

FACTORS INFLUENCING ACTIVITY PATTERNS IN THE KENNEL AND CHANGES IN  
BEHAVIOR POST-ADOPTION IN SHELTER DOGS

By

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## ABSTRACT

Little is known about normal activity patterns of dogs in the shelter setting, how activity patterns influence adoption, or how activity and behavior develop in the new home after adoption. Our first objective was to compare dogs' daily activity levels in the first week at the shelter and determine if activity levels were influenced by dog-related factors or contributed to the length of stay in the shelter. Activity was monitored via an accelerometer (Actigraph). Seventy-six dogs were enrolled at a local shelter and activity was monitored for 24 hours per day during the first week. Results revealed that dogs display consistent patterns in activity levels between the first and last day of enrollment ( $t_{(74)} = 6.67, P = 4.04^{-9}$ ), and dogs that display higher levels of activity stay longer at the shelter as compared to those with low activity levels ( $t_{(63)} = 2.13, P = 0.04$ ). In addition, male dogs show higher activity levels compared to females ( $t_{(70)} = 1.70, P = 0.09$ ). Our second objective was to quantify the behavioral changes in newly adopted dogs during the first three months after adoption and to identify the factors that correlate with behavior changes. Among 58 adopters, there were 10 adopters who completed C-BARQ behavioral assessment surveys for all seven post-adoption timepoints between day 3 and week 12. Results revealed that five categories of behavior did not change over time, while nine others varied in their expression between three days and three months. Based on these results, it appears that dog's activity levels in the shelter and dog's behavior changes at home were found to be influenced by the dog's age, sex, and the interactions between the new owners and dogs at home

This thesis is dedicated to Mom, Dad, and my older brother.  
Thank you for always supporting and believing in me.

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## TABLE OF CONTENTS

LIST OF ABBREVIATIONS .....	viii
CHAPTER 1: COMPREHENSIVE LITERATURE REVIEW .....	3
BIBLIOGRAPHY .....	40
CHAPTER 2: ACTIVITY LEVELS OF SHELTER DOG OVER TIME .....	47
BIBLIOGRAPHY .....	59
CHAPTER 3: DESCRIBING BEHAVIORAL CHANGES THROUGH THREE MONTH POST ADOPTION .....	61
BIBOGRAPHY .....	89
CHAPTER 4: SUMMARY AND CONCLUSIONS .....	91
APPENDIX.....	94

## **LIST OF ABBREVIATIONS**

BSL – Breed-Specific-Legislation

C-BARQ – Canine Behavioral Assessment and Research Questionnaire

DAQ – Dog Attachment Questionnaire

SA – Stranger Directed Aggression

DDA – Dog-Directed Aggression

DDF – Dog-Directed Fear

ODA – Owner-Directed Aggression

EX – Excitability

SDF – Stranger-Directed Fear

SRB – Separation-Related Behavior

NSF – Nonsocial Fear

DR – Dog Rivalry

CH – Chasing

TR – Trainability

AAS – Attachment/Attention-Seeking

EL – Energy Level s

TS – Touch Sensibility

cpm – count per minute

## INTRODUCTION

When a potential adopter is searching for a shelter dog, there are a variety of factors that may influence their selection. Future owners may review the content available online, such as photos, behavioral descriptions and breed information when deciding to visit with a shelter dog. Once arriving at the shelter, adopters may be influenced by a variety of factors, including physical characteristics such as size, breed and coat color, as well as behavior, including proximity to the front of the kennel and staying close to potential adopters (Protopopova and Wynne, 2014; Protopopova et al., 2016; Wells and Hepper, 1992).

While physical features are unable to be modified, understanding what factors may influence the expression of desirable behaviors both in kennel and in the adoptive home remains an under-studied, but meaningful, area of research. The first chapter of this thesis will provide a review from current scientific literature on factors that were considered to have an impact on adoption decisions and will discuss areas that need to be addressed and investigated in the future. The second and third chapters will address activity levels of shelter dogs, and behavior changes in newly adopted dogs in the home environment respectively.

Besides observing the dog's behavior directly, measuring activity levels using accelerometer could be used to identify daily movement in shelter dogs which may be used to indicate their stress while staying at the shelter which could indicated shelter welfare (Jones et al., 2014). To our knowledge, there is no study investigate the relationship between activity levels and adopters' preferences. Thus, the second chapter investigates changes in activity levels among shelter dogs within the first week after arriving at the shelter, and the effect of activity levels may have on the length of stay in the shelter.

In-home behavior of newly adopted dogs is not well understood. Anecdotally, it is suggested that dogs may be behaviorally suppressed during the first three days post-adoption and will slowly begin to express their personality and consistent behavioral responses to stimuli over the next three months. The third chapter describes behavior changes in newly adopted dogs at seven timepoints during the first three months, as well as identifying attributes influencing behavior changes on newly adopted dogs.

Overall, we anticipate our findings to provide a better understanding of dog behavior in both shelter and in home environments and inform future adopters and shelter staff on when and how dog's behavior changes over time.

# **CHAPTER 1**

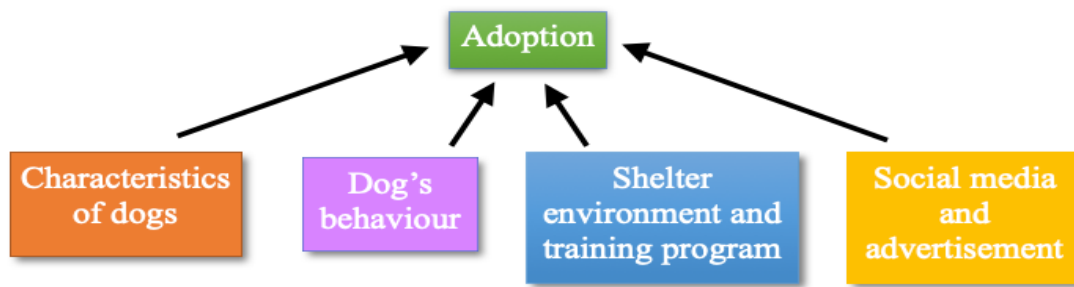
## **COMPREHENSIVE LITERATURE REVIEW**

### **INTRODUCTION**

When potential new owners are interested in adopting a shelter dog, they often turn to the internet to find available dogs of interest, using major online search engines such as Petfinder. When searching for dogs, people often have a specific list of physical attributes in mind, such as breed, age, size, and coat color (Posage et al., 1998; Lepper et al., 2002; Diesel et al., 2007, Garrison and Weiss, 2015). Additional information provided in those online advertisements, such as photos, lists of known or assumed breeds, and personality, influence the decision of the adopter to visit with the dog. Once arriving at the shelter, a variety of factors influence further decisions. For example, there are certain desirable behaviors that adopters often look for when making adoption decisions, such as friendly dogs who will come forward in their kennel to greet them, dogs who play and socialize with them, or dogs who show a tendency to bark less than others (Protopopova et al., 2016; Well and Hepper, 1992). Even though a dog's physical characteristics cannot be changed, their behavior is something that may be shaped over time through shelter programs, such as conditioning to approach the kennel door.

Thus, the purpose of this review is to summarize the factors that could influence adopter decisions and which factors could be influenced to increase the likelihood of adoption.

In this review, the factors that were reported to have an important impact in adopter decisions in each study were categorized into three areas: (1) social media and advertisement; (2) physical and behavioral characteristics of dogs; (3) shelter related factors (Figure 1.1).



**Figure 1.1** Factors influencing time until adoption as summarized in previous literature

## **MEDIA AND ADVERTISEMENT FOR SHELTER DOGS**

Weiss and colleagues (2012) reported that people found the information from the internet to be an important resource for dogs. Many animal shelters have a social media presence or utilize their own websites to communicate with potential adopters. Lam and Wu (2011) investigated online dog adoptions in Taiwan. The authors found that attitudes toward online adoption, opinion of others and ability to access online adoption influenced their decision to adopt dogs online without going to the shelter. In the same paper, for those who did not consider adopting dogs from shelter, the most mentioned reason was belief that pets from shelters are unhealthy following with unfamiliar with adoption process, did not know the location of the shelters, and did not know they can adopt dogs from the public shelter. This study suggests that shelters must promote the idea of adoption and provide health categories on the website for adopters to ensure that dogs were healthy and could be adopted from them. Since this is only study mentioned health categories, further study should investigate how health issues among shelter dogs might relate to adoption rate.

Media advertising has proved beneficial in increasing adoption rates (Menchetti et al., 2015). In this study, researchers used local newspapers, television, and online social networks to promote shelter dogs. A whole page of a local newspaper was used to promote the project. Dogs

available for adoption were published biweekly. Photographs and information of each available dog were advertised in the newspaper as well. Facebook pages were used to promote the project, along with an appearance on local television four to five times a year. To increase the interaction between shelter dogs and people outside the shelter, events were organized at a shopping center close to the shelter.

The correlation between characteristics in online dogs' photos and the time to adoptions were investigated by Lampe and colleagues (2015). Photo quality had the greatest impact on time to adoption. Other factors that showed a positive impact on adoption speed included the dogs showing direct eye contact to the camera and standing up in the photo. In addition, the size of the photo and outdoor location showed a positive impact on adoption speed. Thorn and Mitchell (2013) investigated the preference of people towards a dog's photograph by supplying a pair of photographs of dogs that were in different conditions: wearing a collar vs no collar, in vs out of the kennel, sitting in a chair or no chair, the presence of a toy vs no toy, and surrendered vs stray. Results showed that participants preferred dogs not in the kennel and wearing a collar. In contrast, a study by Nakamura and colleagues (2020) showed that a photograph that showed a dog's presence in kennel, had their mouth closed, black coat color, and floppy ears had the shortest length of stay. While Thorn and Mitchell (2013) compared dogs in and out of the kennel, Nakamura and colleagues (2020) used the photograph of rescued dogs which increased willingness of people to help dogs in kennel rather than the dogs out of kennel. Overall, these could apply to both photo advertisement and shelter dogs since these suggest the physical preferences desired by potential dog adopters; and may lead to more attention on the adoption of shelter dogs and visiting the shelters.

## CHARACTERISTICS OF DOGS INFLUENCING ADOPTER'S SELECTION

### *Physical Factors*

When adopters make the decision to acquire shelter dogs, there are a multitude of factors that influence the decision including age, breed, size, sex, behavior, and coat color. Comparisons across studies suggest conflicting factors of primary relevance, although younger dogs are consistently preferred over older animals.

### *Age*

Age was a significant factor in many studies, and consistently, dogs less than one year of age had a shorter length of stay in the shelter than older dogs (Lepper et al., 2002; Nemcova & Novak, 2003; Diesel et al., 2007; Protopopova et al., 2012; Brown et al., 2013; Zak et al., 2015; Normando et al., 2006; Kay et al., 2018; Cain et al., 2020; Clevenger & Kass, 2003; Sietou et al., 2014). Cain and colleagues (2020) reported that puppies ( $\leq 6$  months) were found to have a higher rate of adoption compared to adults ( $\geq 2$  years to  $\leq 8$  years). Moreover, the results reported that puppies were less likely to be adopted the longer they remained in a shelter. This might be because people tend to show more affection toward cute puppies or babies (Golle et al., 2013) which lead to a shorter length of stay among puppies.

Mesarcova and colleagues (2021) showed significant differences among length of stay for age categories ( $p = 0.0002$ ). Puppies younger than 3 months of age ( $n = 14$ ) spent a shorter time in the shelters (length of stay avg. 59 days) compared to older groups of dogs (3-6 months ( $n = 34$ , length of stay avg. 77 days), 6-12 months ( $n = 21$ , length of stay avg. 111 days) and dogs over 12 months ( $n = 93$ , length of stay avg. 272 days). The authors did not define or describe the range of ages in the 12+ month category, nor did they describe physical criteria for age categories, so it is

difficult to generalize these results to other shelters or studies. However, this study offers further evidence that the younger the shelter dogs are, the more likely they are to get adopted. These studies supported the idea that puppies and younger dogs are the preferred age among adopters, whereas older dogs might have lower chances of getting adopted and stay in the shelter longer.

Weiss and colleagues (2012) studied reasons why adopters chose their pets by dividing participants into two groups: those adopting puppies (less than 5 months of age) and those who adopted adult dogs. The authors reported that appearance, behavior with people, and age were the most selected reasons for both groups. These findings indicated that age is not the only factor that influences an adopter's decision. Other factors such as appearance (breed, coat colors, etc.) and interaction with people had an impact on the adoption decision. These factors will be discussed further in the following sections.

### *Breed and Size (Weight)*

Breed has been reported to be related to the dogs' length of stay in the shelter, although in many cases, dogs in shelters are mixes of multiple breeds. Research into the influence of breed on adoption in shelters can therefore be difficult to interpret or make direct comparisons between papers; in some cases, authors may opt to categorize based on appearance and presumed primary breed or simply label any mixed dog as 'mixed breed'. Lepper and colleagues (2002) and Diesel and colleagues (2007) reported that "crossbred dogs" were less likely to be adopted than "purebreds." Garrison and Weiss (2015) also reported that a "rare" or "unusual breed" was the most selected by participants, and the least popular was "unknown" or "mixed breed"; however, breed had less influence on adopter decision compared to age and source of the dog in their study.

The breed of a dog was categorized differently across the previous studies which made it difficult to conclude which breed type has been found to be significant than the other. Table 1.3 summarizes how each study categorized and grouped the breed dogs. Posage and colleagues (1998) categorized dogs into 7 group breeds according to the American Kennel Club (AKC). They reported that specific group breeds such as toy, terrier, hound, and non-sporting group breeds correlated to successful adoptions. Protopopova and colleagues (2012) and Lepper and colleagues (2002) reported dogs categorized into ‘ratter’ and ‘lap breed groups’ (see Table 1.2 for list of breeds in these categories) spent the shortest time in the shelter (median 8.5 days in ratters and 9 days for lap breeds). Results from three studies (Posage et al., 1998; Protopopova et al., 2012, Lepper et al., 2002) are similar since dogs in these group breeds — toy, terrier (Posage et al., 1998), ratter, and lap breed groups (Protopopova et al., 2012, Lepper et al., 2002) — are mostly referred to as small dogs. Additionally, the ‘giant breeds’ (Great Dane, Pyrenees, Irish Wolfhound, Mastiff, Newfoundland, and Saint Bernard) had the shortest length of stay in the shelter (Brown et al., 2013). Dog breeds in the categories ‘fighting’ (Lepper et al., 2002; Protopopova et al., 2012) and ‘guarding’ (Brown et al., 2013; Lepper et al., 2002) were found to spend the longest time in the shelters. Although the results from previous studies are varied among the grouped breeds, they suggest that breed of dog does influence adopters’ preferences.

Breed labels were reported to have a greater influence on adopter decision (Gunter et al., 2016). These findings suggest that removing breed labels from information cards might increase the adoption rates and decrease stigmatized dogs’ behavior based on breed. In addition, specific terms provided on shelter dogs profile online to identify dog’s personality influenced adopter’s decision to adopt dogs (Nakamura et al., 2019).

Nakamura and colleagues (2019) reported that the presence of certain adjectives on an online profile of shelter dogs provided through the shelter website was associated with the length of stay. The word “active” among Australian cattle dogs, “gentle” among Jack Russell terriers and Staffordshire bull terriers, and “quiet” among Labrador retrievers had the shortest length of stay. On the other hand, the absence of these adjectives for each breed; “energetic” among Australian cattle dogs, Jack Russell terriers and Staffordshire bull terriers and “active” among Labrador retrievers, had the shortest length of stay. Overall, these findings suggest that breed labels and specific adjectives used to identify the personality of shelter dogs could influence the adopter’s decision.

Size is inextricably linked with breed in many cases, although there are instances of ‘mixed breeds’ that are only referenced by their size. Size was one of the factors with a significant influence in the adoption process, based on numerous studies (Brown et al., 2013; Diesel et al., 2007; Mesarcova et al., 2021; Protopopova et al., 2012; Zak et al., 2015). Mesarcova and colleagues (2021) found that dogs weighing up to 5 kg (~ 11 lbs.) and between 5 to 10 kg (~11 to 22 lbs.) were adopted faster than other weight groups, and the dogs 10 kg to 25 kg (~22 to 55 lbs.) spent the longest time in the shelter. Other studies have similar findings (Brown et al., 2013; Diesel et al., 2007; Posage et al., 1998; Protopopova et al., 2012; Zak et al., 2015). The preference for small dogs is in contrast to the findings of Garrison and Weiss (2015) in which survey participants selected medium sized dogs most frequently (i.e., no specific dog’s weight is identified in this study). Measurements of preference differed in the latter study, with participants selecting their preference in dog size virtually, in comparison to collecting length of stay data from shelters in the former studies. Again, the differences between methodologies may be reflected in the reported

results, with a disconnect between what people hypothetically prefer compared to what they acquire in reality. However, further investigation is needed to confirm this hypothesis.

Another factor that might lead to varied preference in dog breed and size is the location where each study was conducted. Each of the aforementioned studies were conducted in various locations within the United States, including New York, California, and Florida, respectively. And varied in location type within those states (e.g., cities, urban, suburban, or rural). It is possible that these locations represent a demographic variation in breed preferences, or breed availability, thus influencing the outcomes of these studies. Cain and colleagues (2020) reported that the location of shelters in the U.S. is associated with the number of adoptions. The authors reported that dogs from shelters located in the southern region (Mississippi and Oklahoma) were less likely to be adopted compared to the dogs from shelters located in northern (Michigan and Pennsylvania) and western regions (Colorado). Therefore, further studies that investigate city or state or regional breed preferences among the population or breed availability within those shelters might reveal new trends.

### *Sex*

Female dogs were preferred over males in two separate studies (Diesel et al. 2007; Zak et al., 2015). Lepper and colleagues (2002) reported neutered males and females were more likely to be adopted than intact animals which was also reported by Clevenger and Kass (2003). In contrast, Mesarcova and colleagues (2021) found no difference in the length of time that male and female dogs spent in the shelters. These results are similar to those found in other studies (Brown et al., 2013; Nemcovak & Novak, 2003; Normado et al., 2006; Protopopova et al., 2012; Wells & Hepper, 1992), however, these studies were reported regardless of spay or neuter status of dogs. It

was impossible to study people's preferences on neutering since dogs were neutered before they became available for adoption (Diesel et al., 2007; Normado et al., 2006; Protopopova et al., 2012).

In the past twenty years, the majority of animal shelters have strived to only adopt sterilized animals, either through in-house spay and neuter clinics or by offering reduced fees for external veterinary clinics to perform the surgery. Moreover, thirty-two states require releasing agencies, including animal shelters, to sterilize dogs and cats before they are available for adoption (Hodges, 2010). These contrasting reports may indicate a lack of preference in sex in general and spay or neuter status.

### *Coat Color*

Two studies (Brown et al., 2013; Mesarcova et al., 2021) found that coat color — including shade of coat color (Brown et al., 2013) and coat length (Mesarcova et al., 2021) — did not affect the length of stay in shelters for dogs. In contrast, fully black-coated dogs were less likely to be adopted compared to other coat colors in three separate studies (Diesel et al., 2007; Wells & Hepper, 1992; Voslarova et al., 2019). Lepper and colleagues (2002) reported that brindle and black dogs were the least likely to be adopted compared to black/tan, red, merle, and tricolor. Other coat colors (black/white, brown, gray, solid with white) are preferred slightly more than black/tan. Diesel and colleagues (2007) also reported that dogs with grey or merle coat color, yellow or golden coat color, and liver/white coat color had a higher rate of adoption compared to dogs with black on their coats, which is consistent with findings reported in Voslarova and colleagues (2019). These results suggested that light or mixed color were preferred rather than a coat consisting of a black color (Diesel et al., 2007; Lepper et al., 2002; Voslarova et al., 2019). In general, the majority

of research including coat color as a factor influencing adoption reveals the lighter coat-colored dogs or mixed colors are more likely to be adopted than dogs with other coat colors.

### *Facial Expression*

Large, wide-set eyes are classic infantile facial features that humans inherently respond to positively (Sternglanz et al., 1977; Glocker et al., 2009). These facial features are preferred in non-human animals too, such as dogs (Archer and Monton, 2011; Hecht and Horowitz, 2015), as they increase the desire for caregiving (Little, 2012). Waller and colleagues (2013) also reported that dogs that express an exaggerated inner brow raise have shorter stays in the shelter. The authors suggested that this movement (the inner brow raise) may be interpreted as a sad expression in humans, encouraging empathetic feelings towards the dog and increasing the desire to remove them from their perceived 'sad' situation at the shelter. Thus, these results suggested that facial expression (such as raising the inner brow) and face features (such as large and wider-set eyes) are an additional factor that influences the adopter's decision.

Protopopova and colleagues (2012) trained dogs to gaze into potential adopters' eyes, predicting this behavior would increase the dog's appeal. Gazing behavior has been suggested as a marker of or an influence on increased social bonding (Nagasawa et al., 2009), and it was predicted that this behavior might cause a similar response in potential owners. However, Protopopova and colleagues (2012) reported that there was no difference in adoption rates between dogs that were trained to gaze at people and dogs that were not trained to perform this behavior. In another study, Miho and colleagues (2009) reported that gazing from the dogs promote relationship with the owners by measuring the owner oxytocin. These different results might be due to Miho and colleagues (2009) having dogs and their owners being familiar with one another

while Protopopova and colleagues (2012) investigated this behavior between the potential adopters and shelter dogs who met each other for the first time. Therefore, this could be the reason that gazing gestures might not be the key factor in the decision to adopt shelter dogs.

Overall, the physical appearance of dogs both in person and in the photograph via an online platform including age, breed, size, sex, age, coat color and facial expression is reported to have an impact on preference and time to adoption among shelter dogs

**Table 1.1** Summary of preferred dog's characteristics and the length of stay (LOS) in the shelter; adapted from Brown et al. (2013)

Reference	Location/ Region	no. adopted dogs	Avg. LOS (Days)	Study period (months)	Preferred characteristics				
					Age	Breed	Coat color	Sex	Size/Weight
<b>Wells &amp; Hepper (1992)</b>	Northern Ireland	273	-	1	-	No difference	No difference	No difference	-
<b>Posage et al. (1998)</b>	Michigan, U.S.	1,073	-	36	-	Toy, terrier, hound, nonsporting breeds	Gold, grey, white	-	Small (< 35 lbs./16 kg) (< 15 in/38 cm)
<b>Lepper et al. (2002)</b>	California, U.S.	1226	-	9	Puppies (<1 year)	Lapdogs, cocker spaniels, ratters (Purebred)	Red, merle, and tricolor	Female	-
<b>Nemcova &amp; Novak (2003)</b>	Czech Republic	*75, 50	*53, 85	8	Puppies (2-4 months)	Mixed breed	No difference	No difference	No difference
<b>Diesel et al. (2007)</b>	U.K.	11,663	28	9	Puppies (< 1 year)	Gundog and utility breed	grey/merle, yellow/golden, liver & white	Female	Small (No specific size identifies)
<b>Protopopov a et al. (2012)</b>	Florida, U.S.	176	18	6	No difference	No difference	No difference	No difference	Small (~0.35 m height)
<b>Brown et al. (2013)</b>	New York, U.S.	*1,063, 203	34.6	*41, 26	Puppies (0-6 months)	Giant breeds	No difference	No difference	Small (1-4.5 kg)
<b>Garrison &amp; Weiss (2015)</b>	U.S.	**	-	-	Puppies (No specific ages)	unusual breed > common and mix breeds	black/dark	No difference	Medium (No specific weight)
<b>Zak et al. (2015)</b>	Czech Republic	2,261	23	36	Puppies (< 1 year)	-	-	Female	Small (< 35 cm; size at the withers)

Table 1.1 (cont'd)

<b>Normando et al. (2006)</b>	Italy	733	180	36	Puppies ( $\leq 6$ months)	-	-	No difference	-
<b>Kay et al. (2018)</b>	Canada	8,325	-	48	Puppies ( $< 1$ year)	Shih Tzu	White, yellow	-	-
<b>Voslarova et al. (2019)</b>	Czech Republic	3,875	-	36	-	-	Brindle, multicolor	-	-
<b>Cain et al. (2020)</b>	U.S.	4,500	14.1	12	Puppies ( $\leq 6$ months)	-	-	-	Small ( $\leq 13.6$ kg)
<b>Mesarcova et al. (2021)</b>	Slovakia	162	-	11	Puppies ( $< 3$ months)	-	No difference	No difference	Small ( $< 5$ kg)

Note: ( - ) indicates the characteristic was not examined in the study

\*The studies were conducted in two different shelters

\*\*The study was conducted using surveys and there was a total of 1,009 respondents participating in the study

**Table 1.2** List of dog breeds and groupings as presented in past literature

References	Group Breeds	Breeds
Posage et al. (1998)	Herding	(Refer to AKC group breeds lists) <a href="https://www.akc.org/public-education/resources/general-tips-information/dog-breeds-sorted-groups/">https://www.akc.org/public-education/resources/general-tips-information/dog-breeds-sorted-groups/</a>
	Hound	
	Toy	
	Non-Sporting	
	Sporting	
	Terrier	
	Working	
Protopopova et al. (2012)	Ratters	Cairn Terrier, Fox Terrier, Jack Russell Terrier, Basenji, Dachshund
	Fighting Breeds	American Pit Bull Terrier, Bulldog, Sharpei, Boxer
	Hounds	Basset Hound, Beagle, Catahoula Hog Dog, Coonhound, Plotthound, Treeing Walker Hound, Whippet, Rhodesian Ridgeback, Carolina Dog
	Working Breeds	German Shepherd Dog, Rottweiler, Mastiff, Husky, Anatolian Shepherd
	Herding Breeds	Border Collie, Corgi, Australian Shepherd, Australian Heeler
	Sporting breeds	Golden Retriever, Labrador Retriever, Pointer
	Lap Breeds	Maltese, Miniature Poodle, Chihuahua, Boston Terrier, Pug, Pomeranian
Lepper et al. (2002)	Companion – large (23 to 27")	Afghan hound, Bernese Mountain dog, Shepherd mix, Rhodesian ridgeback, Standard poodle
	Pointers	German wirehaired pointer, German shorthaired pointer, Vizla
	Ratters	Miniature schnauzer, Cairn terrier, Finnish spitz, Fox Terrier, Jack Russell terrier, Basenji, Schipperke, Scottish terrier, Toy fox terrier, Dachshund
	Sled dogs	Alaskan malamute, Eskimo, Samoyed, Siberian husky
	Fighting breeds	Bull terrier, Chow chow, English bulldog, Shar-pei
	Hounds	Basset hound, Beagle, Norwegian elkhound, Walker hound, Catahoula hog dog, Miscellaneous hounds
	Guarding breeds	Airedale terrier, Akita, Doberman pinscher, German shepherd
	Herding breeds	Belgian sheepdog, Border collie, Collie, Old English sheepdog, Shetland sheepdog, Welsh corgi

Table 1.2 (cont'd)

	Companions - giant (greater than 27")	Borzoi, Bullmastiff, Irish Wolfhound, Newfoundland, Briard, Great Dane, Mastiff, Saint Bernard
	Labrador retrievers	
	Lap dogs	Lhasa apso, Miniature pinscher, Pekingese, Pug, Shih tzu, Yorkshire terrier, Maltese, Miniature dachshund, Toy poodle, Miniature poodle, Pomeranian, Chihuahua, Bichon frise, Papillon
	Cocker spaniel	
	Australian herding breeds	Kelpie, Australian shepherd, Australian heeler
	Companion – medium (17 to 22")	Boxer, Dalmatian, Greyhound, Keeshond
	Miscellaneous sporting breeds	Weimaraner, Brittany spaniel, Chesapeake Bay retriever, Golden retriever, Gordon setter, Irish setter, Springer spaniel, Miscellaneous setters
	Miscellaneous terriers, Rottweilers, Staffordshire terrier (pit bull)	
Brown et al., (2013)	Bully	American bulldog, American pit bull terrier, American Staffordshire terrier, Staffordshire bull terrier
	Companion	American cocker spaniel, Boxer, Collie mixes, Dalmatian, English cocker spaniel, Greyhound, Husky mixes, Poodle, Shepherd mixes, Shetland sheepdogs, Shiba Inu, Welsh corgi, Unspecified mix
	Giant	Great Dane, Great Pyrenees, Irish wolfhound, Mastiff, Newfoundland, Saint Bernard
	Guard	Akita, Chow chow, Doberman pinscher, Rhodesian ridgeback, Rottweiler, Shar-Pei
	Herding	Australian cattle dog, Australian shepherd, Bearded collie, Border collie, Smooth collie
	Hound	All coonhounds, American foxhound, Basset hound, Beagle, Bloodhound

Table 1.2 (cont'd)

	Lap	All toy terriers, Bichon fries, Boston terrier, Chihuahua, Chinese crested, Dachshund, English toy spaniel, Japanese chin, Lhasa apso, Maltese, Miniature pinscher, Miniature poodle, Miniature schnauzer, Pekingese, Pomeranian, Pug, Schipperke, Shih Tzu, Yorkshire terrier
	Spitz	Alaskan malamute, American Eskimo dog, Keeshoud, Samoyed, Siberian husky
	Sporting	Brittany, Catahoula leopard dog, Chesapeake Bay retriever, English setter, English springer spaniel, German shorthaired pointer, Golden Retriever, Labrador retriever, Pointer
	Terrier	Airedale terrier, Cairn terrier, Dandie Dinmont terrier, Fox terrier, Jack Russell terrier, Rat terrier, Skye terrier, Soft coated wheaten terrier, West Highland white terrier, Unspecified terrier

## **DOG'S BEHAVIOR IN SHELTER**

### ***In-Kennel Behavior of Shelter Dogs***

In addition to physical features, a dog's behavior in the shelter environment has been reported to strongly influence the choice made by adopters (Wells and Hepper, 1992; Protopopova and Wynne, 2014; Protopopova et al., 2014; Protopopova et al., 2016). In Southland and colleagues (2019) study, the most frequently selected criteria for adoption among adopters were animals who were affectionate followed by friendliness, good health, and playfulness. In addition, the majority of the adopters who had planned to adopt dogs that day and did not adopt any animals reported the lack of the animal's reaction toward them as the reason for abandoning their intended adoption plans. In contrast, the animal's reaction was not a reason frequently reported by adopters who adopted dogs. Thus, this finding suggests that behavioral response to potential adopters correlated with the decision not to adopt.

In one study, behavioral response to potential adopters was found to be the most influential factor to acquiring the dog but in a different context. Specifically, adopters prefer dogs positioning at the front of the kennel, near the people, rather than the back (Wells and Hepper, 1992). Further, Protopopova and colleagues (2014) reported that a back-and-forth motion in the kennel, leaning or rubbing on the enclosure wall, facing away from the front of the kennel, or facing backward and standing were less appealing to adopters. This resulted in an increase of time dogs spent in the shelters by 24 days (back-and-forth motion in the kennel), 30 days (leaning or rubbing on the enclosure wall), 15 days (facing away from the front of the kennel, or facing backward), and 7 days (standing). Collectively, these results suggested that the behavioral reaction of animals leads to attention from shelter visitors, which allows visitors to look closely at whether that animal has the particular characteristics they're looking for, such as age, breed, sex, coat color. In contrast,

particular characteristics of dogs are being seen first by adopters when they are looking for adopting dogs online which is discussed earlier in the previous section. Thus, we could conclude that both dog's physical characteristics and behaviors play an important role in adoption.

## ***‘Meet and Greet’ Behavior***

### *Proximity between Adopters and Shelter Dogs*

Interactions between potential adopters and dogs outside the shelter kennel are one of the final determinants of adoption decisions (Protopopova and Wynne, 2014; Protopopova et al., 2016). In one study, dogs laying down near adopters were 14 times more likely to be adopted. Protopopova and colleagues (2016) also found that dogs that spent more time near adopters were more likely to be adopted than the preferred physical aspects of dogs including puppies, long coats, and small and specific breeds (lab dogs, ratters, and herders). This finding suggests that adopters pay most attention to the dog’s behavior. In some cases, behavior may be prioritized over appearance which stresses the importance of providing opportunities for quality interaction between potential adopters and shelter dogs during the adoption process.

Luescher and Medlock (2009) trained dogs to walk on a leash without pulling, sit on command, not jump up to an approaching person, and not bark when someone walked by (training group 92 dogs vs control group 88 dogs). The authors engaged the dogs in 20 minutes of daily positive training, which increased the chances of adoption by 1.4 times, compared to dogs not participating in the training program. Menchetti and colleagues (2015) also reported that shelter dogs that were part of a specialized training program showed a higher rate of adoption compared to another group that was not part of the program. This program consisted of training, socialization, and advertising. The training protocols had six sessions which contained ten training exercises: getting out of the pen calmly, coming when called, wearing a harness, human focalization, walking outside on a leash, socializing with people, following given commands (ex. sit, down, and stay), problem-solving and cuddles. Each step lasted for 5 minutes except for walking outside on a leash which lasted for 15 min. The training program lasted for two weeks (three sessions/week).

Moreover, the program also used media to advertise shelter dogs: local newspapers, television, and online social networks. Therefore, this study did not measure the degree of influence between the three components of their program, making it difficult to conclude which component (training, socialization, or media) had the most significant influence on adoption rates.

### *Play Behavior*

Play behavior is another desirable trait that adopters seek to observe when interacting with shelter dogs. Protopopova and Wynne (2014) showed that during interactions with potential adopters, dogs that ignored play initiations were less likely to be adopted. In contrast, Protopopova and colleagues (2016) reported dogs that spent more time playing close to potential adopters were more likely to be adopted. However, not all dogs would want to play or socialize with the adopters and depends on their personality, willingness, moods, and the ability to perform behaviors. Studies also reported that play behavior could be influenced by toy types (Pullen et al., 2010; Protopopova et al., 2016). In studies where toys were used to assist in initiating play behavior, only a small number of dogs preferred to play with toys; tennis ball, nylon squeaky toy, cotton plush toy and flannel rope toy were presented by the researchers (Wells and Hepper, 2000; Pullen et al., 2010; Protopopova et al., 2016). These findings suggested that the dog's engagement in play behavior affects adopters' decisions. Thus, further studies should focus on how to enhance play behavior possibly through training; and how this specific behavior could increase the rate of adoption.

### *Vocal Behavior*

Vocal behavior in the home was reported as irritating by potential adopters (O'Connor et al., 2017), identifying it to be an area of concern and avoidance for potential adopters when seeking dogs from animal shelters. Wells and Hepper (1992) also reported that people prefer dogs not to bark when looking to adopt. However, barking behavior has been found to be influenced by a few factors including time spent in shelters (Titulaer et al., 2013; Wells & Hepper, 2002b), the number of visitors (Wells & Hepper, 2000; Hewison et al., 2014), conditioning training not to bark (Payne and Assemi, 2017), and provision of enrichments (Bowman et al., 2015, 2017; Kogan et al., 2012; Wells et al., 2002a; Binks et al., 2018; Graham et al., 2005). Titulaer and colleagues (2013) reported dogs that had been in the shelters more than six months were more likely to bark or growl at other dogs. In contrast, dogs that were in the shelter more than 5 years spent less time barking compared to the dogs that had been in the shelter less than a month (Wells & Hepper, 2002b).

Another factor that induced barking behavior is the presence of humans as reported by Wells and Hepper (2000). The results showed that the barking increased slightly when dogs were exposed to one experimenter who was walking in front of the dogs' cages every 10 minutes for 4 hours of observation compared to no exposure to experimenters. Therefore, limiting visitor presence in each opening hour of the shelter might reduce barking behavior which could help to increase adoption rates. Hewison and colleagues (2014) also reported similar results in which noise level was decreasing when visitors were allowed to view the dogs from the outside of the kennel (out of dogs' sight) at specific time periods.

Providing enrichments such as playing music (Bowman et al., 2015, 2017; Kogan et al., 2012; Wells et al., 2002a), and specific scents (Binks et al., 2018; Graham et al., 2005) were reported to be effective methods in reducing the amount of barking in dogs, which in turn has been

suggested to increase adoption. Moreover, Payne and Assemi (2017) and Luescher and Medlock (2009) reported that training could reduce barking behavior. Payne and Assemi (2017) studied dog's barking behavior by providing condition training using edible treats along with a digital door chime which adopters used to access the kennel area. Results showed that their procedure could reduce noise level in the kennel area which will be discussed further in the shelter section. Luescher and Medlock (2009) also reported that dogs trained not to bark when someone walked past their cages were adopted more quickly than untrained dogs. However, a suite of trained behaviors was used to improve in-kennel behavior of the dogs, such as training to come to the front of the kennel when a person approaches, so it is difficult to conclude the lack of vocalization alone served to increase the likelihood of adoption in this study.

### *Breed Specific Stigma*

Gunter and colleagues (2016) investigated the relationship between breed perception and adopter decisions, specifically for 'bully-type' dog breeds. The authors provided a video of pit-bull-type and look-alike breeds of dogs to participants who were interested in adopting a dog. Results suggest that pit bulls were seen to be more attractive than look-alike dogs when presented without breed labels. In contrast, look-alike dogs were more attractive to participants when breed labels were available. In another study, pit bull owners reported that they believe pit bulls are stigmatized based on their personal experience with friends, family, or strangers interacting with their dog (Twining et al., 2000). The stereotypes that define these dogs as dangerous will likely remain and potentially influence adopters, although the degree to which they do remain unknown.

In certain areas of North America and Canada, breed specific legislation (BSL) was established in which specific dog breeds were banned due to their perceived increased potential

for injurious aggressive behavior. There are approximately 21 states prohibiting BSL which are regulated by local governments in each city. These prohibitions are divided into two categories: states that prohibit breed-specific-legislation in all animal regulation and states that prohibit breed-specific-legislation in dangerous or vicious dog laws (Wisch, 2018). However, as of February 2021, BSL was approved by governors and assigned as the breed-specific laws among 1,200 cities across multiple states in the United States (Dogsbite.org, 2021). Pit Bulls were the most regulated breed followed by Rottweilers, wolf-dog hybrids, Doberman Pinschers, Presa Canarios, Chow Chows, Mastiff variations, American Bulldogs, and Cane Corsos (Dogbites.org, 2019). These laws might be a factor in preventing certain types of dogs from being adopted.

Raghavan and colleagues (2013) studied the effectiveness of BSL in the Canadian province, Manitoba. Results showed that the incidences of dog-bite injury hospitalizations were lower in a city with BSL compared to the city without BSL. However, these results might be influenced by other factors such as changes in the number of dog populations or the number of households owning pet dogs. Therefore, further studies focusing on the effect of available breeds and a regulation targeting the acquiring of specific breeds are needed to determine whether this breed specific stigma has an influence on adoption decision.

## *Summary*

There are several factors that influence adoption decisions including social media, physical characteristics (age, breed, size, sex, and coat color) and behavior of dogs which were discussed earlier. Although physical characteristics could not be improved, certain behaviors could be improved overtime. Overall, undesirable behaviors such as lack of positive reaction or response when potential adopters approach, back-and-forth motion in the kennel, leaning or rubbing on the enclosure wall, facing away from the front of the kennel or facing backward, barking, and playing alone further away from adopters, had an impact on adopter's final decisions. However, enrichment and training could be used to decrease undesirable behaviors and promote desirable behavior, such as approaching adopters via enrichments and training which are discussed later in this paper.

## **SHELTER RELATED FACTORS**

The intentions of shelter visitors are varied, including people who visit specifically to adopt a certain pet they viewed online, those that want to adopt a pet but do not have one in mind yet, and those who are just browsing. Shelter programming and practices such as animal training, enrichment, treatment and training of staff and volunteers, and the shelter's physical environment may influence the visitor's ultimate decision to adopt a pet from that shelter.

### ***Shelter Program***

#### ***Training Programs***

Shelters have incorporated a variety of different animal training programs aimed at increasing the adoptability of dogs, and researchers have examined the potential impact of various training programs. Perry and colleagues (2020) reported that the enrichment programs studied had no impact on the number of adopted dogs and their time to adoption. The four enrichment programs were evaluated in this study: walking (10 – 15 minutes outdoor walks twice daily), and the additions of a toy (10 – 15 minutes outdoors walks twice daily plus a food-filled toy), petting (10 – 15 minutes outdoors walks twice daily plus 15 – 20 minutes petting and massaging once daily), and obedience (10 – 15 minutes outdoors walks twice daily plus 15 – 20 minutes obedience training once daily). The different results found by Luescher and Medlock (2009), Menchetti and colleagues (2015), and Perry and colleagues (2020) might be caused by the difference in the length of training. Luescher and Medlock (2009) and Menchetti and colleagues (2015) spent six weeks and two weeks training, respectively, while Perry et al. (2020) spent six days. The period of time spent on training shelter dogs might be a factor that affects the success of a training program which could affect the adoption rate. An optimal amount of time in training should be determined, so the

training program provided to dogs is effective enough to increase desirable behavior while diminishing or preventing undesirable behavior. For example, Thorn and colleagues (2006) reported that short training sessions (10 to 15 min a day) were effective in teaching shelter dogs to sit. In these instances, dogs usually learned to respond to the sit command within two days.

However, dogs who spend a longer time in the shelter might develop undesirable behavior (Wells & Hepper, 2002b; Titulaer et al., 2013).

There are other factors that impact a dog's chances of adoption other than training. Dogs that had been in the shelters more than six months were less likely to play with unfamiliar people and more likely to bark or growl at other dogs. They also preferred to play with objects when staying with other dogs (Titulaer et al., 2013). And dogs that were housed in the shelter for more than 5 years spent more time at the back of their kennels and less time barking compared to the dogs that had been in the shelter less than a month (Wells & Hepper, 2002b). According to behavior observation, both studies found dogs that spent a longer time in the shelter spent more time resting (Wells & Hepper, 2002b; Titulaer et al., 2013). These findings support that length of stay could influence resting behavior in shelter dogs.

Besides the training programs reviewed above, training methods such as aversive training (positive punishment) could impact the dog's overall behavior or even increase stress and aggressive behavior (Arhant et al., 2010; Casey et al., 2014; Herron et al., 2009; Hiby et al., 2004). Arhant and colleagues (2010) reported that anxiety and fear in small dogs increased due to more punishment methods used in the training, similar to reports by Hiby and colleagues (2004). Aversive training was reported to increase behavior problems in smaller dogs and associated with the frequency of the punishment. The more punishment methods used, the more anxiety and fear were expressed in smaller dogs. In another study conducted by Herron and colleagues (2009),

confrontational methods were also shown to be connected to aggressive behavior in dogs. Therefore, the length of time and training methods that were used in the training program are important factors that could impact dog's behavior and their health along with their potential to be adopted.

### *Play Behavior Training*

Play behavior was shown to be another behavior that potential adopters were looking for in shelter dogs during interactions when making adoption decisions (Protopopova and Wynne, 2014; Protopopova et al., 2016). However, training dogs to play with potential adopters is challenging since play behavior between dogs and humans depended on the dog's personality and previous training (Tóth et al., 2008). As shown in the Rooney and colleagues (2001) study, dogs perceived play signals (without using any object or toys) differently according to their experiences with their owners. On the other hand, toy types and presentation methods were reported to have an influence on dogs when playing independently (Pullen et al., 2010; DeLuca and Kranda, 1992; Hubrecht's, 1993, 1995).

Pullen and colleagues (2010) investigated dogs' preference of toy types between robust (boomer ball, ragger, tug, and tetra grip; toys that cannot be easily disassembled or torn apart) and less robust toys (squeaky bone, soft teddy, plush teddy, and tennis ball) in dogs housed in kennels. Each toy was placed either on the floor or hanging above the collar height of the dogs. Results show that dogs interacted with toys placed on the floor longer than the hanging toys. Furthermore, dogs interacted with less robust toys (squeaky bone, soft teddy, and plush teddy) more than with robust toys, which was similar to other studies suggesting dogs preferred toys that can be chewed

and make noise (DeLuca and Kranda, 1992; Hubrecht's, 1993, 1995). Pullen and colleagues (2010) also suggested that breed and size have little influence on the interaction between dogs and toys.

In contrast, Protopopova and colleagues (2016) investigated toy preference using tennis ball, nylon squeaky toy, cotton plush toy, and a flannel rope toy in which there were no specific toys preferred by all dogs. These different results might be caused by the type of dogs in which the toys' preferences were investigated, laboratory-housed dogs (Pullen et al., 2010; DeLuca and Kranda, 1992; Hubrecht's, 1993, 1995) and shelter dogs (Protopopova et al., 2016). Wells and Hepper (2000) also reported that shelter dogs showed less interaction with toys, and the interactions with the toys did not last long among shelter dogs (Wells, 2004a). However, Wells (2004b) reported that the Nylabone chew was found to be the most popular compared to other toys (squeaky ball, non-squeaky ball, tug rope and Boomer ball) in which dogs spend more time playing with a Nylabone chew than other toys. Therefore, during meet and greet interaction, shelter staff could suggest the right choice of toy types (a safe chewable and generate noise) and presentation methods (placing toys on the floor) to potential adopters which might increase play behavior between dogs and adopters, potentially increasing adoption rates.

### *Foster Program*

Human interaction was found to be an important enrichment for shelter dogs by decreasing cortisol levels (Coppola et al., 2006; Shiverdecker et al., 2013), reducing vocalization and fear (panting) (Shiverdecker et al., 2013), and promoting social behavior (Bergamasco et al., 2010). Therefore, fostering programs that provide more interaction between dogs and humans are encouraged in terms of familiarizing dogs with humans and home environments. Gunter and colleagues (2019) provided temporary fostering, which was one- and two-night programs to shelter

dogs. This study explored the benefits of temporary fostering program which is different from the typical fostering program. Temporary fostering consists of one- or two-night commitments with one foster home, while the duration of the foster program can range from a few weeks to several months, depending on the individual dog.

In this study, the cortisol creatinine (C/C ratios) were measured from each dog's urine to determine stress levels. During their overnight stays at home, dogs showed lower C/C ratios compared to the measurements taken at the shelter. However, when the dogs returned to the shelters, C/C ratios rebounded back to the same value as shown in pre-sleepover values. The differences in C/C ratios could be the result of dogs suffering anxiety after leaving an environment in which they had positive interactions with people. These results suggest that foster programs can decrease stress in shelter dogs by providing more interaction with humans in the home environment. However, the stress levels in dogs rebound when they go back to the shelters which may cause more stress in dogs to adapt to the new environment again. Further studies should look at the pros and cons of temporary foster care among shelter dogs.

Currently, there are no other studies investigating the negative effect of temporary fostering that provided one- or two- night stays in shelter dogs. Although interaction with humans was reported to have a beneficial effect on shelter dogs as stress levels decrease (Bergamasco et al., 2010; Coppola et al., 2006; Gunter et al., 2019; Shiverdecker et al., 2013), unfamiliar environments such as noise or other animals could induce stress in shelter dogs. Thus, further studies should investigate the long-term effect of temporary fostering and ask the foster owner to report dogs' behavior during their stays as additional information to the cortisol creatinine level and monitoring collars.

Mohan-Gibbons and colleagues (2014) compared two groups of shelter dogs: Adoption Ambassador (AA) where the dogs were placed into foster homes and In-Shelter (IS) group where the dogs were at the adoption area in the shelter. Overall, the dogs in the foster program had a longer length of stay since they were generally unavailable for public viewing and interaction. However, the dogs in foster groups showed a lower rate of shelter returns compared to the dogs that were adopted directly from the shelters. The difference in adoption rates between the two groups might be affected by more time spent on deciding on adoption among adopters who acquired the dogs from foster groups. Almost 30% of adopters in the foster program (n = 54) took one or more days to decide on adoption, which allowed them to make more informed decisions. In contrast, most adopters in the shelter group took a few hours or less to decide on adoption. In addition, those dogs may have had the chance to be habituated to home life and were less likely to perform house destructive behaviors like house soiling and destruction to furniture. Another cause of less return in foster groups might be that foster owners provided more accurate reports of how the dogs would behave in adopters' homes.

Foster programs are reported to provide human interaction which decreased stress levels and also promoted desirable behavior in shelter dogs (Bergamasco et al., 2010; Coppola et al., 2006; Gunter et al., 2019; Shiverdecker et al., 2013). Moreover, placing shelter dogs in foster homes allowed more adoption space for in-shelter dogs. The foster program also expanded the target groups of adopters via volunteers who participated in the program and promoted dogs in public spaces. Volunteers also reached out to family and friends, which expanded the pool of potential adopters.

### *Shelter Staff*

Human-interaction has been shown to provide benefits to shelter dogs in previous studies including decreased stress and improving undesirable behavior (Bergamasco et al., 2010; Coppola et al., 2006; Gunter et al., 2019; Shiverdecker et al., 2013). In shelters, relationships between animals and staff were found to be significant factors in influencing dogs' behavior. Arhant and Troxler (2014) reported that a positive attitude by staff towards shelter dogs and the use of gentle and predictable dog handling practices could increase the willingness of dogs to approach a stranger. This study suggests that attitudes and handling practices could affect dogs' behavior, which was also found in the study of Bright and Hadden (2017).

Staff and volunteers typically take care of shelter dogs; some of their responsibilities include walking dogs after receiving one orientation or meeting the criteria required by each shelter. Bright and Hadden (2017) developed a program called "Safewalk" which provides training programs to the volunteers. The volunteers were divided into various levels according to their training and experience levels (number of working hours): keepers, level 1, level 2, and level 3, and the dogs were distributed to the different volunteer levels based on their behavior. For example, volunteers need to work as a level 2 for six to ten hours to be qualified as a level 3, which can handle shelter dogs that are larger and stronger than the dogs that other levels handle. Results showed adoption rates increased by 46% for pit bull-type dogs after participating in the Safewalk program. This suggests that training programs provided to staff and volunteers are an effective method to increase adoption rate and create a system for all volunteers to handle shelter dogs in the same manner. Furthermore, these findings also suggest more experiences are needed to handle challenging dogs effectively.

Besides the interaction between shelter staff and dogs, the interaction between staff members and potential adopters is important in the process of adoption. Weiss and colleagues (2012) reported that staff members and volunteers are the most important source of information about a shelter dog or cat, followed by information posted on the cage, the internet and family, friend, or neighbor.

In conclusion, not only should the shelter dogs receive a training program, but also staff and volunteers who work with shelter dogs should receive training on how to handle the dogs properly in order to promote desirable behavior and increase the adoption rates.

### ***Housing and Enrichments***

Individual housing for shelter dogs is common in North America shelters and prevents dogs from transmitting disease, stress from interacting with other dogs and for space-saving purposes. However, there are more options to house the dogs or other animals in shelters. Pair-housing is when adjacent individual kennels are connected together via a guillotine-style door where dogs can interact with each other during the day. Pair-housing is recommended for dogs in the shelter (Wells, 2004) because isolation from conspecifics could cause stress in dogs (Bergamasco et al., 2010). Walker and colleagues (2014) investigated the separation of shelter dogs that were pair-housed. The dogs were paired by shelter staff based on similar size, breed, age, sex, and temperament, and had been maintained in the same facility for about 126 days prior to the study. The study showed that after separation, dogs showed more activities in running, grooming, circling, posture changes, and stretching, while positive behavioral indicators such as playing behavior decreased. Moreover, secretory IgA also increased after separation, which suggests that dogs that were separated from conspecifics showed activity and immune level changes. These

findings further suggest that pair-housing could help to increase social interaction between shelter dogs which is reported to be a concern of potential adopters whether a newly adopted dog could get along with their current animals (O'Connor et al., 2017). Grigg and colleagues (2017) also reported that dogs that were paired housed showed lower stress levels. The dogs that were individually housed and then switched to pair housing showed a reduction in levels of cortisol. However, not all the dogs got along well with each other in pair-housing. This could increase stress among paired shelter dogs; therefore, finding a perfect match for each dog might be challenging for the shelters. Additionally, the familiarity between dogs prior to the study could have influenced the results

Another factor besides the type of housing that could affect a dog's behavior is the surrounding environment, especially the noise levels in animal shelters. Noise is seen as a physical stressor that increases cortisol level and other related health problems (Spreng, 2000). Blackwell and colleagues (2013) suggest that dogs that are exposed to specific loud noise such as traffic and TV noises could develop fear responses. The highest noise level was found in the large dog adoptable area exceeding 100 dBA (Coppola et al., 2006) which is considered to be loud (Baker, 1998). Higher noise levels could induce stress in shelter dogs and shelter workers and staff. Moreover, this undesirable noise might affect potential adopters when they come to visit the shelter. There are several enrichments, including music (Bowman et al., 2015, 2017; Kogan et al., 2012; Wells et al., 2002a) and scent (Binks et al., 2018; Graham et al., 2005), which were reported to reduce anxiety and fear induced by noise.

Kogan and colleagues (2012) reported that classical music increased time sleeping in kennelled dogs, which is consistent with other studies (Bowman et al., 2015; Wells et al., 2002a). Another study of Bowman and colleagues (2017) also reported that soft rock and reggae increased

heart rate variability (HRV) suggesting that stress levels of dogs decreased. Furthermore, these studies (Bowman et al., 2015, 2017; Kogan et al., 2012; Wells et al., 2002a) suggested that providing different genres of music such as classical, reggae, and soft rock could reduce the amount of barking which could increase adoption rates since adopters prefer dogs not to bark (O'Conner et al., 2017; Wells and Hepper, 1992). Another enrichment that was reported to be effective in both increasing the relaxing state and decreasing barking behavior was the use of scent (Binks et al., 2018; Graham et al., 2005). For example, Binks and colleagues (2018) investigated the effects of olfactory stimulation on dog's behavior in kennel using vanilla, coconut, ginger, and valerian. The results showed that all four olfactory conditions could lower the level of movement and vocalization including barking, whining, or whimpering. Moreover, coconut and ginger were reported to increase sleeping time in dogs. Lavender and chamomile were also reported to promote time resting and lower level of barking in shelter dogs (Graham et al., 2005). Not only were the plant-based odors effective, but also the odors from other animals could be used to lower vocalization level (McGlone et al., 2014).

Thirty-six dogs with barking and jumping syndrome were exposed to pig pheromone (androsterone) which resulted in decreasing of barking and jumping behavior (McGlone et al., 2014). The study found that the concentration of androsterone related to the number of dogs. Thus, more dogs stopped barking and jumping after being exposed to a higher concentration of androsterone. Even though dogs abruptly stopped barking, androsterone did not startle the dogs because the heart rate of dogs did not change after the exposure. The length of time that the pheromone affects dogs' behaviors needs to be further investigated due to the short period of time (10 minutes before and after exposure to the pheromone) investigated in this study. Payne and Assemi (2017) also suggested that respondent condition with edible treat was an effective method

in reducing the amount of barking. When the experimenter walked to the front of each kennel and a digital door chime was activated, the dogs received edible treats. Thus, the dogs learned the chime meant getting a treat. Results showed that the noise level in kennel level decreased compared with the noise level before using the respondent condition procedures. Although this study did not distinguish the noise levels between barking and other sounds, most of the sound in the kennel area was generated from barking.

Overall, housing and surrounding environment, such as noise, were seen to have an impact on stress level and welfare in shelter dogs. Moreover, stress, anxiety, and fear are the causes that could develop into a long-term behavioral problem. Providing pair-housing and other enrichment such as supplementary diet, music, scents, or respondent conditioning could reduce stress levels and the amount of barking. Reduction of barking has the potential to increase adoption rates.

## **FUTURE DIRECTIONS**

The preferences among potential adopters when looking for a dog including the physical features of dogs (e.g., age, breed, size/weight, sex, and coat color) and dogs' specific behaviors should be investigated. People have their own preferences which might be influenced by the surrounding environment, climate, culture, traditional beliefs, or the news/media. Therefore, further investigation into these factors might help us identify which dog people might prefer. This information can help shelters provide the most suitable dogs to their potential adopter demographic or transfer dogs to other shelters in which those dogs are more preferred. Understanding these preferences can increase adoption rates and decrease the length of time dogs remain in shelters.

Currently, there are no additional studies investigating how breed specific stigma influences adopters' decisions or preferences. The only resource was a public organization which might include biased information instead of scientific fact in which certain breeds were characterized as more dangerous than others (Dogbites.org, 2019). Therefore, further study is needed on the effect of breed specific stigma on adopter's preference and how stigma towards specific breeds impacts dogs and their owners.

The characteristics of potential and actual adopters may influence dog adoption decisions should be an area of further inquiry. Braun and Flaschka (2013) reported that women are more likely than men to adopt shelter dogs with behavior issues. Currently, no other studies investigating how gender may influence adopters' decisions or preferences exist. Therefore, further studies focused on differences in characteristics of adopters, such as gender, may provide insight into the psychology behind the preferences.

The effect of news and media on adoption is another area that requires further study. To what extent does the kind of dog shown, as well as frequency and how they are depicted, impact

the decisions adopters make. This finding will guide shelters on how to use news and other forms of media to promote adoption and provide effective information that will attract more adopters.

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## **CHAPTER 2**

### **ACTIVITY LEVELS OF SHELTER DOGS OVER TIME**

#### **INTRODUCTION**

Accelerometer data has been utilized and validated to evaluate spontaneous activity of dogs in laboratory and home environments, as well as to differentiate intensity of activity (Yam et al., 2011; Preston et al, 2012; Michel and Brown, 2011; Hansen et al, 2007; Yamada and Tokuriki, 2000). The data from accelerometers were reported to correlate well with behavioral data extracted from video monitoring (Yam et al., 2011; Yamada and Tokuriki, 2000). In the home environment, consistency in activity levels and behavior within dogs has also been documented (Dow et al, 2009). An earlier study by Jones and colleagues (2014) suggested that stress experienced in shelter may be able to be partly measured by activity, and therefore an accelerometer may be useful in determining a shelter dog's coping and general welfare status. Further, the behavior of the dog in-kennel may influence adoption (Protopopova et al, 2014; Marston et al, 2005), such that dogs that tend to spend more time stationary at the front of the kennel are adopted faster. However, there is limited data regarding the normal activity level of dogs in the shelter setting or to specifically differentiate canine levels of activity in the shelter environment (Hennessy et al, 2001).

The presence of animals, people, noise, as well as living in a captive environment, could influence dogs' daily activity in shelters. There are several reported stressors for dogs in animal shelters: being isolated from other dogs (Walker et al., 2014), spatial restriction (Beerda et al., 1999), the noise level in the shelters (Scheifele et al., 2012), and interaction with unfamiliar humans (Coppola et al., 2006). These factors could cause acute stress and exposure to prolonged stressors can impact the immune system and make dogs more susceptible to illness (Hekman et al., 2014). As a result, stress can lead to long-term behavior problems in shelter dogs, which may

in turn prevent them from being adopted. Observing and measuring stress in shelter dogs could inform us about their behaviors before behavioral problems develop that are undesirable to potential adopters.

Cortisol is a hormone released by the hypothalamic-pituitary-adrenal (HPA) axis in response to stressful stimuli. Measurement of cortisol levels is used widely in mammals as an indicator of stress, including in shelter dogs. Blood, fecal, urinary, and salivary fluids of dogs are commonly collected and used to measure cortisol levels in dogs. However, the blood collection process can cause stress to dogs, which contributes to confounding of stressors and may lead to inaccurate results. Non-invasive collection methods, such as through fecal, urinary, salivary, and hair cortisol, are preferred methods to avoid adding stressful situations for dogs (Dreschel and Granger, 2009). Further, Jones and colleagues (2014) examined the relationship between cortisol levels and activity levels using accelerometers in shelter dogs. They reported that elevated levels of activity correlated with salivary cortisol, which supports the idea that activity levels may be used as a behavioral indicator of stress.

There were three aims for this study; 1) determine the correlation between activity levels of shelter dogs in the kennel and their length of stay, 2) determine if dog characteristics such as age, sex, and size, may influence activity patterns, and 3) quantify changes in activity levels between the first and last days of enrollment in our study. We hypothesized that higher activity levels of shelter dogs which greater than sedentary behavior (0 – 1351 cpm) could lead to a longer stay, and the activity levels of shelter dogs would decrease over time because dogs would adapt to the shelter's environment. We also hypothesized that dog's age would influence activity levels more than other dogs' traits. These findings will contribute to knowledge regarding adopter's preferences when selecting shelter dogs.

## **MATERIALS AND METHODS**

This study was approved by Michigan State University (MSU) Institutional Animal Care and Use Committee (IACUC), PROTO202100191.

### ***Population***

The dogs enrolled in this study were recruited from the Capital Area Humane Society, Lansing, MI between February 2022 and August 2022. Dogs were housed at the shelter for a minimum of 24 hours of habituation prior to being eligible for enrollment. Exclusion criteria used in this study included dogs that were unhealthy as determined by the shelter veterinarian, pregnant, nursing or less than 6 months of age. All dogs in the study were single housed.

Data regarding each dog, including age at adoption, sex, size, and length of stay, were procured from the shelter's data management software (PetPoint Data Management System, Version 5, Pethealth Software Solution Inc., Oakville, ON, Canada). Age was categorized as young (6 months – 1 year), adult (1 – 6 years), and senior (more than 7 years), and size was categorized as small (under 24 lbs.), medium (24 - up to 44 lbs.), and large (greater than 44 lbs.).

### ***Experimental Procedures***

#### ***Accelerometer Placement and Settings***

Actigraph GT3XP-BTLE accelerometers were used to measure the activity of dogs enrolled in this study. These devices measure dog's movements from three axes; vertical (y-axis), horizontal right-left (x-axis), and horizontal front-back (z-axis) to report precise movements which are integrated with a real time clock. The accelerometers record 30 times per second. The size of the Actigraph device is 4.6 x 3.5 x 1.5 cm. and weighs 19 grams and was attached to a standardized

collar fit around the dog's neck. Data was continually collected in 15 second epochs for a minimum of 3 or maximum of 7 days.

Actilife software (Version 6.13.4, Copyright 2009-2015 ActiGraph, LLC) was utilized to transfer raw data files which contained dates, time, and total volume of vector magnitude (cpm — count per minute). For analysis purposes, dogs were excluded if their records did not meet the minimum time of three days of continuous recording. Complete data was available for 76 dogs. Average activity levels were coded as vector magnitude (cpm) for each enrolled dog.

### ***Statistical Analysis***

Statistical analyses were conducted in R version 4.2.1. Average activity levels (cpm) were continuous data and checked for normality.

Linear regression was conducted to determine the effect of activity levels on the length of stay in shelter dogs according to the following model:

$$Y_i = \mu + \beta_1 X_{i1} + e_i, i = 1, 2, 3, 4, \dots, 76$$

Where  $Y_i$  is the lengths of stay (days),  $\mu$  is the intercept,  $\beta$  is the coefficient estimate of Actigraph activity levels,  $X_i$  is the independent variable representing the average Actigraph activity level of each dog and  $e_i$  is the residual error. Probability values  $< 0.05$  were considered statistically significant.

Similarly, linear regression was performed to investigate whether the dog age, sex, and size influenced activity levels demonstrated at the shelter. Statistical analyses were conducted according to the following model:

$$Y_i = \mu + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \beta_4 X_{i4} + \beta_5 X_{i5} + e_i, i = 1, 2, 3, 4, \dots, 76$$

Where  $Y_i$  is the average Actigraph activity levels (vector magnitude),  $\mu$  is the intercept,  $\beta$  is coefficient estimate of each independent variable,  $X_{i1}$ ,  $X_{i2}$ ,  $X_{i3}$ ,  $X_{i4}$ , and  $X_{i5}$  are dummy variables where  $X_{i1}$  represents the dog sex (female or male),  $X_{i2}$  and  $X_{i3}$  represent dog age (senior, adult, or young), and  $X_{i4}$  and  $X_{i5}$  represent dog size (small, medium, or large). Each dummy variable represents each independent variable, and it is coded with 1 if the case falls in that category and with 0 if not. The  $e_i$  is residual error, and  $p$ -values  $< 0.05$  and/or  $< 0.1$  were considered statistically significant.

Lastly, average activity levels from the first and last days of data collection were compared. Linear regression was utilized to determine the correlation between the first and last day of

Actigraph activity records. All data of Actigraph activity levels were checked for normal distributions. Statistical analyses were conducted according to the following model:

$$Y_i = \mu + \beta_1 X_{i1} + e_i, i = 1, 2, 3, 4, \dots, 76$$

Where  $Y_i$  is the last day of the Actigraph activity records,  $\mu$  is the intercept,  $\beta$  is the coefficient estimate of independent variable,  $X_i$  represents the first day of the Actigraph activity records, and the length of records varied from 3 to 7 days. The  $e_i$  is residual error, and  $p$ -values  $< 0.05$  were considered statistically significant.

## RESULTS

### *Populations*

Descriptions of the shelter dogs enrolled in the study are detailed in Table 2.1.

**Table 2.1** Characteristics of the shelter dog population enrolled in the accelerometer study

Variable	n (76)	Frequency (%)
<b>Sex (altered)</b>		
Male	32	42
Female	44	58
<b>Age</b>		
Young (6 months – 1 year)	8	11
Adult (1 – 6 years)	62	82
Senior (7 years +)	6	8
<b>Breed</b>		
Mixed	66	87
Specific Breeds*	10	13
<b>Size (Weight)</b>		
Small (< 24 lbs.)	6	8
Medium (24 - 44 lbs.)	13	17
Large (> 44 lbs.)	57	75

\*Ten dogs were recorded as specific breeds (e.g., Terrier, Golden Retriever, Great Pyrenees, Siberian Husky (2), Pointer, Spaniel, Beagle, German Shepherd, and French Bulldog)

### *Length of Stay and Activity Levels*

The mean of average activity level was 170.94 (range of average 60.61 - 376.97 (SD =  $\pm$  75.19) count per minute) for each dog throughout the course of their enrollment. The average activity levels were statistically significant correlation with the lengths of stay ( $t_{(63)} = 2.13$ ,  $P = 0.04$ ) indicating that the dogs with higher activity levels tended to stay longer at the shelter than the dogs who showed lower activity levels.

**Table 2.2** The correlation between length of stay and average activity levels in shelter dogs

	<b>Est.</b>	<b>SE</b>	<b><i>t</i>-value</b>	<b><i>p</i>-value</b>	<b>F</b>	<b>DF</b>
Intercept	3.69	5.90	0.62	0.53	4.53	63
Average Actigraph activity levels	0.07	0.03	2.13	<b>0.04</b>		

Bold text shows statistically significant ( $P < 0.05$ )

### *Activity Levels on First Day and Last Day of Data Collection*

Table 2.3 reports a statistically significant difference in activity between the first and last days of enrollment in the study ( $t_{(74)} = 6.67$ ,  $P = 4.04^{-9}$ ) indicating that dogs that are active on their first day tend to be more active on their last day which varied between 3 to 7 days of records.

**Table 2.3** The correlation between activity levels on the first and last days of enrollment

	<b>Est.</b>	<b>SE</b>	<b><i>t</i>-value</b>	<b><i>p</i>-value</b>	<b>DF</b>
Intercept	55.77	18.09	3.08	0.003	74
First day	0.59	0.09	6.67	<b>4.04<sup>-9</sup></b>	

Bold text shows statistically significant ( $p < 0.05$ )

### *Dog's Traits and Activity Levels*

Male dogs trended toward having higher activity levels ( $t_{(70)} = 1.70$ ,  $P = 0.09$ ) (Table 2.4), although age and size was not statistically significant.

**Table 2.4** Factors that influence activity levels in shelter dogs

		<b>Est.</b>	<b>SE</b>	<b><i>t</i>-value</b>	<b><i>p</i>-value</b>	<b>F</b>	<b>DF</b>
Intercept		164.62	12.44	13.23	$< 2^{-16}$		
Dog sex							
	Male	31.34	18.41	1.70	<b>0.09</b>		
Dog age						1.41	70
	Young	-9.61	28.40	-0.34	0.74		
	Senior	-43.16	32.68	-1.32	0.19		
Dog size							
	Small	-46.23	33.66	-1.37	0.17		
	Medium	6.99	23.19	0.30	0.76		

Bold text shows statistically significant difference ( $p < 0.05$  (strong) and/or  $< 0.1$  (moderate))

## DISCUSSION

The goal of this study was three-fold: to investigate the relationship between activity levels and the length of stay in shelter dogs, traits that might affect dog activity at the shelter, and describe the change in activity levels over time.

We found that higher activity was correlated with a longer length of stay as we predicted. One possible explanation is that adopters prefer dogs that were calm over dogs that were active as reported in previous study (Marston et al., 2005). Future studies should use activity level data to define what adopters perceive as calm behavior and investigate whether there is a correlation between calm behavior and adoption.

An additional confounding factor is the spatial restriction of kennels on dog activity levels. Dogs in this study spent the majority of the day in the kennel which prevents them from sustaining high level energy activities such as running. Thus, in this study, there was relatively little variation in dog activity and most dogs fell into the ‘sedentary’ behavior classification which represents little to no movement when lying still or sleeping in free-living dogs (Morrison et al., 2013). The findings in this study suggest that the kennel setting might not provide a suitable environment for shelter dogs to perform behaviors which shown in higher activity levels such as running outdoor and off a lead as found in free-living dogs. From a welfare standpoint, this restriction might limit animals’ ability to exercise and access to outdoor activity which promote health benefits to the shelter dogs. Thus, further study should investigate the relationship between activity levels and health of shelter dogs whether higher activity levels could promote overall health in shelter dogs.

We expected that the activity levels of the shelter dogs would decrease over time as they became habituated and to show the same activity levels from arrival through the first week of shelter residency. However, dogs in this study displayed little variability. It is possible that the

activity levels of dogs shown in the first week in the shelter setting is not enough time for habituation to the environment or not long enough for stress-related activity change to occur. Extending the data collection period could provide a better understanding of how activity levels evolve while housed in the shelter setting.

We found that male dogs showed higher average activity levels during their shelter stay as compared to females, contrasting a previous study by Morrison and colleagues (2014) which found no difference in activity level between sexes in home environments. Our results may represent differences between shelter dogs and free-living dogs based upon environmental factors. Another possible reason might cause by the spay or neuter surgery which occurred during the data collection periods. The surgery could cause the pain to the dog results in low activity levels. In this study, there were total of 39 dogs (21 males and 18 females) that received the surgery during the data collection periods, and 36 dogs (11 males and 25 females) were altered prior to the study. One dog was unknown when she received the surgery. Therefore, further study should consider the data on surgery day that might impact activity levels.

Although age was not statistically significant in this study, we found that senior (more than 7 years) dogs showed numerically lower activity levels than younger dogs (6 months – 1 year). This result is consistent with a previous study that investigated both free-living and caged dogs (Morrison et al., 2014; Siwak et al., 2003). While breed has been previously reported as influencing activity levels in the home environment (Morrison et al., 2014), most dogs in the present study were mixed breed preventing accurate investigation of the correlation between breed and shelter activity levels.

### ***Limitations***

Other factors that can influence activity levels in shelter dogs, such as number of visitors, location of kennel, or the size of the kennel, were not measured in this study and warrant further investigation. In addition, we did not consider spay or neuter surgery which could have an effect on activity levels since it is a painful procedure for the dogs. This might cause the average activity levels in our study to be lower than we expected. Further, expanding the population of dogs enrolled, as well as the duration of data collection, could provide further information about the activity patterns of dogs in a shelter environment over time. Including information about breed (if known) and other factors such as number of visitors, shelter programs (e.g., enrichment and walks per day) would help to better understand how animal and environmental factors may influence activity patterns in shelter dogs.

### **CONCLUSION**

In conclusion, we found dogs who showed higher activity levels tended to have longer shelter stays, and that activity levels were consistent between the first and final day of enrollment within one week of data collection.

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# **CHAPTER 3**

## **DESCRIBING BEHAVIORAL CHANGES THROUGH THREE MONTHS POST ADOPTION**

### **INTRODUCTION**

“Three days, three weeks, three months” is often communicated to shelter adopters to describe the expected changes in dog behavior over time post-adoption. This is a time of rapid environmental and social change for dogs, and their anxiety may prohibit them from displaying behavior that would be considered ‘normal’. For example, dogs may shut down or hide under a table during the first three days post-adoption, may begin to relax at three weeks and may start feeling fully comfortable by three months. There is no scientific support for these timepoints for expected behavioral changes as described above; however, research suggests most dogs were returned to the shelter due to behavioral issues within 24 hours, one to two weeks, or one-month post-adoption (Shore, 2005; Hawes et al., 2020; Mondelli et al., 2004). These findings suggest that there are some changes in dogs' behavior post-adoption, but the timeline of expected change is unclear.

Behavioral issues are the main reason most dogs are returned to shelters (Diesel et al., 2010; Hawes et al., 2020; Stephen and Ledger, 2007; Shore, 2005; Mondelli et al., 2004). In fact, most adopters tend to return dogs within the first week to one month post adoption (Well & Hepper, 2000; Hawes et al., 2020; Mondelli et al., 2004; Shore, 2005). These findings support the idea that there are changes in the behavior of newly adopted dogs which may put the new relationship of the dog and owner at risk and can result in a return of the dog to the shelter.

The goal of this study was twofold; 1) to quantify the changes in dog behavior between three days and three months post adoption in the new home environment and 2) identify the

attributes of the home environment or dog traits that influence behavior changes during the first two weeks post-adoption. We hypothesized that the dogs would begin to show behavior changes during the first three weeks post-adoption compared to at three days according to the 3-3-3 guideline. We also hypothesized that hours of exercise and interactions between owner and dog would influence the changes in dog behavior since previous studies suggest that human interaction could decrease stress in dogs (Coppola et al., 2006; Menor-Campos et al., 2011; Shiverdecker et al., 2013; Gunter et al., 2019) and promote human-animal bonding. These findings will give a better understanding of how dogs may modify their behaviors based on their environment or what factors may help dogs feel more comfortable in a new environment. Herron and colleagues (2007) reported brief counseling with adopter prior to adoption regarding house-training including feeding meals, toilet area, and rewards promote successful training in adopted dogs. Thus, having an improved understanding of behavioral change over time post adoption, and factors that may influence that change, are vital to preparing new adopters to create realistic expectations and in turn, potentially reduce return rates.

## **MATERIALS AND METHODS**

This study was approved by Michigan State University (MSU) Institutional Review Board (IRB), STUDY0005946.

### ***Population***

Shelter dogs already enrolled in the accelerometer study (Chapter 2) were eligible to continue participation in this study. Adopters of enrolled dogs from Capital Area Humane Society (CAHS), Lansing, MI during the study period (February 2022 to October 2022) were asked to continue participation at the time of adoption via a consent form for follow-up contact administered by CAHS adoption counselor. Those that agreed were contacted by the researcher within two days via email containing a link to access the first online survey.

### ***Surveys***

The Qualtrics survey ([www.qualtrics.com](http://www.qualtrics.com)) was open between February 2022 through October 2022. The online survey was distributed to each participant at 7 timepoints post-adoption on day three, and weeks one, two, three, four, eight and twelve. These intervals were selected based on the 3-3-3 suggestion that the time between three days and three months post-adoption is purported to reflect remarkable changes in newly adopted dogs. The additional timepoints were included to investigate if behavioral changes would be observed at other timepoints within those three months. We sent each survey two days prior to each timepoint, followed by one reminder email should adopters initially not respond. Adopters could discontinue their participation at any time by contacting the researcher or by no longer completing the survey. The survey participants would be automatically disenrolled from the study if they stopped responding or missed more than one survey during their first three weeks after adoption.

The survey consisted of three parts. Part 1 included demographic information such as age, gender, household composition, and pet experience (see Table A.1 for full details). Part 2 included the Dog Attachment Questionnaire (DAQ), which measures the human-animal bond and perception of the owner to their new dog (Archer and Ireland, 2011). In the DAQ, the adopters are asked to report their attitudes toward their dogs using a five-point scale to indicate their agreement with each item in which 1 indicates “strongly disagree” and 5 indicates “strongly agree.” Finally, The Canine Behavior and Research Questionnaire (C-BARQ) was included as Part 3 to assess the dog’s behavior in their new home. The questionnaire consisted of 101 questions that form 14 different categories of dog behavior including (1) stranger-directed aggression, (2) owner-directed aggression, (3) dog-directed aggression, (4) dog rivalry, (5) stranger-directed fear, (6) nonsocial fear, (7) dog-directed fear, (8) separation-related behavior, (9) attachment and attention-seeking, (10) trainability, (11) chasing, (12) excitability, (13) touch sensibility, and (14) energy level. In addition, the C-BARQ provides information on the occurrence of 22 miscellaneous behavior problems from coprophagia to stereotypic spinning/tail-chasing. In each question, the adopters are asked to report their dog’s behavior using a five-point scale to indicate the frequency of each behavior in which 0 indicates “never/no sign” and 4 indicates “always/extreme.” If the adopters had not observed their dogs in the provided situation, they could select “not observed/not applicable,” and these responses were recorded as missing data (Hsu and Serpell, 2003; Serpell and Hsu, 2005; Duffy et al., 2008). Parts 2 and 3 of the survey were distributed to owners at each timepoint. Part 1 was only included in their first survey response.

### *Incentive*

Participants received up to a 12-month supply of Heartgard and Nexgard as the incentive in this study for participation. Adopters who completed at least 3 surveys within the first three weeks after adoption received a consultation with the vet and receive 6-month supply. When adopters completed all the remaining surveys, they received an additional 6-month supply.

### *Statistical analysis*

To quantify the changes in dog behavior between three days and three months post-adoption, we looked at the changes of C-BARQ subscale scores (14 subscales representing 14 different categories of dog behavior) over time. C-BARQ subscales were checked for normal distributions. We conducted linear mixed models to assess changes in subscale score including timepoint as fixed variable (three days, one week, two weeks, three weeks, four weeks, eight weeks, and twelve weeks) and dog ID as a random variable. For non-normally distributed C-BARQ subscales, we also conducted linear mixed model since we have a small sample size in which we could still use mixed-effects models even if the distributional assumptions are objectively violated (Schielzeth et al., 2020). Statistical analyses were conducted in R version 4.2.1 with specific packages nlme version 3.1-159 (Pinheiro & Bates., 2000) according to the following model:

$$Y_i = \mu + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \beta_4 X_{i4} + \beta_5 X_{i5} + \beta_6 X_{i6} + Z_i u_i + e_i, \quad i = 1, 2, 3, 4, \dots, 10$$

Where  $Y_i$  is C-BARQ subscale score,  $\mu$  is the intercept,  $\beta$  is coefficient estimate of each timepoint,  $X_i$  is dummy variable representing the timepoint of this study. Each dummy variable represents one timepoint and it is coded with 1 if the case falls in that category and with 0 if not. The  $Z_i u_i$  represents random effect, and  $e_i$  is residual error. The  $p$ -values  $< 0.05$  were considered statistically significant.

To determine factors that could influence dog behavior changes over time, we selected the dogs that had complete data for days three and two weeks ( $n = 24$ ). We ran linear regression to compare changes in C-BARQ subscale scores between three days and two weeks with other factors gathered from adopters' responses including adopter gender, dog age, dog sex, hour of exercise per day, hour of interaction per day, hour of dog spending time alone per day, and number of other

dogs in the household. Statistical analyses were conducted in R version 4.2.1 according to the following model:

$$Y_i = \mu + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \beta_4 X_{i4} + \beta_5 X_{i5} + \beta_6 X_{i6} + \beta_7 X_{i7} + \beta_8 X_{i8} + \beta_9 X_{i9} + e_i,$$

$$i = 1, 2, 3, 4, \dots, 24$$

Where  $Y_i$  is the difference between C-BARQ subscale score from three days and two weeks,  $\mu$  is the intercept,  $\beta$  is coefficient estimate of each dependent variable,  $X_{i1}$ ,  $X_{i2}$ ,  $X_{i3}$ ,  $X_{i4}$  are dummy variables where  $X_{i1}$  represent the adopter gender (female and male),  $X_{i2}$  and  $X_{i3}$  represent dog age (senior, adult, and young), and  $X_{i4}$  represents dog sex (female and male). Each dummy variable represents each independent variable, and it is coded with 1 if the case falls in that category and with 0 if not.  $X_{i5}$  is a continuous variable representing hours of exercise,  $X_{i6}$  is a continuous variable representing hours of interaction,  $X_{i7}$  is a continuous variable representing hours of alone time. The  $e_i$  is residual error, and  $p$ -values  $< 0.05$  were considered statistically significant. For factors analyses,  $p$ -values  $< 0.1$  were also considered statistically significant.

## RESULTS

### *Participants*

A total of 58 adopters completed the consent form and were contacted by a researcher via email. A total of 36 adopters responded to the first survey three days post adoption, and thus were officially enrolled to the study. There are 32 adopters completed the three-day survey, 31 adopters completed the one-week survey, 31 adopters completed the two-week survey, 30 adopters completed the three-week survey, 23 adopters completed the four-week survey, 18 adopters completed the eight-week survey, and 16 adopters completed the twelve-week survey post-adoption. The response rates are 58% for three days, 57% for one week, 69% for two weeks, 73% for three weeks, 72% for four weeks, 56% for eight weeks, and 59% for twelve weeks. Demographic information from these 36 adopters is reported in Table 3.1.

**Table 3.1** Demographic characteristics of adopter population in home behavior study

Variable		N (36)	Frequency (%)
<b>Gender</b>	Male	16	44.4
	Female	20	55.6
<b>Age (years)</b>	18-25	4	12.5
	26-30	8	25.0
	31-35	5	15.6
	36-40	2	6.3
	41-45	0	0.0
	46-50	3	9.4
	51-55	3	9.4
	56-60	7	21.9
	61-70	2	6.3
	71 or older	2	6.3
<b>Area</b>	Rural	7	19.4
	Suburban	15	41.7
	Urban	14	38.9

Table 3.1 (cont'd)

<b>Type of household</b>		
A mobile home	3	8.3
A one-family detached from any other house	23	63.9
A one-family house attached to one or more houses	10	27.8
<b>Number of household members</b>		
1	7	19.4
2	15	41.7
3	10	27.8
4	4	11.1
<b>Number of previous dogs</b>		
1	8	22.2
2	5	13.9
More than 2	19	52.8
None	4	11.1
<b>Other animals living in the household</b>		
yes	22	61.1
no	14	38.9
<b>Number of other animals living in the household**</b>		
Dog	13	59.1
Cat	9	40.9
Bird	1	4.5
Reptile	1	4.5
Amphibian	0	0.0
Small mammal	1	4.5
Other	0	0.0
<b>Number of hours dogs spend time alone per day (hours)</b>		
0	8	22.2
1-3	18	50.0
4-7	7	19.4
8-11	3	8.3
More than 12	0	0.0

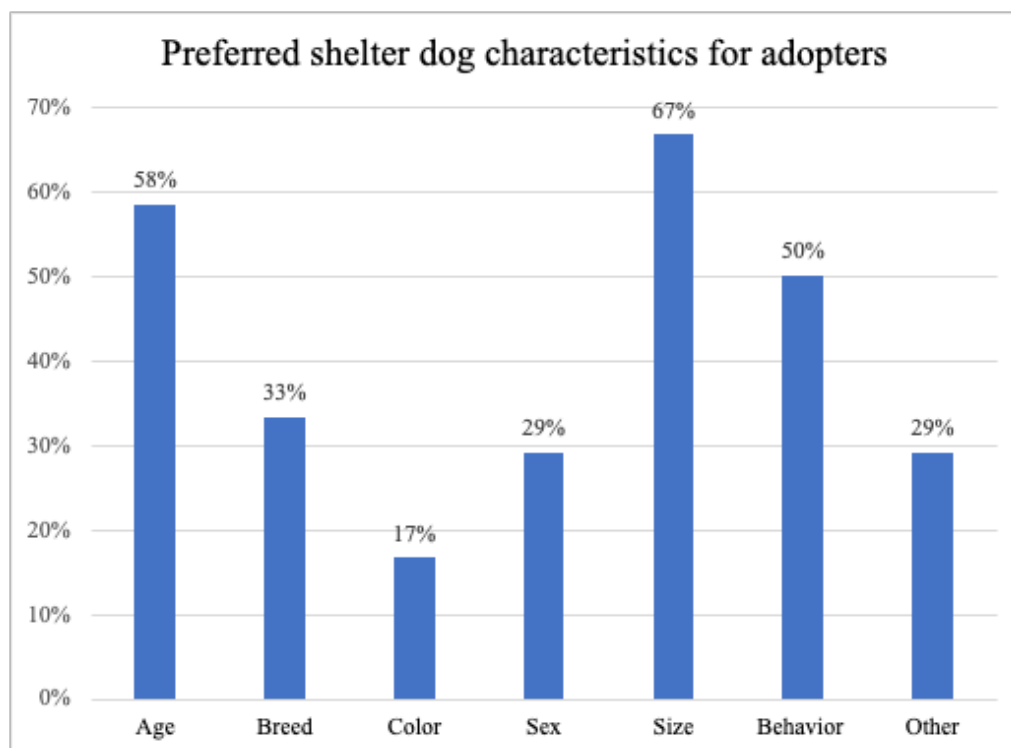
Table 3.1 (cont'd)

<b>Number of interaction hours (owner and dog) per day (hours)</b>		
1	0	0.0
2-3	5	13.9
4-5	11	30.6
6-7	11	30.6
More than 7	9	25.0
<b>Number of hours dogs exercise per day (hours)</b>		
Less than 1	1	2.9
1-2	22	62.9
3-4	10	28.6
More than 4	2	5.7
<b>Types of exercises (multiple response)</b>		
Walk	24	100
Jog / run	3	13
Fetch / other games with humans	15	63
Swim	0	0
Dog playgroup	3	13
Not exercise	0	0
Other	2	8
<b>Training</b>		
Attending training class	15	41.7
Home training	21	58.3
<b>Relationship between owner and dog</b>		
Pet	1	2.8
Best friend	1	2.8
Family member	23	63.9
Child (see yourself as their parents)	10	27.8
An extension of myself	1	2.8
Other	0	0.0

Table 3.1 (cont'd)

Priorities in training	(Rank)	
Basic command (sit, come, and stand)	1	99
Walk on leash	2	79
House and crate training	3	54
Socialization with other dogs	4	66
Socialization with other people	5	62

\*\*Some adopters have more than one kind of animal in their household



**Figure 3.1** Dog traits that participants considered when acquiring their dogs

We asked adopters which of the provided phenotypes may have influenced their decision in adopting their dog (Figure 3.1.). This was a multiple-response question so respondents could select more than one option. Size was selected most often, followed by age, behavior, breed, sex (all dogs are fixed at time of adoption), and color. Adopters could select ‘other’ if the choices provided are not considered as the reason they adopted their dog. One adopter mentioned ‘not barking’ as an important contributing factor.

### ***Dog Behavior Post-Adoption***

Table 3.2 shows the changes in the C-BARQ subscales from day three to week 12 ( $n = 10$ ). Linear mixed models showed that stranger-directed aggression increased significantly between three days and three weeks ( $t_{(9)} = 2.00, P = 0.05$ ) and between three days and four weeks ( $t_{(9)} = 2.10, P = 0.04$ ).

Energy increased significantly between three days and eight weeks ( $t_{(9)} = 2.51, P = 0.02$ ), and between three days and twelve weeks ( $t_{(9)} = 3.29, P = 0.002$ ). There were no statistically significant differences in other timepoints prior to eight weeks in energy level.

Dog-directed aggression increased significantly between three days and four weeks ( $t_{(9)} = 2.22, P = 0.03$ ); between three days and eight weeks ( $t_{(9)} = 3.01, P = 0.004$ ); between three days and twelve weeks ( $t_{(9)} = 3.01, P = 0.004$ ). Dog-directed aggression appeared to increase following adoption, but there were no statistically significant differences between three days and weeks one, two and three.

Separation-related behavior increased significantly between three days and four weeks ( $t_{(9)} = 2.26, P = 0.03$ ), between three days and eight weeks ( $t_{(9)} = 3.16, P = 0.003$ ), and between three days and twelve weeks ( $t_{(9)} = 3.43, P = 0.001$ ). Separation-related behavior appeared to increase following adoption, although the differences were not statistically significant between three days and weeks one, two and three.

For nonsocial fear, the subscale scores increased significantly between three days and eight weeks ( $t_{(9)} = 2.52, P = 0.01$ ). There were no statistically significant differences in other timepoints prior or after eight weeks in nonsocial fear.

Dog rivalry (i.e., the threatening responses to other familiar dogs in the same household) increased significantly between three days and eight weeks ( $t_{(9)} = 2.76, P = 0.008$ ). Dog rivalry

appeared to increase following adoption till eight weeks and decrease in twelve weeks, although the differences were not statistically significant between three days and weeks one, two, three, four and twelve.

Chasing behavior increased significantly following adoption starting at two weeks to 12 weeks; between three days and two weeks ( $t_{(9)} = 2.77, P = 0.008$ ), between three days and three weeks ( $t_{(9)} = 4.65, P = 0.00$ ), between three days and four weeks ( $t_{(9)} = 2.66, P = 0.01$ ), between three days and eight weeks  $t_{(9)} = 4.31, P = 0.0001$ ), and between three days and twelve weeks ( $t_{(9)} = 4.43, P = 0.00$ ). There were no statistically significant differences between three days and one week in chasing.

Trainability increased significantly following adoption starting at two weeks to twelve weeks; between three days and two weeks ( $t_{(9)} = 2.86, P = 0.01$ ), between three days and three weeks ( $t_{(9)} = 2.29, P = 0.03$ ), between three days and four weeks ( $t_{(9)} = 3.53, P = 0.001$ ), between three days and eight weeks ( $t_{(9)} = 2.95, P = 0.005$ ), and between three days and twelve weeks ( $t_{(9)} = 4.00, P = 0.0002$ ). There were no statistically significant differences between three days and one week in trainability.

Touch sensibility (i.e., fearful or wary responses to potential painful procedures such as bathing, grooming, or veterinary examinations) increased significantly starting in three weeks to twelve weeks following adoption; between three days and three days ( $t_{(9)} = 2.11, P = 0.04$ ), between three days and four weeks ( $t_{(9)} = 2.11, P = 0.04$ ), between three days and eight weeks ( $t_{(9)} = 5.07, P = 0.00$ ), and between three days and twelve weeks ( $t_{(9)} = 4.64, P = 0.00$ ). There were no statistically significant differences between three days and week two in touch sensibility.

There were no statistical differences between day three and other timepoints in dog-directed fear, owner-directed aggression, excitability, stranger-directed fear, and attachment/attention-seeking behavior. See Table 3.2 for more details.

**Table 3.2** Changes in C-BARQ subscale scores at 7 timepoints

	Intercept			Week 1			Week 2			Week 3			Week 4			Week 8			Week 12		
	Fixed effects																				
	Est	t	p	Est	t	p	Est	t	p	Est	t	p	Est	t	p	Est	t	p	Est	t	p
SA	1.8	1.64	0.10	0.5	0.48	0.63	0.4	0.38	0.70	2.1	2.00	0.05	2.2	2.10	0.04	1.3	1.24	0.22	0.8	0.76	0.45
DDF	0.9	1.41	0.16	0.5	0.94	0.35	-0.2	-0.38	0.71	0.6	1.13	0.27	0.3	0.56	0.58	1.0	1.88	0.07	1.0	1.88	0.07
DDA	0.2	0.30	0.76	0.9	1.43	0.16	1.0	1.58	0.12	1.1	1.74	0.09	1.4	2.22	0.03	1.9	3.01	0.004	1.9	3.01	0.004
ODA	0.4	1.12	0.27	-0.3	-0.67	0.50	0.4	0.89	0.38	0.1	0.22	0.82	0.5	1.11	0.27	0.3	0.67	0.51	0.4	0.89	0.38
EX	10.7	8.79	0.00	0.6	0.56	0.58	1.0	0.93	0.36	1.4	1.30	0.20	-0.4	-0.37	0.71	-0.1	-0.09	0.92	-0.2	-0.19	0.85
SDF	1.8	2.62	0.01	0.5	0.70	0.49	-0.2	-0.28	0.78	0.0	0.00	1.00	0.3	0.42	0.68	0.3	0.42	0.68	-0.3	-0.42	0.68
SRB	4.4	2.63	0.01	0.9	0.62	0.54	2.0	1.37	0.18	2.6	1.78	0.08	3.3	2.26	0.03	4.6	3.16	0.003	5.0	3.43	0.001
NSF	4.2	2.82	0.01	0.9	1.19	0.24	-0.1	-0.13	0.90	0.5	0.66	0.51	0.5	0.66	0.51	1.9	2.52	0.01	1.0	1.33	0.19
DR	0.1	0.10	0.92	0.5	0.73	0.47	0.7	1.02	0.31	1.0	1.45	0.15	1.0	1.45	0.15	1.9	2.76	0.008	1.1	1.60	0.12
CH	2.7	2.61	0.01	0.6	0.66	0.51	2.5	2.77	0.008	4.2	4.65	0.00	2.4	2.66	0.01	3.9	4.31	0.0001	4.0	4.43	0.00
TR	13.1	9.98	0.00	2.0	1.91	0.06	3.0	2.86	0.01	2.4	2.29	0.03	3.7	3.53	0.001	3.1	2.95	0.005	4.2	4.00	0.0002
AAS	12.3	9.64	0.00	-0.1	-0.08	0.93	1.0	0.83	0.41	1.0	0.83	0.41	1.5	1.24	0.22	0.2	0.17	0.87	1.9	1.58	0.12

Table 3.2 (cont'd)

EL	<b>2.9</b>	<b>4.88</b>	<b>0.00</b>	<b>-0.7</b>	<b>-1.35</b>	<b>0.18</b>	<b>0.7</b>	<b>1.35</b>	<b>0.18</b>	<b>0.9</b>	<b>1.74</b>	<b>0.09</b>	<b>0.4</b>	<b>0.77</b>	<b>0.44</b>	<b>1.3</b>	<b>2.51</b>	<b>0.02</b>	<b>1.7</b>	<b>3.29</b>	<b>0.002</b>
TS	0.2	0.40	0.69	0.6	1.27	0.21	0.5	1.06	0.30	1.0	2.11	<b>0.04</b>	1.0	2.11	<b>0.04</b>	2.4	5.07	<b>0.00</b>	2.2	4.64	<b>0.00</b>

Bold text shows statistically significant difference based on timepoint ( $P < 0.05$ )

Note: SA = Stranger-directed aggression, DDF = Dog-directed fear, DDA = Dog-directed aggression, ODA = Owner-directed aggression, EX = Excitability, SDF = Stranger-directed fear, SRB = Separation-related behavior, NSF = Nonsocial fear, DR = Dog rivalry, CH = Chasing, TR = Trainability, AAS = Attachment/Attention-seeking behavior, EL = Energy level, TS = Touch sensibility

**Table 3.3** Factors that influence changes in dog's behavior between three days and two weeks by C-BARQ subscale score

<b>Factors</b>	<b>Est.</b>	<b>SE</b>	<b>t-value</b>	<b>p-value</b>
<b>Factor 1 – Stranger directed aggression (SA)</b>				
Intercept	0.47	1.39	0.34	0.74
Owner gender				
Male	1.99	1.09	1.82	<b>0.086</b>
Dog age				
Dog sex				
Male	2.89	1.08	2.66	<b>0.02</b>
Hour of exercise / day	-0.87	0.42	-2.09	<b>0.05</b>
Hour of interaction / day				
Hour of dog spends time alone / day	0.05	0.16	0.31	0.76
Other dogs in the household				
Yes	0.09	2.13	0.04	0.97
Alone*other dogs (Yes)	-0.10	0.88	-0.11	0.91
<b>Factor 2 – Dog-directed fear (DDF)</b>				
Intercept	-1.33	0.47	-2.81	0.01
Owner gender				
Male	1.67	0.62	2.70	<b>0.01</b>
Dog age				
Dog sex				
Male	1.71	0.58	2.93	<b>0.008</b>
Hour of exercise / day				
Hour of interaction / day				
Hour of dog spends time alone / day				
Other dogs in the household				
Yes	-1.00	0.72	-1.39	0.18
Alone*other dogs				
<b>Factor 3 – Dog-directed aggression (DDA)</b>				
Intercept	0.04	0.54	0.08	0.94
Owner gender				
Male	2.14	0.70	3.06	<b>0.006</b>
Dog age				
Dog sex				
Male	0.95	0.66	1.43	0.17
Hour of exercise / day				
Hour of interaction / day				

Table 3.3 (cont'd)

Hour of dog spends time alone / day				
Other dogs in the household				
Yes	-2.12	0.82	-2.59	<b>0.02</b>
Alone*other dogs				
<b>Factor 4 – Owner-directed aggression (ODA)</b>				
Intercept	1.01	0.49	2.04	0.05
Owner gender				
Dog age				
Dog sex				
Hour of exercise / day	-0.40	0.22	-1.82	<b>0.08</b>
Hour of interaction / day				
Hour of dog spends time alone / day				
Other dogs in the household				
Alone*other dogs				
<b>Factor 5 – Excitability (EX)</b>				
Intercept	3.64	2.79	1.31	0.21
Owner gender				
Dog age				
Senior	14.52	3.80	3.82	<b>0.001</b>
Young	1.94	1.96	0.99	0.33
Dog sex				
Male	3.51	1.51	2.33	<b>0.03</b>
Hour of exercise / day	1.24	0.86	1.44	0.17
Hour of interaction / day	-1.16	0.62	-1.86	<b>0.079</b>
Hour of dog spends time alone / day				
Other dogs in the household				
Alone*other dogs				
<b>Factor 6 – Stranger-directed fear (SDF)</b>				
Intercept	-2.48	0.93	-2.67	0.02
Owner gender				
Dog age				
Senior	1.76	2.28	0.77	0.45
Young	-1.92	1.06	-1.81	<b>0.09</b>
Dog sex				
Male	2.55	0.96	2.64	<b>0.02</b>
Hour of exercise / day	0.77	0.39	1.95	<b>0.07</b>

Table 3.3 (cont'd)

Hour of interaction / day					
Hour of dog spends time alone / day					
Other dogs in the household					
Yes	-1.95	1.01	-1.94	<b>0.07</b>	
Alone*other dogs					
<b>Factor 7 – Separation-related behavior (SRB)</b>					
Intercept	-4.70	1.67	-2.82	0.01	
Owner gender					
Male	2.85	1.55	1.84	<b>0.08</b>	
Dog age					
Senior	8.81	4.73	1.86	<b>0.08</b>	
Young	-0.33	1.69	-0.20	0.85	
Dog sex					
Male	4.74	1.64	2.88	<b>0.01</b>	
Hour of exercise / day					
Hour of interaction / day					
Hour of dog spends time alone / day	0.82	0.22	3.68	<b>0.002</b>	
Other dogs in the household					
Yes	-1.91	4.39	-0.44	0.67	
Alone*other dogs (Yes)	-0.86	0.63	-1.36	0.19	
<b>Factor 8 – Non-social fear (NSF)</b>					
Intercept	-3.44	1.71	-2.02	0.06	
Owner gender					
Dog age					
Dog sex					
Male	1.69	0.95	1.78	<b>0.09</b>	
Hour of exercise / day					
Hour of interaction / day	0.40	0.27	1.48	0.16	
Hour of dog spends time alone / day	0.12	0.14	0.83	0.42	
Other dogs in the household					
Yes	2.16	1.93	1.12	0.28	
Alone*other dogs (Yes)	-0.50	0.31	-1.63	0.12	
<b>Factor 9 – Dog rivalry (DR)</b>					
Intercept	-3.86	1.68	-2.29	0.03	
Owner gender					
Dog age					

Table 3.3 (cont'd)

Dog sex				
Hour of exercise / day				
Hour of interaction / day	0.65	0.29	2.22	<b>0.04</b>
Hour of dog spends time alone / day				
Other dogs in the household				
Alone*other dogs				
<b>Factor 10 – Chasing (CH)</b>				
Intercept	2.13	0.75	2.84	0.01
Owner gender				
Dog age				
Dog sex				
Hour of exercise / day				
Hour of interaction / day				
Hour of dog spends time alone / day				
Other dogs in the household				
Yes	-1.88	1.30	-1.45	0.16
Alone*other dogs				
<b>Factor 11 – Trainability (TR)</b>				
Intercept	1.07	1.44	0.75	0.46
Owner gender				
Dog age				
Senior	-5.63	3.90	-1.44	0.16
Young	-3.23	2.05	-1.58	0.13
Dog sex				
Hour of exercise / day				
Hour of interaction / day				
Hour of dog spends time alone / day	0.37	0.23	1.62	0.12
Other dogs in the household				
Alone*other dogs				
<b>Factor 12 – Attachment/attention-seeking behavior (AAS)</b>				
Intercept	-4.10	1.87	-2.20	0.04
Owner gender				
Dog age				
Dog sex				
Male	6.03	1.51	4.00	<b>0.0008</b>
Hour of exercise / day	0.88	0.62	1.42	0.17

Table 3.3 (cont'd)

Hour of interaction / day				
Hour of dog spends time alone / day	0.43	0.23	1.86	<b>0.08</b>
Other dogs in the household	2.38	3.15	0.76	0.46
Alone*other dogs	-1.32	0.50	-2.62	<b>0.02</b>
<b>Factor 13 – Energy level (EL)</b>				
Intercept	-0.14	0.44	-0.33	0.75
Owner gender				
Male	1.70	0.57	2.98	<b>0.007</b>
Dog age				
Dog sex				
Male	1.54	0.54	2.85	<b>0.01</b>
Hour of exercise / day				
Hour of interaction / day				
Hour of dog spends time alone / day				
Other dogs in the household:				
Yes	-2.07	0.67	-3.10	<b>0.006</b>
Alone*other dogs				
<b>Factor 14 – Touch sensitivity (TS)</b>				
Intercept	-0.51	0.58	-0.88	0.39
Owner gender				
Dog age				
Dog sex				
Hour of exercise / day	-0.32	0.18	-1.80	<b>0.09</b>
Hour of interaction / day	0.27	0.12	2.19	<b>0.04</b>
Hour of dog spends time alone / day				
Other dogs in the household				
Alone*other dogs				

Bold text shows statistically significant difference based on the score changes between three days and two weeks ( $p < 0.05$  (strong) and/or  $< 0.1$  (moderate))

Note: Factors that are blank were excluded from the statical analysis using stepwise regression, which selected only those independent variables that best fit the model.

### ***Factors that Influence Dog's Behavior Changes between Three Days and Two Weeks***

Dogs with completed surveys between three days and two weeks ( $n = 24$ ) were used to investigate the impact of factors due to the highest numbers of completed C-BARQ data scores of newly adopted dogs.

Selecting 'male' as owner gender was associated with a larger behavior change in newly adopted dogs for several C-BARQ subscales, including stranger-directed aggression ( $t_{(23)} = 1.82$ ,  $P = 0.09$ ), dog-directed fear ( $t_{(23)} = 2.70$ ,  $P = 0.01$ ), dog-directed aggression ( $t_{(23)} = 3.06$ ,  $P = 0.006$ ), separation-related behavior ( $t_{(23)} = 1.84$ ,  $P = 0.08$ ), and energy level ( $t_{(23)} = 2.98$ ,  $P = 0.007$ ) between three days and two months post-adoption.

Additionally, the age of the dog was associated with changes in C-BARQ subscale scores. Senior dogs (more than seven years old) were associated with greater changes in excitability ( $t_{(23)} = 3.82$ ,  $P = 0.001$ ) and separation-related behavior ( $t_{(23)} = 1.86$ ,  $P = 0.08$ ). Young dogs (more than six months and less than one year old) were associated with smaller changes in stranger-directed fear ( $t_{(23)} = -1.81$ ,  $P = 0.09$ ,  $SE = 1.06$ ), and adult (one to six years old) was associated with no changes in C-BARQ subscale scores.

Male dogs were associated with a greater change in stranger-directed aggression ( $t_{(23)} = 2.66$ ,  $P = 0.02$ ), dog-directed fear ( $t_{(23)} = 2.93$ ,  $P = 0.008$ ), excitability ( $t_{(23)} = 2.33$ ,  $P = 0.03$ ), stranger-directed fear ( $t_{(23)} = 2.64$ ,  $P = 0.02$ ), separation-related behavior ( $t_{(23)} = 2.88$ ,  $P = 0.01$ ), nonsocial fear ( $t_{(23)} = 1.78$ ,  $P = 0.09$ ), attention/attachment seeking behavior ( $t_{(23)} = 4.00$ ,  $P = 0.0008$ ) and energy level ( $t_{(23)} = 2.85$ ,  $P = 0.01$ ). Female dogs were not associated with differences in any C-BARQ subscale score between three days and two months following adoption.

Hours of exercise were associated with greater changes in stranger-directed fear ( $t_{(23)} = 1.95$ ,  $P = 0.07$ ) but associated with smaller changes in stranger-directed aggression ( $t_{(23)} = -2.09$ ,

$P = 0.05$ ), owner-directed aggression ( $t_{(23)} = -1.82, P = 0.08$ ) and touch sensibility ( $t_{(23)} = -1.80, P = 0.09$ ).

Hours of interaction are reported to be associated with smaller changes in excitability ( $t_{(23)} = -1.86, P = 0.079$ ) and greater changes in dog rivalry ( $t_{(23)} = 2.22, P = 0.04$ ) and touch sensibility ( $t_{(23)} = 2.19, P = 0.04$ ).

Hours of dogs spending time alone are associated with greater changes in separation-related behaviors ( $t_{(23)} = 3.68, P = 0.002$ ) and attention/attachment seeking behaviors ( $t_{(23)} = 1.86, P = 0.08$ ).

The presence of other dogs in the household is associated with smaller changes in energy level ( $t_{(23)} = -3.10, P = 0.006$ ), dog-directed aggression ( $t_{(23)} = -2.59, P = 0.02$ ), and stranger-directed fear ( $t_{(23)} = -1.94, P = 0.07$ ). The correlation between alone time and other dogs is associated with smaller changes in attention/attachment seeking behaviors ( $t_{(23)} = -2.62, P = 0.02$ ). When alone time longer by one hour, for the dog in household with no other dogs, the score in attention/attachment seeking behaviors will be greater than dog living in the household with other dogs.

## DISCUSSION

The goal of this study was to describe changes in behavior in newly adopted dogs during their first three months post-adoption. Notably, we found that five C-BARQ subscale scores, including dog-directed fear, owner-directed aggression, excitability, stranger-directed fear, and attachment/attention-seeking behavior showed no statistically significant changes during three months after adoption when compared with their score on day three. However, there were nine subscale scores that changed at various timepoints between three days and three months. The expression of undesirable behaviors such as stranger directed aggression, dog-directed aggression, dog rivalry, nonsocial fear, and separation-related behavior in dogs increased, indicating that the expression of these behaviors may change over time. Overall, this finding suggests that nine behaviors may be expected to change over the course of three months post-adoption, while five behaviors remain similar to what is observed at the time of adoption.

Trainability increased significantly starting at two weeks through 12 weeks, which was also reported in a previous study in which training difficulties decreased significantly between two days and four months post adoption (Powell et al., 2022). This may reflect changes to the owner and dog relationship, as they begin to develop increased trust and ability to interpret body language and motivators for training. One previous study reported that interaction with humans, including training, was effective to promote attachment behaviors in shelter dogs (Martson et al., 2005); a finding which likely extends to shelter dogs as they move to a home environment. Further, trainability has been linked to retention of dogs in a household (Duxbury et al., 2003). This finding may be beneficial to shelters in promoting the human-animal bond and retention of dogs in their adoptive homes.

In our study, nonsocial fear increased significantly at eight weeks only, suggesting that eight weeks after adoption is an important timepoint for newly adopted dogs to show changes in nonsocial fear. However, a previous study reported that nonsocial fear decreased significantly between two weeks to four months (Powell et al., 2022). These conflicting results may reflect the use of different versions of C-BARQ where Powell and colleagues (2022) used a “mini C-BARQ” containing 42 questions whereas our study utilized the full version with 101 questions. By asking dog owners more questions to assess the behaviors, the full version could be considered a more thorough assessment of overall behavior. In addition, the differences in sample size (current study:  $n = 10$  vs. Powell et al., (2014):  $n = 28$ ) may contribute to contrasting results with greater representation.

We expected that newly adopted dogs would begin to show behavior changes between three days and three weeks. The 3-3-3 guideline suggests that newly adopted dogs would feel overwhelmed or scared during the first three days and feel more comfortable within three months post-adoption. On the other hand, the increased results might also be influenced by the owner’s perception of their dog’s behavior changes after spending more time with their dogs and having more opportunity to observe behaviors.

Among the factors we investigated in this study, we found behavior changes in dogs between three days and two weeks post adoption were influenced by different factors. Male respondents were associated with a greater change in stranger-directed aggression, dog-directed fear, dog-directed aggression, separation-related behavior, and energy level. However, we do not know the genders of others living in the household. The demographic information was gathered from the adopter who responded to the surveys, and we did not query regarding the human family

composition. Male dogs were associated with greater changes in excitability and energy level. This finding may be an artifact of the small sample size in this study.

We expected that hours of exercise and interactions between owner and dog would influence change in dog behavior; as previous studies support that human interactions would decrease stress in dogs (Coppola et al., 2006; Menor-Campos et al., 2011; Shiverdecker et al., 2013; Gunter et al., 2019). In addition, the interaction could form the attachment between owners and dogs which might help dogs get more comfortable in the home (Serpell, 1996; Payne et al., 2016). We found that hours of exercise, hours of interaction, and hours that the dog spent time alone were associated with changes in dogs' behaviors including stranger-directed aggression, owner-directed aggression, excitability, stranger-directed fear, separation-related behavior, dog rivalry, attachment/attention-seeking, and touch sensibility. The varied changes in behaviors indicate that the amount of interaction hours between owners and their newly adopted dogs, including exercise and interaction, influenced the changes in behavior.

The presence of other dogs in the household is associated with greater changes in energy levels, and smaller changes in dog-directed aggression, and stranger-directed fear. This result indicates that having other dogs in the household could encourage energy levels in newly adopted dogs over time and reduce aggression and fear when approached by unfamiliar people and dogs. Although there is no evidence that fully supports attachment between adult dogs in previous study (Martiti et al., 2014), the authors found that dogs show less stress when cohabitating with other dogs compared to those living in a single-dog household. In our study, we also found that with no other dogs in the household, newly adopted dogs show greater changes in attention/attachment seeking behavior than the dogs living with other dogs in the household. These findings indicate

that having another dog in the household could help newly adopted dogs from developing undesirable behavior and show more desirable behavior in the new home.

### ***Limitations***

We have a limited sample size in this study, which may reflect the significant time component required of survey participation. Completing surveys over three months as well as having many questions to answer may have deterred interest in completing the study for some adopters. However, it is important to note that we did have more than 60% of adopters responding to the first survey, which is a better response rate than many shelter-related surveys, indicating that our incentives may have been appealing to adopters.

## **CONCLUSION**

In conclusion, we found that there were several behaviors such as stranger-directed aggression, energy levels, dog-directed aggression, separation-related behavior, nonsocial fear, dog rivalry, chasing, trainability, and touch sensibility changed over time when compared with three days, while behaviors such as dog-directed fear, owner-directed aggression, excitability, stranger-directed fear, and attachment/attention-seeking did not change within three months post-adoption. Additionally, some behaviors depended on household composition (e.g., the presence of other dogs in the household). We also found that male dogs are associated with greater changes in all C-BARQ subscale scores, and dog age is also associated with changes in behavior between three days and two weeks. Our findings display that behavior changes in newly adopted dogs could last till three months which is not comparable with the 3-3-3 guideline. Therefore, extending time to investigate dog's behavior changes would provide a better understanding on when and which

behaviors of dogs tend to show or develop over time. Future studies should recruit more dogs and adopters from several shelters to expand the demographic of the population in the study.

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## **CHAPTER 4**

### **SUMMARY AND CONCLUSIONS**

The overall goal of these studies was to gain a better understanding of dog activity while housed in the shelter, and how behavior is expressed over time post-adoption. Further, we aimed to determine how internal and external factors might influence dog behavior both in the kennel and in the new home environment. In Chapter 2, we hypothesized that dogs displaying higher levels of activity in the kennel environment could lead to a longer stay, and that the activity levels would decrease over time as dogs began to feel less stressed with the shelter environment. Our findings determined that shelter dogs tended to show the same levels of activity within their first week at the shelter, while dogs that displayed higher levels of activity tended to be adopted less quickly than those who displayed low activity. We also investigated the influence of traits including dog age, sex, and size on the activity levels of shelter dogs. While male dogs were more likely to be active than females, we found no other significant differences with age and size.

The aim of Chapter 3 was to further investigate the behavior changes in newly adopted dogs between three days and three months, and to identify attributes that play a role in behavior changes in the first two weeks of adoption. We hypothesized that the dogs would begin to show changes in behavior in three weeks, and the hour of exercise and interaction between the new owner and adopted dogs would play a big role in behavioral changes. The results from the C-BARQ subscale scores indicated that newly adopted dogs show behavioral changes as early as the second week post-adoption. Additionally, nine categories of behavior as reported by the C-BARQ were likely to increase (stranger-directed aggression, dog-directed aggression, dog rivalry, nonsocial fear, separation-related behavior, trainability, chasing, touch sensibility, and energy level), while the other five categories (owner-directed aggression, stranger-directed fear, dog-

directed fear, attachment/attention-seeking, and excitability) had no differences during the first three months. It is possible that those nine behavioral categories could continue to change after three months or stay the same; given our study period ended after three months, future studies should aim to determine how long that unpredictability in behavioral expression may be observed.

Male respondents were associated with greater changes in several behaviors from C-BARQ including stranger-directed aggression, dog-directed fear, dog-directed aggression, separation-related behavior, and energy level. Since we do not know if there is another person with the opposite gender in the household, we could not conclude that male adopters influence behavior changes in newly adopted dogs. Among dog's traits that were included in this study, age and sex of dogs were associated with the changes in behavior, specifically in young, senior, and male dogs.

Hours of exercise and interaction between the owners and their newly adopted dogs were reported to be associated with the changes in dogs' behavior between three days and two weeks. This suggests that interaction between owners and the dogs affect how dogs behave during those time points. Additionally, hours of alone time were associated with changes in separation-related behaviors and attention/attachment seeking behaviors suggesting that shelter dogs required more attention from their owners when they spent more time alone. We also found that if there were other dogs in the household, newly adopted dogs show greater changes in energy level, dog-directed aggression, and stranger-directed fear. In addition, newly adopted dogs seek more attention from their owners when living with no other dogs in the household. This suggests that the presence of other dogs in the household can influence newly adopted dogs to behave toward their owners or surrounding environments.

These results provide better understanding of shelter dogs' behavior at the shelter and at home post-adoption, particularly those specific behaviors of dogs changing over time within three

months. With the new understanding, adopters could be equipped to keep the newly adopted dogs in the household rather than returning the dogs within one month. The results from the first study suggest that activity levels in shelter dogs within their first week of adoption influence adoption decisions. In addition, shelter dogs tend to perform similar activity levels during their first week after arriving at the shelter. The results from the second study indicate that newly adopted dogs display different types of behaviors at different timepoints during the first three months post-adoption. Since behaviors were influenced by diverse factors including dog's personalities, shelters, and/or surrounding environments, other newly adopted dogs may not show similar behavior changes as shown in this study. In addition, the number of newly adopted dogs that we investigated was limited. Future studies should explore the relationship between in-kennel behavior and post-adoption behavior which could inform adopters about expected changes in behavior thereby potentially increasing retention in the new home.

## APPENDIX

### Survey Questionnaire

#### Part 1: Demographic Questions

1. Please type your name      First name: \_\_\_\_\_  
Last name: \_\_\_\_\_
2. Do you still have the dog that you adopted from the shelter?      Yes      No
3. Gender: How do you identify?
  - ☐ Male
  - ☐ Female
  - ☐ Non-binary / third gender
  - ☐ Prefer not to say
  - ☐ Prefer to self-describe: \_\_\_\_\_
4. Your age:
  - ☐ 18 – 25
  - ☐ 25 – 30
  - ☐ 31 – 35
  - ☐ 36 – 40
  - ☐ 41 – 45
  - ☐ 46 – 50
  - ☐ 51 – 55
  - ☐ 56 – 60
  - ☐ 61 – 70
  - ☐ > 70
5. Number of people in the household including yourself: \_\_\_\_\_

6. Categories of ages of people in household with numbers (excluding self) (select all that apply):

- ☐ < 3 years of age
- ☐ 3 - 10 years of age
- ☐ 11 - 18 years of age
- ☐ 19 - 25 years of age
- ☐ 26 - 35 years of age
- ☐ 36 - 50 years of age
- ☐ 51 - 70 years of age
- ☐ > 71 years of age

7. Which of the following best describes the area where you live?

- ☐ Urban
- ☐ Suburban
- ☐ Rural

8. Which of the following best describes your home?

- ☐ A mobile home
- ☐ A one-family house detached from any other house
- ☐ A one-family attached to one or more houses
- ☐ Prefer not to say

9. Have you had other dogs in the past?                      Yes      No

10. If yes, please select the number of previous dogs:

- ☐ 1
- ☐ 2

- > 2

11. Do you currently have other animals living in your household?      Yes      No

12. If yes, which animals and how many? (select all the apply)

- Dog: \_\_\_\_\_
- Cat: \_\_\_\_\_
- Bird: \_\_\_\_\_
- Reptile: \_\_\_\_\_
- Amphibian: \_\_\_\_\_
- Small mammal per (for example, hamster, gerbil, rabbit): \_\_\_\_\_
- Other (please specify): \_\_\_\_\_

13. What is the reason you decided to adopt this dog? (select all the apply)

- Age
- Breed
- Color
- Sex
- Size
- Behavior
- Other (please specify): \_\_\_\_\_

14. How many hours does the dog spend alone per day?

- 0
- 1 – 3
- 4 – 7
- 8 – 11

- ☐ > 12

15. On average, how many hours per day are spent interacting with your dogs? ('interaction' includes exercise, playing, petting, training, etc.)

- ☐ 1
- ☐ 2 – 3
- ☐ 4 – 5
- ☐ 6 – 7
- ☐ > 7

16. On a typical day, how do you exercise your dog? (select all that apply)

- ☐ Walk
- ☐ Jog or run
- ☐ Fetch or other games with humans
- ☐ Swim
- ☐ Dog playgroups
- ☐ Not exercise
- ☐ Other (please specify): \_\_\_\_\_

17. Typically, how many hours per day does your dog exercise?

- ☐ < 1
- ☐ 1 – 2
- ☐ 3 – 4
- ☐ > 4

18. Do you plan to take your dog to professional classes or training programs? Yes No

19. If no, do you intend to spend time training your dog at home? Yes No

20. Which of the following training that is the first priority for your dogs? (please rank from 1 to 5 in which 1 is the most important)

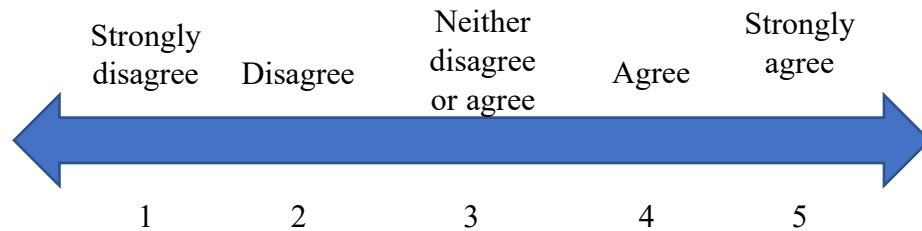
- ☐ Basic command (sit, come, stand)
- ☐ Walk on leash
- ☐ House and crate training
- ☐ Socialization with other dogs
- ☐ Socialization with other people

21. Which of the following best describes your relationship with your dogs? (select one)

- ☐ Pet
- ☐ Best friend
- ☐ Family member
- ☐ Child (see yourself as their parents)
- ☐ An extension of myself
- ☐ Other (please specify): \_\_\_\_\_

## Part 2: Dog Attachment Questionnaire (DAQ)

Instructions: answer the following questions based on your attitudes toward dogs:



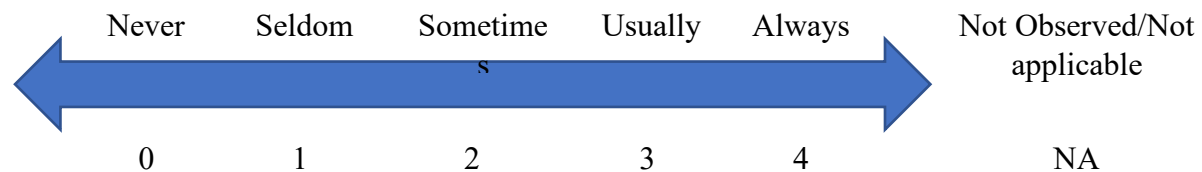
- \_\_\_ 1. Life without my dogs would be unbearable as though a vital part were missing
- \_\_\_ 2. My dog is treated like a family member
- \_\_\_ 3. The loss of my dog would mean as much to me as the loss of a family member or friend
- \_\_\_ 4. There was an increase in happiness after getting my dog
- \_\_\_ 5. Having to deal with the death of my dog would be very hard
- \_\_\_ 6. My dog is an important part of my life
- \_\_\_ 7. When I think of losing my dog, I become very upset
- \_\_\_ 8. It's hard to express to others what the loss of my dog would mean to me
- \_\_\_ 9. What I like about my dog is its acceptance, love, and loyalty
- \_\_\_ 10. When upset or anxious I turn to my dog for comfort
- \_\_\_ 11. I spend a lot of time talking to my dog
- \_\_\_ 12. I/we do not celebrate my dog's birthday
- \_\_\_ 13. I feel a strong companionship with my dog
- \_\_\_ 14. If my dog became lost, I would not give up until I found him or her
- \_\_\_ 15. A reward would be offered for their return
- \_\_\_ 16. Having a dog is a source of contact and comfort
- \_\_\_ 17. I feel very close to my dog

- \_\_\_\_ 18. Extra care is taken to ensure my dog is well taken care of whilst on holiday
- \_\_\_\_ 19. I enjoy feeling my dog sitting close to me
- \_\_\_\_ 20. Extra care is taken to ensure my dog does not escape or get lost
- \_\_\_\_ 21. I often find myself talking about my dog when in company
- \_\_\_\_ 22. Having a dog increased my self- esteem and self- worth
- \_\_\_\_ 23. When I'm alone, I often think about my dog
- \_\_\_\_ 24. I feel more relaxed in company when my dog is present
- \_\_\_\_ 25. He/she is encouraged to sleep on my bed at night
- \_\_\_\_ 26. I hate going home when my dog is not there to greet me
- \_\_\_\_ 27. I never go away on holiday where my dog cannot accompany me
- \_\_\_\_ 28. When talking to my dog I often use endearing terms or baby talk
- \_\_\_\_ 29. Having a dog means you cannot do what you want to
- \_\_\_\_ 30. If I am on holiday without my dog, I hardly ever think about him or her
- \_\_\_\_ 31. People are more important to me than my dog is
- \_\_\_\_ 32. When people let me down, I don't find that I rely more upon my dog for companionship and solace
- \_\_\_\_ 33. I find it easier to talk to my dog than to people
- \_\_\_\_ 34. I receive more companionship from friends or family than from my dog
- \_\_\_\_ 35. I spend a lot of time stroking and petting my dog

### Part 3: C-BARQ (Canine Behavioral and Research Questionnaire)

#### Section 1: Training and obedience

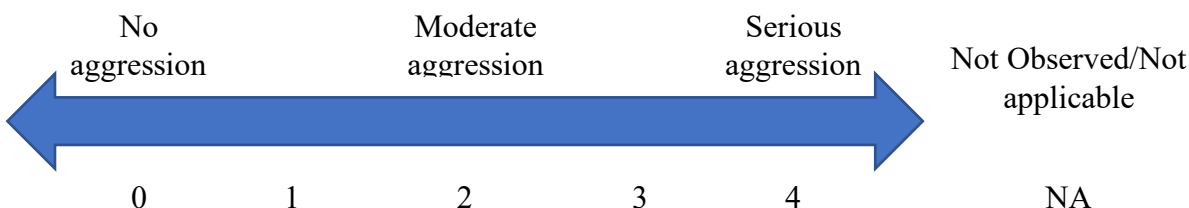
By selecting the appropriate number from the scale, please indicate how trainable or obedient your dog has been in each of the following situations in the recent past:



- \_\_\_ 1. When off the leash, returns immediately when called.
- \_\_\_ 2. Obeys the "sit" command immediately
- \_\_\_ 3. Obeys the "stay" command immediately.
- \_\_\_ 4. Seems to attend/listen closely to everything you say or do.
- \_\_\_ 5. Slow to respond to correction or punishment; "thick-skinned".
- \_\_\_ 6. Slow to learn new tricks or tasks.
- \_\_\_ 7. Easily distracted by interesting sights, sounds, or smells. 8. Will "fetch" or attempt to fetch sticks, balls, or objects

## Section 2: Aggression

By selecting the appropriate number from the scale, please indicate your own dog's recent tendency to display aggressive behavior in each of the following contexts:



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

\_\_\_ 10. When approached directly by an unfamiliar adult while being walked/exercised on a leash.

\_\_\_ 11. When approached directly by an unfamiliar child while being walked/exercised on a leash.

\_\_\_ 12. Toward unfamiliar persons approaching the dog while s/he is in your car (at the gas station, for example).

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

\_\_\_ 14. When bathed or groomed by a household member.

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

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

\_\_\_ 17. When approached directly by a household member while s/he is eating.

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

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

- \_\_\_\_ 20. When strangers walk past your home while your dog is outside or in the yard.
- \_\_\_\_ 21. When an unfamiliar person tries to touch or pet the dog.
- \_\_\_\_ 22. When joggers, cyclists, rollerbladers or skateboarders pass your home while your dog is outside or in the yard.
- \_\_\_\_ 23. When approached directly by an unfamiliar male dog while being walked/exercised on a leash.
- \_\_\_\_ 24. When approached directly by an unfamiliar female dog while being walked/exercised on a leash.
- \_\_\_\_ 25. When stared at directly by a member of the household.
- \_\_\_\_ 26. Toward unfamiliar dogs visiting your home.
- \_\_\_\_ 27. Toward cats, squirrels or other animals entering your yard.
- \_\_\_\_ 28. Toward unfamiliar persons visiting your home.
- \_\_\_\_ 29. When barked, growled, or lunged at by another (unfamiliar) dog.
- \_\_\_\_ 30. When stepped over by a member of the household.
- \_\_\_\_ 31. When you or a household member retrieves food or objects stolen by the dog.
- \_\_\_\_ 32. Towards another (familiar) dog in your household.
- \_\_\_\_ 33. When approached at a favorite resting/sleeping place by another (familiar) household dog.
- \_\_\_\_ 34. When approached while eating by another (familiar) household dog.
- \_\_\_\_ 35. When approached while playing with/chewing a favorite toy, bone, object, etc., by another (familiar) household dog.

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

### Section 3: Fear and anxiety

By selecting the appropriate number from the scale, please indicate your own dog's recent tendency to display fearful behavior in each of the following contexts:

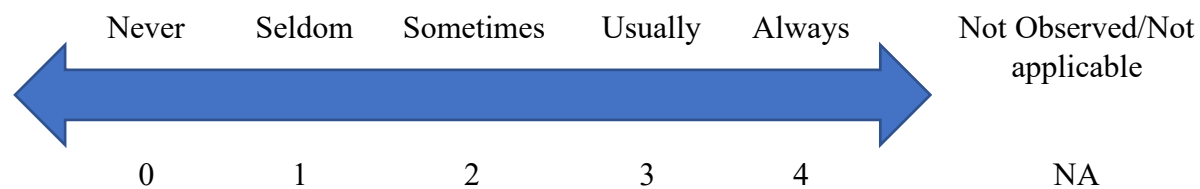


- \_\_\_ 36. When approached directly by an unfamiliar adult while away from your home.
- \_\_\_ 37. When approached directly by an unfamiliar child while away from your home.
- \_\_\_ 38. In response to sudden or loud noises (e.g. vacuum cleaner, car backfire, road drills, objects being dropped, etc.).
- \_\_\_ 39. When unfamiliar persons visit your home.
- \_\_\_ 40. When an unfamiliar person tries to touch or pet the dog.
- \_\_\_ 41. In heavy traffic.
- \_\_\_ 42. In response to strange or unfamiliar objects on or near the sidewalk (e.g., plastic trash bags, leaves, litter, flags flapping, etc.).
- \_\_\_ 43. When examined/treated by a veterinarian.
- \_\_\_ 44. During thunderstorms, firework displays, or similar events.
- \_\_\_ 45. When approached directly by an unfamiliar dog of the same or larger size.
- \_\_\_ 46. When approached directly by an unfamiliar dog of smaller size.
- \_\_\_ 47. When first exposed to unfamiliar situations (e.g. first car trip, first time in elevator, first visit to veterinarian, etc.).
- \_\_\_ 48. In response to wind or wind-blown objects.

- \_\_\_ 49. When having nails clipped by a household member.
- \_\_\_ 50. When groomed or bathed by a household member.
- \_\_\_ 51. When stepped over by a member of the household.
- \_\_\_ 52. When having his/her feet towed by a member of the household.
- \_\_\_ 53. When unfamiliar dogs visit your home.
- \_\_\_ 54. When barked, growled, or lunged at by an unfamiliar dog.

#### Section 4: Separation-related behavior

Thinking back over the recent past, how often has your dog shown each of the following signs of separation-related behavior when left, or about to be left, on his/her own:

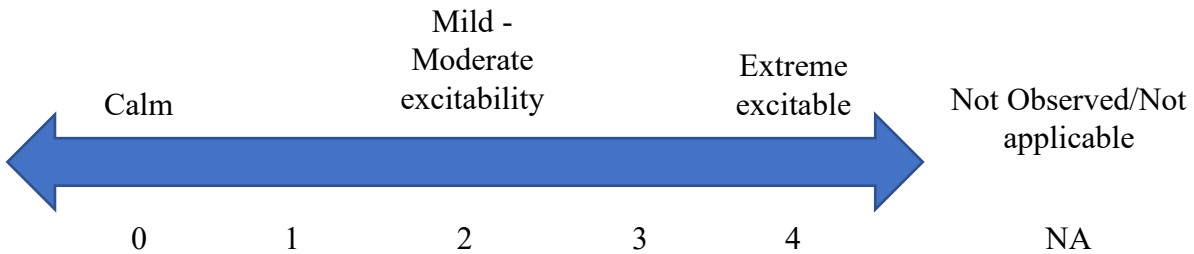


- \_\_\_ 55. Shaking, shivering, or trembling.
- \_\_\_ 56. Excessive salivation.
- \_\_\_ 57. Restlessness, agitation, or pacing.
- \_\_\_ 58. Whining.
- \_\_\_ 59. Barking.
- \_\_\_ 60. Howling.
- \_\_\_ 61. Chewing or scratching at doors, floor, windows, curtains, etc.
- \_\_\_ 62. Loss of appetite.

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

## Section 5: Excitability

By selecting the appropriate number from the scale, please indicate your own dog's recent tendency to become excitable in each of the following contexts:



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

\_\_\_ 64. When playing with you or other members of your household.

\_\_\_ 65. When doorbell rings.

\_\_\_ 66. Just before being taken for a walk.

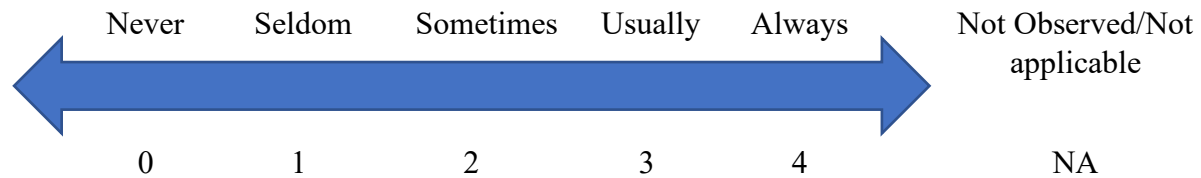
\_\_\_ 67. Just before being taken on a car trip.

\_\_\_ 68. When visitors arrive at your home.

Are there any other situations in which your dog sometimes becomes over-excited? If so, please describe briefly:

## Section 6: Attachment and attention-seeking

Thinking back over the recent past, how often has your dog shown each of the following signs of attachment or attention-seeking:



\_\_\_ 69. Displays a strong attachment for one particular member of the household.

\_\_\_ 70. Tends to follow you (or other members of the household) about the house, from room to room.

\_\_\_ 71. Tends to sit close to, or in contact with, you (or others) when you are sitting down.

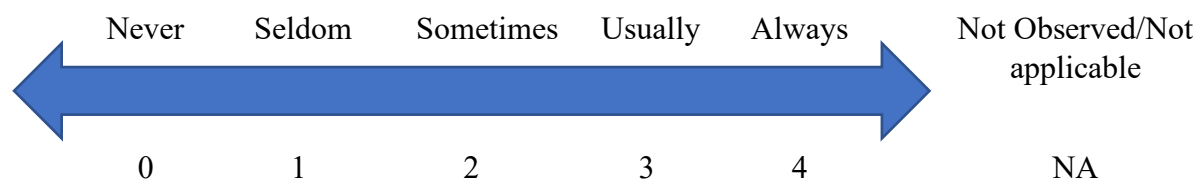
\_\_\_ 72. Tends to nudge, nuzzle, or paw you (or others) for attention when you are sitting down.

\_\_\_ 73. Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another person.

\_\_\_ 74. Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another dog or animal.

## Section 7: Miscellaneous

Thinking back over the recent past, please indicate how often your dog has shown any of the following behaviors:



- \_\_\_ 75. Chases or would chase cats given the opportunity.
- \_\_\_ 76. Chases or would chase birds given the opportunity.
- \_\_\_ 77. Chases or would chase squirrels, rabbits and other small animals given the opportunity.
- \_\_\_ 78. Escapes or would escape from home or yard given the chance.
- \_\_\_ 79. Rolls in animal droppings or other "smelly" substances.
- \_\_\_ 80. Eats own or other animals' droppings or feces.
- \_\_\_ 81. Chews inappropriate objects.
- \_\_\_ 82. "Mounts" objects, furniture, or people.
- \_\_\_ 83. Begs persistently for food when people are eating.
- \_\_\_ 84. Steals food.
- \_\_\_ 85. Nervous or frightened on stairs.
- \_\_\_ 86. Pulls excessively hard when on the leash.
- \_\_\_ 87. Urinates against objects/furnishings in your home.
- \_\_\_ 88. Urinates when approached, petted, handled or picked up.
- \_\_\_ 89. Urinates when left alone at night, or during the daytime.
- \_\_\_ 90. Defecates when left alone at night, or during the daytime.
- \_\_\_ 91. Hyperactive, restless, has trouble settling down.

- \_\_\_\_ 92. Playful, puppyish, boisterous.
- \_\_\_\_ 93. Active, energetic, always on the go.
- \_\_\_\_ 94. Stares intently at nothing visible.
- \_\_\_\_ 95. Snaps at (invisible) flies.
- \_\_\_\_ 96. Chases own tail/hind end.
- \_\_\_\_ 97. Chases/follows shadows, light spots, etc.
- \_\_\_\_ 98. Barks persistently when alarmed or excited.
- \_\_\_\_ 99. Licks him/herself excessively.
- \_\_\_\_ 100. Licks people or objects excessively.
- \_\_\_\_ 101. Displays other bizarre, strange, or repetitive behavior(s).\*

\*Describe briefly: