormède et al., 2007). Thus, cortisol (as a measure of the stress response) may be used as an indicator of a dog's mental well-being.

Many researchers have attempted to reduce the stressfulness of the shelter by enriching dogs' environment with human social contact. The presence of a human caretaker prevented an increase in cortisol concentrations in laboratory dogs when placed in a novel environment (Tuber et al., 1996), and gentle human contact mitigated the cortisol response in shelter dogs exposed to various acute stressors (venipuncture, novel and startling stimuli) (Hennessy et al., 1998; Hennessy et al., 2002a; Hennessy et al., 2002b). Even a single 45-minute session of dog-human interaction in an animal shelter (which included petting, playing, and practicing obedience commands) resulted in lower cortisol concentrations the following day as compared to shelter dogs not receiving human contact (Coppola et al., 2006).

Other researchers found that shelter dogs receiving intensive socialization and obedience training by prison inmates demonstrated greater improvement in response to obedience commands (as compared to dogs who remained in the shelter and did not receive human socialization or training)—but not in their cortisol responses to an unfamiliar person or remote-controlled toy car in a novel environment (Hennessy et

al., 2006). In a later study (Luescher and Medlock, 2009), daily obedience training enhanced adoptability of shelter dogs. That study, however, did not examine the effect of training on in-shelter cortisol concentrations.

Because providing human interaction or obedience training requires time, personnel, and money, other options of enriching the shelter environment of dogs (e.g., with toys) have been examined. Young laboratory dogs showed interest in novel toys suspended in their kennels—even after 2 months (Hubrecht, 1993), whereas shelter dogs largely ignored most toys presented (Wells, 2004). Kennelled dogs engaged in more appetitive behaviors (eating) and were more active when provided with a food-filled toy (Schipper et al., 2008). To our knowledge, however, the effects of providing food-dispensing toys on cortisol concentrations in shelter dogs have not been examined.

Our objectives were to investigate the effects of four enrichment programs (twice-daily walking alone or with either daily provision of food-filled toys, daily human handling, or daily obedience training) on: 1) physiological and behavioral measures of stress; 2) adoptability (frequency of and time to adoption); and 3) frequency of desirable and undesirable behaviors and retention of adopted dogs in their new homes. Our focus in this report is on the dogs' physiological stress responses as reflected in blood and urinary cortisol concentrations. Our hypothesis was that the enrichment programs (particularly those involving human contact) would differentially affect cortisol concentrations in shelter dogs.

## **2.2. Methods**

A clinical trial evaluating four enrichment strategies for dogs frequently used by animal shelters was conducted in an open-admission shelter serving a community of urban and rural areas in upstate New York. The enrichments were: 1) walks outdoors

twice-daily (Walking); 2) twice-daily walking plus a food-dispensing toy once daily (Toy); 3) twice-daily walking plus gentle human interaction for 15-20 minutes once daily (Petting); 4) twice-daily walking plus obedience training for 15-20 minutes once daily (Obedience).

Dogs of various breeds and sex were recruited from April 2007 through November 2008. During this time the shelter admitted 5,907 dogs of which ~ 53% (3,115) were adopted, 37% (2,215) were euthanized, 6% (354) were returned to their owners, and 4% (223) died or were transferred to another facility. The mean length of stay for all dogs (as reported by the shelter) was 9.4 days.

### **2.2.1. Dogs and Housing**

Apparently healthy (as assessed by the shelter veterinarian) owner-surrendered and stray dogs 10 to 24 months old who passed the shelter's standardized behavioral evaluation (described below) were eligible initially for inclusion in the study. Dogs seized in cruelty cases, returned to the shelter by a previous adopter, relinquished in pairs, or transferred from another shelter were excluded. Enrollment was suspended periodically due to crises arising in the shelter (e.g., kennel cough outbreaks, staff illnesses, staff traveling to assist with the aftermath of hurricane Ike, etc.). As a result, during the first month of enrollment, the number of age-eligible dogs was less than originally estimated; therefore, we expanded the age requirement to include dogs 8 to 48 months old. Similarly, 11 months into the study, it became clear that the number of eligible stray dogs was too few to achieve the estimated sample size of 100 strays; thus, we excluded stray dogs from the study.

Dogs were housed in a designated adoption suite within the shelter. The suite consisted of six kennels (labeled A through F), each of which was 117 cm wide by 274 cm long and divided by a pulley-operated door to assist in cleaning. Kennels were

cleaned between 8 and 11am daily and thereafter as needed. All dogs were provided with raised beds in the front section of their kennels. Dogs could not see or physically interact with dogs in adjacent kennels. Throughout the study, members of the public could view the dogs through windows along the front wall or walk into the suite and interact with the dogs. The rear of the kennels was accessed through a secured section of the shelter and was not available to the public.

The Cornell University Institutional Animal Care and Use Committee approved the use of shelter dogs in this study. In addition, all authors completed an education program for the care and use of research animals.

### **2.2.2. Allocation to Treatment and Sample Size**

The first dog was assigned to an enrichment group using a computer-generated random number from 1 through 4 (1 = Walking, 2 = Toy, 3 = Petting, 4 = Obedience). Thereafter, enrichments were assigned systematically to each dog according to a previously-generated table. For example, if the first dog was randomized to enrichment group #3 (Petting), then the next eligible dog was assigned to enrichment group #4 (Obedience), the third dog to enrichment group #1 (Walking), and so forth.

One person (author PJP) generated the allocation sequence and one shelter staff-person assigned dogs to enrichment groups using that sequence. Due to the limited number of shelter staff available to assist with the study, the person assigning dogs to enrichments was also involved in other aspects of the study (including behavioral evaluations of dogs). To minimize bias in allocation to enrichment group, each dog was assigned to a group according to the time/day stamp received when the dog entered the shelter. Therefore, if two dogs were evaluated on the same day, the dog who had been relinquished earliest was assigned to the next enrichment group in the sequence.

Blinding of the shelter staff was not possible due to the nature of the enrichments and because staff could access the enrichment-group information for each dog. However, efforts were made to keep the enrichment-group assignment list and dogs' treatment sheets out of plain view. Moreover, laboratory technicians analyzing cortisol samples were blinded to each dog's enrichment group.

Changes between baseline cortisol concentrations (on Day 1) and Day 4 for each group were estimated from published data (Beerda et al., 2000). Using a sample size estimation module for one-way ANOVA, the sample size of 25 dogs per group was derived making the following assumptions: the corrected sum of squares was estimated as 7.7 ng/ml, the standard deviation as 4.5 ng/ml, and statistical power was set at 80% with an alpha error rate of 0.05.

### **2.2.3. Management of Dogs on Trial**

At the time of admission, all dogs in this shelter received a parenteral vaccine to protect against the distemper virus, adenovirus-2, parainfluenza virus, and parvovirus, and an intranasal vaccine for *Bordetella bronchiseptica*, parainfluenza virus, and adenovirus-2. In addition, all dogs were vaccinated for rabies prior to adoption. Following the initial vaccinations, all dogs were placed in a holding kennel. Behavioral evaluations were performed on dogs of eligible age and health status within 24-72 hours of admission using a modified version of the Sternberg Assess-a-pet™ procedure (Sternberg, 2002). Staff members performing the assessments were trained by a certified animal behavior consultant who investigated the evaluation procedure (Bollen and Horowitz, 2008). Briefly, the behavioral assessment consisted of nine component subtests (cage-presentation test, sociability test, teeth-exam test, handling test, arousal test, food-bowl test, possession test, stranger test, and dog-to-dog test) during which each dog's reactions were observed (Appendix A). Dogs could

fail a component of the overall test, but still be made available for adoption. Dogs who exhibited serious aggression (lunged while growling and snarling, or attempted to bite the evaluator) during any of the subtests and dogs who failed three or more component subtests failed the entire evaluation and were not made available for adoption. For dogs who passed, the day of behavioral evaluations was designated as Day 1 of the study, which meant that dogs had been in the shelter from 1 to 3 days prior to enrollment (Figure 2.1).

Approximately 2 hours after passing the behavioral evaluation, each dog was taken to a designated treatment room where blood was collected for cortisol evaluation and heartworm testing. The dog then received a physical examination and intestinal de-worming with Strongid® or Drontal® Plus. At this time, the dog was assigned to an enrichment group (as described earlier) and walked outside for urine collection for cortisol evaluation. The dog then was placed in a kennel in the suite designated for the study.

The usual protocol in this shelter was to neuter owner-surrendered dogs on the fourth day in the shelter. However, to standardize the protocols across dogs and ensure that all dogs had a minimum of three consecutive days of enrichment prior to neutering, all dogs on trial were neutered (if needed) on Day 5 of the study, on which day enrichments were suspended. Enrichments resumed the following day. Dogs in this shelter were typically available for adoption as soon as they were placed in the adoption area. However, dogs in the study were made available for adoption on Day 8 of the study (Figure 2.1) to ensure that each dog had a minimum of 6 days of exposure to their enrichment and 3 days of sample collection (Days 1, 4, and 8) for cortisol determinations. Signs on the dogs' cages in the adoption area indicated that the dogs were part of a study and not available for adoption until a specified date (Day 8 of the study). The public could, however, interact with the dogs as described above and

express interest in adopting a dog. All dogs received their enrichment daily and remained in their respective enrichment groups until they were adopted or until Day 28 of the study, whichever came first.

Any dog in the study who became ill, aggressive, or appeared to be adversely affected by the study enrichment (as determined by shelter staff and the first author) was removed from the study. Moreover, if a dog remained in the shelter beyond 28 days, the shelter manager and senior dog trainer reassessed the dog's status and instituted an enrichment they believed was in the best interest of the dog. These dogs were moved from the study suite to the general adoption area; however, their cortisol data until their time of removal from the study were included in the final analyses.

#### **2.2.4. Enrichments**

The standard care for all dogs in this shelter was twice-daily 10- to 15-minute walks outdoors. Dogs in all groups received this enrichment. Persons walking the study dogs were instructed not to practice basic obedience commands with them during the walks. Shelter staff members participating in the enrichments were assigned to particular kennels (designated A through F) and were responsible for dogs in their assigned kennel throughout the study. Each person recorded the day and time (start and finish) he or she provided enrichments to the dogs (including walks) to assess compliance. All staff members participating in the enrichments were trained by the first author (PJP) prior to the start of the study to standardize treatments. Adherence to the enrichment protocols was emphasized at staff meetings held approximately every 6 months during the course of the study. Moreover, a written protocol detailing the enrichments was available to staff members at all times. The four enrichment groups were:



1. **Walking** – Dogs were walked twice daily by their assigned shelter staff member.
2. **Toy** – Dogs were walked twice daily by their assigned shelter staff member. In addition, dogs received an appropriate-sized Kong® toy once daily between 2 and 3 pm. Kongs® were filled with 2/3 dry and 1/3 canned dog food, and topped off with 1 to 2 teaspoons of peanut butter. Kongs® were frozen for at least 24 hours prior to giving them to dogs.
3. **Petting** – Dogs were walked twice daily by their assigned shelter staff member. In addition, dogs received 15-20 minutes per day between 2 and 3 pm of standardized petting and massaging by a shelter staff member who was trained by the first author. The protocol for interacting with the dogs, detailed below, is based on that described by Hennessy et al. (1998).
  - a. The petter attempted to sit with the dog in his/her kennel.
  - b. The petter *gently* encouraged the dog to lean against him/her by having the dog sit or lie down. [NOTE: The dog's size and controllability were factors in the position.]
  - c. The petter used long, firm strokes of the hand from the dog's head to the hindquarters or applied a deep massaging motion to the dog's shoulder, back, and neck muscles.
  - d. The petter used medium to firm pressure in order to massage the underlying muscle (not just the skin)—adjusting the actual amount of pressure applied according to the dog's response.
  - e. Throughout the session, the petter spoke to the dog in a calm and soothing voice.

**4. Obedience** – Dogs were walked twice daily by their assigned shelter staff member. In addition, dogs participated in 15-20 minutes per day between 2 and 3 pm of standardized obedience training. Dogs were taught basic obedience commands (sit, down, and sitting when approached in the kennel) and to walk on a leash (as dictated by the shelter’s obedience protocols) using positive and negative reinforcement.

#### **2.2.5. Demographics**

Age, sex, and neuter status were recorded for all dogs entering the shelter. The shelter staff estimated age based on dentition if date of birth was unknown. Weights were obtained on all dogs during the physical examination. Any dog who was presumed to be purebred was assigned a special adoption fee (which was greater than the standard fee). The presence of a special fee was recorded as a yes/no variable.

#### **2.2.6. Study Outcomes**

Blood samples were collected for cortisol determinations (as a physiological indicator of stress) in the shelter on Days 1, 4, and 8 for all dogs, and on Days 14, 21, and 28 for dogs still remaining in the shelter. Because acute environmental stressors (e.g., sudden, loud noises) prior to blood collection could have elevated blood cortisol concentrations (which measured instantaneous cortisol concentrations), urine samples were collected for evaluation of cortisol-to-creatinine ratios (which measured cortisol production over several hours).

#### **2.2.7. Blood Collection**

Early in the study, cortisol determinations were made from blood plasma. Blood samples were drawn from the cephalic vein into an EDTA vial to the “fill volume”.

The vial was inverted several times to mix the anticoagulant and then immediately centrifuged. Plasma was extracted from the centrifuged sample into a plastic tube and frozen. The prompt centrifugation required for plasma was difficult for shelter staff to perform due to their busy schedules. Thus, the remaining cortisol determinations were made from serum. Data from dogs for whom the type of sample (plasma or serum) was not consistent across sampling days were excluded from analysis of cortisol concentrations across time to avoid comparing plasma to serum cortisol within dogs. The numbers of plasma versus serum blood samples are listed by enrichment group in Table 2.1.

For serum cortisol evaluation, blood samples were collected from the cephalic vein into plain red-top tubes (without any serum separator). The blood was allowed to clot at room temperature for up to 1 hour. Samples then were centrifuged after which serum was extracted into a plastic collection tube and frozen. All samples (plasma and serum) were frozen at -20° C until batch shipment to the New York State Animal Health Diagnostic Center (AHDC).

All blood sampling was performed in the dogs' kennels by experienced veterinary technicians who did not participate in any other aspect of the study: this avoided any negative association of the sampling procedure with persons providing enrichment for the dogs. Samples were collected on Days 1, 4, 8, and on Days 14, 21, 28 for dogs remaining in the shelter. All blood samples were collected between 8 and 9 am to minimize any influence of time of day on cortisol determinations. Veterinary technicians collecting blood recorded the start and finish times for the sampling procedure to assess the influence of blood-collection (and handling) time on cortisol concentrations.

**Table 2.1.** Numbers of plasma and serum blood samples by enrichment group.

	Walking	Toy	Petting	Obedience
<b>Day 1</b>				
Plasma	3	2	3	2
Serum	20	21	23	21
<b>Day 4</b>				
Plasma	3	2	3	2
Serum	20	23	18	17
<b>Day 8</b>				
Plasma	3	1	3	2
Serum	19	16	20	14

#### **2.2.8. Urine Collection**

Urine samples were collected into a plastic cup using a free-catch technique. On Day 1 of the study, urine was collected in the afternoon following temperament testing and blood sampling. Thereafter (on Days 4, 8, 14, 21, and 28), urine samples were obtained during morning walks (after blood samples were drawn). After collection, the urine sample was transferred to a plastic collection tube and frozen at -20° C until batch shipment to the AHDC.

#### **2.2.9. Radioimmunoassay**

Plasma cortisol concentrations were measured using a commercially available radioimmunoassay kit (Coat-A-Count® by Siemens Healthcare Diagnostics, formerly Diagnostic Products Corporation, Los Angeles, CA), which previously was validated for use in dogs (Lee et al. 1991). The intra-assay coefficients of variation for four canine samples with mean values of 1.55, 2.95, 5.62, and 13.43 µg/dL were 0.10, 0.04, 0.03, and 0.03, respectively. The inter-assay coefficients of variation for five quality-control canine samples with mean values of 2.79, 3.09, 4.89, 6.43, and 10.12 µg/dL

(tested in 10 separate assays) were 0.12, 0.11, 0.08, 0.07, and 0.04. The minimum detection limit of the assay was 0.2 µg/dL.

Urine cortisol concentrations were measured using the same radioimmunoassay kit as for plasma cortisol, and urine creatinine concentrations were measured using a Roche Modular P Chemistry Analyzer (Roche Diagnostics, Indianapolis, IN). The urine cortisol:creatinine ratio was calculated from these two measurements (reference range was 1.2-5.0) as previously described for use in dogs (Jones et al. 1990).

#### **2.2.10. Statistical Analysis**

The percentage of walks received, and percentage of treatments (excluding twice-daily walks) received, and median age (none of which were normally distributed) were compared across enrichment groups using Kruskal-Wallis tests. Comparability across enrichment groups of weight (which followed a Gaussian distribution) was assessed using a one-way ANOVA, and of sex and prior neutering status (recorded as yes or no) using Pearson chi-square ( $\chi^2$ ) tests of independence.

To achieve normality of the data and homogeneity of the variances, a natural logarithmic transformation was applied to blood cortisol values. However, blood cortisol results are presented with non-transformed data (using medians and inter-quartile ranges) to facilitate the reader's interpretation.

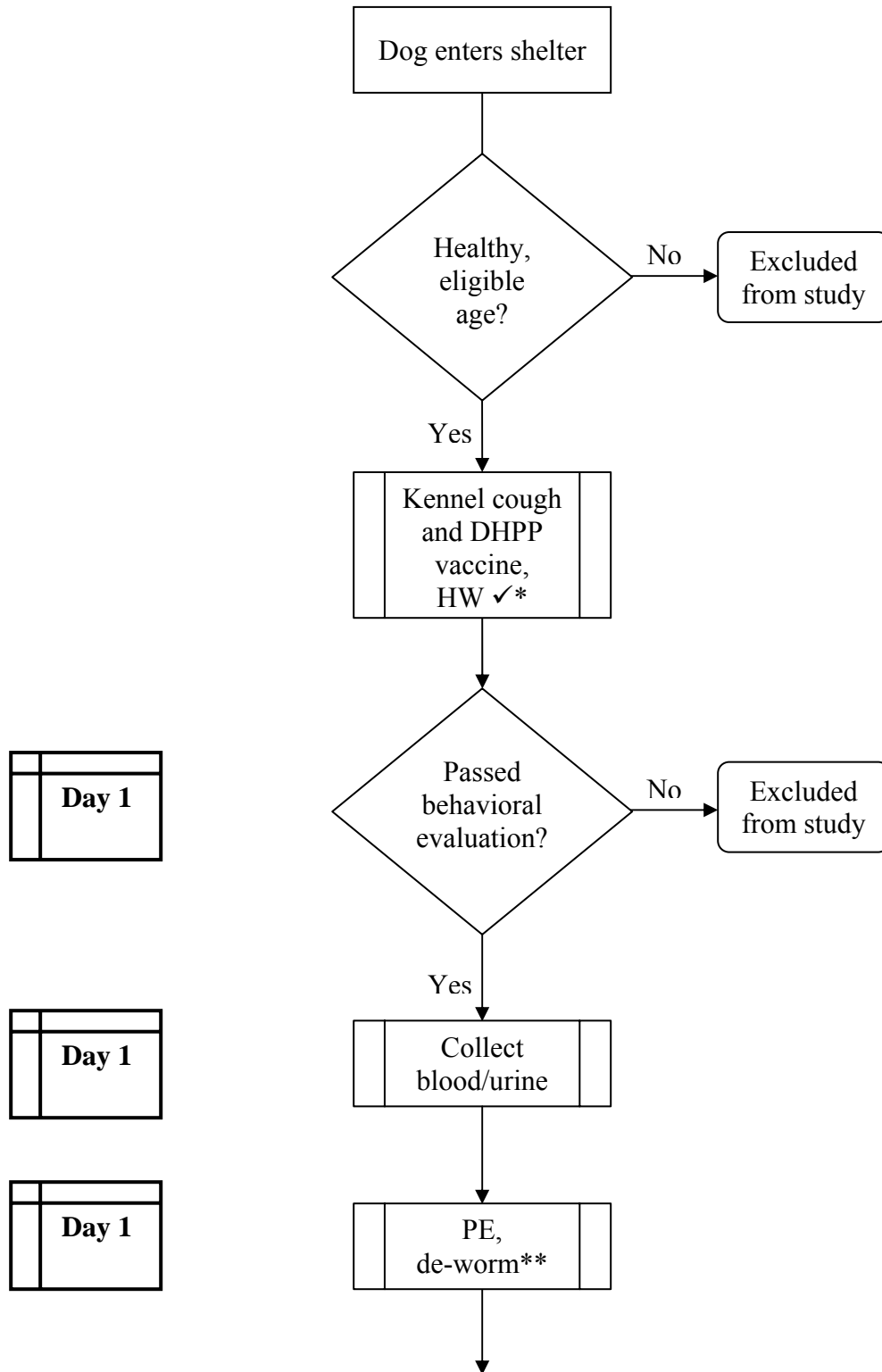
Some dogs were neutered in the shelter on Day 5. Thus, we assessed any residual effects of the stress of surgery on cortisol concentrations on Day 8 (i.e., whether in-shelter neutering confounded comparisons of cortisol across groups): mean cortisol concentrations (on Day 8) were compared between dogs neutered on Day 5 and dogs neutered prior to enrollment (regardless of enrichment group) using an independent 2-sample *t*-test.

Because the number of days that dogs were in the shelter before being enrolled in the study might have affected blood cortisol concentrations on Day 1, the relationship between Day 1 blood cortisol and days-in-shelter (which was non-Gaussian) was evaluated using a Spearman's rank correlation. Likewise, because time to collect blood samples on all days might have affected the corresponding cortisol concentrations, any monotonic associations between blood-collection time (which was non-Gaussian) and cortisol concentrations were evaluated using Spearman's rank correlations for each sampling day. Spearman's rank correlations also were used to test for linear associations between blood cortisol concentrations and urinary cortisol:creatinine ratios for each sampling day.

Paired *t*-tests were used to assess changes in blood cortisol concentration *within* each enrichment group between Days 1 and 4, and between Days 4 and 8. Mean cortisol concentrations were then plotted for each group on Days 1, 4, and 8. Because the relationships between mean cortisol concentrations and day of sampling across enrichment groups were not uniformly linear, a multivariable least-squares regression model was used to evaluate separately the mean changes in blood cortisol concentrations between Days 1 and 4 and between Days 4 and 8 among enrichment groups while adjusting for potential confounders (neutering status, sex, age, and weight). In light of the small numbers of dogs within groups, interaction terms were not evaluated. Model selection was not used because all potential confounders were forced to remain in the model.

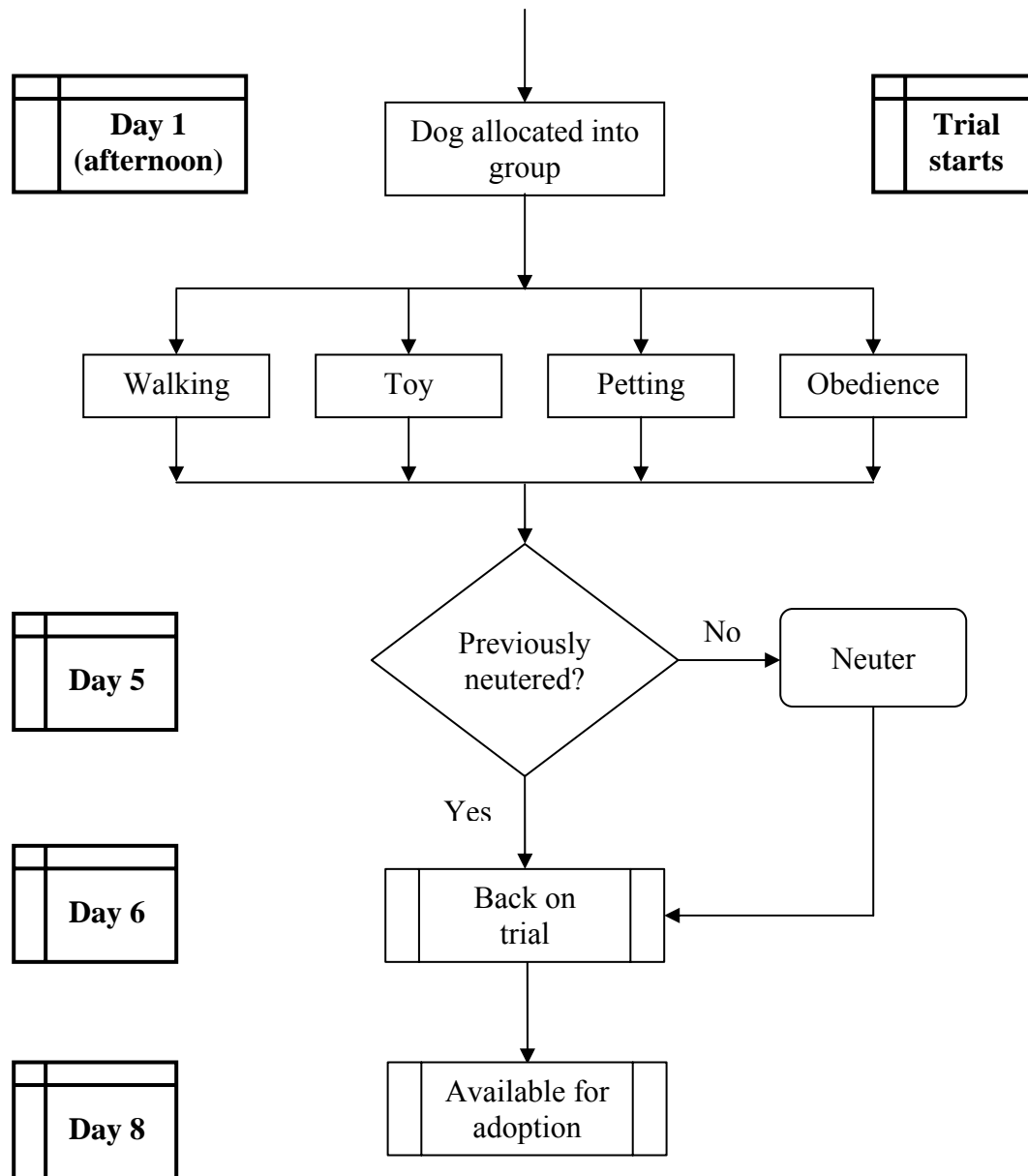
Statistical significance was set at  $p < 0.05$  and all tests were 2-tailed. Because multiple within-group comparisons were made between Days 1 and 4 and Days 4 and 8, adjusted *p* values for multiple comparisons (using a Bonferroni correction) are included in the text in addition to unadjusted *p* values. All statistical analyses were performed using JMP 8.0 (SAS Institute, Cary, NC, USA).

**Figure 2.1.** Schematic of the flow of dogs through the study.





**Figure 2.1** (Continued)



\* Kennel cough vaccine = an intranasal vaccine for *Bordetella bronchiseptica*, parainfluenza virus, and adenovirus-2; DHPP = vaccination for distemper virus, adenovirus-2, parainfluenza virus, and parvovirus; HW ✓ = heart worm check

\*\* PE = physical exam; de-worm = intestinal de-worming with Strongid® or Drontal® Plus

## **2.3. Results**

### **2.3.1. Descriptive Statistics and Preliminary Analyses**

One-hundred eight dogs were enrolled in the study between April 2007 and November 2008, of which 16 were withdrawn prior to being adopted. One dog each in the Toy, Petting, and Obedience groups were withdrawn soon after enrollment (before treatments started) because of health issues not apparent at the time they were randomized. In addition, two dogs in the Obedience groups were withdrawn soon after enrollment (before treatments started) because of observed aggression and one dog in the Obedience group was returned to her owner soon after enrollment (before she received any treatments). Reasons for withdrawal within each enrichment group are provided in Table 2.2. Data from withdrawn dogs (who had at least one blood sample taken) were included in the cortisol analyses.

Most dogs were adopted on or soon after the day they were made available for adoption (Day 8). As a result, no more than three dogs per group were sampled on Days 14, 21, or 28; hence, no analyses were performed for those days. Numbers of samples analyzed on Days 1, 4, and 8 are listed in Figure 2.2.

Not all treatments were administered to every dog (because of staff shortage, time constraints, or human illness). The median percentage of walks received from Day 1 to 8 was 89% for the Walking group, 86% for the Toy and Petting groups, and 93% for the Obedience group; this did not differ among groups (Kruskal-Wallis  $\chi^2 = 1.27, p = 0.74$ ). The median percentage of treatments received from Day 1 to 8 (excluding twice-daily walks) was 76% for the Toy group and 71% for the Petting and Obedience groups; this also was not different among groups (Kruskal-Wallis  $\chi^2 = 0.12, p = 0.94$ ).

**Table 2.2.** Numbers of dogs enrolled and subsequently withdrawn from the study and reasons by group.

	<b>Walking</b>	<b>Toy</b>	<b>Petting</b>	<b>Obedience</b>
<b>Randomized</b>	27	27	27	27
<b>Withdrawn</b>	2	2	4	8
<i>Before treatments started</i>	0	Health (n=1)	Health (n=1)	Aggression (n=2) Health (n=1) Returned to owner (n=1)
<i>After treatments started, but before Day 4</i>	0	0	0	Health (n=1)
<i>Between Day 4 and Day 7</i>	Aggression (n=1)	Health (n=1)	0	Health (n=1)
<i>After Day 7 but before adopted</i>	Aggression (n=1)	0	Aggression (n=2) Other* (n=1)	Aggression (n=1) Health (n=1)
<b>Remaining</b>	25	25	23	19

\*Animal withdrawn due to shelter error

The age of dogs in the study ranged from 8 to 48 months (median 12 months; 1<sup>st</sup> quartile = 10 months, 3<sup>rd</sup> quartile = 18 months); only 4 dogs (1 per group) were > 24 months old. The mean weight of all dogs was 20.0 kg (SD = 9.7 kg). Age, weight, sex, and prior neutering status of dogs were not different among enrichment groups (Table 2.3; all  $p \geq 0.11$ ).

**Table 2.3.** Distribution of age, sex, prior neutering status, and weight of dogs in each enrichment group.

	Walking	Toy	Petting	Obedience
<b>Age (months)</b>				
1 <sup>st</sup> quartile	9	9	10	12
Median	12	12	12	18
3 <sup>rd</sup> quartile	18	18	12	24
<b>Weight (kg)</b>				
Mean	18.0	21.0	18.8	22.3
SD	11.0	8.9	11.0	7.4
<b>Sex</b>				
Female	8 (30%)	12 (46%)	11 (41%)	11 (44%)
Male	19 (70%)	14 (54%)	16 (59%)	14 (56%)
<b>Prior neutering status</b>				
Neutered	12 (44%)	6 (23%)	7 (26%)	10 (40%)
Intact	15 (56%)	20 (77%)	20 (74%)	15 (60%)

### 2.3.2. Cortisol Analyses

Day 1 referred to the day dogs were enrolled in the study. Seventy-one dogs entered the shelter 1 day before enrollment into the study, 19 dogs entered 2 days and two dogs entered 3 days prior to enrollment. However, days-in-shelter prior to Day 1 was not significantly correlated with blood cortisol concentrations on Day 1 (Spearman's  $\rho = 0.15$ ,  $p = 0.18$ ).

Urinary cortisol:creatinine ratios were moderately but significantly correlated with blood cortisol concentrations on Day 1 (Spearman's  $\rho = 0.48$ ;  $p = 0.006$ ), Day 4 (Spearman's  $\rho = 0.44$ ;  $p = 0.003$ ), and Day 8 (Spearman's  $\rho = 0.59$ ;  $p < 0.0001$ ). The median time to draw blood was 2 minutes on Day 1 (inter-quartile range = 1-2 minutes), 2 minutes on Day 4 (inter-quartile range = 1-2 minutes), and 1.5 minutes on Day 8 (inter-quartile range = 1-2 minutes). There was no significant correlation between time to collect blood samples and cortisol concentrations on any day

(Spearman's  $\rho$ ; all  $p \geq 0.31$ ). Blood cortisol concentrations on Day 8 (post-surgical) were greater in dogs who had been neutered while in the shelter (Day 5) compared to dogs who were neutered prior to entering the shelter ( $t$  ratio = 2.18;  $p = 0.03$ ). Hence, neutering status was included as a potential confounder in the analyses of changes in blood cortisol concentrations among enrichment groups across days.

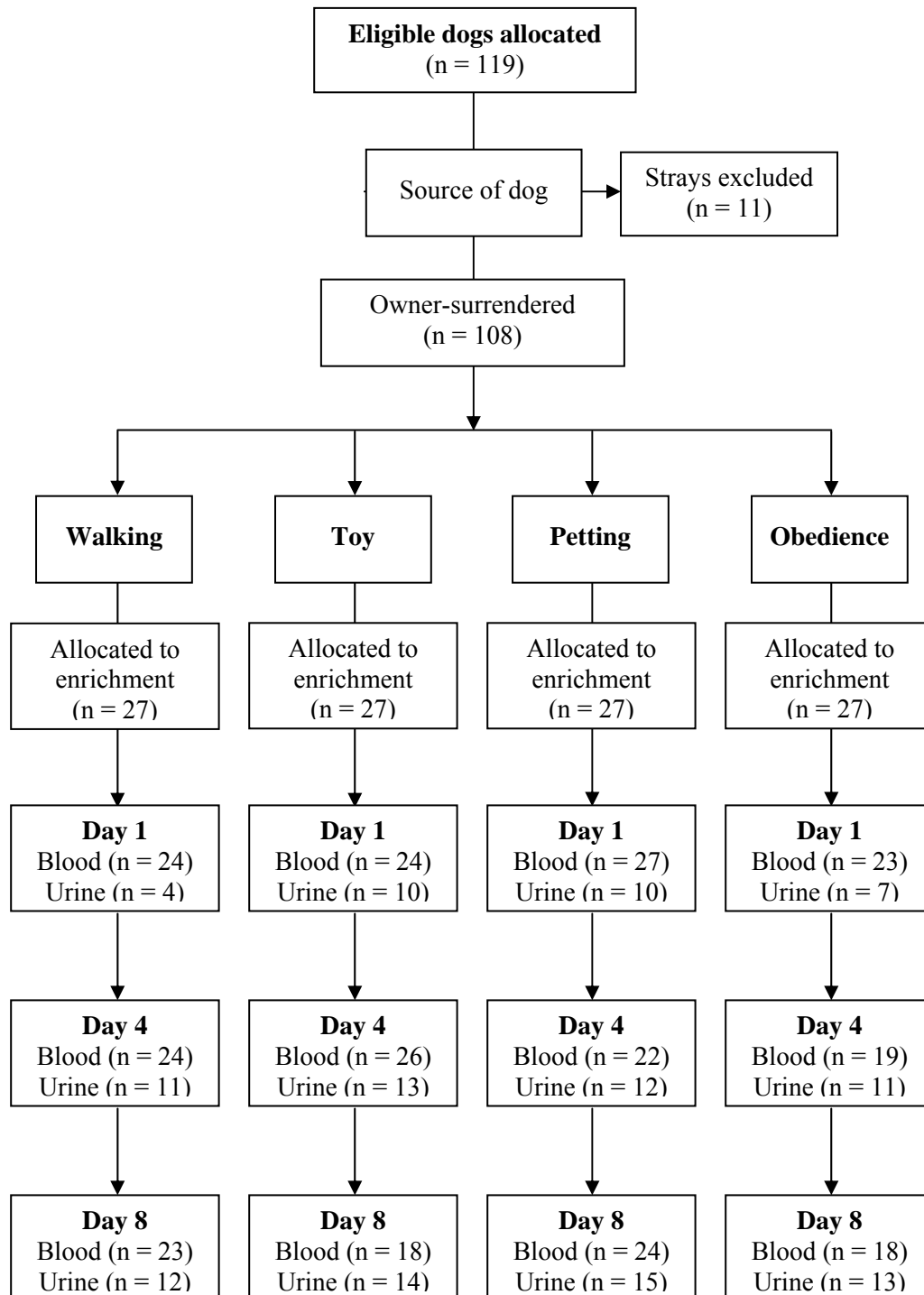
Median baseline (Day 1) blood cortisol concentrations ( $\mu\text{g/dL}$ ) by enrichment group are given in Table 2.4. Within each group, the mean log-cortisol concentrations did not change significantly from Day 1 to Day 4 (paired  $t$ -test; all  $p \geq 0.22$ ; Figure 2.3; Table 2.5a). After controlling for the potential confounders neutering status, sex, age, and weight, the mean differences in log-cortisol concentrations from Day 1 to Day 4 also were not different among enrichment groups ( $F(3,76) = 0.97$ ;  $p = 0.41$ ).

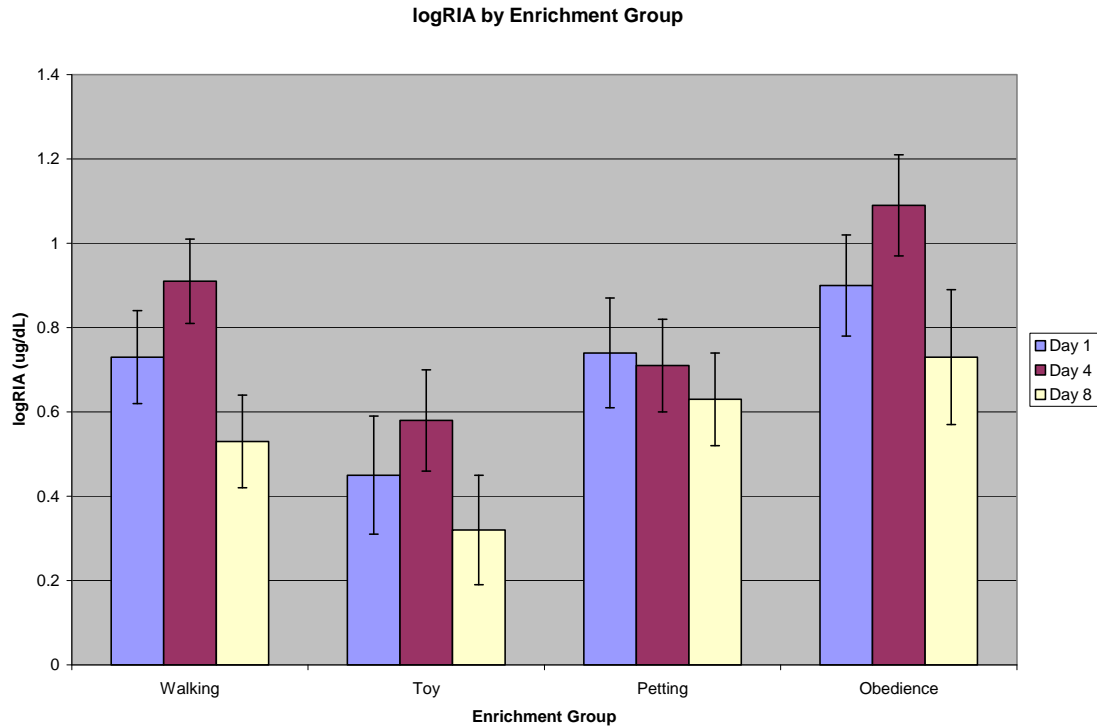
Between Day 4 and Day 8, the within-group decrease in mean log-cortisol concentrations was significant in the Walking group (paired  $t$ -test;  $p = 0.02$ ), marginally significant in the Toy group (paired  $t$ -test;  $p = 0.06$ ), and non-significant in the Petting and Obedience groups (paired  $t$ -tests;  $p = 0.57$ ,  $p = 0.11$ , respectively; Figure 2.3; Table 2.5b). (Note that if a Bonferroni correction had been used, the  $p$  value would have been 0.01 rendering these results non-significant.) The mean changes in log-cortisol concentrations from Day 4 to Day 8 (controlling for neutering status, sex, age, and weight), however, were not different among groups ( $F(3,66) = 0.52$ ;  $p = 0.67$ ).

**Table 2.4.** Median cortisol concentrations ( $\mu\text{g/dL}$ ) and interquartile ranges by enrichment group on Day 1 (baseline).

Group	N	1 <sup>st</sup> quartile	Median	3 <sup>rd</sup> quartile
Walking	24	1.48	2.01	2.73
Toy	24	0.88	1.56	2.86
Petting	27	1.14	2.13	3.78
Obedience	23	1.66	2.67	3.78

**Figure 2.2.** Numbers of dogs contributing cortisol data by day and by enrichment group.





**Figure 2.3.** Mean blood cortisol concentrations  $\log(\mu\text{g/dL})$  ( $\pm$  SEM) by enrichment group on Days 1, 4, and 8.

**Table 2.5.** Mean blood cortisol concentrations ( $\log \mu\text{g/dL}$ ) by day and enrichment group (adjusted for neutering status, sex, age, and weight), compared between Days 1 and 4 (a), and between Days 4 and 8 (b).

**a.**

Group	N	logRIA Day1	logRIA Day4	Mean Difference	Std Error of Difference	<i>p</i> value
<b>Walking</b>	21	0.77	0.89	0.12	0.12	0.31
<b>Toy</b>	24	0.45	0.55	0.10	0.10	0.35
<b>Petting</b>	22	0.77	0.71	-0.07	0.15	0.66
<b>Obedience</b>	18	0.95	1.14	0.19	0.15	0.22

**b.**

Group	N	logRIA Day4	logRIA Day8	Mean Difference	Std Error of Difference	<i>p</i> value
<b>Walking</b>	20	0.89	0.56	-0.34	0.14	<b>0.02</b>
<b>Toy</b>	18	0.68	0.32	-0.36	0.18	0.06
<b>Petting</b>	21	0.70	0.64	-0.05	0.09	0.57
<b>Obedience</b>	16	1.08	0.76	-0.31	0.19	0.11



## **2.4. Discussion**

### **2.4.1. Objective and Justification of Enrichment Groups**

The main objective of our study was to compare the effects of four enrichment programs on blood and urinary cortisol concentrations of dogs in an animal shelter. The types of enrichment selected were those commonly used by many shelters. Staff in the participating shelter walked dogs twice daily as their standard enrichment, so this was provided for dogs in all enrichment groups.

Food-filled toys provide olfactory, oral, and mental stimulation (dogs must work to get the food), which is important for shelter dogs who often are housed in an otherwise unstimulating environment. In a previous study, kennel dogs showed an increase in activity and appetitive behavior when provided with food-filled toys (Schipper et al., 2008). To our knowledge, this study was the first to investigate the effect of a food-dispensing toy (Kong™) provided once daily on cortisol concentrations in shelter dogs.

Researchers previously demonstrated the effectiveness of regular human contact in mitigating the cortisol response of shelter dogs exposed to acute stressors (Hennessy et al., 1998; Hennessy et al., 2002a; Hennessy et al., 2002b). This form of enrichment requires a modest time commitment (15-20 minutes per day) and minimal training of shelter staff. Therefore, we selected daily standardized human interaction, based on the procedure described by Hennessy et al. (1998), as the enrichment for the third group.

Finally, many shelters perform obedience training with dogs who are assessed to be “unruly”. Training dogs in a shelter setting requires considerable resources (i.e., time and expertise). Thus, it is important to assess the relative effectiveness of this type of enrichment (as was done in the fourth group) to help shelters allocate their resources appropriately to programs that benefit the dogs.

#### **2.4.2. Use of Cortisol as a Physiological Measure of Stress**

Dogs confined in many animal shelters experience psychogenic stress because of isolation in an inescapable, unfamiliar, noisy, barren environment with frequent, unpredictable disturbances (Hennessy et al., 1997; Hennessy et al., 2001). In response to this stress, the HPA axis is activated and cortisol is released into the blood stream (Koolhaas et al., 1999; Mormède et al., 2007); therefore, cortisol is a commonly used physiological measure of stress in dogs (Jones et al., 1990; Beerda et al., 1996; Hennessy et al., 1997; Beerda et al., 1999; Stephen and Ledger, 2006).

In previous studies, cortisol concentrations increased in dogs introduced into a novel kennel environment, even when dogs were previously habituated to kenneling (Rooney et al., 2007). Likewise, cortisol concentrations increased in laboratory dogs when moved to a new environment, even if they were with their kennel mate (Tuber et al., 1996). Salivary cortisol concentrations have also been demonstrated to increase in dogs within 20 minutes of being transferred from outdoor group- to indoor individual-housing (Beerda et al., 1999). Moreover, cortisol concentrations (salivary or plasma) have been shown to increase in dogs exposed to aversive stimuli (e.g., loud noises and startling stimuli), which occur frequently in shelters (Dess et al., 1983; Engeland et al., 1990; Beerda et al., 1997; Beerda et al., 1998; Koolhaas et al., 1999; Hennessy et al., 2001; King et al., 2003; Hydbring-Sandberg et al., 2004; Haverbeke et al., 2008). In this study, blood cortisol (which we expected to be elevated due to the stress of the shelter environment) was selected as the primary outcome as a direct measure of circulating cortisol concentrations and, therefore, as a measure of the physiological stress response.

In the dog, cortisol concentrations in urine peak ~ 3 hours after intravenous injection of radiolabeled cortisol (Schatz and Palme, 2001). Hence, urinary cortisol

concentrations reflect circulating cortisol concentrations over several hours preceding urine collection (Jones et al., 1990). Collection of adequate numbers of urine samples from dogs in a shelter setting, however, can be difficult (some dogs urinate in their kennels; others are reluctant to urinate during a free-catch technique). In fact, in one study, complete data sets of urine samples were available for only 21 out of 81 dogs from days 2 to 10 in an animal shelter (Stephen and Ledger, 2006). In our study, urinary cortisol concentrations were measured as a secondary outcome to assess their correlation with blood cortisol concentrations. Although correlations were significant on all sampling days, the strength of the correlations was only moderate. The number of urine samples per enrichment group for each sampling day was comparatively small (see Figure 2.2). Furthermore, some dogs might have urinated in their kennels several hours before morning urine samples were collected; thus their urinary cortisol concentrations might have been reflective of only 1 to 2 hours (as opposed to 3 to 8 hours) of cortisol secretion (which could have introduced variability into the urinary cortisol:creatinine ratios). Different environmental stimuli occurring prior to blood sampling also could have increased variability in blood cortisol concentrations. Controlling these potential sources of variation might have allowed a more accurate assessment of the correlation between the two measures of cortisol.

Physical restraint and the blood collection procedure itself have been shown to activate the HPA axis and increase blood cortisol concentrations (Coover et al., 1979). Nevertheless, in a previous study, cortisol concentrations in shelter dogs from samples that took up to 5 minutes to collect did not differ from concentrations in samples collected within 4 minutes of handling (Hennessy et al., 1998). The veterinary technicians who collected blood for our study were experienced in venipuncture techniques and most samples were collected within 3 minutes (median = 2 minutes). In addition, there were no significant correlations between time taken to collect blood

samples and cortisol concentrations on any sampling day. Therefore the effects (or lack thereof) of the enrichments on cortisol were not likely to have been influenced by stress of the venipuncture procedure itself.

### **2.4.3. Baseline Data**

The age criterion of dogs in our study was selected because it reflects the age group of dogs who are at increased risk for relinquishment (New et al., 2000) and, therefore, represents the most common age group of dogs entering US shelters (Miller et al., 1996; Patronek et al., 1996; Salman et al., 2000). Basal cortisol concentrations have been reported to be higher in aged dogs (11-14 years old) than in younger dogs (18-24 months old) (Rothuizen et al., 1993), and higher in juvenile/adult dogs (6-24 months old) than in puppies (< 6 months old) (Hennessy et al., 1998). Furthermore, female dogs were found to have higher basal cortisol concentrations (Garnier et al., 1990) and a greater increase in cortisol in response to acute stressors (Beerda et al., 1996) than did male dogs. Other studies, however, failed to find significant relationships between age, sex, or weight and cortisol concentrations (Hennessy et al., 1997; Stephen and Ledger, 2006; Luescher and Medlock, 2009). In our study, the four enrichment groups were not statistically different in age, weight, or sex (Table 2.3). Baseline cortisol concentrations (on Day 1) also did not differ statistically among enrichment groups. Although cortisol concentrations on Day 8 were higher for dogs neutered in the shelter compared to those who were already neutered at entry, the frequency of prior neutering status did not differ statistically among enrichment groups. Nevertheless, despite no statistical differences in dog demographic variables among enrichment groups, these variables were included in the multivariable least-squares regression model to control for any residual confounding.

#### **2.4.4. Cortisol**

The mean differences in blood cortisol concentrations between Days 1 and 4 and between Days 4 and 8 were not significantly different among enrichment groups (after controlling for neutering status, sex, age, and weight). Thus, the effects of enrichments on cortisol concentrations over time were equivalent among the groups. This was surprising because we had expected that cortisol concentrations would be affected differentially in the human-interaction (Petting) group. Hennessy et al. (1998, 2002a) found that 20 minutes of gentle human interaction prevented an increase in cortisol concentrations in shelter dogs in response to an aversive stimulus (but was unable to reduce concentrations to those measured in pet dogs). In our study, however, cortisol determinations were made without challenging dogs with acute stressors, which might explain the lack of differences among groups. Although cortisol concentrations appeared to decrease across sampling days in the human-interaction (Petting) group, this trend was not statistically different from those in the other three groups (in which cortisol tended to increase from Day 1 to Day 4 before decreasing to Day 8). The difference in pattern of change, however, warrants further investigation.

Cortisol concentrations did not change significantly from Day 1 to Day 4 in any group. These values may reflect the peak concentrations reported to occur in dogs within their first few days in the shelter (Hennessy et al., 1997; Stephen and Ledger, 2006). It is important to note that in the current study, Day 1 referred to the day dogs were enrolled in the study and not to the day of admittance to the shelter. Dogs were in the shelter between 1 and 3 days prior to enrollment, which means that Day 1 of the study refers to days 2 to 4 in the shelter. The number of days dogs were in the shelter prior to being enrolled into the study was not significantly correlated with blood cortisol concentrations on Day 1—suggesting that cortisol concentrations had not changed dramatically between the first and third day of admittance.

Hennessy et al. (1997) found that plasma cortisol concentrations were elevated in shelter dogs for the first 3 days after admission (after which concentrations decreased). However, contrary to the present study, those investigators rarely included dogs who were excessively fearful (but did include strays). We included all eligible dogs (who passed the behavioral evaluation) whether or not they were fearful. Because fear induces a cortisol response (Korte, 2001; Hydbring-Sandberg et al., 2004), it is possible that eliminating fearful dogs skewed the sample of Hennessy et al. (1997) towards dogs who adapted more quickly to the shelter environment (and who, therefore, likely would have had an earlier decline in cortisol) (Stephen and Ledger, 2006). Stephen and Ledger (2006) reported that urinary cortisol concentrations in owner-surrendered shelter dogs peaked on day 17 (albeit with a lot of individual variation), after which they declined. Cortisol concentrations in the current study did not appear to decline until after day 5 to 7 in the shelter (Day 4 of the study), which is longer than reported by Hennessy et al. (1997)—who excluded fearful dogs—and shorter than reported by Stephen and Ledger (2006). However, in neither of those studies were enrichments provided for dogs. The inclusion of fearful dogs in the current study as well as the provision of enrichments may explain the discrepancy between our results and those of Hennessy et al. (1997) and Stephen and Ledger (2006). The large amount of variability in our data, however, cautions against generalizing the results to dogs in other shelters.

Our study results also may reflect beneficial effects of all the enrichment programs (which might have resulted in an earlier decline in cortisol concentrations than would have occurred without enrichments). We did not use a control group for which no enrichment was provided; it was deemed to be in the dogs' best interest to provide the usual standard of care (twice-daily walks). It is difficult, therefore, to determine whether the enrichments used in our study would have had a significant

effect compared to a control group for which no enrichment was provided. Nevertheless, even dogs in the twice-daily walks only group (Walking) also experienced a decline in cortisol concentrations between Days 4 and 8. Dogs in Stephen and Ledger's (2006) study, in whom cortisol concentrations peaked on day 17, were walked for 30 minutes two to three times per week and were exercised for 20 minutes daily in a fenced outdoor enclosure. It is possible that being walked by a shelter staff member twice daily in our study was more effective at mitigating stress than was once-daily exercise. However, differences in management and study design makes comparisons between the studies difficult.

The apparent decrease in cortisol concentrations across groups after Day 4 in our study may also reflect habituation to the shelter environment (resulting in decreased stress). Alternatively, the lack of effect of enrichments on cortisol could have been partly attributable to differences in dogs' behavioral or coping strategies (Koolhaas et al., 1999; Horváth et al., 2007). We did not assess personality types or coping styles and therefore were unable to assess the impact they might have had on our results.

#### **2.4.5. Limitations**

Assignment of dogs to enrichment groups was not truly random. Rather, following a random start, dogs were systematically assigned to treatment. Although this was done to facilitate enrollment by a shelter staff member, balance sample sizes across groups, and minimize any seasonal fluctuations in dog enrollment, this type of rotating assignment made the allocation sequence predictable, which could have led to biased assignment of dogs to treatment groups. However, protocols to avoid such bias were implemented. Each dog was assigned to a treatment group according to the time/day stamp received when the dog entered the shelter. Therefore, if two dogs were

evaluated on the same day, the dog who had been relinquished earliest was assigned to the next available group. Nonetheless, enrollment of dogs was occasionally suspended because of unforeseen shelter crises (e.g., kennel cough outbreaks, staff illnesses, staff travel to assist with the aftermath of hurricane Ike). Such delays in enrollment also could have resulted in selection bias even though the dogs were comparable between groups with respect to age, weight, sex, prior neutering status, and baseline (Day 1) cortisol concentrations.

Complete blinding of shelter staff was not possible. Efforts were made, however, to conceal enrichment-group assignment. The master assignment list and the treatment sheets for each dog were kept out of plain view from staff members. Moreover, the outcome measures chosen were objective, and laboratory personnel performing the cortisol analyses were unaware of enrichment-group assignment.

Although the influence of the public's interactions with the dogs on trial (which could have affected dogs' stress levels) could not be controlled or assessed, the public was blinded to enrichment-group assignment to prevent bias in how they treated the dogs. Our study was designed to be practical for the collaborating shelter and to mimic a shelter setting as much as possible: controlling or recording all interactions was not feasible.

Another potential source of bias involved administration of enrichment—not every dog received his or her assigned enrichment every day. The percentage of missed treatments, however, did not vary between groups. Our data were analyzed by intention-to-treat to avoid introducing bias (if we omitted data from dogs who were withdrawn from the study or who did not receive their intended enrichment) into our results. This technique, however, might have underestimated the full effect of the enrichments. Similarly, providing enrichments for only 6 or 7 days might have limited our ability to find differences among groups. Providing enrichments for a longer



period of time was not practical for the shelter (due to space limitations), nor did we wish to keep dogs in the shelter for longer than necessary.

Initial cortisol determinations were made from plasma samples. Because processing the plasma was difficult for the shelter staff, the remaining cortisol determinations were made from serum. There are no data in the literature to suggest that cortisol concentrations differ between plasma and serum samples. Nevertheless, comparisons were made across groups assuming relative changes would be equivalent and only from equivalent sample types (plasma to plasma or serum to serum).

#### **2.4.6. Conclusions**

In conclusion, we found no differential effects of enrichment on the change in cortisol concentrations across days. However, before concluding that the enrichment programs had no effect on cortisol, it should be reiterated that we did not use a comparison group without any enrichment. Nonetheless, it is possible that the common feature of twice-daily walking had the maximal effect and that adding food-dispensing toys, human interaction, or obedience training had no further influence on cortisol concentrations. Finding ways to enhance the benefits of these types of enrichments or identifying other means of reducing stress in shelter dogs should be investigated.

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CHAPTER 3  
THE EFFECTS OF ENVIRONMENTAL ENRICHMENT ON IN-SHELTER  
BEHAVIOR AND ADOPTABILITY OF SHELTER DOGS

### **3.1. Introduction**

In recent years, there has been a growing interest in the welfare of dogs confined in animal shelters. This is not surprising given that there are ~3,500 million shelters in the US (HSUS estimate) to which ~4 million dogs are admitted annually (Patronek and Glickman, 1994; Patronek et al., 1995). In designing shelter, more thought usually is given to maximizing the health and safety of dogs rather than to promoting the dogs' mental well-being. Dogs in shelters typically are housed alone in relatively sterile environments and are subjected to excessive noise levels (often exceeding 100 dB (Coppola et al., 2006)), unfamiliar surroundings, dogs, and people, and unpredictable and frequent interruptions—all of which have been shown to induce physiological and behavioral stress responses (Engeland et al., 1990; Beerda et al., 1996; Beerda et al., 1997; Hennessy et al., 1997; Beerda et al., 1999a; Beerda et al., 1999b; Hennessy et al., 2001; Rooney et al., 2007). The stress of the shelter environment also may promote the development or exacerbation of problem behaviors (Mertens and Unshelm, 1996; Beerda et al., 1999a; Beerda et al., 1999b; Beerda et al., 2000), which are undesirable to potential adopters (Wells and Hepper, 1992).

Many researchers have examined the benefits of providing environmental enrichment (e.g., human social contact, food-dispensing toys) for kennel dogs (see Wells, 2004b, for review). Dogs receiving regular human contact (petting) had lower cortisol concentrations and less behavioral reactivity when introduced into a novel environment or when confronted with novel, startling, or frightening stimuli than did dogs not receiving any petting (Hennessy et al., 2002a; Hennessy et al., 2002b; Hennessy et al., 2006). Furthermore, kennel dogs provided with feeding enrichment (a food-filled Kong® toy) displayed more appetitive behaviors and increased activity while the toy was available (Schipper et al., 2008). The same food-filled toy had no discernible adverse effects on the working ability or general behavior of military dogs



housed in kennels (Gaines et al., 2008).

The most practical way to alleviate the stress of sheltering, however, is to reduce the amount of time that a dog is in the shelter, i.e., by enhancing adoptability (Wells and Hepper, 2000). Several retrospective studies found that particular characteristics of the dog—e.g., light coat colors, smaller breeds, neutered, and young age (< 6 months old)—were associated with increased adoption (Posage et al., 1998; Lepper et al., 2002; Němcová and Novák, 2003; Normando et al., 2006). A survey of the general public in Northern Ireland, however, reported that a dog’s behavior was more important than his or her appearance to potential adopters (Wells and Hepper, 1992). Nevertheless, increased human contact, provision of a toy, and moving the dog’s bed to the front of the kennel were all associated with increased frequency of adoption even though the latter two environmental changes had no effect on dogs’ behavior (Wells and Hepper, 2000). A current trend in shelters is to provide obedience training for dogs, particularly those who are deemed unruly. One study found that 20 minutes of obedience training per day increased adoptability of shelter dogs as compared to dogs not receiving any training (Luescher and Medlock, 2009).

The present report is part of a larger study that investigated the effects of four enrichment programs (twice-daily walks alone or twice-daily walks plus either provision of food-filled toys, daily human handling, or daily obedience training) on: 1) physiological and behavioral measures of stress; 2) frequency of and time to adoption (“adoptability”); and 3) frequency of desirable and undesirable behaviors and retention of adopted dogs in their new homes. This manuscript addresses the effects of the four enrichment programs on the behavior and adoptability of dogs in an animal shelter. Our hypotheses were that in-shelter enrichment programs—particularly those involving regular human contact—would differentially affect: 1) the occurrence of stress-related, attention-seeking, and calm behaviors during an in-shelter mock

adoption session, and 2) adoptability of dogs (as measured by the percentage of dogs adopted and days to adoption). Behaviors of dogs were scored during a mock adoption session during which an unfamiliar person approached and interacted with the dog. In addition, time to adoption (days) was recorded for each dog. To our knowledge, no other studies to date have compared the effects of different enrichment programs either on the behavior of dogs in shelters while interacting with a potential adopter or on time to adoption.

## **3.2. Methods**

### **3.2.1. Animals**

Owner-surrendered and stray dogs of different breeds and both sexes were enrolled from April 2007 through November 2008 at an open-admission in upstate New York. During this time, 5,907 dogs were admitted to this shelter; ~ 53% (3,115) of those dogs were adopted, 37% (2,215) euthanized, 6% (354) returned to their owners, and 4% (223) died or were transferred to another facility. The shelter reported a mean length of stay for all dogs during the study period of 9.4 days.

Initially, dogs between 10 and 24 months of age that passed the shelter's standardized behavioral evaluation were eligible for inclusion. Dogs also had to be in good health (as determined by one of the shelter veterinarians) and not have been seized in a cruelty case, returned to the shelter by a previous adopter, relinquished with another dog, or transferred from another sheltering facility. Our original goal was to enroll 100 stray and 100 owner-surrendered dogs. However, enrollment was suspended periodically because of unforeseeable events (e.g., kennel cough outbreaks, staff illnesses, etc.) causing difficulties in enrolling adequate numbers of eligible dogs within the time constraints of the study. Thus, the age criterion was increased to

include dogs between 8 and 48 months old, and stray dogs were excluded from the study.

All study dogs were housed within the shelter in a designated adoption suite consisting of six adjacent solid-walled kennels, which prevented dogs from seeing or interacting with each other. Each kennel (117-cm wide and 274-cm long) was divided by a pulley-operated door to assist in cleaning (which occurred between 8 and 11 am daily and thereafter as needed). Raised beds were provided for all dogs in their kennels, and each dog was fed at 8:30 am and 4:30 pm and had access to water at all times.

The use of shelter dogs in this study was approved by the Cornell University Institutional Animal Care and Use Committee. Moreover, all authors completed an education program for the care and use of research animals prior to the initiation of the study.

### **3.2.2. Allocation to treatment and sample size**

A computer-generated random number corresponding to each enrichment group was used to enroll the first dog in the study. The remaining dogs then were assigned systematically to an enrichment group using a rotating sequence with a goal sample size of 25 dogs per group as described previously in Chapter 2 (Section 2.2.2).

The person assigning dogs to treatments was also involved in other aspects of the study (including behavioral evaluations of some dogs). Thus, each dog was allocated to an enrichment group according to the day/time stamp received when the dog entered the shelter to minimize bias in assignment to groups, particularly if two dogs underwent behavioral evaluations on the same day. The dog who had been relinquished earliest was allocated to the next group in the sequence.

Due to the nature of the enrichments and because shelter staff could access the

treatment group information for each dog, blinding of the persons involved in providing enrichments to the dogs was not possible. However, the persons performing the mock adoption sessions (described below) and the person scoring behaviors and entering data into a database (PJP) were blinded to treatment groups. Furthermore, the public was unaware of the dogs' enrichment-group assignments.

### **3.2.3. Management of dogs on trial**

All dogs entering the shelter were vaccinated against distemper virus, adenovirus-2, parainfluenza virus, parvovirus, and *Bordetella bronchiseptica* (Chapter 2, Section 2.2.3). Within 24-72 hours of entering the shelter, behavioral evaluations of dogs of eligible age and health status were performed by trained staff members. Day 1 of the study was designated as the day that behavioral evaluations were performed, meaning that dogs were in the shelter from 1 to 3 days prior to enrollment. The behavioral assessment was a previously investigated (Bollen and Horowitz, 2008) modification of the Assess-A-Pet™ procedure (Sternberg, 2002) evaluation (Appendix A). The dog's reactions were observed during nine sub-components of the evaluation (cage presentation test, sociability test, teeth exam, handling test, arousal test, food-bowl test, possession test, stranger test, and dog-to-dog test). Any dog who displayed serious aggression (any attempts to bite or lunging at the evaluator while growling and snarling) during any of the components, or failed at least three sub-components was not made available for adoption. Approximately 2 hours after an eligible dog passed the behavioral evaluation, blood was collected by a licensed veterinary technician for cortisol determination (Chapter 2, Section 2.2.7) and heartworm testing. In addition, the dog was physically examined and assigned to an enrichment group.

Although dogs were placed in the adoption area on Day 1 of the study, they were not made available for adoption until Day 8 (Chapter 2, Figure 2.1). Signs on

the dogs' kennels indicated that they were part of a study and were not available for adoption until this specified date (Day 8). However, the public was able to interact with the dogs and place a monetary adoption hold on a dog.

Provision of enrichments to dogs began on Day 1 of the study (unless the dog was enrolled too late in the day). To ensure that all dogs had a minimum of 3 to 4 consecutive days of enrichment preceding neutering, all intact dogs on trial were neutered on Day 5. Enrichments were suspended on that day for dogs having surgery, and were resumed the following day. All dogs received their enrichment daily (including weekends), and remained in their respective groups until they were adopted or until Day 28 of the study, whichever came first. Any dog remaining in the shelter beyond Day 28 was withdrawn from the study and provided with an enrichment that the shelter manager and senior dog trainer believed was in the dog's best interest. Although these dogs were moved to the general adoption area, their in-shelter behavioral data (until the time of their withdrawal) were included in the analyses. If a dog in the study became ill, aggressive, or was adversely affected by the study treatment (as determined by shelter staff and the first author), he/she was withdrawn from the study. Data from dogs who were withdrawn from the study after Day 8 but before being adopted were included in the time-to-adoption analysis as censored data.

#### **3.2.4. Enrichments**

All dogs in the study were to receive the standard enrichment, which was 10-15 minute walks twice daily outdoors. To minimize bias, staff members were instructed not to practice any basic obedience commands with the dogs during walks. Shelter staff members providing enrichments were pre-assigned to a particular kennel (designated A through F), and were responsible for any dogs in their kennel throughout the study. The first author (PJP) used a standardized protocol to train all

staff members providing enrichments prior to the start of the study. Adherence to the protocol was emphasized during staff meetings (which were conducted approximately every 6 months throughout the study) and a copy of the protocol was available to staff members at all times. The four enrichment groups were:

1. **Walking** – Dogs were walked twice daily.
2. **Food-dispensing Toy** – Dogs were walked twice daily and received a food-filled Kong® toy (appropriately sized for each dog) once daily between 2 and 3 pm (in addition to their regular meals). Kongs® were filled with 2/3 dry kibble and 1/3 canned dog food, topped off with 1 to 2 teaspoons of peanut butter, and frozen for at least 24 hours.
3. **Petting** – Dogs were walked twice daily and received standardized petting and massaging for 15-20 minutes per day between 2 and 3 pm. The protocol used (based on that described by Hennessy et al., 1998) involved the petter speaking to the dog using a calm, soothing voice while: 1) attempting to sit with the dog in his/her kennel, 2) gently encouraging the dog to sit or lie down or to lean against him/her (depending on the dog's size and excitability), and 3) petting the dog with long, firm strokes starting from the dog's head and ending at the hindquarters, or using a deep, firm massaging motion on the muscles of the dog's shoulders, back, and neck (adjusting the amount of pressure according to the dog's acceptance).
4. **Obedience** – Dogs were walked twice daily and received obedience training for 15-20 minutes per day between 2 and 3 pm, which involved learning to walk on a leash and basic commands (sit, down, and sitting at the kennel door). All training adhered to the shelter's standardized obedience protocols and used positive and negative reinforcement.  
[Protocols are available from the senior author by request.]

### **3.2.5. Adoption**

The number of days to adoption was calculated for each dog as the difference between the date the dogs were made available for adoption (Day 8) and the date the dogs were adopted or withdrawn from the study. Some adopters placed an adoption hold on dogs for one or more days after they became available. These hold days were not counted in the time to adoption. Data from a dog who was made available for adoption—but subsequently withdrawn from the study before being adopted—were recorded as censored (on the day of withdrawal) in the data analysis of time to adoption.

Because weight, size, coat color, age, and sex have been reported to influence time to adoption, data were collected regarding these variables. The sex and age of dogs were recorded upon admission to the shelter. If the age was unknown, it was estimated by the shelter staff based on the dog's dentition. Weights were recorded for all dogs during their initial physical examination. Coat colors were classified according to the dog's predominant coat color into four categories: black, brown, light (including tan, cream, grey, and white), and multicolored. A higher ("special") adoption fee was placed on dogs who were presumed to be purebred. The special fee was recorded as a yes/no variable.

### **3.2.6. Behavior during Mock Adoption**

A Mock Adoption procedure was performed and videotaped (using a Canon ZR800 miniDV camcorder) to evaluate the behavior of each dog in the context of what potential adopters would experience as they considered a dog for adoption. The procedure was performed on Days 4 and 8 between 9 and 11 am on all study dogs, and on Days 14, 21, and 28 for dogs who were still in the shelter (i.e., not adopted). Data for Days 4 and 8 only were analyzed because the number of dogs observed declined dramatically after Day 8 (due to being adopted). Shelter staff members who were not

involved in any other part of the study served as potential adopters for these sessions. Mock adopters used a digital stopwatch to keep track of time during each stage of the session. The procedure, described below, lasted ~ 3 minutes.

1. A designated person (separate from enrichment and blood- or urine-sampling personnel) entered the kennel suite, set up the camcorder in front of the dog's kennel, and turned on the camcorder.
2. This person approached the front of the dog's kennel, stood still for 1 minute, and greeted the dog verbally in a calm voice. If the dog approached, the person extended the back of his/her hand for the dog to sniff.
3. The person entered the kennel and stood with hands held loosely clasped in front of their body for either 1 minute or until the dog no longer jumped up.
4. The person squatted down in the kennel and interacted with the dog for 1-2 minutes by calling the dog to him/her and stroking the dog's head and shoulder region.
5. The person exited the kennel, turned off and removed the camcorder from the kennel area.

The dogs' behavior was subsequently analyzed by one observer (PJP) using a continuous recording method. The ethogram consisted of one behavioral state and eight behavioral events, which were recorded independently of the state. In addition, latency to approach the person was recorded in seconds. Behaviors selected for scoring were those that represent calm, obedient behavior (e.g., sitting or lying down) and attention-seeking behavior (e.g., jumping), and those reported to be manifestations of anxiety (e.g., lip licking). The behavioral state (inactive) was a composite of sitting and lying behavior, and was measured as duration (in seconds), and behavioral events were measured as number of occurrences (frequency) during the observed time; the



behavior variables were not mutually exclusive. Definitions and method of measurement of the behaviors scored are provided in Table 3.1.

Behaviors were scored for each mock-adoption session, which commenced as soon as the mock adopter was positioned slightly to the left or right of the kennel (as to not block the camera's view of the dog), and ended as soon as the mock adopter began to open the kennel door to exit. Recording was suspended when the mock adopter began to enter the kennel and recommenced as soon as the mock adopter closed the kennel door.

**Table 3.1.** Definitions and measurements of behaviors scored during mock adoption sessions.

<b>Latency</b>		
	Approach	Number of seconds until dog moves towards person
<b>State*</b>		
	Inactive	Total time (in seconds) sitting or lying down
<b>Events**</b>		
<b>AttnSeek:</b>		
	Bark	Number of discrete vocalizations
	Paw	Number of times dog strikes at person or object with one forepaw
	Jump	Number of times dog rears up on hind legs or completely leaves the ground
	Lick	Number of licking movements directed toward (while person is outside the kennel) or contacting person
<b>Ambiv:</b>		
	Paw lift	Number of times dog lifts one paw while standing or sitting
	Lip lick	Number of quick licking motion with tongue over lips or snout
	Yawn / sneeze	Number of times dog yawns or sneezes
	Body / head shake	Number of times dog shakes body or head

\* The behavioral state was standardized to percentage of observed time

\*\* All behavioral event data were standardized to events per 60 seconds

### 3.2.7. Statistical Analysis

The number of times a dog barked, pawed at, jumped on, or licked the mock adopter were counted and summed to create an attention-seeking variable (AttnSeek). Similarly, the number of occurrences of the behaviors “paw lifting”, “lip licking”, “yawning or sneezing”, and “body or head shaking” were summed into an ambivalent behavior variable (Ambiv). During the sessions, the dogs’ head was not always visible. Thus, the “observed time in-view” was recorded as well as the “total observed time”. To standardize the event data, the behavioral event variables (AttnSeek and Ambiv) each were divided by the “observed time in-view” and multiplied by 60 to obtain the number of events per 60 seconds. The behavioral state (Inactive) was standardized by dividing the duration of the state by the “total observed time” to obtain the percentage of observed time spent in that state. Most dogs were adopted on or soon after Day 8, resulting in small numbers of dogs observed on Days 14, 21, and 28. Hence, data for Days 4 and 8 only were analyzed with four variables for events (AttnSeek\_Day4, AttnSeek\_Day8, Ambiv\_Day4, Ambiv\_Day8), and two variables for states (Inactive\_Day4, Inactive\_Day8).

Because all behavior data were non-Gaussian continuous variables, non-parametric statistics were used. The “observed time in-view” and “total observed time” and the variables Approach, Inactive, AttnSeek, and Ambivalent were each compared among enrichment groups using a separate Kruskal-Wallis rank-sum test for each recording day (Days 4 and 8). For any variable that was significantly different among groups, pair-wise comparisons between groups were made using a Wilcoxon rank-sum test.

The comparability of the enrichment groups regarding potential confounding variables was evaluated. Age of dogs was did not follow a Gaussian distribution; therefore, it was compared among enrichment groups using a Kruskal-Wallis test.

Weight, which was normally distributed, was compared among groups using a one-way ANOVA. Sex, purebred status (special fee), and color group were each compared across enrichment groups using a  $\chi^2$  test for independence.

Logistic regression analysis was used to assess the effects of enrichment group (independent variable) on the binary outcome adopted or not adopted. Because weight, age, purebred status, and color group could act as potential confounders for adoption, they were included in the model; however, no interaction terms were included because of sparse data in each level of these variables.

Weight and purebred status were significantly associated with each other (Wilcoxon Rank-sum test  $\chi^2 = 32.05, p < 0.0001$ ) and models with either variable gave similar estimates for enrichment group parameters; therefore, both variables were not included in the model. Weight was selected to remain in the final model because it was the stronger of the two predictors. Univariable analysis of the proportion of dogs remaining in the shelter (i.e., not yet adopted) by enrichment group was performed using the Kaplan-Meier product-limit method of survival analysis. Because most dogs were adopted within the first 2 days of being made available for adoption, the Wilcoxon test (which places more weight on earlier differences) was chosen for comparison of survival curves among enrichment groups. A Cox proportional-hazard model then was used to evaluate the effect of enrichment group on time-to-adoption after adjusting for the potential confounders weight, age, and color group.

All statistical analyses were performed using JMP 8.0 (SAS Institute, Cary, NC, USA). *For all other analyses*, two-tailed  $p$ -values  $\leq 0.05$  were considered statistically significant. Statistical significance for pair-wise comparisons (following a significant Kruskal-Wallis rank-sum test) was also reported at the  $p \leq 0.008$  using a Bonferroni correction. [Note: this software package uses a chi-square approximation for Kruskal-Wallis and Wilcoxon rank-sum tests.]

### **3.3. Results**

#### **3.3.1. Descriptive statistics**

One-hundred eight dogs were enrolled between April 2007 and November 2008. Seven dogs were withdrawn before Day 4 (one each in the Toy and Petting groups and two in the Obedience group because of health issues; two in the Obedience group because of aggressive behavior; and one in the Obedience group who was returned to the owner), three were withdrawn before Day 8 (one each in the Toy and Obedience groups because of health reasons, and one in the Walking group because of aggression), and six were withdrawn after being made available for adoption but before they were adopted (one each in the Walking and Obedience groups and one in the Petting group because of aggression; one in the Obedience group because of medical issues; and one in the Petting group because of a shelter error) (Table 2.1, Chapter 2, Section 2.3.1).

The median age of dogs remaining in the study on Day 4 (when mock adoption sessions were first recorded) was 12 months (range 8 to 48 months); only one dog per group was > 24 months old. Furthermore, age, sex, weight, prior neutering status (at enrollment), purebred status, and color of dogs did not differ significantly among enrichment groups (Table 3.2; all  $p \geq 0.06$ ).

The median “total observed time” (in seconds) did not differ among groups on Day 4 (Kruskal-Wallis  $\chi^2 = 5.15$ ,  $p = 0.16$ ; Table 3.3), but did on Day 8 (Kruskal-Wallis  $\chi^2 = 7.69$ ,  $p = 0.05$ ). The “total observed time” for dogs in the Walking and Toy groups was greater than that for dogs in the Petting group (Wilcoxon rank-sum  $\chi^2 = 4.19$ ,  $p = 0.041$ ; Wilcoxon rank-sum  $\chi^2 = 6.64$ ,  $p = 0.010$ , respectively)—but neither was significant after a Bonferroni correction. No other groups differed with respect to median “total observed time” on Day 8 (Wilcoxon rank-sum, all  $p > 0.06$ ).

The median “observed time in-view” (in seconds) varied among groups on Day

4 (Kruskal-Wallis  $\chi^2 = 11.65, p = 0.009$ ; Table 3.3) and Day 8 (Kruskal-Wallis  $\chi^2 = 9.64, p = 0.022$ ). Dogs in the Walking group were observed “in-view” longer than were dogs in the Petting group on both days (Day 4: Wilcoxon rank-sum:  $\chi^2 = 8.29, p = 0.004$ ; Day 8: Wilcoxon rank-sum  $\chi^2 = 8.37, p = 0.004$ ). No other groups differed with respect to median “observed time in-view” on Day 8 (Wilcoxon rank-sum, all  $p > 0.06$ ).

One of the videotapes of the mock adoption sessions for 9 dogs (two each in the Walking, Toy, and Petting groups, and three in the Obedience group) was misplaced in the shelter; thus, behavior data were available for only 59 dogs on Day 4 and 52 dogs on Day 8 (Table 3.4). Moreover, most dogs were adopted on or soon after the day they were made available for adoption (Day 8). As a result, only 7 dogs were observed during mock adoption sessions on Days 14, 21, and 28; these data were excluded from the analyses. Out of the 92 dogs available for adoption (and who were not withdrawn from the study), only two dogs were not adopted by Day 28 (one each in the Walking group and Toy groups).

**Table 3.2.** Distribution of demographic variables among enrichment groups.

	<b>Walking</b>	<b>Toy</b>	<b>Petting</b>	<b>Obedience</b>
<b>Age (months)</b>				
<b>1<sup>st</sup> quartile</b>	9	9	9.8	12
<b>Median</b>	12	12	12	18
<b>3<sup>rd</sup> quartile</b>	18	18	12	24
<b>Sex</b>				
<b>Female</b>	8 (30%)	12 (46%)	11 (42%)	9 (41%)
<b>Male</b>	19 (70%)	14 (54%)	15 (58%)	13 (59%)
<b>Weight (kg)</b>				
<b>Mean</b>	18.0	21.0	18.2	21.0
<b>SEM</b>	2.1	1.7	2.2	1.5
<b>Prior Neutering Status</b>				
<b>Intact</b>	15 (56%)	20 (77%)	20 (77%)	14 (64%)
<b>Neutered</b>	12 (44%)	6 (23%)	6 (23%)	8 (36%)
<b>Purebred Status</b>				
<b>No</b>	20 (74%)	22 (85%)	18 (69%)	21 (95%)
<b>Yes</b>	7 (26%)	4 (15%)	8 (31%)	1 (5%)
<b>Color Groups</b>				
<b>Black</b>	8 (30%)	9 (35%)	11 (42%)	7 (32%)
<b>Brown</b>	4 (15%)	7 (27%)	1 (4%)	7 (32%)
<b>Light*</b>	10 (37%)	4 (15%)	4 (15%)	3 (13%)
<b>Mix</b>	5 (18%)	6 (23%)	10 (39%)	5 (23%)

\* Included white, grey, and cream coat colors

**Table 3.3.** Distribution of “total observation time” (sec.) and “observation time in-view” (sec.) on Days 4 and 8 by enrichment group during an in-shelter mock adoption session.

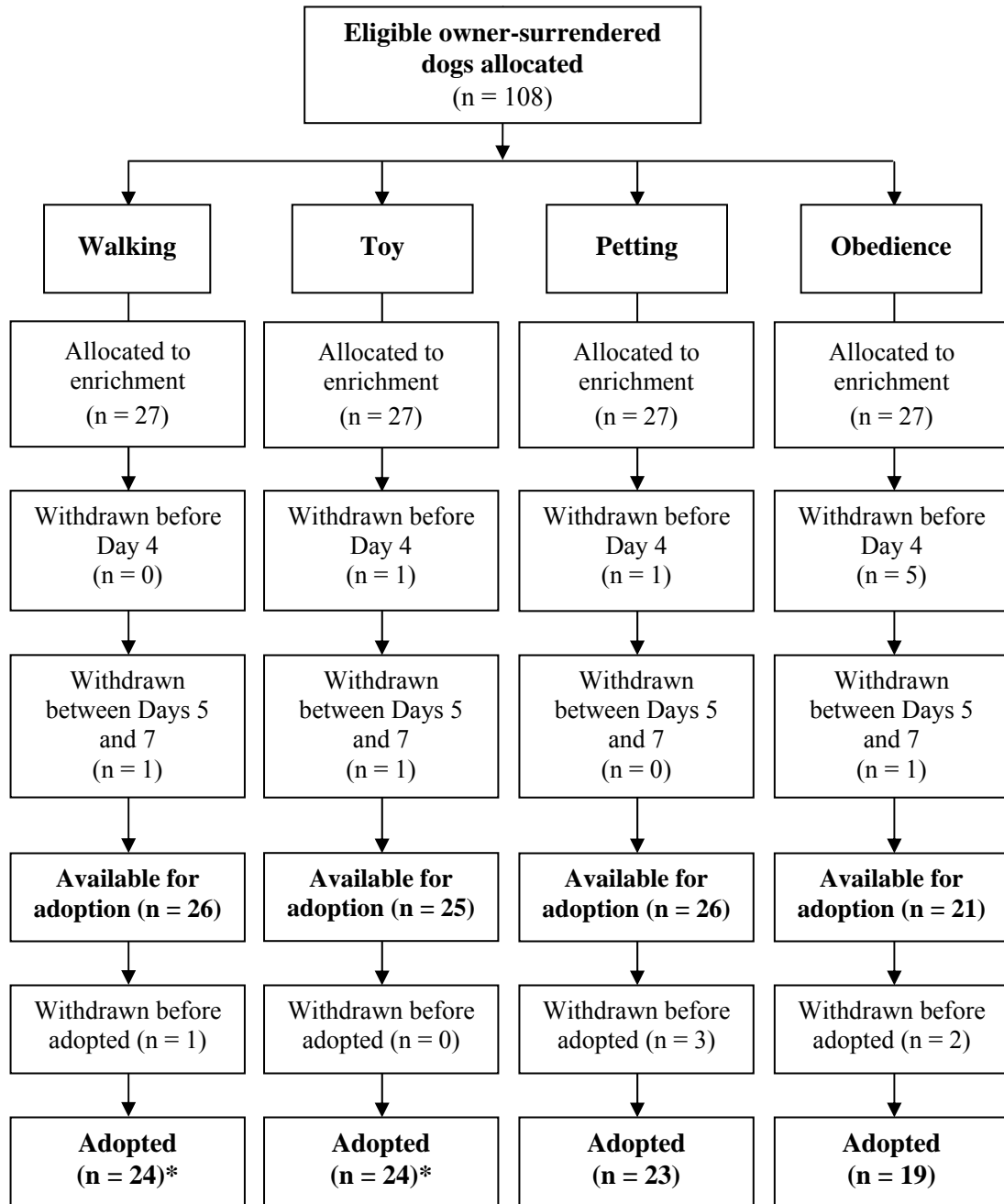
	<b>Walking</b>	<b>Toy</b>	<b>Petting</b>	<b>Obedience</b>
<b>Total Observed Time Day 4 (seconds)</b>	(n = 18)	(n = 16)	(n = 12)	(n = 13)
<b>1<sup>st</sup> quartile</b>	180	171	99	148
<b>Median</b>	<b>209</b>	<b>181</b>	<b>169</b>	<b>185</b>
<b>3<sup>rd</sup> quartile</b>	245	221	215	245
<b>Total Observed Time Day 8 (seconds)</b>	(n = 17)	(n = 14)	(n = 11)	(n = 10)
<b>1<sup>st</sup> quartile</b>	173	179	159	173
<b>Median</b>	<b>182</b>	<b>189</b>	<b>171</b>	<b>179</b>
<b>3<sup>rd</sup> quartile</b>	228	226	179	203
<b>Total Time In View Day 4 (seconds)</b>	(n = 18)	(n = 16)	(n = 12)	(n = 13)
<b>1<sup>st</sup> quartile</b>	174	135	80	107
<b>Median</b>	<b>187</b>	<b>164</b>	<b>143</b>	<b>125</b>
<b>3<sup>rd</sup> quartile</b>	240	181	173	201
<b>Total Time In View Day 8 (seconds)</b>	(n = 17)	(n = 14)	(n = 11)	(n = 10)
<b>1<sup>st</sup> quartile</b>	158	138	84	137
<b>Median</b>	<b>181</b>	<b>174</b>	<b>147</b>	<b>164</b>
<b>3<sup>rd</sup> quartile</b>	206	179	161	177

**Table 3.4.** Number of tapes scored per group for each mock adoption day.

	<b>Walking</b>	<b>Toy</b>	<b>Petting</b>	<b>Obedience</b>
<b>Day 4</b>	18	16	12	13
<b>Day 8</b>	17	14	11	10

**Figure 3.1.** CONSORT-style flow diagram—Flow of dogs through the study until adopted.





\* 1 dog each in the Walking and Toy groups were not adopted by the end of the study (Day 28)

### 3.3.2. Behaviors

Enrichment groups did not differ with respect to the behavior variables Approach, AttnSeek, and Inactive (all  $p \geq 0.13$ ). However, there was a significant effect of enrichment group on the variable Ambiv on Day 8 (Kruskal-Wallis  $\chi^2 = 8.82$ ,  $p = 0.032$ ): dogs in the Petting and Obedience groups performed a greater median number of ambivalent behaviors per minute on Day 8 than did dogs in the Walking group (Table 3.5; Wilcoxon rank-sum  $\chi^2 = 5.21$ ,  $p = 0.023$ ; Wilcoxon rank-sum  $\chi^2 = 6.05$ ,  $p = 0.014$ , respectively). However, after adjusting for multiple comparisons, neither difference was significant ( $p > 0.008$ ). There were no significant differences between any of the other groups (all  $p \geq 0.08$ ; Table 3.5).

**Table 3.5.** Minimum, median, and maximum values of the frequency of each behavior or the percentage of time spent exhibiting the behavior per minute of observation.

	Walking			Toy			Petting			Obedience		
	Min	Md	Max	Min	Md	Max	Min	Md	Max	Min	Md	Max
<b>AttnSeek*</b>												
Day 4	0.0	<b>8.5</b>	104.5	0.0	<b>12.2</b>	93.1	0.0	<b>9.6</b>	68.2	0.0	<b>13.2</b>	106.0
Day 8	0.0	<b>6.7</b>	42.6	2.9	<b>35.2</b>	136.0	0.0	<b>19.9</b>	63.8	3.0	<b>11.7</b>	179.1
<b>Ambiv*</b>												
Day 4	0.0	<b>5.5</b>	36.5	0.0	<b>6.4</b>	14.3	0.0	<b>6.9</b>	14.2	0.0	<b>6.2</b>	17.7
Day 8	0.0	<b>3.1</b>	21.3	1.0	<b>5.1</b>	31.9	3.7	<b>7.9</b>	27.0	5.2	<b>8.7</b>	21.7
<b>Inactive**</b>												
Day 4	0.00	<b>0.16</b>	0.99	0.06	<b>0.32</b>	0.95	0.00	<b>0.25</b>	0.75	0.00	<b>0.25</b>	0.84
Day 8	0.00	<b>0.11</b>	0.98	0.00	<b>0.19</b>	0.59	0.00	<b>0.17</b>	0.79	0.00	<b>0.27</b>	0.86
<b>Approach***</b>												
Day 4	0	<b>0</b>	181	0	<b>0</b>	161	0	<b>2</b>	11	0	<b>0</b>	8
Day 8	0	<b>0</b>	61	0	<b>0</b>	58	0	<b>5</b>	59	0	<b>0</b>	15

\* Recorded as number of events per 60 seconds

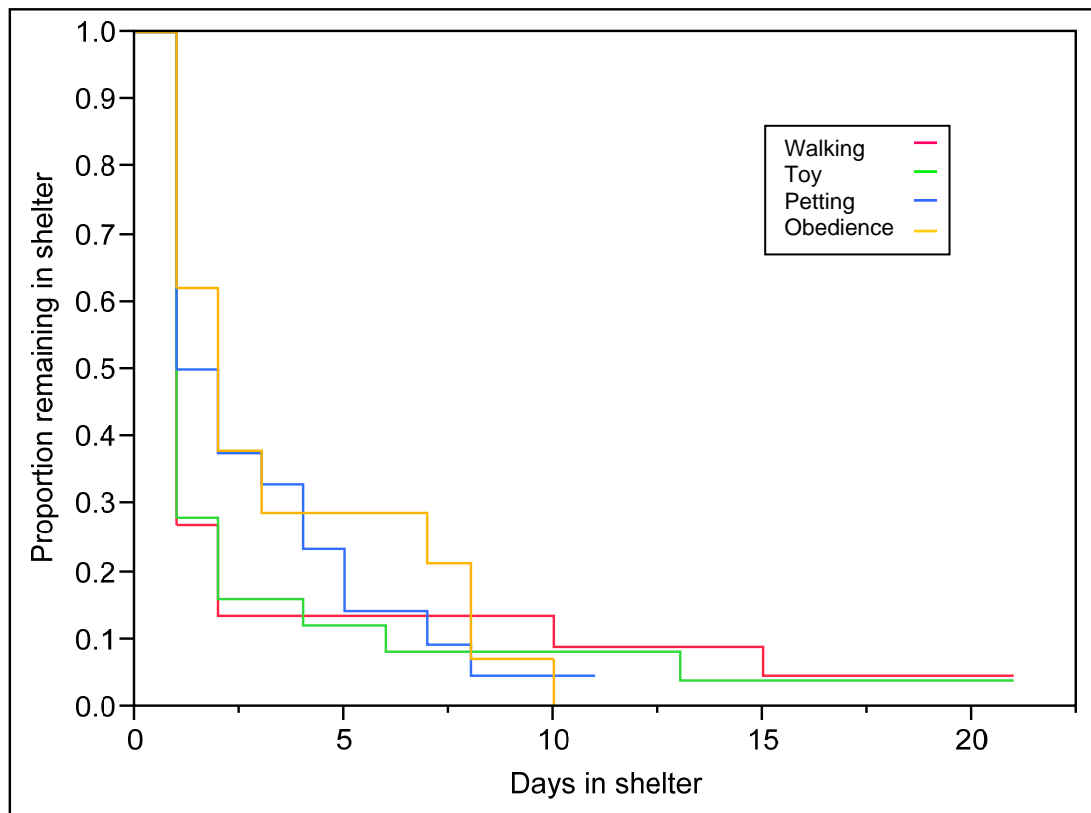
\*\* Recorded as percentage of observed time

\*\*\* Recorded as number of seconds

### 3.3.3. Adoption

Ninety-eight dogs were made available for adoption, of which six were withdrawn from the study before being adopted. Ninety out of the remaining 92 dogs (98%) were adopted before Day 28 (end of the study): 64% on Day 8, 16% on Day 9, 3% on Day 10, and 17% on or after Day 11 (Figure 3.2).

A logistic-regression analysis (controlling for the potential confounders weight, age, and color) revealed that enrichment group had no effect on the odds of adoption (Likelihood ratio  $\chi^2 = 3.94$ ,  $p = 0.27$ ). Likewise, comparison of Kaplan-Meier curves evaluating time spent in the shelter before adoption among enrichment groups revealed no statistical differences (Wilcoxon  $\chi^2 = 7.54$ ,  $p = 0.06$ ; Figure 3.2). After controlling for the same potential confounding variables in a Cox proportional-hazard model, the results were the same: time to adoption did not differ among the enrichment groups (Likelihood ratio  $\chi^2 = 1.39$ ,  $p = 0.71$ ).



**Figure 3.2.** Kaplan-Meier survival curves showing the proportion of dogs remaining in the shelter over time by enrichment group.

### **3.4. Discussion**

#### **3.4.1. Objective and Justification of Enrichment Groups**

The main objective of this study was to investigate the effects of four enrichment programs on 1) dogs' behavior during a mock adoption session; and 2) adoptability (frequency of and time to adoption). We selected enrichments commonly used by animal shelters in the US to ensure feasibility. The standard enrichment (which was basic protocol for the shelter in this study) was a walk outdoors for approximately 10 to 15 minutes twice daily (Walking). All dogs received this enrichment.

In a previous study, incidence of adoption of dogs from a shelter increased whenever a toy was placed in the front of the dogs' kennels, even though the dogs largely ignored the toy (Wells and Hepper, 2000). A later study found that kennelled dogs displayed an increase in activity and appetitive behaviors when provided with food-filled toys (Schipper et al., 2008). As part of their enrichment program, the participating shelter in the current study typically provided dogs with food-filled toys (Kong®); thus, it was included as the second enrichment (Toy group).

Regular human interaction has been shown to benefit dogs by reducing their behavioral reactivity to unfamiliar people, novel environments, and aversive stimuli (Hennessy et al., 1998; Hennessy et al., 2002a; Hennessy et al., 2002b). To our knowledge, however, the influence of gentle human interaction (e.g., petting) on adoptability of shelter dogs has not been evaluated. Thus, the third enrichment was standardized human interaction (Petting) based on the procedure described by Hennessy et al. (1998).

A recent study reported that dogs receiving obedience training for 20 minutes daily in an animal shelter were more likely to be adopted than dogs who were not trained (Luescher and Medlock, 2009). Moreover, the shelter in our study frequently performed obedience training with "special needs" (i.e., unruly) dogs while in

residence in the shelter. Because training dogs requires substantial time and expertise, it was important to evaluate its effectiveness. Hence, obedience training was chosen as the fourth enrichment (Obedience).

#### **3.4.2. Use of Mock Adoption Session to Assess Behavior**

Several studies have observed the behavior of kennel dogs under different housing and social conditions (Hetts et al., 1992; Hubrecht et al., 1992; Stephen and Ledger, 2005; Hiby et al., 2006) and in response to a perceived stressor (such as a novel environment, remote-controlled car, loud noise, or an opening umbrella) (Tuber et al., 1996; Beerda et al., 1997; Beerda et al., 1998; Beerda et al., 1999a; Beerda et al., 1999b; Beerda et al., 2000; Hennessy et al., 2001; King et al., 2003; Ley et al., 2007; Rooney et al., 2007; Haverbeke et al., 2008). In addition, the influence of various enrichments (human interaction, toys, conspecific contact, and sensory stimulation) on shelter dogs' behavior, either undisturbed or in response to a test battery, has been investigated (Wells and Hepper, 1998, 2000; Hennessy et al., 2002b; Wells et al., 2002; Wells, 2004a; Graham et al., 2005a; Graham et al., 2005b; Hennessy et al., 2006). The behaviors that adopters observe, however, are those which dogs display when approached in their kennels. Therefore, in this study dogs were observed during a mock adoption session (during which one of the shelter staff, unfamiliar to the dog, interacted with the dog for ~3 minutes). The length of time selected for these sessions was deemed adequate based on the results of a previous study (Wells and Hepper, 2001), which found that visitors spent an average of 70 seconds in front of a dog's cage and interacted with the dog for only 20 seconds on average. Although the mock adoption sessions were standardized in a written protocol, there was some variability in the interaction due to differences in temperaments of the dogs and persons performing the sessions. The allocation sequence used for enrolling dogs in

enrichment groups, however, was intended to help distribute such differences equally across groups. Moreover, the mock adopters were not involved in any other aspect of the study and were blinded to the treatment groups to prevent bias in how they interacted with the dogs.

### **3.4.3. Behavior Data**

Ambivalent behaviors were selected for scoring (lip licking, paw lifting, yawning or sneezing, and head or body shaking) because they are reported to be indicative of anxiety and stress (Beerda et al., 1997; Beerda et al., 1998, 1999b; Beerda et al., 2000). To evaluate dogs' willingness to interact with the mock adopter, latency to approach and frequency of attention-seeking behaviors (including jumping, barking, pawing, and licking directed toward a person) also were measured. Finally, to assess calm, obedient behavior—which is typically preferred by dog owners (Serpell, 1996; Duxbury et al., 2003; Marston et al., 2005)—the percentage of time inactive (sitting or lying) was recorded.

Not every dog displayed every behavior during each scoring session. Thus, we combined behaviors into the composite variables AttnSeek (the number of attention-seeking behaviors per minute) and Ambiv (the number of ambivalent behaviors per minute). Despite this grouping, only the frequency of the ambivalent behavior variable was different among the enrichment groups, and only on Day 8. Dogs in the Petting and Obedience groups performed more ambivalent behaviors per minute of observation than dogs in the Walking group. However, these differences did not remain significant after adjusting for multiple comparisons. Nevertheless, ambivalent behaviors (such as yawning, paw-lifting, and lip licking) have been observed in dogs in austere housing conditions, when exposed to acute stressors, and in the presence of an unfamiliar person; therefore, those behaviors have been interpreted as indicative of



stress (particularly in a social context) or as a sign of submission (Beerda et al., 1998; Hennessy et al., 1998; Beerda et al., 1999b; Beerda et al., 2000; Hennessy et al., 2002b; Hennessy et al., 2006). Dogs in the Petting and Obedience groups were exposed to daily interaction with the same persons throughout their stay in the shelter. However, the persons performing the mock adoption sessions were unfamiliar to the dogs. Thus, it is possible that the dogs in the Petting and Obedience groups were experiencing social conflict in that they were accustomed to human contact with familiar persons, but were anxious when interacting with an unfamiliar person. Indeed, dogs in an earlier study receiving regular human interaction performed more yawning when interacting with an unfamiliar person (Hennessy et al., 2002b).

The lack of an enrichment effect for the remaining variables might be explained in several ways. It is possible that the lack of differences in the frequency of behaviors between groups was real, i.e., the dogs' behaviors (when interacting with the mock adopter) were not affected by enrichment. This is consistent with previous findings that provision of toys had no effect on shelter dogs' behavior (Wells, 2004a), and that daily enrichment with food-stuffed Kong™ toys did not influence the general behavior of military working dogs (Gaines et al., 2008). Even though shelter dogs provided with 3 weeks of a socialization and training program in a previous study showed less jumping on an unfamiliar person, a decrease in vocalization, and improvement in obedience work (Hennessy et al., 2006), the majority of dogs in our study received their enrichments for only 6-7 days (5-6 days for dogs neutered in the shelter) and their compliance with obedience commands was not assessed.

The tremendous variability in dogs' behaviors might have masked real differences (Table 3.5). Although dogs in the Toy group displayed the most attention-seeking behaviors on Day 8, dogs in the Walking group were the most active on Day 4, and dogs in the Petting group took the longest to approach the mock adopter on Day

8—none of these were significantly different among groups. Marked individual variability in behaviors of shelter dogs observed daily for 6 weeks also was noted in one study despite using a large sample size ( $N = 148$ ), which those authors attributed in part to differences in age, gender, and breed (Stephen and Ledger, 2005). However, even a homogenous group of 1-year-old male Labrador retrievers in a military training facility were reported to have a lot of variation in their behaviors (Rooney et al., 2007). Moreover, the only behavioral response that was common to a group of beagles exposed to a sudden sound blast was a lowered posture (Beerda et al., 1997). Differences in behavioral responses to perceived stressors have been theorized to be due to differences in coping styles, which are affected by both genetics and learning (Horváth et al., 2007). The dogs in our study were all owner-surrendered, but their backgrounds were unknown. Although the age eligibility requirement was restricted to dogs between 8 and 48 months of age, there is still a large range of social experiences and learning that could have occurred between these ages. Because of the marked variability in behaviors observed in our study, statistical differences among enrichment groups would have been difficult to find—even with larger sample sizes.

Competing motivations for performance of some behaviors also could have accounted for the lack of differences observed among groups. For example, barking was categorized as an attention-seeking behavior. However, because dogs in other kennels within the study suite often barked during the recordings of the mock adoption sessions, barking in the study dogs might have been due to social facilitation and not as an attempt to gain attention from the mock adopter. Moreover, the heightened arousal and anxiety level of dogs in the shelter could have contributed to the barking observed. Although most dogs appeared to be barking at the mock adopter, it is impossible to know whether other competing motivations were affecting their behavior. Additionally, combining behaviors into categories might not be valid

because dogs might not have had the same motivations for performing each behavior. For instance, dogs could well have performed jumping and barking behaviors in response to frustration but licked the mock adopter as an et-epimeletic (care-soliciting) behavior.

The behaviors scored might not have been representative of the behaviors that would differ among groups if there were indeed a treatment effect. Finding a more sensitive behavioral measure may be needed to compare adequately the effects of the four enrichments. Beerda et al. (1998) cautioned that behavioral parameters might be misinterpreted due to differences between dogs and suggested that a combination of physiological and behavioral parameters be measured to evaluate accurately stress in kennelled dogs. Recently, fearful behavior in shelter dogs was found to be associated with poor performance in learning an operant conditioning task (Blackwell et al., 2010). Perhaps assessing the dogs' ability to learn simple associative tasks in the current study would have helped to distinguish differences among groups.

Finally, all enrichments potentially could have affected behaviors equally. This study did not use a control group for which no type of enrichment was provided because it was deemed inappropriate with respect to the dogs' welfare. Therefore, the Walking enrichment might have affected behavior equally as compared to the other three enrichment protocols. This also would imply, however, that none of the additional three enrichments acted synergistically with the standard walking treatment. Although previous studies reported beneficial effects of regular (gentle) human contact on behavioral reactivity (Hennessy et al., 1998; Hennessy et al., 2002a; Hennessy et al., 2002b; Hennessy et al., 2006), an earlier study found that contact with a passive person was a stronger reinforcer to dogs (as measured by speed to approach a researcher) than was active handling (holding and petting) (Stanley and Elliot, 1962). The human contact obtained during twice-daily walks might have been

sufficient enrichment for dogs in all groups in the current study.

One might expect that dogs in the Obedience group would perform obedient behaviors (e.g., sitting) more frequently by Day 8 than dogs in the other three groups. However, persons acting as potential adopters during the recorded sessions did not specifically ask dogs to obey obedience commands (including “sit”). It is possible that dogs who were obedience trained had not generalized to sitting for all human interactions. A more effective strategy might have been to teach dogs to sit prior to receiving any resources—including attention (Campbell, 1973; Voith, 1982). With this type of behavior modification (“nothing in life is free”, which is commonly used by veterinary behaviorists to teach dogs to defer to their owners), all interactions with humans would have been contingent on the dogs’ behavior (sitting); therefore, the dogs would have been more likely to generalize sitting behavior to the mock adoption session.

All mock adopters were instructed to follow a particular time schedule for interacting with the dogs. Nevertheless, differences existed. The median “total observed time” (in seconds) was greater for dogs in the Walking and Toy groups than that for dogs in the Petting group on Day 8. The reason for these differences is unclear. After entering the dog’s kennel, mock adopters were instructed to stand for either 1 minute or until the dog no longer jumped up. Then they were instructed to squat down and interact with the dog. It might have taken longer for dogs in the Walking and Toy groups to calm down enough for the person to be able to squat down and interact with them. However, this was not reflected in their behavior data. The median “observed time in-view” also was greater for dogs in the Walking group than for dogs in the Petting group on both Day 4 and Day 8. Dogs were often recorded as “out of view” because they were resting their heads against the mock adopter. If dogs in the Petting group were accustomed to close contact with people, they might have

been more likely to have their heads nuzzled against the mock adopter during the sessions.

#### **3.4.4. Adoption Data**

Most of the dogs (80%) in this study were adopted within the second day of being made available for adoption (Day 9). Because of reported associations in the literature between adoptability and color, age, sex, breed, and size, these variables were added into a logistic-regression model (when comparing odds of adoption) and a Cox proportional-hazards model (when comparing time-to-adoption) to control for any residual confounding. No differences among enrichment groups in either model were observed. Although in a recent study, dogs undergoing daily obedience training were significantly more likely to be adopted than were dogs not receiving any training (Luescher and Medlock, 2009), all but two dogs were adopted within the 28-day study period in our study (one each in the Walking and Toy groups). With such a high proportion of dogs adopted (and 80% adopted by the second day of being made available), it was difficult to find differences among the enrichment groups.

#### **3.4.5. Limitations**

As explained in Chapter 2, Section 2.4.5, the allocation sequence used for assigning dogs to enrichment groups could have introduced selection bias. However, dogs were assigned to the next available group according to the time/day stamp received when they entered the shelter to help minimize this type of bias.

Nevertheless, it is still possible that eligible dogs were skipped in the sequence, particularly because there were many interruptions in study enrollment. The enrichment groups, however, were comparable with respect to age, weight, sex, prior neutering status, and coat color—suggesting minimal selection bias.

Complete blinding of all shelter staff was not possible because of the nature of the enrichments. However, persons performing the mock adoption sessions and the person scoring videotaped behaviors were unaware of enrichment-group assignment. In addition, although we could not assess the influence of the public's interaction with study dogs, we ensured that the public was unaware of enrichment-group assignment. Thus, any selection of a dog for adoption was not based on knowledge of the enrichment group.

The in-shelter mock adoption sessions were standardized to minimize variability in the mock adopter's styles. Nevertheless, it is feasible that differences in the mock adopters' styles affected the dogs' behavior (Hennessy et al., 1998). Furthermore, the behaviors observed were those that are purported to be indicative of anxiety (Ambiv), solicitous (AttnSeek, Approach), and calm (Inactive) behaviors, but might not have been representative of differences in behavior that influence adoption (see earlier). In addition, even though the loss of the final video recording of mock adoption sessions limited the number of dogs analyzed for behaviors (which reduced our statistical power to find differences among groups), the missing data were evenly distributed among the enrichment groups (two each in the Walking, Toy, and Petting groups, and three in the Obedience groups).

#### **3.4.6. Conclusions**

In summary, dogs in the Petting and Obedience groups performed more ambivalent behaviors than dogs in the Walking group, possibly due to social conflict during interaction with an unfamiliar person. This difference, however, was not significant after correcting for multiple comparisons. In light of the conservative nature of the Bonferroni adjustment (which makes it more difficult to find a true difference when one exists) and the limited statistical power (due to small numbers of observations in

each group), this finding is worth investigating further.

Although there were no effects of enrichment on odds of or time to adoption, the majority of dogs (80%) were adopted within the first day after being made available for adoption. Moreover, 98% of dogs in the study were adopted. With such a large percentage of dogs adopted within a short period of time, it is not surprising that we did not find any differences among enrichment groups. Nevertheless, it appears that other factors (e.g., dog characteristics) were more important than the effects of enrichment in influencing adopters' selection of dogs from this shelter, which is in agreement with previous studies (Posage et al., 1998; Němcová and Novák, 2003; Normando et al., 2006; Diesel et al., 2007).

This study examined the effects of enrichment on shelter dog presentation to potential adopters, and on time to adoption. Enrichment activities are used also to enhance the mental well-being of dogs and to prevent their behavioral deterioration in the shelter. We did not evaluate these effects directly, and data from this study should not be used to argue against enrichment programs for these purposes. Although results of previous studies examining ways to enhance adoptability of shelter dogs have been promising (Wells and Hepper, 2000; Luescher and Medlock, 2009), additional research in this area is greatly needed.

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CHAPTER 4  
THE EFFECTS OF ENVIRONMENTAL ENRICHMENT ON POST-ADOPTIVE  
BEHAVIORS AND RETENTION OF SHELTER DOGS

#### **4.1. Introduction**

Dog owners frequently report that their dogs exhibit behaviors which are bothersome or unacceptable. In fact, surveys of veterinary clients in the US have found that anywhere from 42 to 90% of dog owners claimed that their dogs displayed at least one undesirable behavior (Vacalopoulos and Anderson, 1993; Voith et al., 1992). This is of concern not only because of the potential impact on the human-dog bond and welfare of the dogs, but also because behavior problems are a leading cause of relinquishment of dogs to shelters in the US every year (Patronek and Glickman, 1994; Patronek et al., 1995; Patronek et al., 1996; Miller et al., 1996; DiGiacomo et al., 1998; Salman et al., 1998; Salman et al., 2000; New et al., 2000). Indeed, ~30-40% of owned dogs admitted to shelters are surrendered because of behaviors that are unacceptable to owners (Miller et al., 1996; DiGiacomo et al., 1998; Salman et al., 2000). Yet, the stressfulness of the shelter environment (due to barren, noisy, unpredictable, uncontrollable, and socially isolated conditions) (Hennessy et al., 2001) can lead to or exacerbate problem behaviors (Mertens and Unshelm, 1996; Beerda et al., 1999a, 1999b, 2000) and in turn, diminish the dogs' chances of being adopted (Lepper et al., 2002; Wells and Hepper, 1992; Marston et al., 2005). Furthermore, even after dogs are adopted, the existence of behavior problems can pose a risk for their return to the shelter (Neidhart and Boyd, 2002; Mondelli et al., 2004; Shore 2005; Diesel et al., 2008). Thus, it is reasonable to assume that minimizing the stressfulness of the shelter might prevent the occurrence or exacerbation of undesirable behaviors, and ultimately lead to improved adoption of dogs and retention in their adoptive homes.

Because dogs are social animals, provision of canine and/or human contact has been investigated as a means of mitigating the stress of confinement and improving dogs' welfare (Wells, 2004; Coppola et al., 2006; Hennessy et al., 1998, 2002, 2006;

Tuber et al., 1996; Hubrecht et al., 1992; Hetts, 1992; Mertens and Unshelm, 1996). However, allowing dogs to interact with conspecifics in a shelter setting is often difficult due to the time required to assess compatibility and prevent aggression between dogs. Alternatively, providing human contact is relatively easy to do and requires less expertise. In one study, the mere presence of a familiar caretaker was more beneficial than that of a long-standing (conspecific) kennelmate in mitigating dogs' cortisol response to a novel environment (Tuber et al., 1996). Furthermore, shelter dogs provided with gentle human contact had reduced behavioral reactivity and cortisol responses when exposed to a stressful situation (Hennessy et al., 2002a, 2002b, 2005). However, it is not known whether the benefits of providing additional in-shelter human interaction persist after a dog has been adopted.

Obedience training provides dogs with social and mental stimulation—dogs learn that rewards are contingent upon their behaviors—and teaches them to perform appropriate behaviors when interacting with humans. In previous studies, shelter dogs receiving regular obedience training had greater compliance with commands and were more likely to be adopted than dogs not receiving training (Luescher and Medlock, 2009; Hennessy et al., 2006; Thorn et al., 2006). Obedience training, however, requires both expertise and an important time investment (which is not always feasible in a shelter setting). Furthermore, although dogs receiving obedience training were found to retain the learned behavior (sitting) after 2 days (Thorn et al., 2006), it is not known whether this behavior would be retained post-adoption.

A less time-consuming way of enriching dogs' environment would be to provide them with feeding enrichment. Because dogs explore their environment with their mouths, food-dispensing toys provide an outlet for normal chewing tendencies and stimulate foraging behavior (Segurson, 2009; Gaines et al., 2008). Previous studies found that food-filled toys (Kong extreme™) promoted increased activity and



appetitive behaviors in laboratory dogs (Schipper et al., 2008), but did not adversely affect the working ability or general behavior of military dogs (Gaines et al., 2008). However, to our knowledge, no studies have examined the effects of feeding enrichment on the behaviors and retention of shelter dogs post-adoption.

The present report is part of a larger study that investigated the effects of four in-shelter enrichment programs for dogs (daily walking alone or with provision of either food-filled toys, daily human handling, or daily obedience training) on: 1) physiological and behavioral measures of stress; 2) adoptability (frequency of and time to adoption); and 3) frequency of desirable and undesirable post-adoption behaviors and retention of adopted dogs in their new homes. The overall objective of the current study was to assess the effects of the four enrichments on in-shelter behaviors that might influence selection of dogs for adoption, post-adoption behavior up to 1 month following adoption (via questionnaires mailed to new owners), and retention up to 6 months post-adoption. The current study focused on questionnaire items pertaining to behaviors that dog owners have frequently reported to be problematic (Kobelt et al., 2003; Voith et al., 1992), and those that have been associated with an increased risk of relinquishment or return of dogs to a shelter (Patronek et al., 1996; Miller et al., 1996; Salman et al., 2000; New et al., 2000; Marston et al., 2004, 2005; Segurson et al., 2005). Specifically, our hypotheses were that in-shelter enrichment programs—particularly those involving regular human contact (i.e., human interaction and obedience training), would: 1) influence in-shelter behaviors that would affect selection of dogs for adoption; 2) influence behaviors up to 1 month post-adoption; and 3) differentially affect retention of dogs in their new homes. There are no studies comparing the effects of different enrichment programs either on post-adoptive behavior of dogs or on retention of dogs in their adoptive homes to our knowledge.

## **4.2. Materials and Methods**

### **4.2.1. Animals**

The study was conducted in an open-admission shelter in upstate New York (serving urban and rural areas) from April 2007 through November 2008. During this time, the shelter admitted 5,907 dogs of which 3,115 (53%) were adopted, 2,215 (37%) euthanized, 354 (6%) returned to their owners, and 223 (4%) died or were transferred to another facility. The mean length of stay for all dogs during the study period (as reported by the shelter) was 9.4 days.

Dogs of any breed or sex relinquished by their owners or admitted as strays were recruited for the study. In addition, dogs were required to be at least 10- and no more than 24-months-old, be in good health as determined by the shelter veterinarian, and have passed the shelter's standardized behavioral evaluation. Dogs were excluded if they were relinquished in pairs, returned to the shelter by a former adopter, seized in cruelty investigations, or transferred from another shelter.

It was apparent after the first month of the study that there were fewer eligible dogs than anticipated. Hence, the age criterion was extended to include dogs between 8 and 48 months, inclusive. Similarly, the number of eligible stray dogs severely lagged behind the projected enrollment by 11 months into the study. Therefore stray dogs were excluded from the study and final analyses.

A designated adoption suite within the shelter was used to house dogs in the study. The suite consisted of six adjacent solid kennels, each of which was 117-cm wide and 274-cm long. Dogs were unable to see or interact with each other. A pulley-operated door in the middle of each kennel was used to assist in cleaning, which occurred between 8 and 11 am daily and thereafter as required. All dogs had raised beds in their kennels, were fed daily at 8:30 am and 4:30 pm, and had free access to water at all times. The public could view the dogs through windows along the front

wall of the adoption suite and was allowed to enter the suite and interact with dogs throughout the study.

Approval from the Cornell University Institutional Animal Care and Use Committee for the use of shelter dogs was obtained prior to the start of the study. In addition, approval from the Cornell University Institutional Review Board for Human Subjects (IRB) was obtained for requesting participation from adopters of study dogs. Furthermore, before initiation of the study, all authors completed an education program for the care and use of research animals.

#### **4.2.2. Study Design**

The study was a clinical trial in which the effects of four enrichment programs for dogs were investigated. The enrichment programs were: 1) outdoor walks for 10-15 minutes twice daily (Walking); 2) twice-daily walks plus provision of a food-filled toy (Kong®) once daily (Toy); 3) twice-daily walks plus 15-20 minutes once daily of standardized gentle human interaction (Petting); 4) twice-daily walks plus 15-20 minutes once daily of standardized obedience training (Obedience).

#### **4.2.3. Allocation to Treatment and Sample Size**

A computer-generated random number from 1 through 4 (1 = Walking, 2 = Toy, 3 = Petting, 4 = Obedience) was used to enroll the first dog into the study. Each dog thereafter was assigned systematically to an enrichment group using a previously generated allocation-sequence table as described previously in Chapter 2, Section 2.2.2. A sample size of 25 dogs per treatment group was estimated and described previously (Chapter 2, Section 2.2.2).

Each dog was allocated into an enrichment group (using a rotating sequence allocation table) based on the day/time stamp received when the dog entered the

shelter to minimize bias in assignment to treatment. Consequently, if two dogs underwent behavioral evaluations on the same day, the dog who had entered the shelter earlier was assigned to the next available enrichment group in the sequence.

Although complete blinding of the shelter staff was not possible because of the type of enrichments and because enrichment-group information was accessible in the shelter, the public and persons adopting dogs in the study were unaware of enrichment-group assignment. Moreover, the person entering questionnaire data into a database (PJP) was blinded to treatment groups, and all return data were verified using computerized shelter records.

#### **4.2.4. Management of dogs on trial**

Upon admittance to the shelter, all dogs underwent preventive medicine practices described previously (see Chapter 2). Prior to enrollment into the study, behavioral evaluations were performed within 1-3 days on dogs of eligible age and health status. Those dogs passing the evaluation were eligible for inclusion. The day on which the behavioral evaluations were performed was designated “Day 1” of the study.

The evaluation procedure was a modification of the Assess-a-pet™ procedure (Sternberg, 2002) previously investigated (Bollen and Horowitz, 2008) by a certified animal behavior consultant who trained all staff members performing the behavioral assessments. The evaluation was comprised of nine subtests described in Chapter 2, Section 2.2.3 (Appendix A). Any dog who showed serious aggression (lunging at the evaluator while growling and snarling, or any attempts to bite) during any part of the evaluation, or who failed three or more subtests was not made available for adoption.

Dogs passing the evaluation were returned to their kennels for ~2 hours after which they were taken to the shelter treatment area for heartworm testing, physical examination, vaccination, and assignment to an enrichment group. Blood and urine

samples were collected at this time for cortisol determinations (Chapter 2, Sections 2.2.7–2.2.8).

Dogs were then placed in the designated adoption suite (where the public could view and interact with them), but were not available for adoption until Day 8 of the study, which was indicated by a sign on the dogs' kennel door. All intact dogs were neutered on Day 5; enrichments were withheld for these dogs for that day, but resumed the following day. Otherwise, all dogs received their enrichment 7 days per week. (See Chapter 2, Figure 2.1. for a flowchart of dogs through the study.)

Dogs remained in their respective enrichment groups until they were adopted or until Day 28 of the study (whichever came first). The shelter manager and senior dog trainer reassessed any dog not adopted by Day 28 and instituted an enrichment program they believed was in the best interest of the dog. The dog was then removed from the study and moved to the general adoption area. In addition, any dog who became ill, aggressive, or appeared to be adversely affected by their enrichment (as determined by shelter staff and the primary investigator) was removed from the study.

#### **4.2.5. Enrichments**

Enrichments were provided by shelter staff members who were trained by PJP prior to commencement of the study. Each person was responsible for dogs in a pre-assigned kennel (designated A through F) for the duration of the study. A notebook containing the detailed enrichment protocols was available to staff members at all times. In addition, staff meetings were held approximately every 6 months throughout the study during which questions or concerns regarding the study were addressed and adherence to the enrichment protocols was emphasized.

The standard enrichment in the study was 10- to 15-minute walks outdoors twice daily. Dogs in all groups received this enrichment. Persons were instructed not

to practice basic obedience commands with dogs in the study during the walks. The four enrichment programs provided were:

- 1. Walking** – Dogs were walked outdoors twice daily (morning and afternoon).
- 2. Toy** – Dogs were walked outdoors twice daily and were given an appropriate-sized food-filled Kong® toy once daily (between 2 and 3 pm) in addition to their regular meals. The toys were filled with 2/3 dry, 1/3 canned dog food, and 1 to 2 teaspoons of peanut butter. The toys were frozen overnight before being given to dogs.
- 3. Petting** – Dogs were walked outdoors twice daily and received 15-20 minutes once daily (between 2 and 3 pm) of standardized petting and massage. The procedure used was based on that described by Hennessy et al. (1998). Briefly, the person spoke to the dog in a calm, soothing voice and attempted to sit with the dog in the kennel, gently encouraged the dog to sit or lie down against him/her (depending on the dog's size and temperament), and petted the dog using long, firm strokes down the length of the dog or using a deep, firm massaging motion (adjusting the pressure according to the dog's reactions) on the neck, shoulder, and back muscles.
- 4. Obedience** – Dogs were walked outdoors twice daily and participated in 15-20 minutes per day of standardized obedience training (based on the shelter's obedience protocols). Dogs were taught basic commands (sit, down, and sitting at the kennel door) and to walk on a leash using positive and negative reinforcement. [Protocols available upon request from the primary author.]

#### **4.2.6. Demographics**

A dog's sex and age (in months) were recorded upon entering the shelter. Shelter staff estimated age using the dog's dentition if the exact age was unknown. Additionally, each dog was weighed while in the shelter. A special adoption fee (above that of the standard adoption fee) was placed on all (presumed) purebred dogs, and was recorded as a yes/no variable.

#### **4.2.7. Behavior Questionnaire**

When a dog in the study was adopted, an adoption counselor at the shelter explained that the dog was part of a study examining the effectiveness of various in-shelter behavior enrichment approaches on enhancing the welfare of dogs while they were in the shelter as well as on their post-adoption behaviors and integration in their new homes. The adoption counselor then requested the new owners' participation in the study and obtained their signature on an informed-consent form (Appendix B). For owners who agreed to participate, questionnaires were mailed (at 3, 11, and 23 weeks following adoption of dogs) to collect data regarding dogs' behaviors at approximately 4, 12, and 24 weeks post-adoption. Reminder postcards were sent to adopters if questionnaires were not received within 2 weeks after the initial mailing. If the questionnaire still was not received within 1 week after mailing the postcard, the adopter was contacted by phone and asked to return the completed questionnaire even if the dog was no longer owned. If the questionnaire still had not been returned within 1 week after the phone-call reminder, the questionnaire was re-sent. Thereafter, no further reminders were made to the adopter. This procedure was followed for each of the three questionnaires. However, if an adopter did not return both the first and second questionnaires, the adopter was considered "non-compliant" and was not sent a third questionnaire.

Each questionnaire contained 37 questions, and incorporated modified sections of a standardized behavioral evaluation (C-BARQ) with the kind permission from Dr. Serpell (Hsu and Serpell, 2003) (Appendix C). The questionnaire was organized into 11 sections that were comprised of yes/no questions, behavioral rating scales, multiple choice, and open-ended questions. Section 1 requested general information: whether the dog was still in the adoptive home, reasons for selecting that particular dog, veterinary care, and any bothersome behaviors exhibited. Sections 2 through 5 asked questions regarding training and obedience; separation-related behavior; fear and anxiety; and attachment and attention-seeking, respectively. Section 6 contained items relating to aggression towards people, other dogs, or other animals. Section 7 asked questions relating to excitability, and section 8 contained questions regarding miscellaneous behaviors (escaping, coprophagy, barking, jumping, digging, etc.). Section 9 contained items related to behavioral activities, where the dog was kept during the day, and where he/she slept at night. Section 10 asked questions regarding the adoptive household and environment, and section 11 requested information regarding the adopter's satisfaction with their dog. Furthermore, in the first questionnaire only, owners were asked about why they selected their particular dog (see Table 4.5). [Questionnaires are available upon request from the first author.]

Questions for six of the sections consisted of a series of 4-point behavioral rating scales. For sections regarding obedience and separation-related, attachment and attention-seeking, and miscellaneous behaviors, a score of 0 indicated the dog never performed the behavior, and a score of 1 through 3 indicated increasing frequency of occurrence of that particular behavior (Table 4.1). For sections regarding fear and anxiety and excitability, a score of 0 indicated no signs of the behavior, and scores 1 to 3 indicated increasing severity of behavioral signs (Table 4.1). A score of 9 was used in all sections for items that did not apply or for which the owner was unaware of the



dog's behavior. In the analyses, any score of 9 was treated as a missing value.

The questionnaire was pilot tested by 10 to 12 dog owners of various experiential and educational backgrounds who completed the questionnaire and provided feedback regarding the content and clarity of questions asked. Revisions based on their comments were made to the final version that was mailed to adopters. Second and third questionnaires (which were identical) differed from the first questionnaire in that they did not request information regarding reasons for selecting a particular dog—but did ask questions regarding any recent changes in the adoptive household. All other questions were identical except that they pertained to the period since the last questionnaire.

**Table 4.1.** Description of behavioral rating scales.

<b>Obedience, Separation-Related Behavior, Attachment and Attention-seeking</b>	
<b>0</b>	Never (0%)
<b>1</b>	Seldom (1-25%)
<b>2</b>	Sometimes (26-75%)
<b>3</b>	Usually (76-100%)
<b>9</b>	Do not know
<b>Miscellaneous Behaviors</b>	
<b>0</b>	Never
<b>1</b>	Less than 1 time per week
<b>2</b>	2-3 times per week
<b>3</b>	Every day or every other day
<b>9</b>	Does not apply
<b>Fear and Anxiety</b>	
<b>0</b>	No visible signs of fear
<b>1</b>	Mild fear: avoiding eye contact and feared object
<b>2</b>	Moderate fear: whimpering or whining, shivering or cringing, tail tucked
<b>3</b>	Severe fear: shaking, trembling, freezing (unwilling to move), attempting to escape or hide
<b>9</b>	Do not know
<b>Excitability</b>	
<b>0</b>	Calm: little or no reaction
<b>1</b>	Mild reaction: looking at source of noise, ears up
<b>2</b>	Moderate reaction: moving toward source of noise, barking, jumping
<b>3</b>	Severe reaction: running toward source of noise, loud barking or yelping, difficult to calm down
<b>9</b>	Do not know

#### **4.2.8. Retention Data**

Each questionnaire requested information regarding the retention status of the adopted dog. Adopters who no longer owned their adopted dog were asked the length of ownership, what happened to their dog [the dog ran away or was lost, euthanized (including reason for euthanasia), died (including cause of death), was given away, or

was returned to the shelter], and reasons for giving up their dog [too many animals in home, allergies to dog, family moved, dog had problems with another pet (including description of problems), behavior problems (including description of behavior), did not like dog's personality, dog had medical problems (including description of medical issues), dog was more time and work than expected, or cost]. In addition, shelter records were searched at the end of the study to record any dogs who had been returned to the shelter, but for whom a questionnaire was not received. Reasons for returning a dog to the shelter were recorded at the time the dog was returned and were categorized into two broad categories: 1) behavioral reasons (including aggression, excessive activity, barking, house soiling, destructiveness); and 2) owner issues (including moving, too much work, personal issues).

#### **4.2.9. Statistical Analysis**

The current study evaluated the effects of the four in-shelter enrichment programs on dogs' behaviors post-adoption. To test the hypothesis that enrichment programs would change post-adoptive behaviors, only data from the first questionnaire (at approximately 1 month post-adoption) were analyzed due to the number of potential factors that could have influenced the behaviors of dogs at 3 and 6 months following adoption (e.g., family composition, presence or absence of obedience training, housing conditions, presence of other dogs, experiential influences, etc.). We compared select questionnaire items (among enrichment groups) that related to behaviors that have been frequently reported by dog owners to be particularly problematic and are often cited as reasons for relinquishment or return of a dog to an animal shelter (Voith et al., 1992; Miller et al., 1996; Patronek et al., 1996; New et al., 2000; Salman et al., 2000; Wells and Hepper, 2000b; Kobelt et al., 2003; Marston et al., 2004; Marston et al., 2005b; Segurson et al., 2005; Lord et al., 2008) (see Table 4.2).

Differences in distributions of categorical variables were compared using a Pearson chi-square ( $\chi^2$ ) test for independence; distributions of continuous Gaussian variables were compared using a one-way ANOVA; and distributions of non-Gaussian continuous variables were compared using a Kruskal-Wallis or Wilcoxon rank-sum test.

A Pearson  $\chi^2$  test of independence was used to test whether proportions of returned dogs differed among enrichment group. Kaplan-Meier survival curves were compared using the log-rank test to evaluate the number of days until return by enrichment group (combined and separately for each level of reason for return).

Statistical tests were 2-sided and significance was set at  $p \leq 0.05$ . This strategy was adopted in light of the hypothesis-generating (as well as hypothesis-testing) nature of this study. However, where multiple between-group comparisons were made, the level of significance was adjusted using a Bonferroni correction (Saville, 1990; Greenland and Robins, 1991) set at  $p \leq 0.008$ . Statistical analyses were performed using JMP 8.0 (SAS Institute, Cary, NC, USA). [Note: this software package uses a chi-square approximation for Kruskal-Wallis and Wilcoxon rank-sum tests.]

**Table 4.2.** Questionnaire items compared between enrichment groups.

<b>Yes / No questions:</b>	
1.	What factors influenced your selection of <i>this</i> dog as opposed to another dog?
	a. Dog did not bark
	b. Dog remained calm; not excitable
2.	Does your dog show any <i>behaviors</i> that you find bothersome?
3.	Have you ever consulted a veterinarian, behaviorist, or animal trainer about changing any of your dog's behaviors?
4.	Has your dog ever growled at, snapped at, nipped, or bitten:
	a. A person
	b. Another dog
<b>Behaviors rated as frequency of occurrence (from 0 = never to 3 = usually):</b>	
5.	Please estimate how often (what percentage of time) your dog does each item listed below since the time you adopted him or her.
	a. Obeys the "sit" command immediately
	b. Pulls too hard when being walked on the leash
6.	How often has your dog shown each of the following signs when left alone, <i>or about to be left alone</i> , since the time you adopted him or her?
	a. Chewing, damaging, or destroying objects or furniture in the house (for example, sofas, chairs, or cushions) that are not dog toys
	b. Chewing or scratching at doors, walls, floors, windows, curtains, etc.
7.	Since you adopted your dog, how often has he or she shown each of the following signs of attachment or attention-seeking to you or another family member?
	a. Tends to nudge, nuzzle, lick, or paw at a family member when he/she is sitting down
8.	Please indicate how often your dog has shown any of the following behaviors since you adopted him or her.
	a. Escapes from the home or yard; roams
	b. Chews inappropriate objects while you are home
	b. Jumps up on you or other household members
	c. Seems hyperactive, restless, or has trouble settling down
	d. Barking so much that it bothers someone in your home
	e. Urinates when approached, petted, or handled, or when someone speaks in a loud or harsh voice
<b>Behaviors rated as severity of occurrence (from 0 = no signs to 3 = severe signs):</b>	
9.	Please indicate your dog's tendency, since you adopted him or her, to show fearful behavior in each of the situations below.
	a. In response to sudden or loud noises
	b. In unfamiliar situations (for example, first car ride, first visit to veterinarian, etc.)
10.	Please indicate your dog's tendency, since you adopted him or her, to become excitable in each of the circumstances below.
	a. Just before being taken for a walk or car ride
	b. When someone knocks at the door or rings the bell

### **4.3. Results**

#### **4.3.1. Descriptive Statistics**

One-hundred eight dogs were enrolled in the study between April 2007 and November 2008; 16 dogs were withdrawn before being adopted (Table 2.1, Chapter 2, Section 2.3.1). Ninety of the 92 remaining dogs (98%) were adopted by the end of the study period (Day 28); informed consent was obtained from adopters of all 90 dogs.

Seventy-eight percent (70/90) of the first questionnaires mailed to adopters 3 weeks following adoption were returned. The proportion of returned questionnaires did not differ among enrichment groups (Pearson  $\chi^2 = 2.5$ ,  $p = 0.48$ ).

The median age of dogs made available for adoption was 12 months (range 8 to 48 months); only one dog per enrichment group was > 24 months old. The demographic characteristics of adopted dogs were not significantly different among enrichment groups (Table 4.3; all  $p \geq 0.08$ ). In addition, the demographic characteristics of dogs with returned questionnaires did not differ from those without returned questionnaires (Table 4.4; all  $p \geq 0.13$ ).

**Table 4.3.** Distribution of demographic variables of adopted dogs among enrichment groups.

	Walking	Toy	Petting	Obedience
<b>Age (months)</b>				
<b>1<sup>st</sup> quartile</b>	9	10	10	12
<b>Median</b>	12	12	12	18
<b>3<sup>rd</sup> quartile</b>	18	18	12	24
<b>Sex [number (%)]</b>				
<b>Female</b>	7 (28%)	11 (44%)	10 (43%)	7 (37%)
<b>Male</b>	18 (72%)	14 (56%)	13 (57%)	12 (63%)
<b>Weight (kg)</b>				
<b>Mean</b>	16.9	21.1	18.2	20.2
<b>SD</b>	10.6	9.1	11.3	6.9
<b>Purebred [number (%)]</b>				
<b>No</b>	19 (76%)	21 (84%)	16 (70%)	18 (95%)
<b>Yes</b>	6 (24%)	4 (16%)	7 (30%)	1 (5%)

**Table 4.4.** Distribution of demographic characteristics of dogs with and without returned first questionnaires.

	Questionnaire 1 Received	Questionnaire 1 Not Received
<b>Age (months)</b>		
<b>1<sup>st</sup> quartile</b>	10	10
<b>Median</b>	12	18
<b>3<sup>rd</sup> quartile</b>	18	18
<b>Sex [number (%)]</b>		
<b>Female</b>	25 (36%)	10 (45%)
<b>Male</b>	45 (64%)	12 (55%)
<b>Weight (kg)</b>		
<b>Mean</b>	19.1	18.7
<b>SD</b>	9.7	9.9
<b>Purebred [number (%)]</b>		
<b>No</b>	58 (83%)	16 (73%)
<b>Yes</b>	12 (17%)	6 (27%)

### 4.3.2. Questionnaire Data

*Selection:* The most common reasons (out of a possible 13) reported by respondents for selecting their dog were: size, friendliness, appearance/coat color, age or sex, and breed (Table 4.5). Adopters were allowed to select more than one factor influencing selection; thus, percentages totaled more than 100%.

Adopters selecting dogs who “did not bark” differed among enrichment groups (Table 4.6; Pearson  $\chi^2 = 10.11, p = 0.018$ ): more adopters of dogs in the Toy (58%) and Obedience groups (75%) indicated that they selected their dogs because they were quiet than did adopters of dogs in the Walking group (23%) (Fisher’s Exact test,  $p = 0.029, p = 0.005$ , respectively). However, with a Bonferroni correction (i.e., significance is set at  $p \leq 0.008$ ), only the difference between the Obedience and Walking groups remained significant. Comparison of adopters selecting dogs who were calm did not reveal any differences among enrichment groups (Table 4.6; Pearson  $\chi^2 = 2.93, p = 0.40$ ).

**Table 4.5.** Possible reasons for selecting a dog (N = 70).

	Yes	No
<b>Dog was the size I wanted</b>	58 (83%)	12 (17%)
<b>Dog appeared friendly (wagging tail)</b>	52 (74%)	18 (26%)
<b>Liked his/her coat color and appearance</b>	47 (67%)	23 (33%)
<b>Dog was the age and/or sex I wanted</b>	43 (61%)	27 (39%)
<b>Dog was the breed or breed-mix I wanted</b>	39 (56%)	31 (44%)
<b>Dog did not bark</b>	32 (46%)	38 (54%)
<b>Dog remained calm; not excitable</b>	29 (41%)	41 (59%)
<b>Dog approached the front of the run when I approached him/her</b>	28 (40%)	42 (60%)
<b>My children selected him/her</b>	11 (16%)	59 (84%)
<b>Dog reminded me of a former pet</b>	11 (16%)	59 (84%)
<b>Shelter staff recommended him/her</b>	6 (9%)	64 (91%)
<b>Thought no one else would adopt him/her</b>	1 (1%)	69 (99%)



*Post-adoption behavior:* At 1 month post-adoption, 79% of owners reported that their dog exhibited behaviors that were bothersome; this percentage did not differ among enrichment groups (Pearson  $\chi^2 = 0.62$ ,  $p = 0.89$ ). When asked if they had consulted a veterinarian, behaviorist, or trainer about changing any of their dog's behaviors within the first month of adoption, 46% of adopters answered "yes"; however, this percentage did not vary among enrichment groups (Table 4.6; Pearson  $\chi^2 = 1.20$ ,  $p = 0.75$ ).

Only 26% of adopters reported taking their dog to a formal obedience class; however, 77% of adopters reported training their dog at home. (Note that adopters were allowed to select more than one option for obedience training; thus, percentages summed to  $> 100\%$ ). Attendance at obedience class differed by enrichment group (Pearson  $\chi^2 = 14.04$ ,  $p = 0.003$ ): dogs in the Petting (53%) and Obedience (42%) groups were more likely to attend a formal obedience class than dogs in the Toy group (5%) (Fisher's Exact,  $p = 0.002$ ,  $p = 0.022$ , respectively). The latter difference was not significant at the  $p \leq 0.008$  cut-off level.

Thirty-six percent of owners reported that their dog showed some form of aggression toward people, 33% showed aggression toward other dogs, and 84% displayed aggression toward another animal (primarily squirrels) within the first month following adoption. However, no people or dogs were reported to require medical care due to aggression. The percentage of dogs reported to show any type of aggression toward people or other dogs did not differ among groups (Pearson  $\chi^2$ , all  $p \geq 0.64$ ).

Twenty-three percent of adopters claimed that their dog was not housetrained when first brought home from the shelter, and 30% of these reported that by 1 month post-adoption, their dog still was not housetrained. The percentages did not vary among enrichment groups for either question (Pearson  $\chi^2$ , both  $p \geq 0.13$ ).

There were no differences among enrichment groups in the median frequencies

with which dogs obeyed the “sit” command (Table 7; Kruskal-Wallis  $\chi^2 = 0.76, p = 0.86$ ), nor did the median frequencies with which dogs pulled excessively hard on the leash vary significantly among groups (Table 4.6; Kruskal-Wallis  $\chi^2 = 1.78, p = 0.62$ ).

Median frequencies of hyperactive behavior varied significantly among enrichment groups at 1-month post-adoption (Table 4.6; Kruskal-Wallis  $\chi^2 = 9.08, p = 0.028$ ): dogs in the Obedience group were reported to display “hyperactive” behaviors more often than dogs in either the Walking and Toy groups (Wilcoxon rank-sum  $\chi^2 = 4.08, p = 0.043$ ; Wilcoxon rank-sum  $\chi^2 = 9.53, p = 0.002$ , respectively). Using a Bonferroni adjustment, only the difference between the Obedience and Toy groups remained significant. In addition, median frequencies of barking that bothered family members differed among groups (Table 4.6; Kruskal-Wallis  $\chi^2 = 9.10, p = 0.028$ ): dogs in the Walking and Petting groups displayed more bothersome barking than did dogs in the Toy group (Wilcoxon rank-sum  $\chi^2 = 7.99, p = 0.005$ ; Wilcoxon rank-sum  $\chi^2 = 4.76, p = 0.029$ , respectively). After adjusting for multiple comparisons, the difference between the Petting and Toy groups was not significant.

There were no differences in the median reported frequencies of the questions relating to separation-related behaviors (destroys objects or destroys doors), attention-seeking behavior (nudges or paws at owners), or other miscellaneous behaviors (escapes, chews, jumps up, submissive urination) (Table 4.6; all  $p \geq 0.34$ ). Similarly, there were no differences in the median reported intensity of the questions relating to fearful behavior (to loud noises or unfamiliar situations) or excitability (before a walk or car ride, or at door) (Table 4.6; all  $p \geq 0.06$ ).

**Table 4.6.** Results for specific questionnaire items.

	Walking			Toy			Petting			Obedience			<i>p</i>
<b>Selection</b>													
<b>Did not bark</b>	23% (5/22)			58% (11/19)			41% (7/17)			75% (9/12)			<b>0.02</b>
<b>Calm</b>	36% (8/22)			47% (9/19)			29% (5/17)			58% (7/12)			0.40
<b>Problem behaviors</b>													
<b>% Yes</b>	85% (17/20)			79% (15/19)			76% (13/17)			75% (9/12)			0.89
<b>Behavioral consultation</b>													
<b>% Yes</b>	50% (11/22)			37% (7/19)			53% (9/17)			42% (5/12)			0.75
<b>Aggression</b>													
<b>Person</b>	32% (7/22)			33% (6/18)			35% (6/17)			50% (5/10)			0.78
<b>Dog</b>	23% (5/22)			37% (7/19)			41% (7/17)			33% (4/12)			0.64
<b>Behaviors scored 0 to 3</b>	<b>Min</b>	<b>Md</b>	<b>Max</b>	<b>Min</b>	<b>Md</b>	<b>Max</b>	<b>Min</b>	<b>Md</b>	<b>Max</b>	<b>Min</b>	<b>Md</b>	<b>Max</b>	<i>p</i>
<b>Obedience*</b>													
<b>Obeys "sit"</b>	0	<b>3</b>	3	2	<b>3</b>	3	1	<b>3</b>	3	1	<b>3</b>	3	0.86
<b>Pulls on leash</b>	0	<b>1</b>	3	0	<b>1</b>	3	0	<b>0</b>	3	0	<b>1</b>	3	0.62
<b>Separation-related**</b>													
<b>Destroys objects</b>	0	<b>2</b>	3	0	<b>1</b>	3	0	<b>1</b>	3	0	<b>2</b>	3	0.78
<b>Destroys doors, etc.</b>	0	<b>0</b>	3	0	<b>1</b>	3	0	<b>0</b>	3	0	<b>0</b>	3	0.93
<b>Attention-seeking*</b>													
<b>Nudge, paw, etc.</b>	0	<b>3</b>	3	0	<b>3</b>	3	1	<b>2</b>	3	0	<b>2</b>	3	0.67

Table 4.6 (Continued)

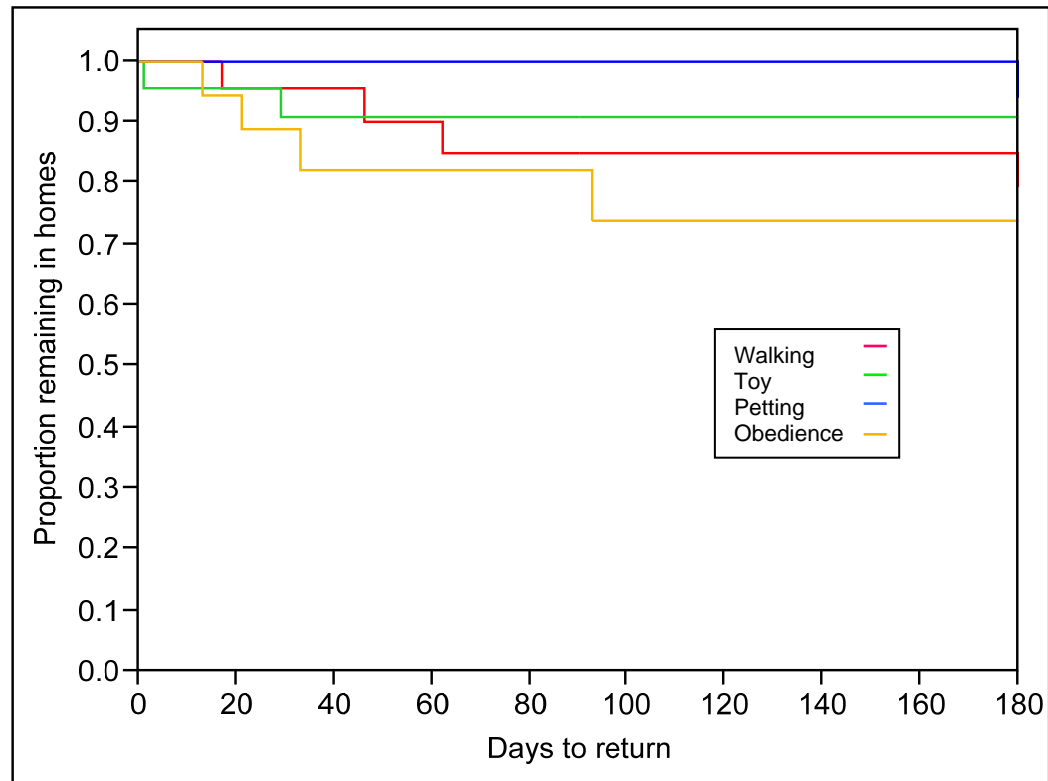
Behaviors scored 0 to 3	Min	Md	Max	Min	Md	Max	Min	Md	Max	Min	Md	Max	<i>p</i>
<b>Unruly*</b>													
Escapes	0	<b>0</b>	1	0	<b>0</b>	1	0	<b>1</b>	3	0	<b>0</b>	3	0.34
Chews	0	<b>1</b>	3	0	<b>1</b>	3	0	<b>1</b>	3	0	<b>1</b>	3	0.64
Jumps up	0	<b>3</b>	3	0	<b>2</b>	3	0	<b>3</b>	3	1	<b>3</b>	3	0.80
Excessive activity	0	<b>1</b>	3	0	<b>0</b>	3	0	<b>1</b>	3	0	<b>2</b>	3	<b>0.03</b>
Excessive barking	0	<b>1</b>	3	0	<b>0</b>	2	0	<b>1</b>	3	0	<b>0</b>	3	<b>0.03</b>
Submissive urination	0	<b>0</b>	3	0	<b>0</b>	1	0	<b>0</b>	3	0	<b>0</b>	0	0.71
<b>Fearful behavior**</b>													
Noises	0	<b>0</b>	2	0	<b>1</b>	2	0	<b>0</b>	1	0	<b>0</b>	2	0.47
Unfamiliar situations	0	<b>0</b>	1	0	<b>0</b>	3	0	<b>0</b>	3	0	<b>1</b>	2	0.54
<b>Excitability**</b>													
Before walk or ride	1	<b>2</b>	3	0	<b>1</b>	3	0	<b>2</b>	3	1	<b>2</b>	3	0.06
At door	1	<b>2</b>	3	0	<b>2</b>	3	0	<b>2</b>	3	1	<b>2</b>	3	0.14

\* 0 = never, 1 = <1 time/week, 2 = 2-3 times/week, 3 = every or every other day

\*\* 0 = calm, 1 = mild reaction, 2 = moderate reaction, 3 = severe reaction

### 4.3.3. Return Data

Ten dogs were lost to follow-up by 1 month post-adoption, another 8 dogs were lost by 3 months post-adoption, and an additional 8 dogs were lost to follow-up by 6 months post-adoption; thus, 29% (26/90) of dogs did not have complete follow-up. Five dogs (6%) were returned by 1 month post-adoption. By 3 months after adoption, the total number of returned dogs had increased to 8 (11%), and by 6 months post-adoption, a total of 11 dogs (17%; 95% C.I. = 10-28%) were returned. Of the returned dogs, four were in the Walking group, two in the Toy group, one in the Petting group, and four in the Obedience group. Seven of these dogs were relinquished for behavioral reasons, and four because of owner issues. The proportion of returned dogs did not differ among enrichment groups (Pearson  $\chi^2 = 2.88, p = 0.41$ ). Kaplan-Meier curves of the number of days to return also did not differ among enrichment groups (Figure 4.1; log-rank  $\chi^2 = 3.43, p = 0.33$ ).



**Figure 4.1.** Kaplan-Meier survival curves showing the proportion of dogs remaining in their adoptive homes over time by enrichment group.

## **4.4. Discussion**

### **4.4.1. Objective and Justification of Enrichment Groups**

The aim of this study was to evaluate the effects of four enrichment programs on 1) the in-shelter behavior of dogs that might influence their selection for adoption; 2) post-adoptive behavior of dogs in their new homes up to 1-month following adoption; and 3) the retention of dogs up to 6 months after adoption. The enrichments chosen for study were those previously investigated (Hennessy et al., 1998; Hennessy et al., 2002a; Hennessy et al., 2002b; Coppola et al., 2006; Hennessy et al., 2006; Gaines et al., 2008; Schipper et al., 2008; Luescher and Medlock, 2009) and commonly used by animal shelters in the US. The basic enrichment (10- to 15-minute walks outdoors twice daily) was the standard of practice for the shelter in this study and was provided to dogs in all groups.

The food-filled toy (Kong®) was selected as an enrichment because it was relatively simple to provide, and was commonly given to dogs in the collaborating shelter. Previous studies examined the influence of toys on kennel dogs' behaviors and desirability to potential adopters, and of food-filled toys on working ability and in-kennel behaviors (Wells and Hepper, 1992; Wells and Hepper, 2000a; Wells, 2004; Gaines et al., 2008; Schipper et al., 2008), but to the authors' knowledge, none have examined the effects of feeding enrichment for shelter dogs on post-adoptive behavior and retention.

Although providing dogs with regular, gentle human contact has been shown to moderate the physiological and behavioral stress responses to aversive stimuli (Lynch and McCarthy, 1967; Kostarczyk and Fonberg, 1982; Hennessy et al., 1997; Hennessy et al., 1998; Hennessy et al., 2002a; Coppola et al., 2006; Hennessy et al., 2006), no studies have examined whether the effects of such contact is retained following adoption (as measured by post-adoptive behavior and retention). The

human-contact enrichment provided in the current study (Petting) was based on the procedure described by Hennessy et al. (1998), who showed that this type of interaction inhibited a cortisol response in shelter dogs following the stress of venipuncture.

Obedience training for unruly or boisterous dogs has become popular in shelters as a way to improve the dogs' in-shelter behavior and, therefore, increase dogs' desirability to potential adopters. Indeed, in a randomized, controlled trial, dogs receiving 20 minutes per day of obedience training were adopted more often than dogs not receiving training (Luescher and Medlock, 2009). Moreover, dogs receiving socialization and obedience training were more compliant with commands, showed less jumping on an unfamiliar person, and less vocalizing in a novel environment (Hennessy et al., 2006). Shelters dogs trained to sit when approached in their kennel retained the sitting behavior (and generalized to unfamiliar people) after 2 days without training (Thorn et al., 2006). Although those results are promising, it is imperative to assess the long-term effectiveness of obedience training on the behavior and retention of dogs post-adoption to determine whether the benefits outweigh the costs of focusing large amounts of shelter resources on this type of enrichment. In this study, the collaborating shelter provided basic obedience training to dogs in the Obedience group using their standardized training protocols.

#### **4.4.2. Use of Questionnaire to Assess Post-Adoption Behavior**

We used a questionnaire (11 sections, 37 questions) to assess dogs' behaviors at 1 month post-adoption. Although directly observing dogs' post-adoptive behavior might have minimized variability and subjectivity in owner assessments, it was not practical for this study. Moreover, owners are more knowledgeable regarding their dogs' behaviors in particular circumstances because they are the ones who live with



the dogs (Hsu and Serpell, 2003). Our questionnaire incorporated sections from a previously validated questionnaire designed to evaluate canine behavior (C-BARQ: Canine Behavioral Assessment and Research Questionnaire; Hsu and Serpell, 2003), but was modified to accommodate our aims. The use of a questionnaire to collect data on the dogs' behavior during the first month following adoption potentially could have led to problems with owner recall. Bias also could have occurred if owners of dogs with problematic behaviors were more likely to return questionnaires than owners of dogs without behavior problems. The adopters of dogs in our study, however, were blinded to enrichment-group assignment, which eliminated any influence of prior knowledge of group assignment on their responses (e.g., owners who knew that their dogs received obedience training while in the shelter might have expected their dogs to "sit" or "down" more frequently and, therefore, more likely to report compliance with these commands). Moreover, adopters were encouraged to contact the researchers with any questions or concerns regarding the questionnaire (although no adopter did so). Finally, our questionnaire was pilot-tested by various dog owners of differing backgrounds who assessed its clarity and content. Based on the recommendations from those owners, minor wording and content revisions were made to the final version that was mailed to adopters.

#### **4.4.3. Questionnaire Data**

Because there is a lack of data examining the effectiveness of enrichment programs for dogs in shelters on post-adoptive behaviors, our data analyses focused not only on hypothesis testing, but also on generating new areas for future research. However, whenever multiple comparisons are made, the probability of falsely claiming a significant result (i.e., a Type I error) is increased. The Bonferroni correction is one approach for dealing with the issue of multiple comparisons by adjusting the

significance level according to the number of parameters analyzed. However, it is conservative—although it protects against falsely claiming that a difference exists, it does so at the cost of increasing the probability of failing to find a real difference (i.e., a Type II error). Therefore, in light of the hypothesis-generating (as well as the hypothesis-testing) nature of this study, we reported results significant at the  $p \leq 0.05$  level and addressed which results remained significant after using a Bonferroni correction ( $p \leq 0.008$ ).

One hypothesis of our study was that enrichments would differentially affect behaviors that might affect selection of a dog for adoption. Although there was no significant enrichment-group effect on the proportion of adopters selecting dogs who were calm, dogs in the Toy and Obedience groups were more often selected for adoption because they did not bark (in the shelter) as compared to dogs in the Walking group. In a previous study, barking “decreased” in dogs conditioned to sit at the front of their kennels, although it was not tested statistically (Thorn et al., 2006). Dogs in the Obedience group in our study were accustomed to receiving rewards contingent upon their behavior. Thus, it is not surprising that they did not bark when approached by a visitor because barking most likely would not have been rewarded during their obedience training sessions.

It is unclear why dogs in the Toy group also were more likely to be chosen for not barking. Schipper et al. (2008) found a non-significant decrease in the frequency of barking in dogs when supplied with a food-filled toy, which those authors suggested might have been due to a shift in time budgets (dogs spent  $> 30\%$  of their time interacting with the toy) or to reduced responsiveness of dogs to their environment (resulting in decreased arousal and, hence, barking). Persons providing dogs with food-filled toys in our study could have reinforced quiet behaviors only (i.e., had not given the toy to the dog until he or she was quiet)—even though they

were not instructed to do so. It also is possible that providing dogs with a means to display a normal species-specific behavior (chewing) resulted in less frustration-related barking. Alternatively, the result could have been due to sampling error (i.e., dogs assigned to the Toy group were quieter by nature than dogs in the other groups). Because of the large number of variables tested, it is not unreasonable to attribute the result to a Type-I error (i.e., we observed a difference when in truth there was none).

When asked if there were any behaviors that they considered bothersome, 79% of adopters answered “yes”—although this percentage did not differ among enrichment groups. Likewise, when asked if they had consulted a veterinarian, behaviorist, or trainer to change their dogs’ behavior, 46% answered “yes”, with no difference among groups. Hence, any effect of enrichment was not grossly apparent to adopters in what they perceived to be problematic behaviors or in what they perceived to be severe enough to warrant assistance. Although one might expect adopters of dogs receiving in-shelter obedience training to cite fewer behavior problems, an earlier study found that the total number of reported undesirable behaviors by dogs’ owners was not affected by their attendance at obedience training classes (Blackwell et al., 2008). Owners were blinded to enrichment-group assignment to prevent any influence of knowing which enrichment their dog received on their responses to questionnaire items (for instance, adopters of dogs in the Obedience group might have had higher expectations of their dogs’ behavior and therefore more likely to report higher frequency or severity of particular “problematic” behaviors). Nonetheless, the number of adopters reporting bothersome behaviors is of concern because it might affect the human-dog bond (Serpell, 1996).

When asked questions about specific behaviors at 1 month following adoption, owners of dogs in the Obedience group reported that their dog displayed “hyperactive” behaviors more frequently than did adopters of dogs in the either the Walking or Toy

groups. Similarly, dogs in the Walking and Petting groups were reported to display annoying barking more frequently than were dogs in the Toy group. This is surprising considering that dogs in the Petting and Obedience groups were more likely to attend a formal obedience class in the month following adoption than were dogs in the Toy group. It is possible that the differences in “hyperactive” behaviors and barking were due to frustration experienced by dogs in the Petting and Obedience groups, who were accustomed to 15-20 minutes of daily interaction with a familiar person; dogs in the Toy group were accustomed only to receiving a food-filled toy each day. Following adoption, it is highly unlikely that dogs continued to receive their respective enrichments at the regularity and intensity to which they were accustomed. Even for dogs attending obedience classes post-adoption, it is feasible to suppose that owners did not continue to practice obedience (as a form of interaction) with their dogs on a regular schedule in between class sessions. In a previous report, cortisol levels increased in kennel dogs after sudden interruption of a 10-day walking and petting program—suggesting that the dogs were stressed by the cessation of the interaction (Normando et al., 2005). Furthermore, military working dogs receiving an irregular enrichment program of exercise and human contact had higher levels of cortisol after 7 weeks than did dogs receiving the same enrichment, but on a regular schedule (Lefebvre et al., 2009). Although cortisol levels were not analyzed post-adoption in the current study, it is possible that dogs in the Petting and Obedience groups were frustrated (i.e., stressed) due to the discontinuation of their regular enrichment programs, which involved regular human interaction in both groups, and that this frustration was manifested by an increase in barking and hyperactivity, respectively.

As stated earlier, it is possible that despite our allocation approach, the Toy group included dogs who were calmer than dogs in the other three groups (they were selected for not barking and displayed hyperactive behaviors and annoying barking

less frequently post-adoption). This also could explain the lower attendance at obedience class in this group—if dogs were initially calmer (and quieter as explained above), owners would be less inclined to enroll them in training classes.

The finding that owners of dogs in the Walking group reported that their dogs displayed fewer “hyperactive” behaviors but more bothersome barking (versus dogs in the Obedience and Toy groups, respectively) was unexpected. In a previous report, dogs that were rated high on playfulness, exploration, and excitability were more likely to display signs of frustration (barking, jumping, chewing) (Stephen and Ledger, 2007). We, however, did not assess the dogs’ personalities. Dogs in the Walking group might have been barking more frequently due to reasons other than excessive activity (e.g., separation-related anxiety, social facilitation). It is also possible that the finding was spurious due to the large number of variables tested.

There was no difference among enrichment groups with respect to the frequency that dogs obeyed the “sit” command as reported by their owners. This finding was unexpected, particularly because dogs who received in-shelter obedience training were expected to obey basic obedience commands more than dogs not receiving in-shelter training (Clark and Boyer, 1993; Kobelt et al., 2003). In a previous study, shelter dogs trained to sit when approached in their kennels retained the behavior after 2 days without training when tested by an unfamiliar person (Thorn et al., 2006). Thus, in some dogs the effects of in-shelter obedience training in the present study either did not persist after adoption or were not reinforced adequately by adopters (who might have realized their dogs knew obedience commands and, therefore, were less likely to pursue additional training). The latter explanation is less likely because dogs in the Obedience group were more likely to attend obedience class within the first month following adoption than were dogs in the Toy group (although this was not significant at  $p < 0.008$ ). Further investigation of the effectiveness of the

shelter's training protocols on post-adoption behavior is warranted.

No other significant differences in reported behaviors were found among enrichment groups (Table 4.6). Although this might be due to a lack of effectiveness of the enrichment programs on post-adoptive behavior, it is likely that other post-adoption influences (such as household composition and demographics, and consistency, predictability, and quality of interactions with the adoptive family) obscured any lasting enrichment effects.

Multiple comparisons were made in this study with and without adjusting the level of significance. This was done to avoid missing possible real effects of enrichment. Dogs in the Toy group were selected more often because they did not bark, and were reported to display less frequent hyperactive behaviors and barking post-adoption. However, using a Bonferroni correction, only the post-adoptive behavior results remained significant. Nonetheless, the pattern of behavior in this group is consistent; therefore, the findings are less likely to be spurious. Dogs in the Obedience group were selected more frequently because they did not bark, but were reported to show more hyperactive behaviors post-adoption (even though they were more likely to attend obedience class). These results appear to be contradictory, which raises questions whether they are due to a Type-I error. However, except for attendance at obedience class, the results remained significant even after adjusting the  $p$ -value for multiple comparisons ( $p \leq 0.008$ ). Owners of dogs in the Walking group less frequently reported selecting dogs who did not bark in the shelter and more frequently reported that their dogs exhibited bothersome barking post-adoption. Both of these results are consistent behaviorally and remained significant with a Bonferroni correction. Conversely, dogs in this group also were reported to display hyperactive behaviors less frequently after adoption. However, this result did not remain significant with an adjusted  $p$ -value. Dogs in the Petting group were more likely to

attend post-adoption obedience training and were reported to bark more frequently following adoption. The owners could have sought assistance with their dogs' annoying barking through obedience training; however, this latter result did not remain significant with a Bonferroni correction.

#### **4.4.4. Retention Data**

The proportion of returned dogs in our study (17%; 95% C.I.: 10-28%) is similar to proportions previously reported (Neidhart and Boyd, 2002; Mondelli et al., 2004; Marston et al., 2005a; Diesel et al., 2008). However, neither the proportion of dogs returned nor time-to-return differed among enrichment groups. The small numbers of dogs ( $n = 11$ ) no longer remaining with their owners at 6-months following adoption limited the statistical power and our ability to find any differences.

#### **4.4.5. Limitations**

A systematic assignment of dogs to enrichment groups (following a random start) was used to simplify the procedure for shelter personnel (and increase their compliance with protocols) and to ensure equal numbers of dogs in each enrichment group. Because this rotating sequence made the allocation sequence predictable, each dog was assigned into an enrichment group according to the day/time stamp received when the dog entered the shelter (so that the dog who had been relinquished earliest was assigned to the next available group) to minimize bias in enrollment of dogs to groups. The fact that the characteristics of adopted dogs (with regards to sex, weight, pure-bred status, and age) were comparable across groups suggests that bias was minimal.

Although complete blinding of shelter staff was not possible, the adopters were unaware of enrichment-group assignment throughout their participation in the study. Furthermore, retention data were verified by shelter records for any dog returned to

the shelter. However, many dogs (29%) were lost to follow-up by 6 months post-adoption. The reduced sample size limited our ability to find differences (if any existed) among enrichment groups. Furthermore, some dogs who were lost to follow-up might not have remained in their adoptive homes (which could have affected the retention data results).

The questionnaire used to collect post-adoption behavior data incorporated items from a previously validated questionnaire (C-BARQ, Hsu and Serpell, 2003); however, our modified version was not validated or tested for repeatability. The questionnaire was pilot tested to ensure appropriate clarity and content prior to the initiation of the study, and only individual questionnaire items directly pertaining to our *a priori* hypotheses were analyzed. Despite these efforts, it is possible that the questionnaire did not accurately assess post-adoptive behaviors.

The enrichment programs used in our study potentially served two primary purposes—one to enhance adoption and retention, and the other (addressed in Chapters 2 and 3) to enrich the dogs (and decrease their stress) to prevent behavioral deterioration while in the shelter. Dogs were given enrichments daily for 6-7 days before they were made available for adoption—this might not have been long enough to affect the dog’s behaviors during the first month post-adoption. Because of the costs of keeping dogs and the need to place them in their adoptive homes, retaining dogs in the shelter for a longer period (to receive enrichment) was not feasible.

To make the study practical and mimic real-world situations, shelter staff compliance with providing enrichments was not strictly monitored. Although shelter staff members were required to record the start and finish times of all enrichments, the accuracy of their data was not verified. Instead, all data were analyzed on an intention-to-treat basis (making our analyses conservative).



#### **4.4.6. Conclusions**

Very few significant differences were found between treatment groups for post-adoptive behaviors. In addition, there were no differences in retention or time to return among enrichment groups. Nevertheless, the large number of owners reporting problematic behaviors within the first month following adoption is of concern particularly because behavior problems can lead to relinquishment. Efforts should be made to promote greater use of the participating shelter's behavioral hotline by adopters who experience problems with their new dogs. The effectiveness of such programs should be investigated in future studies.

Within the limitations of this study (including the limited period of enrichment provision), it appears that in-shelter enrichment programs exert little if any lasting effect on the measured post-adoption behaviors and the dogs' ability to integrate into their new homes. However, there still may be in-shelter effects that enhance the dogs' lives, such as providing outlets for species-typical behaviors and preventing in-shelter behavioral deterioration. All enrichments provided in this study are commonly used in US shelters. Within the constraints of their available resources, shelters should continue to provide such enrichment programs to help stimulate dogs in an otherwise barren environment. In addition, other means of affecting dogs' post-adoption behavior and retention should be investigated.

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CHAPTER 5  
SUMMARY AND CONCLUSIONS

Of the vast numbers of dogs entering animal shelters in the US each year, a high proportion are mixed-breed, young adults with perceived behavior problems (Miller et al., 1996; Patronek et al., 1996; Salman et al., 2000). The shelter environment itself, however, can promote or exacerbate existing behavior problems, which may not only affect welfare (Hennessy et al., 2001), but also decrease a dog's chances of being adopted and increase his/her risk of return to the shelter (Mondelli et al., 2004; Shore, 2005; Diesel et al., 2008). Many shelters implement enrichment programs as a means of improving dogs' behavior and reducing the stress of the shelter environment. These programs, however, require significant amounts of time and money.

This dissertation examined the benefits of four enrichment programs for dogs in an animal shelter. Our results suggested that the enrichments had no differential effect on blood cortisol concentrations in dogs on Days 1, 4, and 8 of the study (which represents roughly days 2, 6 and 10 in the shelter). Despite no statistically significant differences, the pattern of change in cortisol was different in dogs receiving 15-20 minutes per day of gentle human contact (petting). In particular, cortisol concentrations in this group decreased across sampling days, whereas concentrations increased before decreasing in dogs receiving twice daily walks alone or in combination with a food toy or obedience training. This differential pattern is worth investigating further with a larger sample size considering that previous research also suggests that human contact can mitigate the effects of stress in dogs (Hennessy et al., 1998; Hennessy et al., 2002; Coppola et al., 2006).

The enrichment programs had few effects on dogs' behaviors during an in-shelter mock adoption session. Furthermore, enrichments had no effect on adoption



frequency or time to adoption. However, it must be noted that most dogs (80%) were adopted within the second day of being made available for adoption (Day 9). In fact, the shelter reported that potential adopters queued up outside the shelter (before opening) on days the study dogs were made available, a phenomenon that had not occurred prior to the study. It appeared that simply being part of a study resulted in dogs appearing more desirable to potential adopters. Perhaps shelters could develop programs for “at risk” dogs (such as extra walks throughout the day), place signs on the dogs’ kennels that indicate which dogs are part of this “special” group, and monitor effects on adoptability.

Few post-adoption behaviors were associated with the enrichments, and time to return did not vary among groups despite an overall return frequency of 17% among dogs followed through 6 months post-adoption. Most owners (79%) reported that their dogs displayed bothersome behaviors during the first month after adoption regardless of type of enrichment. Considering that most behavior problems reported by dog owners are normal canine behaviors, providing education programs for owners regarding recognizing and managing normal dog behavior could lead to better acceptance of the pet into the home and improvement of the human-dog bond.

The collaborating shelter in our study used positive reward-based training during obedience sessions. This type of training provides dogs with control over their environment—rewards are contingent upon dogs’ actions (Luescher and Medlock, 2009). However, dogs in the obedience training group did not display more obedient behaviors post-adoption (e.g., responding to the “sit” command) as compared to dogs in the other enrichment groups. Implementing a “nothing in life is free” program (whereby dogs are required to perform a behavior, e.g., “sit”, before receiving

anything, including meals, attention, walks, etc.) would teach the dogs to perform a behavior (e.g., sitting) in order to interact with humans, and would make interactions more predictable. As a result, dogs' behavior should improve and their anxiety levels decrease (because of increased predictability and controllability over their environment), both of which may improve their welfare as well as adoptability, post-adoptive behavior, and retention. It is crucial, however, to educate owners regarding appropriate methods of training and interacting with their dogs so that any benefits from these programs will continue to be realized after adoption.

In conclusion, although the enrichment programs had no differential effect on dogs' adoptability, retention, and few effects on their behavior in the shelter and in the adoptive homes, they might have been more beneficial to the dogs than no enrichment at all. It is likely that the enrichments benefited the dogs by providing an outlet to express normal species-typical behavior (e.g., chewing, socializing), but these effects were not studied here.

Differences in dogs' personalities and coping styles introduce variability in how they respond to perceived stressors (Koolhaas et al., 1999; Horváth et al., 2007). Perhaps tailoring programs to particular types of dogs (e.g., obedience for unruly dogs, human interaction for fearful dogs, toys for destructive dogs, and walking only for the stoic "couch potato" dogs) would be more effective at improving dogs' welfare than assigning all dogs to a standard enrichment. This approach might also enhance their adoptability and improve their behaviors and retention in the adoptive homes.

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## APPENDIX A

### COMPONENTS OF BEHAVIORAL EVALUATION

The components, conducted in this order, were:

1. **Cage presentation:** evaluator gave 5 s of non-threatening eye contact while standing in front of the kennel run.
2. **Sociability:** evaluator ignored dog for 30 s; then spoke to the dog in a friendly voice for 10 s; then stroked the dog three times along its back.
3. **Teeth examination:** evaluator attempted to lift dog's lips five times in succession and hold that position for 5 s each time.
4. **Handling:** evaluator stroked the dog's back; picked up back leg and touched foot; touched tail; handled both ears; wiped body with a towel; tugged on the collar; applied pressure to shoulders; and hugged dog.
5. **Arousal:** evaluator engaged the dog in play to determine play style, level of arousal, and ability to calm down once play ceased.
6. **Food bowl:** evaluator stood near; stroked dog's back; reached into the bowl several times while dog was eating.
7. **Possessions:** evaluator stood near; stroked dog's back; reached towards valued item of which the dog was in possession.
8. **Stranger:** unfamiliar human knocked and entered room; gave 10 s of non-threatening eye contact; took a step towards the dog with out-stretched hand; then bent down with sideways body posture and solicited attention with a calm voice.
9. **Dog introduction:** test dog was introduced to other dogs.

APPENDIX B  
INFORMED CONSENT FORM

Person ID # \_\_\_\_\_

Congratulations! You are adopting one of roughly 2 million dogs that are adopted from U.S. animal shelters each year. Your new companion has been participating in a collaborative study between Lollypop Farm and Cornell University to examine the effectiveness of various in-shelter behavior enrichment approaches used to enhance the welfare of dogs while they are in a shelter. As a continuation of this study, we would like to monitor how your new companion does during the first months he/she is in your home, particularly his/her behavior. We will compare the progress (e.g. behavior, time adapting to your home) of dogs to see if particular behavior interventions are more successful at reducing post-adoption concerns.

We invite your participation in this follow-up study of your dog. If you agree, we will ask you to fill out 3 mailed surveys at 4, 12, and 24 weeks after this adoption. There will be no expense to you (except about 20 minutes of your time) to participate. We do not anticipate any risks associated with your participation, and you will be making *an important contribution* to our understanding of how best to enrich the lives of dogs in shelters and minimize post-adoption concerns for new owners like yourself.

All information collected will be kept strictly confidential and the following steps will be taken to assure the privacy of your answers:

- Only authorized research personnel will have access to the interview materials.
- Your name does not appear on the questionnaire – only a code number that enables us to know who has returned their questionnaires.
- No other agencies or individuals will have access to the names of study participants.
- All the information you provide will be reported as summarized group data. No individual answers will be reported.

Your participation is entirely voluntary and your decision regarding participation will not influence this adoption or your access to assistance from Lollypop Farm regarding your new pet. You are free to withdraw from the study at any time with no penalty of any sort.

If you have questions or concerns about the study, please contact Dr. Janet Scarlett (607 253-3574; [jms15@cornell.edu](mailto:jms15@cornell.edu)) in the College of Veterinary Medicine at Cornell University. If you have any questions or concerns regarding your rights as a subject in this research study, you may contact the University Committee on Human Subjects (UCHS) at Cornell University at (607) 255-5138 or at <http://www.osp.cornell.edu/compliance/UCHS/homepageUCHS.htm>.

I have read the above information and have received answers to any questions I asked. I consent to participate in the study.

Signature \_\_\_\_\_

Date \_\_\_\_\_

Print Name \_\_\_\_\_

APPENDIX C  
POST-ADOPTIVE BEHAVIOR QUESTIONNAIRE

**Dog Behavior Study**  
(Follow-up to Shelter Enrichment Study)

Sponsored by the  
Cornell College of Veterinary Medicine in cooperation with Lollypop Farm



**Directions:**

Please make a checkmark (✓ or ✕) to indicate your answers where required.

If you need to provide any explanations or additional information, please use the space provided below Question #37 on page 25, or include a separate sheet of paper.

When you finish the questionnaire, please mail it in the pre-paid envelope provided or send to:

Dr. Janet Scarlett  
Cornell University  
Box 26, S1 066 Schurman Hall  
Ithaca, NY 14853

If you have any questions or comments about this questionnaire or this study, please feel free to contact us at:

Dr. Janet Scarlett, Study Director  
Phone: (607) 253-3574  
Email: [jms15@cornell.edu](mailto:jms15@cornell.edu)

Dr. Pamela Perry, Study Leader  
Email: [pjp22@cornell.edu](mailto:pjp22@cornell.edu)

Please fill out the following information.

Your adopted dog's name: \_\_\_\_\_

Date questionnaire completed: \_\_\_\_\_  
(month / day / year)

**SECTION 1: General**

1. Do you still own the dog that you adopted from Lollypop Farm on \_\_\_\_\_?

Yes – **PLEASE GO TO QUESTION #2 (page 4)**

No

→ a. We are interested in *every* dog. If you no longer have your dog, please tell us how many **days** you owned him or her: \_\_\_\_\_ days

b. Please tell us what has happened to him or her.

Ran away or was lost

Was euthanized (put to sleep)

Give reason(s): \_\_\_\_\_

\_\_\_\_\_

Died (but not put to sleep)

Cause of death: \_\_\_\_\_

\_\_\_\_\_

Was given to another owner

Was returned to Lollypop Farm

Other, please describe: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

c. If you gave away your dog or returned him or her to Lollypop Farm, please indicate your reasons for doing so. *(Please check ALL that apply)*

- Too many other animals in my home
- Someone in my home had allergies to the dog
- I moved to a different home, apartment, etc.
- Dog had problems with another pet in the home – Please describe (for example, “dog chased my cat”):

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- Other behavior problem(s) with the dog – Please describe (for example, “dog urinated (peed) in the house” or “dog barked too much”):

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- Dog’s personality was not what I had hoped
- Medical problem(s) with the dog – Please describe (for example, “dog developed a skin condition”):

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- Personal reason (for example, divorce, new baby)
- Landlord issues (for example, did not allow dogs)
- Dog required more work and time than I expected
- Too expensive to take care of the dog
- Other reason(s), please describe: \_\_\_\_\_

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2. What factors influenced your selection of *this* dog as opposed to another dog?  
(Please check ALL that apply)

- Liked his/her coat color and appearance
- Dog was the breed or breed-mix I wanted
- Dog was the age and/or sex I wanted
- Dog was the size I wanted
- Dog approached the front of the run when I (we) approached him/her
- Dog appeared friendly (wagging tail)
- Dog did not bark
- Dog remained calm; not excitable
- My children selected him/her
- Shelter staff recommended him/her
- Dog reminded me of a former pet
- Thought no one else would adopt him/her
- Other, please describe: \_\_\_\_\_

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**If you no longer have your dog, we would greatly appreciate your time in filling out the remainder of the questionnaire for the time period he or she was in your household. However, even if you choose to stop here, please return the questionnaire to us.**

**Thank you!**

3. Has the dog you adopted from Lollypop Farm EVER been seen by a veterinarian since you adopted him or her? *(Please check ALL that apply)*

Yes, for regular checkups – Please describe: \_\_\_\_\_

\_\_\_\_\_

Yes, for medical problems – Please describe: \_\_\_\_\_

\_\_\_\_\_

No

4. Does your dog show any *behaviors* that you find bothersome?

Yes – Please describe: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

No

**SECTION 2: Training and obedience**

5. What type(s) of obedience training (other than housetraining) has your dog had since you adopted him or her from Lollypop? *(Please check ALL that apply)*

- No training
- Training at home by myself or other household members
- Puppy training class
- Obedience training class
- Agility training class
- Private training
- Other, please describe: \_\_\_\_\_

\_\_\_\_\_

6. If your dog has had any training, please explain your reason(s) for pursuing obedience training for your dog:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

7. Please estimate how often (what percentage of time) your dog does each item listed below since the time you adopted him or her. (*Record the number of your answer in the space to the left of each statement*)

0 = Never (0%)

1 = Seldom (1-25%)

2 = Sometimes (26-75%)

3 = Usually (76-100%)

9 = Do not know

- \_\_\_\_\_ a. When off leash, returns immediately when called
- \_\_\_\_\_ b. Obeys the "sit" command immediately
- \_\_\_\_\_ c. Obeys the "stay" command immediately
- \_\_\_\_\_ d. Pays attention to everything you say or do
- \_\_\_\_\_ e. Responds slowly to correction or punishment; 'thick-skinned'
- \_\_\_\_\_ f. Responds slowly when learning new tricks or tasks
- \_\_\_\_\_ g. Easily distracted by interesting sights, sounds or smells
- \_\_\_\_\_ h. Pulls too hard when being walked on the leash

### SECTION 3: Separation-related behavior

8. Some dogs show signs of anxiety or abnormal behavior when LEFT ALONE, even for relatively short periods of time. How often has your dog shown each of the following signs when left alone, *or about to be left alone*, since the time you adopted him or her? (*Please record the number of your answer in the space to the left of each statement*)

- 0 = Never (0%)  
1 = Seldom (1-25%)  
2 = Sometimes (26-75%)  
3 = Usually (76-100%)  
9 = Do not know

- \_\_\_ a. Shaking, shivering, or trembling  
\_\_\_ b. Excessive salivation or drooling (evident by wet muzzle, paws, crate, or bedding)  
\_\_\_ c. Loss of appetite (for example, does not eat treats or food left for him/her while you are away)  
\_\_\_ d. Urinating (peeing) or defecating (pooping) in the house  
\_\_\_ e. Restlessness, agitation, or pacing  
\_\_\_ f. Whining, barking, or howling  
\_\_\_ g. Chewing, damaging, or destroying objects or furniture in the house (for example, sofas, chairs, or cushions) that are not dog toys  
\_\_\_ h. Chewing or scratching at doors, walls, floors, windows, curtains, etc.



## SECTION 4: Fear and Anxiety

9. Dogs sometimes show signs of anxiety or fear when exposed to particular sounds, objects, persons, or situations. Please indicate your dog's tendency, since you adopted him or her, to show fearful behavior in each of the situations below using the following criteria. (*Record the number of your answer in the space to the left of each statement*)

0 = No visible signs of fear

1 = Mild fear: avoiding eye contact and feared object

2 = Moderate fear: whimpering or whining, shivering or cringing, tail tucked

3 = Severe fear: shaking, trembling, freezing (unwilling to move), attempting to escape or hide

9 = Do not know

- \_\_\_ a. When approached directly by an unfamiliar person
- \_\_\_ b. In response to sudden or loud noises
- \_\_\_ c. During thunderstorms
- \_\_\_ d. In response to unfamiliar objects on or near the ground (for example, plastic bags, leaves, etc.)
- \_\_\_ e. In unfamiliar situations (for example, first car ride, first visit to veterinarian, etc.)
- \_\_\_ f. When approached directly by an unfamiliar dog

10. Please describe any other situations in which your dog is fearful or anxious, including when it occurs: \_\_\_\_\_

\_\_\_\_\_

## SECTION 5: Attachment and Attention-seeking

- 11.** Many dogs are strongly attached to their people and may demand a lot of attention and affection from them. Since you adopted your dog, how often has he or she shown each of the following signs of attachment or attention-seeking to you or another family member? *(Please record the number of your answer in the space to the left of each statement)*

- 0 = Never (0%)  
1 = Seldom (1-25%)  
2 = Sometimes (26-75%)  
3 = Usually (76-100%)  
9 = Do not know

- \_\_\_\_\_ **a.** Displays a strong attachment for one particular member of the household
- \_\_\_\_\_ **b.** Tends to follow a family member around from room to room
- \_\_\_\_\_ **c.** Tends to sit close to, or in contact with a family member when he/she is sitting down
- \_\_\_\_\_ **d.** Tends to nudge, nuzzle, lick, or paw at a family member when he/she is sitting down
- \_\_\_\_\_ **e.** Becomes agitated (whines, jumps up, tries to intervene) when a family member shows affection for another person
- \_\_\_\_\_ **f.** Becomes agitated (whines, jumps up, and/or tries to intervene) when a family member shows affection for another dog or animal

**SECTION 6: Aggression**

**12.** Some dogs display aggressive behavior from time to time. Has your dog EVER growled at, snapped at, nipped, or bitten a person?

- Yes
- No – **PLEASE GO TO QUESTION #13 (page 13)**

→ **a.** Who was the person growled at, snapped at, nipped, or bitten by your dog?

- Household member(s)
- Familiar person(s), but NOT a household member(s)
- Stranger(s)

**b.** How old was the person(s) growled at, snapped at, nipped, or bitten by your dog? (*Please check ALL that apply*)

- 4 years old or younger
- 5-11 years old
- 12-17 years old
- 18 years old or older
- Not sure / don't remember

**c.** List for each category how many times your dog growled at, snapped at, nipped, or bit a person(s)?

	Never	1 time	2-4 times	5 or more times
Growl:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Snap:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nip:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bit:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**d.** Did someone EVER require medical care after being nipped or bitten by your dog?

- Yes
- No
- Not sure / do not remember

- e. Please describe the general circumstances under which your dog growled at, snapped at, nipped, or bit someone (for example, the person tried to pet your dog, the person disturbed your dog while it was sleeping, etc.)

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13. Has your dog EVER growled at, snapped at, nipped, or bitten another dog?

- Yes
- No – **PLEASE GO TO QUESTION #14 (page 14)**
- a. Who was/were the dog(s) growled at, snapped at, nipped, or bitten by your dog?

- Another/other dog(s) in the household
- Familiar dog(s), but NOT part of your household
- Strange dog(s)

b. How old was/were the dog(s) growled at, snapped at, nipped, or bitten by your dog? *(Please check ALL that apply)*

- Puppy (approximately 6 months old or younger)
- Adult dog (greater than 6 months old)
- Not sure / do not remember

- c. List for each category, how many times your dog growled at, snapped at, nipped, or bit another (other) dog(s).

	Never	1 time	2-4 times	5 or more times
Growl:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Snap:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nip:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bit:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- d. Did any dog(s) EVER require medical care after being nipped or bitten by your dog?

- Yes  
 No  
 Not sure / do not remember

- e. Please describe the general circumstances under which your dog growled at, snapped at, nipped, or bit another (other) dog(s) (for example, the dog tried to play with your dog, the dog approached your dog while it was eating, etc.):

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14. Are there any other situations in which your dog sometimes barks, growls, or lunges (for example, while in the car, towards cats, squirrels, or other animals in your yard)?

- Yes – Please describe: \_\_\_\_\_  
\_\_\_\_\_
- No

**SECTION 7: Excitability**

**15.** Please indicate your dog's tendency, since you adopted him or her, to become excitable in each of the circumstances below using the following criteria. (*Record the number of your answer in the space to the left of each statement*)

0 = Calm: little or no reaction

1 = Mild reaction: looking at source of noise, ears up

2 = Moderate reaction: moving toward source of noise, barking, jumping

3 = Severe reaction: running toward source of noise, loud barking or yelping, difficult to calm down

9 = Do not know

- \_\_\_ a. When you or other members of the household come home after a brief absence
- \_\_\_ b. When playing with you or other members of your household
- \_\_\_ c. Just before being taken for a walk or car ride
- \_\_\_ d. When someone knocks at the door or rings the bell
- \_\_\_ e. When visitors enter your home

**16.** Are there any other situations in which your dog becomes over-excited?

Yes – Please describe: \_\_\_\_\_

\_\_\_\_\_

No

## SECTION 8: Miscellaneous

17. Please indicate how often your dog has shown any of the following behaviors since you adopted him or her. (*Record the number of your answer in the space to the left of each statement*)

0 = Never

1 = Less than 1 time per week

2 = 2-3 times per week

3 = Every day or every other day

9 = Does not apply

- \_\_\_ a. Escapes from the home or yard; roams
- \_\_\_ b. Eats own or other animals' droppings or feces
- \_\_\_ c. Chews inappropriate objects (for example, shoes, furniture, etc., but NOT toys) *while you are home*
- \_\_\_ d. 'Mounts' objects, furniture, or people
- \_\_\_ e. 'Mounts' other dogs
- \_\_\_ f. Jumps up on you or other household members
- \_\_\_ g. Jumps up on visitors or strangers
- \_\_\_ h. Seems hyperactive, restless, or has trouble settling down
- \_\_\_ i. Acts playful, puppyish, boisterous
- \_\_\_ j. Seems active, energetic, always on the go
- \_\_\_ k. Barking so much that it bothers someone in your home
- \_\_\_ l. Barking so much that it bothers your neighbors

**18.** Please indicate how often your dog has shown any of the following behaviors since you adopted him or her. (*Record the number of your answer in the space to the left of each statement*)

0 = Never

1 = Less than 1 time per week

2 = 2-3 times per week

3 = Every day or every other day

9 = Does not apply

- \_\_\_ **a.** Urinates against objects/furnishings in your home
- \_\_\_ **b.** Urinates when approached, petted, or handled, or when someone speaks in a loud or harsh voice
- \_\_\_ **c.** Urinates when happy or excited (for example, when greeting you when you first come home)
- \_\_\_ **d.** Urinates when frightened (for example, when hears thunder or a sudden loud noise)
- \_\_\_ **e.** Urinates or defecates in the house *while you are home*, but not in the situations described above
- \_\_\_ **f.** Digs holes in the yard
- \_\_\_ **g.** Licks or chews him/herself so much that it causes sore spots
- \_\_\_ **h.** Licks people or objects excessively
- \_\_\_ **i.** Displays other unusual, strange, or repetitive behavior(s).  
Please describe: \_\_\_\_\_

\_\_\_\_\_



**SECTION 9: Behavior Activities**

**19.** How many HOURS per day is your dog physically active (not just lying in the yard), such as going for a walk or running in the yard? *(Please check the boxes under the correct answers)*

- |              | Less than 1<br>hour      | 1 hour or more, but<br>less than 3 hours | 3 or more<br>hours       |
|--------------|--------------------------|--|--------------------------|
| a. Weekdays: | <input type="checkbox"/> | <input type="checkbox"/>                 | <input type="checkbox"/> |
| b. Weekends: | <input type="checkbox"/> | <input type="checkbox"/>                 | <input type="checkbox"/> |

**20.** Was your dog housetrained when you first brought him or her home from Lollypop?

- Yes  
 No

→ **a.** How long did it take for him or her to be housetrained to the point that he or she urinated (peed) or defecated (pooped) in the house less than once per week? *(Please check the box next to the correct answer)*

- Less than 1 week  
 1-4 weeks  
 More than 4 weeks (if applicable)  
 Not yet housetrained  
 Not sure / Do not remember

21. Where does your dog sleep at night? *(Please check ALL that apply)*

- On your (or other household member's) bed
- In a bedroom, but on the floor or on a dog bed
- In a crate, but with the door open. Please indicate in which room the crate is kept: \_\_\_\_\_  
\_\_\_\_\_

- In a crate with the door closed. Please indicate in which room the crate is kept: \_\_\_\_\_  
\_\_\_\_\_

- In another part of the house, but *not* in a crate (for example, in the kitchen, on the couch, etc.). Please describe: \_\_\_\_\_  
\_\_\_\_\_

- In the cellar or basement
- In the garage
- On the porch or outside in the yard
- Other, please describe: \_\_\_\_\_  
\_\_\_\_\_

22. Where is your dog kept during the day? *(Please check ALL that apply)*

- Free in the house
  - In the house, but confined to a room
  - In the house, but confined in a crate
  - In the garage or cellar
  - In a fenced-in yard
  - In the yard confined by an invisible electronic fence
  - In the yard tethered to a dog house
  - Free in the yard (no fencing)
  - Other, please describe: \_\_\_\_\_
- \_\_\_\_\_

23. How does your dog like to play? *(Please check ALL that apply)*

- With chew toys
  - Playing catch with a ball, Frisbee, etc.
  - Wrestling with a household member
  - With another dog
  - With another pet (for example, your cat)
  - Other, please describe: \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

**SECTION 10: Household and Environment**

**24.** Since you adopted him or her, has your dog EVER lived with another dog in your household?

- Yes – how many? \_\_\_\_\_
- No

**25.** How many animals CURRENTLY live in your home?

- \_\_\_\_\_ number of cats
- \_\_\_\_\_ number of dogs (including dog(s) adopted from Lollypop Farm)
- \_\_\_\_\_ number of other animals (other than dogs or cats)

**26.** How many of your CURRENT animals were adopted from the Lollypop Farm?

- \_\_\_\_\_ number of dogs adopted from Lollypop Farm
- \_\_\_\_\_ number of cats adopted from Lollypop Farm

**27.** How many times per day is your dog fed?

- 1 time per day
- 2 or more times per day
- Free choice (food is available at all times)
- Other, please describe: \_\_\_\_\_

**28.** What brand of dog food do you typically feed your dog? (*Please list all brands fed*) \_\_\_\_\_

\_\_\_\_\_

**29.** In what type of *home* do you CURRENTLY live?

- Apartment
- Mobile home or trailer
- House or duplex
- Other, please describe: \_\_\_\_\_

**30.** In what type of *area* do you CURRENTLY live?

- In the city / urban
- In the suburbs
- In the country
- Other, please describe: \_\_\_\_\_

**31.** How many people of the following ages lived in your home when you FIRST adopted your dog?

- \_\_\_\_\_ number of children less than 5 years old
- \_\_\_\_\_ number of children 5 to 12 years old
- \_\_\_\_\_ number of children 13 to 18 years old
- \_\_\_\_\_ number of adults 19 to 64 years old
- \_\_\_\_\_ number of adults 65 years old or older

**32.** What is the HIGHEST grade level any person in the household has achieved?

- Some grade school or high school
- Completed high school
- Completed college (Bachelor's or Associate degree)
- College work beyond Bachelor's degree
- Other, please describe: \_\_\_\_\_  
\_\_\_\_\_

**33.** What was the total combined household income in 2006?

- Less than \$15,000
- \$15,000 - \$29,999
- \$30,000 - \$49,999
- \$50,000 - \$74,999
- \$75,000 - \$99,999
- \$100,000 or more
- Not comfortable answering

**SECTION 11: Final questions ☺**

**34.** Have you ever consulted a veterinarian, behaviorist, or animal trainer about changing any of your dog's behaviors?

Yes – Please describe: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

No

**35.** What do you like *most* about your dog? Please describe:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**36.** What do you like *least* about your dog? Please describe:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

37. Please use this space to add any comments:

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\*\*\* End of questionnaire\*\*\*

THANK YOU ☺



Please return completed questionnaire in the pre-paid envelope provided, or send to:

Dr. Janet Scarlett  
Cornell University  
Box 26, S1 066 Schurman Hall  
Ithaca, NY 14853

**THANK YOU FOR YOUR TIME!**

*The authors gratefully acknowledge the permission of Dr. Serpell and his colleagues at the Center for the Interaction of Animals and Society of the University of Pennsylvania for incorporation of questions from their Canine Behavioral Assessment and Research Questionnaire (C-BARQ).*

Code \_\_\_\_\_