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The effect of physical and demographic factors and training on the time-to-adoption of domestic cats in a local shelter

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The Effect of Physical and Demographic Factors and Training on the Time-to-Adoption of Domestic Cats in a Local Shelter

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Abstract

About 7.6 million animals enter shelters each year (Pet Statistics. (n.d.)). Many factors have been examined to determine what affects adoption rates for these companion animals. A study of a kill-shelter has found that age, gender, and circumstance all influenced cat adoption rates (Lepper et. al., 2002). Training was also found to increase the adoption rates of dogs (Luescher and Medlock, 2009). Data on cat adoptions were collected from Charlottesville-Albemarle SPCA (a no-kill shelter) and were analyzed using Sigma Plot and STATA. Training cats took place at Rockingham/Harrisonburg SPCA and the data was also analyzed using Sigma Plot. Color, age, and source were all found to influence adoption rates. None of the animals which were trained failed training, however the five which were fully trained were adopted or transferred before data could be collected. Cats which were included in the training group showed significantly fewer returns when compared to the control. The differences between adoption factors could be explained through population differences in the areas serviced by the shelters as well as by differences between the shelters themselves (kill vs no-kill).

Introduction

The Humane Society of the United States, based on a survey conducted by the National Council on Pet Population Study and Policy in 2012, estimates that approximately six to eight million cats and dogs enter private and municipal shelters every year (Pets by the Numbers. (n.d.)). Similarly, an estimate from the American Society for the Prevention of Cruelty to Animals (ASPCA) reports 7.6 million companion animals entering shelters per year (Pet Statistics. (n.d.)). Unfortunately, the statistics for incoming pets are estimates based on data from a limited number of shelters. As of 2014, there were approximately 13,600 independent animal shelters servicing different communities but there is no institution responsible for gathering data from all of these shelters and compiling that data for research purposes, which means that any estimate of incoming dogs and cats is a rough guess. Nevertheless, these numbers suggest that approximately 867 companion animals arrive at shelters every hour of every day of the year.

A breakdown of adoption outcomes for dogs and cats in shelters shows that each year only about 35% and 37% respectively are adopted, 31% and 41% are euthanized, and 26% and <5% are returned to their owners (Pet Statistics. (n.d.)). The ASPCA estimates that 2.7 million are adopted (48.1% dogs and 51.9% cats). Another 2.7 million (48.1% dogs and 51.9% cats) are euthanized each year, which is equivalent to 160 cats and 137 dogs being euthanized each hour. About 649,000 animals classified as strays are returned to their owner and of these only 100,000 are cats. This means only 15.4% of strays returned to their owners are cats (Pet Statistics. (n.d.)). Wenstrup and Dowidchuk (1999) learned that cats are more likely than dogs to be euthanized (65% cats opposed to 52% dogs) and are less likely to be adopted (29% to 32%). Although these numbers do not match those from the ASPCA, the use of different shelters could explain any

differences in percentages. When comparing reasons for euthanasia between cats and dogs, cats were more often chosen to be euthanized due to behavioral issues, although insufficient space in the shelter was also an important factor (Wenstrup and Dowidchuk, 1999). As further evidence of the substantial role played by shelters, the Humane Society reports figures from the American Pet Products Association, which estimate that in 2012-2013, 26% of 95.6 million owned cats had been adopted from a shelter (Pets by the Numbers. (n.d.)).

While more information about pet movement through shelters could help identify best practices to increase adoptions, there is no national census of pets entering and leaving shelters (Gourkow and Fraser, 2006). All shelter-based statistics are derived from surveys sent out by individuals to local shelters. Wenstrup and Dowidchuk reviewed a number of these surveys in an attempt to identify a common set of shelter data but found that, due to issues including differences in local policies, it was not possible to compare shelters (Wenstrup and Dowidchuk, 1999).

Each animal that enters a shelter is estimated to cost the shelter about $176 (Wenstrup and Dowidchuk, 1999). This cost was calculated by dividing estimates of total shelter expenses by estimates of the number of animals in shelters. Expenses include food, care, and staff salaries. When this cost is multiplied by the number of animals entering shelters each year, the result indicates that shelters spend close to $1.4 billion each year housing unwanted pets. This breaks down to $159,817 dollars per hour and $44 per second.

Physical Factors Affecting Adoption Rates

The physical characteristics of animals can influence their adoption rates. In a study by Lepper et al (2002), the physical characteristics of cats and dogs were observed to correlate with their adoption rates. The study was conducted at the Sacramento County Department of Animal Care and Regulation, a kill shelter. In general, an odds ratio is the ratio of the probability of being adopted to the probability of not being adopted for the group divided by the ratio of the probability of being adopted to the probability of not being adopted for the control group. For dogs they found that the relative odds ratio of a dog being adopted after age one decreases significantly from 1.00 at less than one year to 0.43 from one to two years, 0.33 from two to five years, and finally to 0.02 from when they are older than 5 years. Dogs under one year are used as the control group, and as is the case for all comparison populations (control groups), the odds ratio is normalized to one. In terms of spay/neuter, unspayed females were used as the basis for comparison (1.00 odds ratio). The only significant difference in adoption rates occurred with spayed females which had an increased odds ratio (1.76) over untreated females (Lepper et. al., 2002). A study on the adoption rates of male and female dogs from the spay/neuter program at the California Veterinary Student Surgery Program also looked at the effect of spay/neuter on adoption and found neutered dogs were more likely to be adopted (Clevenger and Kass, 2003). Color was not found to be a significant factor in determining adoption for dogs (Lepper et. al., 2002).

Similar results were reported for cats. Lepper and colleagues found that as age increased the likelihood of adoption decreased significantly. Using kittens less than one year old as a reference, the odds ratio of being adopted dropped to 0.27 for cats aged 1-2 years, 0.22 for cats aged 3-5 years, and 0.054 for cats older than 5 years (Lepper etal., 2002). Gender was also

found to be important to adopters, with males preferred over females. Only neutered males were significantly different from the standard females; males had a higher odds ratio of 1.17 while neutered males had an odds ratio of 6.68 (Lepper et. al., 2002). Color was not a significant factor in determining adoption. By contrast, in another study of factors affecting cat adoption, Gourkow found that more than 50% of adopters reported hair color, coat length, and neuter status were important considerations in the adoption process, while few adopters considered size, eye color, breed, or sex important (Gourkow, 2001).

Circumstantial Factors Affecting Adoption Rates

Other factors can influence adoption. Lepper et al examined the effects of status (stray, owner/guardian surrender, etc.), breed, and reason for surrender on adoption. In dogs, as compared to strays as the basis for comparison (1.00), dogs relinquished on account of behavioral problems (0.057) or because of age or sickness (0.17) had significantly lower odds of being adopted. Strays are considered to be any unclaimed animal collected by a shelter off the street. Breed played a factor as well. Using large companion dogs as the standard, lap dogs (3.86) had a higher odds of and fighting breeds (0.37) and Staffordshire terriers (0.070) had lower odds of being adopted. Purebred dogs were more likely to be adopted than crossbreeds (1.43), while injured dogs were less likely to be adopted than uninjured dogs (0.22) (Lepper et. al., 2002).

In cats, the reason for impoundment also seemed to influence adopters. Strays, comprising most of the intake of the shelter (the Sacramento County Department of Animal Care and Regulation), were adopted over pets who were relinquished by their owners, even if the reasons for owner surrender were expense (0.59) or landlord related (0.54). Cats which were impounded due to injury (0.47), behavioral problems (0.25), or age (0.36) were not as likely to be adopted; however, only in the case of age was the difference statistically significant. Breeds did not seem to influence adoption rates. As compared to domestic short hairs, Persians (1.86) and other rare breeds (1.75) were found to be slightly more adoptable, but not significantly so (Lepper et. al., 2002). While color was not significant in a kill shelter, it could influence adoption in no-kill shelters.

Environmental Factors Affecting Adoption Rates

While physical and intake characteristics cannot really be controlled by shelters, environmental factors can be controlled. There are many studies examining the effects of environment on adoption. A study by Mertens and Unshelm (1996) found that while dogs are often housed separately from compatriots due to concerns about aggression, most dogs housed in groups of two or three would "settle matters" through non-violent behavior. Housing dogs together also resulted in a greater human socialization on average (80% as opposed to 43%) as dogs were more socially adjusted. The dogs also showed a decreased likelihood of behavioral problems, with only 11% of the communally housed dogs developing behavioral problems compared to 31% in the individual housing. Dogs in communal housing were adopted more quickly (10 days compared to 17 days) as well as returned less often (9% compared to 25%) (Mertens & Unshelm, 1996).

Regarding cats, Gourkow (2001) was able to determine that housing arrangements had a significant effect on both stress levels and adoption times of cats. Adoption time refers to the length of time a cat or dog spends on the adoption floor of a shelter, not including the time following intake when the cat is kept in the back for quarantine and is not yet up for adoption. Standard treatment, defined as having no enrichment in the cage, resulted in fewest adoptions and most euthanasias. Enrichment in Gourkow's study was defined to include spaces for hiding as well as separation between food bowl, litter box, and sleeping area. The three treatments were: enriched communal (open cage with many cats and environmental enrichment), basic communal (open cage with many cats and no enrichment), and enriched single (cage for one cat with enrichment).

Housing can influence how increased stress in cats can lead to a decreased chance of adoption. Stress can result in unwanted behavior in cats, such as aggression or over-grooming, but beyond behavioral aspects stress can also harm the cats physiologically as their immune system is affected. The three treatments all showed a decreased median duration of stay and stress level assessed using posture, activity levels, and vocalizations. Those cats that were euthanized by the shelter all showed signs of elevated stress.

A later study found that approximately 45% of cats in a standard single cage were adopted, while cats in the three treatments had adoption rates of between 69 and76% (Gourkow and Fraser, 2006). The number of days until adoption also differed between control and treatment groups, with cats in the control group waiting on average 12.5 days until adoption while those in the treatment groups waited on average only 5 days (Gourkow and Fraser, 2006). Finally, the study showed that while there were significant differences in adoption times between the standard and treatment groups, there was no significant difference in adoption times between the treatments (Gourkow and Fraser, 2006).

Other environmental factors potentially influencing adoption rates of cats include activity levels, cage location, and whether or not toys are present. In a study conducted by Fantuzzi et. al.(2010), it was found that cats were viewed more often by potential adopters if there were toys in the cage, whether or not the toys influenced activity levels. Cats that were more active were viewed for a longer duration than those who were less active. Cats in upper tier cages were also viewed more (Fantuzzi et al, 2010).

There are still gaps in our knowledge about factors influencing feline adoption, however. Due to the lack of shelter data the effects of many factors such as influence of geographic

location and population diversity of that location cannot be determined. Each shelter also makes subjective judgments about some of the characteristics of the animals they intake, especially color. One person may see a cat as being primarily black while another sees it as being primarily white. The differences in opinion can influence the data collected by each shelter as there is no objective scale. While the raw data cannot be applied across the United States, when standardized it can be comparable from region to region.

Training

Learning is a change in behavior as a result of experience, excluding changes as a result of maturation of the nervous system, fatigue, or sensory adaptation (Goodenough and McGuire, 2010). There are many categories of learning, two of which are classical conditioning and operant conditioning. Also known as associative learning, classical conditioning is the result of a connection forming between two stimuli. A stimulus, such as a clicker, is called an unconditioned stimulus when the animal has not yet learned a response to it. The unconditioned response, such as salivation, is the behavior when it is not paired with a stimulus. Over time the stimulus becomes conditioned as the animal responds to it, the behavior becoming a conditioned response. The conditioned response can be different from the unconditioned response (Goodenough and McGuire, 2010).

Operant conditioning is the process by which an animal performs a behavior and receives some form of reward, called a reinforcer. The reinforcement is positive, such as food. Shaping can be done through operant conditioning. This type of training is often used to train animals, and is a gradual molding of a behavior into a more desirable one. For example, when teaching an animal to sit, any movement to sit down is rewarded at first. Eventually the animal must sit down more and more before getting the reward until the behavior is learned (Goodenough and McGuire, 2010).

Much like dogs, cats can be trained to perform various tricks, such as sitting, begging, or jumping through hoops (Shaffer & Shaffer, (n.d.)). Clicker training is an effective means of training in general, as it allows the animal to recognize when it has performed the requested behavior. Over time, cats can learn to associate a signal to a corresponding action.

No studies exist on how training affects the adoption rates of shelter cats. However, Luescher and Medlock (2009) performed a study observing the effects of training on the adoption rates of dogs in a shelter. Dogs with training were 1.4 times more likely to be adopted than untrained dogs (Luescher and Medlock, 2009).

If training dogs can increase their likelihood of adoption it is possible that the same is true for cats. Not only is seeing a cat perform a trick on command a novelty, but it might influence a potential adopter. Many pet owners see cats as being untrainable, therefore easily fixed problems are allowed to grow. If shelters could train cats to respond to clickers in shelters, people could then correct their cat's behavior if needed once they took it home. Knowing that the cat can be trained could increase the chance of adoption.

Specific Aims

While shelter statistics from kill-shelters have been studied, little has been collected from no-kill shelters. The differences between shelters could influence the data as no-kill shelters have the ability to choose which pets are accepted and rarely use euthanasia, and only when the pets are terminally ill or in a similar state. By choosing the pets they keep, no-kill shelters can more easily accommodate the preferences of the region.

Beyond basic house-training, cats are not taught any tricks, such as sitting or high-fiving. Training can affect adoptability by influencing an adopter's opinion about the animal being adopted. An animal perceived as trainable might draw in adopters, thus decreasing the time until adoption as well as decreasing the chances of the animal being returned.

The first aim of this research is to collect and analyze data from a no-kill shelter to determine adoption preferences. Factors such as age, color, source, breed, and gender will be examined and analyzed to determine how they affect adoption rate and time.

The second aim is to determine how training affects shelter stay duration and adoption rates. The hypothesis is that training will significantly decrease the shelter stay times of cats while increasing adoptions. This treatment was chosen for the ease of performance by shelter staff and volunteers, to ensure that time and money are not an issue for shelters with low funding and staff.

Methods

Data Collection

Survey data on the outcomes of cats offered for adoption in 2014 were collected from the Charlottesville Albemarle Society for the Prevention of Cruelty to Animals (SPCA). The no-kill shelter is the only one servicing Charlottesville and Albemarle County that accepts cats.

Adoption is not necessarily affected by the characteristics of the animals and their environment; the demographics of the community could also potentially affect which animals are more likely to be adopted. Charlottesville is comprised of an almost equal ratio of males to females, with percentages of 52% to 48% respectively (Charlottesville: Demographics, (n.d.)). There is a diverse grouping of ages, with 34% 20-29 years old, 13% 30-39 years old, and 11% 10 to 19 years old. Demographically, 69.3% of the population is White, with about 20% African American, 6.5% Asian, 6% other, and the remaining population is negligibly small (Figure 2). The breakdown of the population's education had 27% with a post graduate degree, 21% with a Bachelor's Degree, 21% with a high school graduation or GED, and 14% with some college experience. About 3% had an Associate's Degree, 8% had some high school, and only 6% had less than 9^{th} grade (Charlottesville: Demographics, (n.d.)).

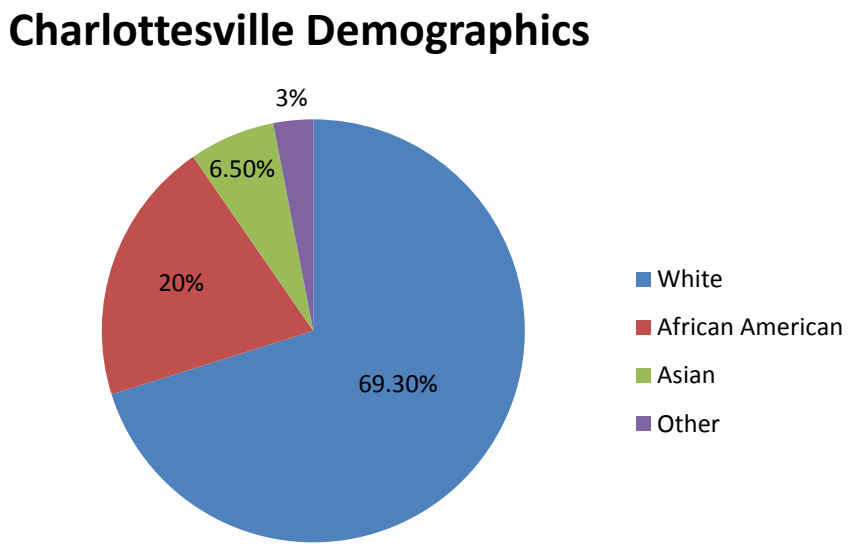

Figure 2: The demographic breakdown of Charlottesville. The population is 69.3% white, 20% African American, 6.5% Asian, and 3% other.

Originally the sample included 1,623 cats; however, all un-adopted cats were removed from the analysis. As the shelter is no-kill, the cats which were euthanized were likely either never placed up for adoption, terminally ill, or were brought in by owners to be euthanized. Other animals died without euthanasia or were transferred out; therefore the outcome was unknown (Table 1).

Each cat was characterized by time until adoption, age, breed, color, spay/neuter status, gender, reason for surrender, circumstance, source, and current status. Age was specified in week increments. Breed was initially broken down into 43 categories, but was later broken into two categories of purebred mix and domestic mix (Figure 3, upper right). Both gender and neuter status were broken down into two groups (male and female) (Figure 3, bottom). There were 6 categories for source (See in Figure 3, upper left) and 3 for circumstance (owner surrender, protective custody, stray). There were 32 categories for surrender reason (See in Figure 5). Color was divided into 25 categories (See in Figure 4)

Table 1: Cat Intake Statistics for 2013-June 30, 2014

	January1, 2013 – December 31, 2013	January 1, 2014 – March 31, 2014	April 1, 2014 – June 30, 2014
Beginning Shelter Count:	280	330	237
Intake from Public:	1988	271	468
Intake from Transfers in Community	0	0	0
Intake from Transfers outside Community	5	6	0
Total Intake	1993	638	468
Total Adoptions	1677	325	284
Outgoing Transfers in Community	0	0	0
Outgoing Transfers outside Community	28	7	6
Return to Owner/Guardian	84	15	31
Total Euthanized	89	16	21
Died or Lost in Shelter Care	61	7	8
Ending Shelter Count	334	237	355
Annual Live Release Rate/Percentage	95%	95%	93%

Training Procedure

The study was carried out using domestic cats (*Felis catus*) at the local Rockingham-Harrisonburg SPCA. IACUC and IRB approval was obtained prior to beginning the study. Age, color, breed, source, and adoption cost were recorded throughout the experiment.

Cats that were ready for adoption were randomly assigned to either a treatment (training) or a control group while incoming cats were randomly assigned to either the control or treatment groups on an alternating basis. The setup was used to diminish the effects of physical characteristics on adoption. The quantitative measure selected to determine the effectiveness of each treatment was days until adoption. Number of cats adopted in each group was also recorded. Factors that were known to affect adoption, such as coat color and location of cage, were controlled for when assigning cats to one treatment or another. Color was controlled by keeping track of which cats were entering the study and, within the constraints of controlling for other factors, were divided fairly evenly between groups. If two cats came in with the same coloration, one was placed in the control group while the other was placed in the treatment group provided that they were on the same side of the housing. When controlling for location, each side of the adoption space was treated differently, and an even number of controls and training were on each side. Each incoming cat was placed in either the control or the treatment group on an alternating basis, still dependent on side. All cats in the study were housed in the same cage type (enriched single), therefore differences in adoptability due to differing environment were minimalized. Other factors affecting adoption values, such as the presence of toys, were accounted for by exposing each cat to the same environment. The shelter has a system in place for handling cats; when opening the cage, volunteers rest their arm on the cage door and wait for the cat to approach them before initiating contact. Cats that huddled in a corner or refused to

approach the experimenter were not included in the study, as stress levels affect both training and adoptability (Gourkow and Fraser, 2006).

Cats were trained to perform a simple learned behavior, a high-five, while staying in the adoption cage (Figure 1). To train the cats to high five, various treats that were donated to the SPCA were used along with a standard iClick clicker. To first clicker train the cats in the treatment, the experimenter clicked the clicker and immediately gave a treat to the cat. The process was repeated 10-20 times until after either five minutes or the cat showed signs of boredom. To test whether they were successfully clicker trained, at the end of the visit the experimenter retested the treatment cats. After waiting for the cat's attention to wander, the experimenter clicked the clicker. If the cat was clicker trained, it would look at the experimenter while waiting for the food reward.

Once clicker trained, the high five was taught using associative training. First the hand was placed on the floor of the cage with a treat held in two fingers. As soon as the cat's paw touched the hand, the experimenter clicked the clicker and gave the cat the treat. Over time, the hand was lifted to make the cat reach up before getting the treat. After the cats were trained, volunteers continued to work with them to ensure that the cats did not forget the behavior during the adoption period. While the behavior was being taught, trainers were asked to use a clicker to accustom cats to hearing the click and receiving a treat. Trainers interacted with cats in the control group for five minutes, similar to the treatment cats. Treats were also used, but without the clicker. Data were collected for the amount of time spent before adoption for each cat as well as number of cats in each treatment that were adopted.

Figure 1: A cat demonstrating the high five behavior. The cat was an Egyptian Mau belonging to the experimenter which was trained prior to the experiment and used to demonstrate the behavior when teaching to assistants.

Statistical Analysis

The program Sigma Plot was used to analyze the data from the Charlottesville Albemarle SPCA. A t-test was used to look for significance when only two variables were considered, as with age and neuter status. A One Way ANOVA was used for categories with more than one indexed number, such as breed and color. As all of the data failed the normality test, a ranked t-test and ANOVA were used. Dunn's Test was used for post-hoc comparisons when significance was found.

For multiple linear regressions, the program STATA SE 13 was used. The F-test was calculated by hand using information obtained from the linear regressions (Formula 1).

$$\frac{\frac{(SSresidual - SSunrestricted)}{(restricted\ DR - unrestrictedDF)}}{\frac{SSunrestricted}{unrestrictedDF}}$$

Formula 1: F-test formula used to calculate the F-value.

Sigma Plot was also used to analyze the data from the Rockingham/Harrisonburg SPCA. A Chi-Square test was used to analyze differences between the adoption rates of the treatment and control groups.

Results

Demographics of Cats

Before analyzing the data from the Charlottesville Albemarle SPCA, it was necessary to determine the demographics of cats admitted in 2014. The data showed that there was a rather even intake of male and female cats (51% to 49%) (Figure 3, bottom). The sample was primarily composed of strays (67%) however the second largest group was owner/guardian surrenders (19%) with the third largest group being returns (8%) (Figure 3, top left). In terms of breed, the vast majority of the sample was composed of domestic mixes, including short, medium, and long hair (92%). Only 8% of the sample was a purebred mix (Figure 3 top right). Black was the primary incoming color (29%) with grey (16%) and brown (12%) being the second and third most common colors (Figure 4). The most common reason for surrender, which applies only to those cats which were surrendered by an owner/guardian, was having too many animals already (24%) (Figure 5). Two other reasons for surrender include abandonment (9%) and moving/no pets allowed (9%) (Figure 5). Most of the incoming cats were also young, with the majority under 200 weeks, or 2/3 of a year old (Figure 6).

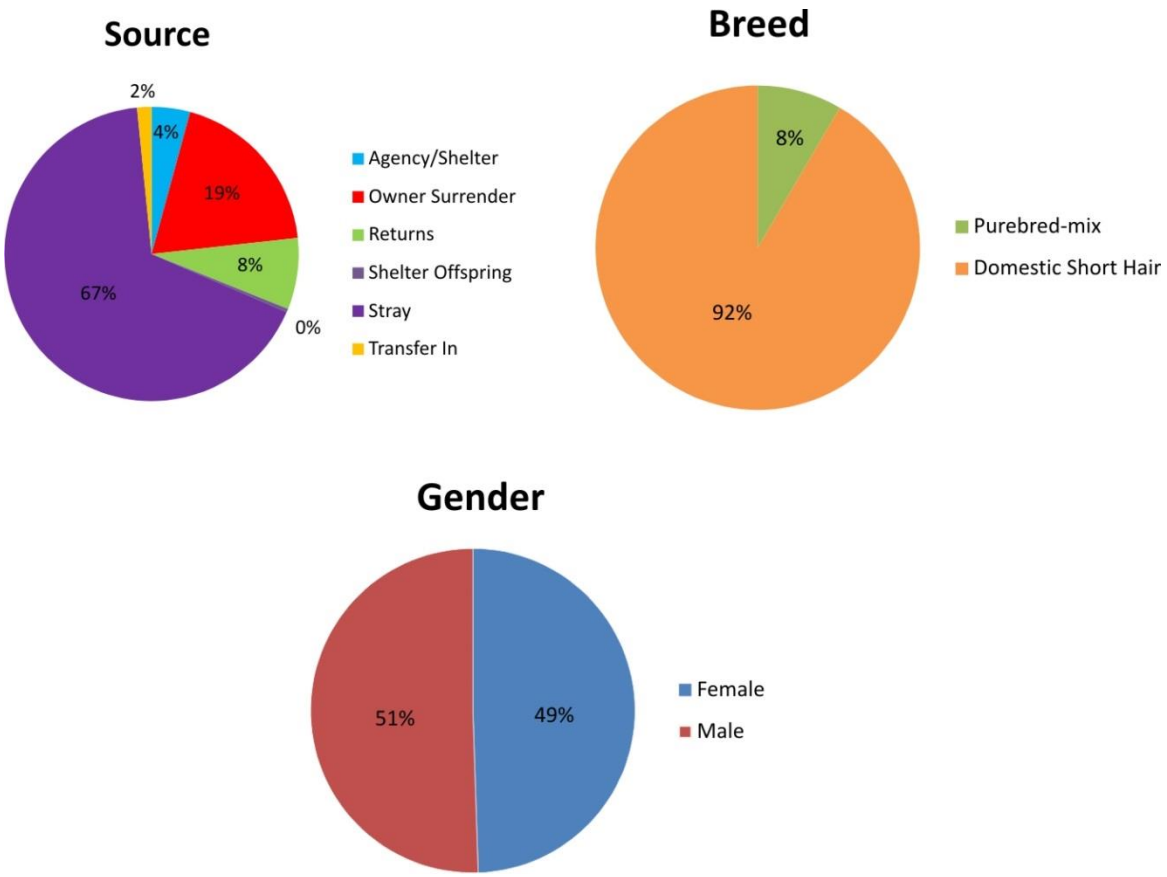

Figure 3: Demographics of Source, Breed, and Gender. The categories for Source included Agency/Shelter (56), Owner Surrender (253), Returns (104), Shelter Offspring (5), Stray (889), and Transfer In (21). Agency/Shelter were brought in from another agency. Owner Surrenders were surrendered by the owner. Returns were previously adopted but returned to the shelter for various reasons. Shelter offspring were born from pregnant cats in the shelter. Transfer-Ins were transferred from another facility by the shelter. Breed is composed of 112 purebred mixes and 1216 Domestic mixes. Purebred mixes have a discernable breed as a characteristic, but no papers. Domestic mixes are generally comprised of any other cats whose heritage is not recognizable. The breakdown by gender indicates there were 657 females and 671 males.

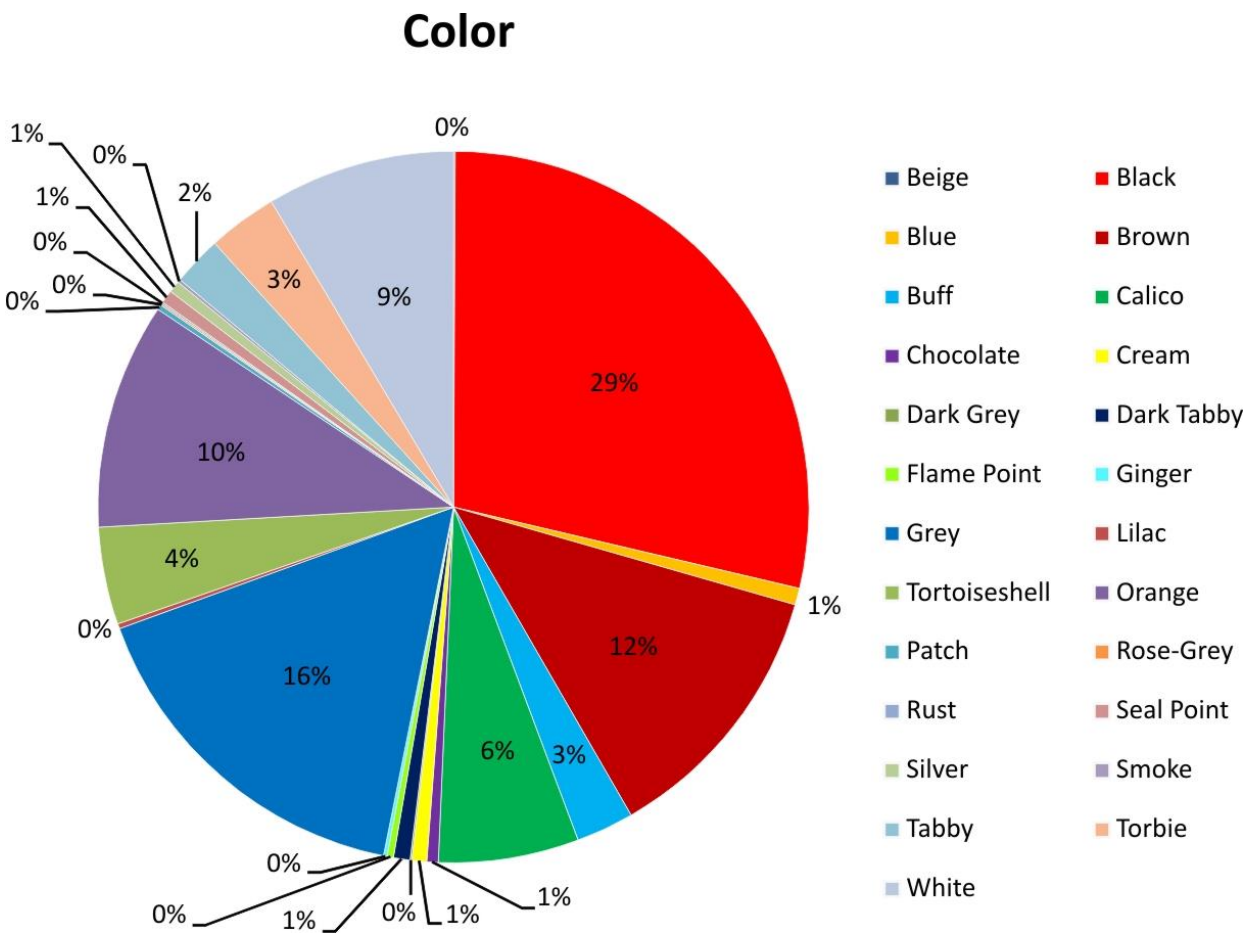

Figure 4: Demographics of Cat Color. The colors seen were Beige (1), Black (381), Blue (10), Brown (163), Buff (35), Calico (85), Chocolate (7), Cream (9), Dark Grey (1), Dark Tabby (10), Flame Point (4), Ginger (2), Grey (217), Lilac (3), Tortoiseshell (59), Orange (137), Patch (3), Rose-Grey (1), Rust (1), Seal Point (8), Silver (7), Smoke (2), Tabby (30), Torbie (42), and White (114). To define some of the colors, buff is a shade of orange which can look peachy; calicos have three colors, usually black, brown, or white in patches; tortoiseshell are predominantly black with orange mixed together; torbies have the same color as tortoiseshells, but with stripes; points usually have color on their face, feet, and tail. A category was made called Rare which includes all cat colors with 0-2% values. All percentages of 0% are those comprising less than 0.5%.

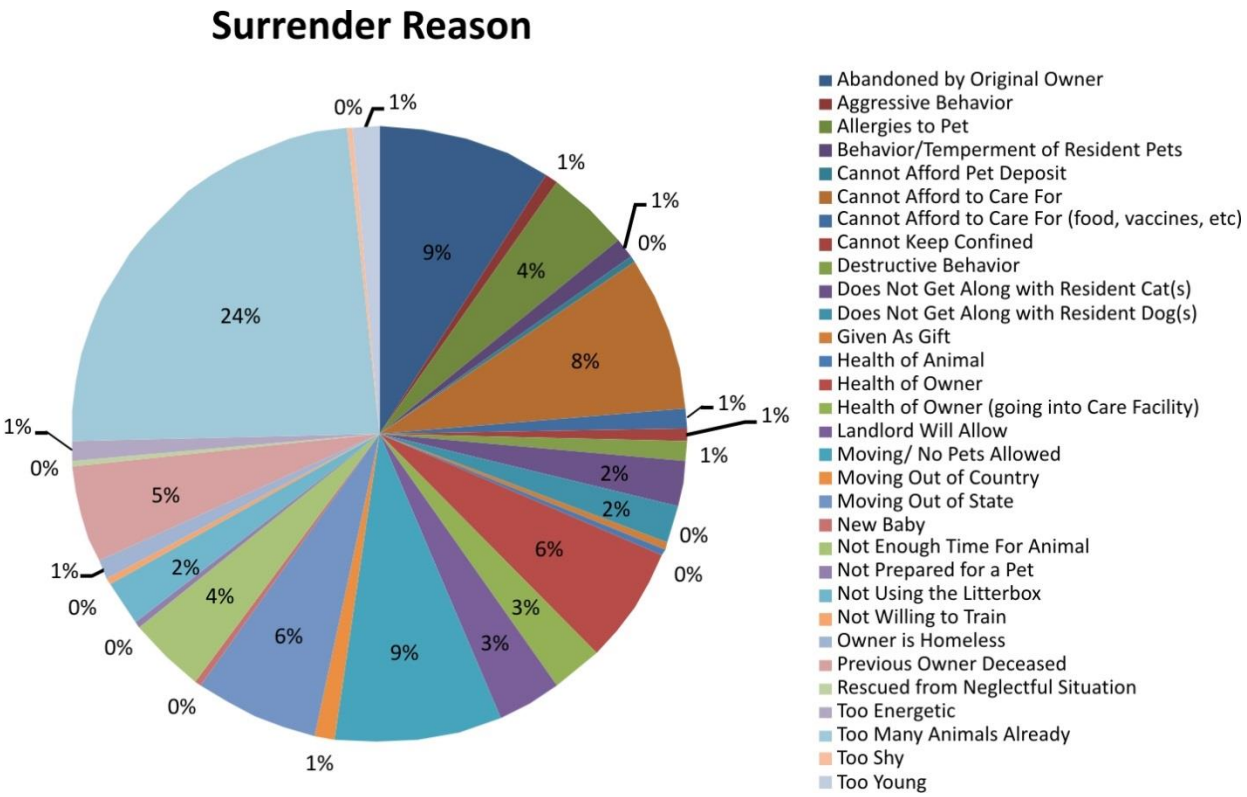

Figure 5: Demographics of Cat Surrender Reason. The categories were Abandoned by Original Owner (27), Aggressive Behavior (2), Allergies to Pet (13), Behavior/Temperament of Resident Pets (3), Cannot Afford Pet Deposit (1), Cannot Afford to Care For (24), Cannot Afford to Care For (food, vaccines, etc…) (3), Cannot Keep Confined (2), Destructive Behavior (3), Does Not Get Along With Resident Cat(s) (7), Does Not Get Along With Resident Dog(s) (6), Given as Gift (1), Health of Animal (1), Health of Owner (18), Health of Owner (going into Care facility) (8), Landlord Won't Allow (10), Moving/No Pets Allowed (26), Moving Out of Country (3), Moving Out of State (19), New Baby (1), Not Enough Time for Animal (12), Not Prepared for a Pet (1), Not Using the Litterbox (7), Not Willing to Train (1), Owner is Homeless (3), Previous Owner Deceased (15), Rescued from Neglectful Situation (1), Too Energetic (3), Too Many Animals Already (70), Too Shy (1), and Too Young (4). All percentages of 0% are those comprising less than 0.5%.

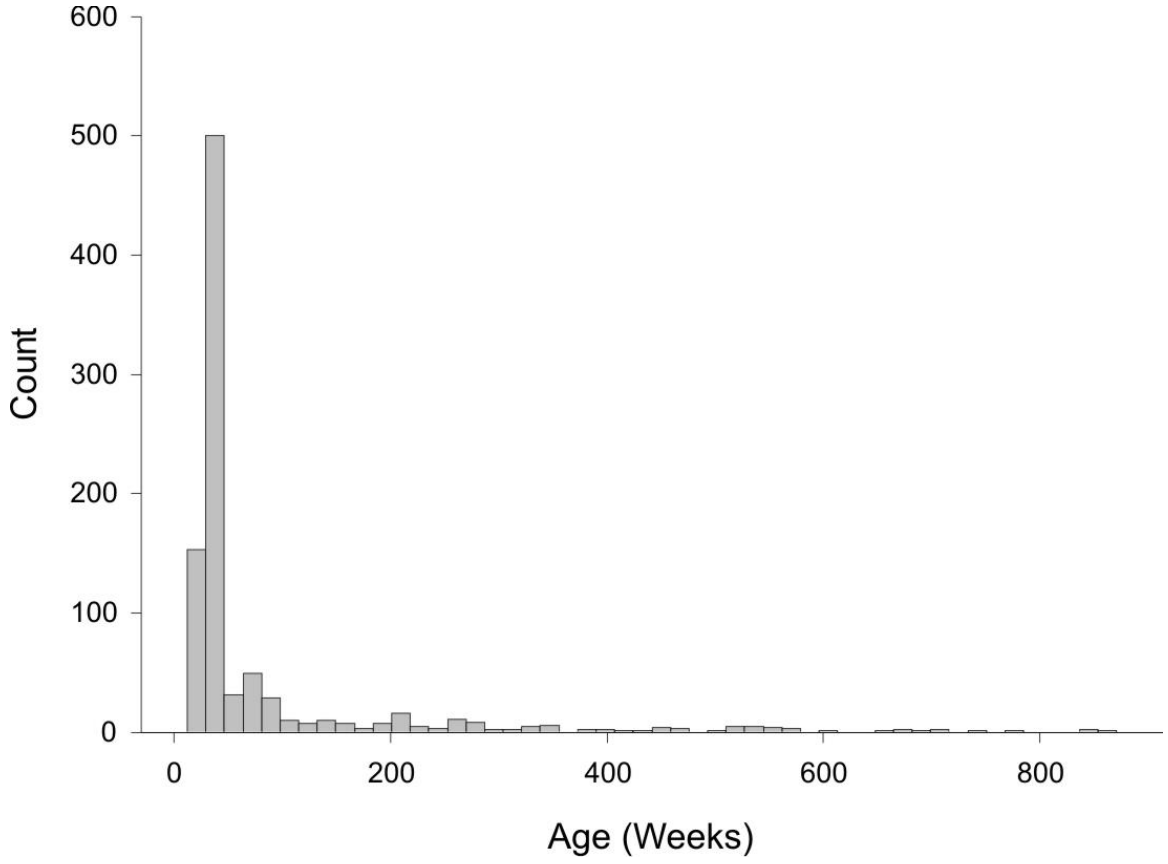

Figure 6: Frequency of Age in weeks. The bin width was about 17 weeks. The largest bin was cats between 35 and 52 weeks of age, with the youngest cat being 18 weeks and the oldest being 871 weeks (about 16.75 years).

Analysis of Factors Affecting Adoption

Each variable was examined individually to determine if it was significantly associated with time until adoption. Regarding source, cats coming from an agency/shelter took the longest time to be adopted, followed by stray, returns, owner/guardian surrender, and transfer-ins (Figure 7). Shelter offspring were not included in the final ANOVA due to the small sample size (5 animals) making the time significant. Source was significant ($p<0.000002$, ANOVA on Ranks) as a whole but there was no significant difference between groups.

Regarding color, some of the colors which were associated with quick adoption were seal point, ginger, rose-grey, and cream while longer adoption were rust, chocolate, blue, and silver (Figure 8). Color was found to significantly influence adoption ($p=0.0217$, ANOVA on Ranks). There was no difference between colorss found ($p>0.05$, Dunn's Method). However, when examining one color compared to the others, black cats were found to be adopted after more time had passed ($p=0.0183$, Mann-Whitney Rank Sum Test). While the other colors had an average adoption time of 36 days, Black took 43 days on average until adoption. Black was looked at separately because it was mentioned in the study by Lepper and colleagues (2002) even though it was not found to be significant. White, also mentioned in the study, was tested and found to be insignificant ($p=0.11$, Mann-Whitney Rank Sum Test).

When examining surrender reason without statistics, animals with the shortest adoption times were landlord will not allow, new baby, too energetic, and given as a gift. Surrender reason only applied to cats which were surrendered by owner/guardian. Animals that took longer to adopt were surrendered due to owner is homeless, health of animal, moving/no pets allowed, and aggressive behavior (Figure 9). Similar to color, surrender reason was also found to

be significant ($p=0.02$, ANOVA on Ranks), however there were no significant differences between surrender reasons ($p>0.05$, Dunn's Method).

The other factors were not found to be statistically significant. These factors included Incoming Spay/Neuter Status ($p=0.89$, Mann-Whitney Rank Sum Test), Circumstance ($p=0.44$, ANOVA on Ranks), and Breed ($p=0.23$, Mann-Whitney Rank Sum Test). Breed was tested both individually and by dividing the breeds into Fancy and Domestic.

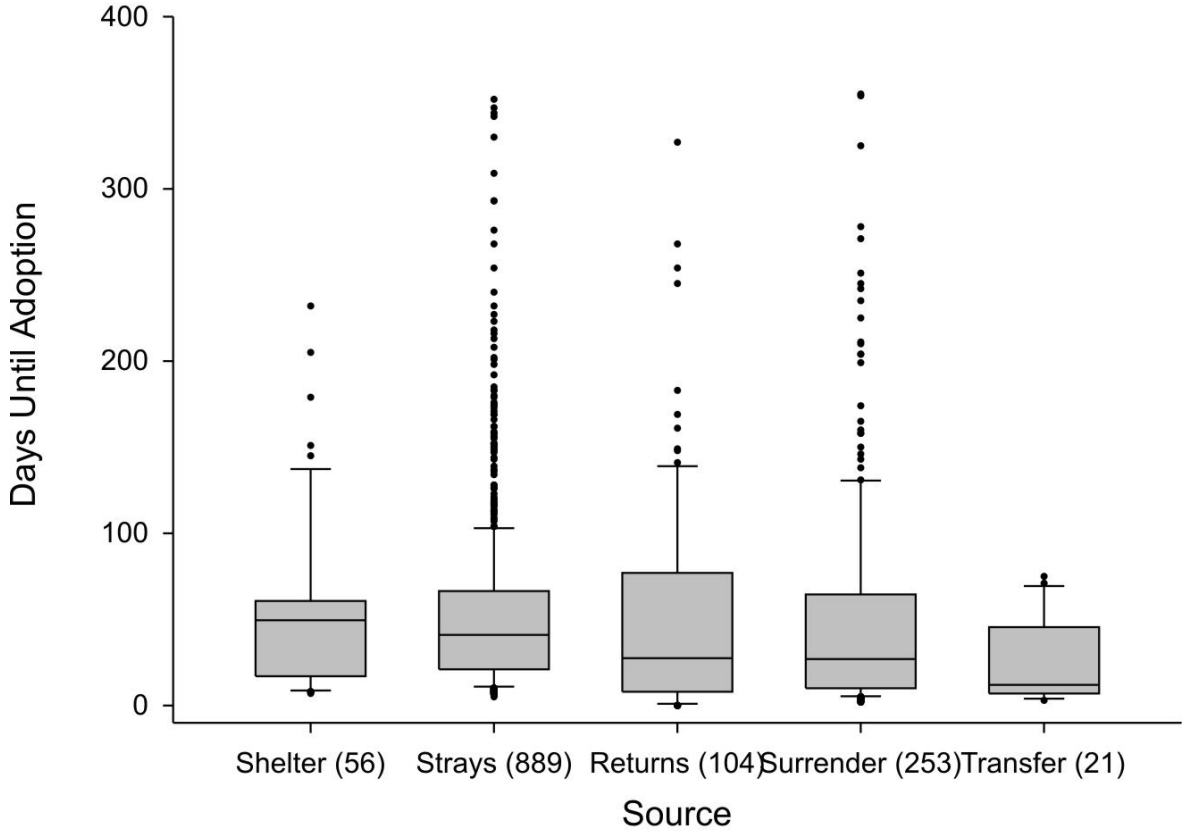

Figure 7: Days until Adoption related to Source. On average, shelter took the longest followed by strays, returns, owner/guardian surrenders, and transfer-ins took the least time. Bars represent the average number of days until adoption while the dots represent outliers.

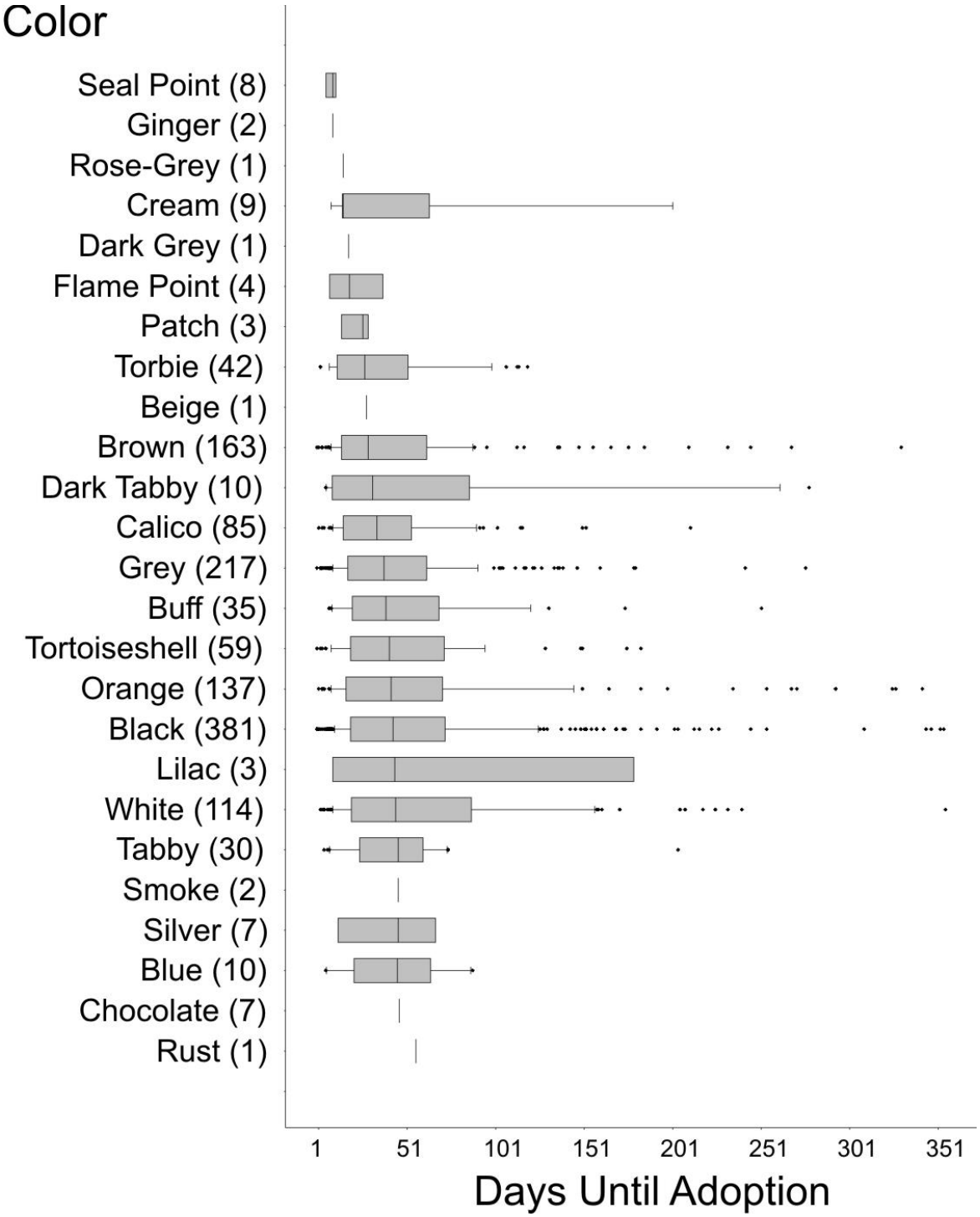

Figure 8: Days until Adoption organized by Color. Seal Point had the least time on average until adoption while Rust had the most time on average until adoption. Bars represent the average number of days until adoption while the dots represent outliers.

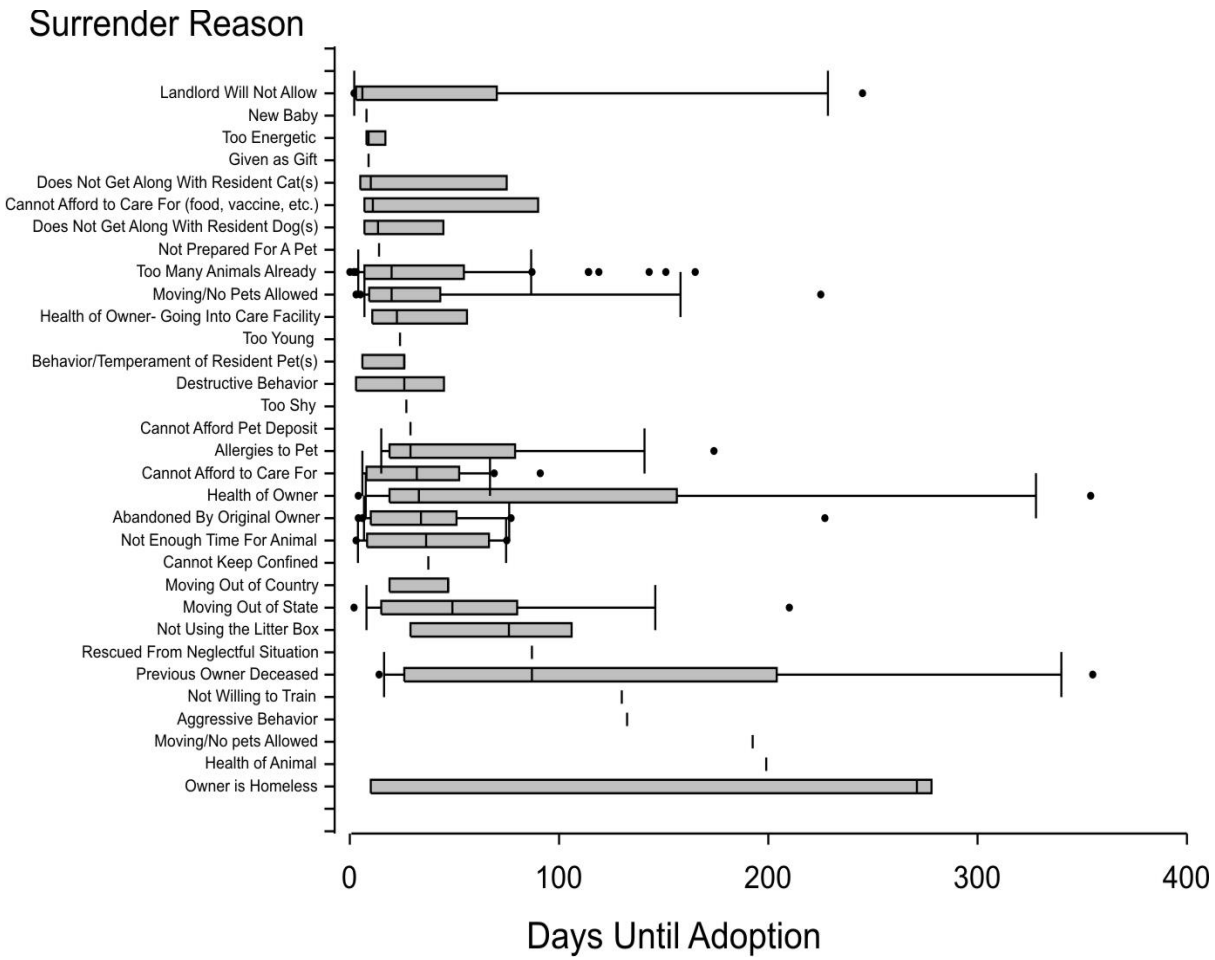

Figure 9: Days until Adoption organized by Surrender Reason. Cats surrendered due to the reason Landlord will not allow were, on average, adopted the quickest, while those surrendered because the Owner is Homeless were adopted the slowest. Bars represent the average number of days until adoption while the dots represent outliers.

Multiple Linear Regression

A multiple linear regression was performed on the data to examine the effect of all the variables together rather than their individual effects. The adjusted R^2 value for the model was found to be 0.0855, meaning that 9% of the variance in the dependent variable, time until adoption, can be explained. Age was found to be significant ($p<0.0005$, multiple linear regression). Since an age of 0 weeks was used as the standard, the test showed that for every year (52 weeks) over that age time until adoption increased by 5 days. Some cats (421) had an indeterminate age, and the shelter listed them as adult in their records. These cats were found to take 32 days longer to be adopted than cats age 0 to be adopted and that difference is significant ($p<0.0005$, multiple linear regression).

When examining source, strays were used as the standard for comparison as they comprised the largest number of cats. Source was found to have a significant effect, specifically cats surrendered by their owner/guardian ($p=0.027$, multiple linear regression) were adopted 8.6 days faster than strays, and transfer-ins ($p=0.018$, multiple linear regression) were adopted 27.2 days faster than strays.

Finally, color was also found to be significant. An F-test was conducted to determine if color as a whole had a significant association with time until adoption. Two multiple linear regressions were run, one with and one without color while controlling for other factors. The F value was found to be 2.189 ($p=0.005$, F-test (1318, 1303)), meaning that color does have a significant effect while controlling for other factors. Black was used as a standard for the same reason as strays for source. The color brown was found to be statistically significant ($p=0.019$, multiple linear regression), with brown cats adopted 11.3 days faster than black cats. Cats which

were calico (p=0.0004, multiple linear regression) were adopted 18.6 days faster. Grey cats (p=0.004, multiple linear regression) were adopted 12.6 days faster while seal points (p=0.013, multiple linear regression) were adopted 46.8 days faster. Cats which were categorized as torbie (p=0.016, multiple linear regression) were adopted 20.7 days faster. Finally, colors of cats whose numbers were too small to individually have an effect (color categories containing fewer than 7 cats) were grouped into a 26th group to see if together they would have a significant effect. This group was called Rare. The group's colors included beige, chocolate, dark grey, flame point, ginger, lilac, patch, rose-grey, rust, and smoke. As a group, they were found to have a statistically significant effect (p=0.016, multiple linear regression) and were adopted 28.2 days faster than blacks on average.

Training:

The experiment examining the effect of training on adoption rates involved 50 cats total. Over the course of the study, 20 cats were randomized to the control while 30 were in the training group. Significantly fewer of the trained cats were returned during the study (3%) than the control cats (15%) ($p=0.074$, Chi Squared) (Figure 10). However, of the cats in the training group, 0 failed training, 25 were in the process of training, and 5 were fully trained before they were adopted or otherwise removed from the floor (Figure 11). In terms of adoption, 16 cats were adopted from the control and 25 from the training group (Figure 12). The difference in cats adopted from the control and treatment groups was not found to be significant ($p=0.65$, Chi Squared)

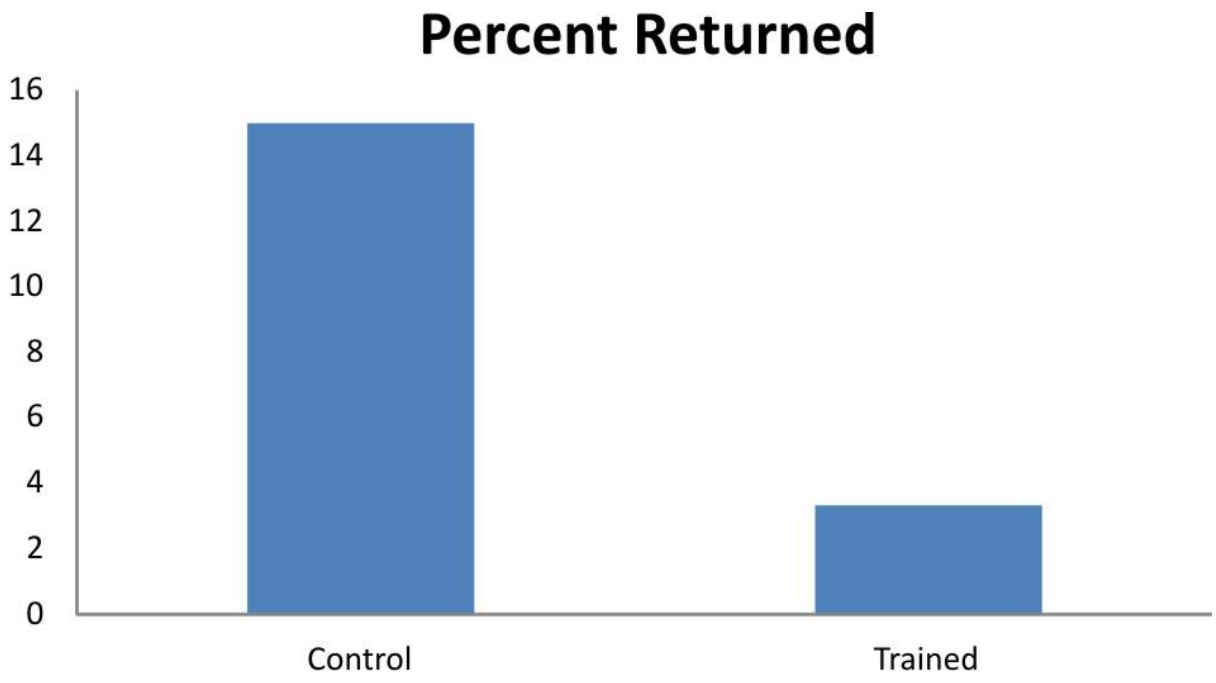

Figure 10: Percent of Cats Returned for Control and Trained Groups. 15% of the cats in the control group were returned and 3% were returned for the trained group. This difference between the control and trained group was found to be significant (p=0.074, Chi Squared).

Figure 11: Results for cats included in the trained group. The trained group division into trained (5), in the process of training (25), and failed training (0).

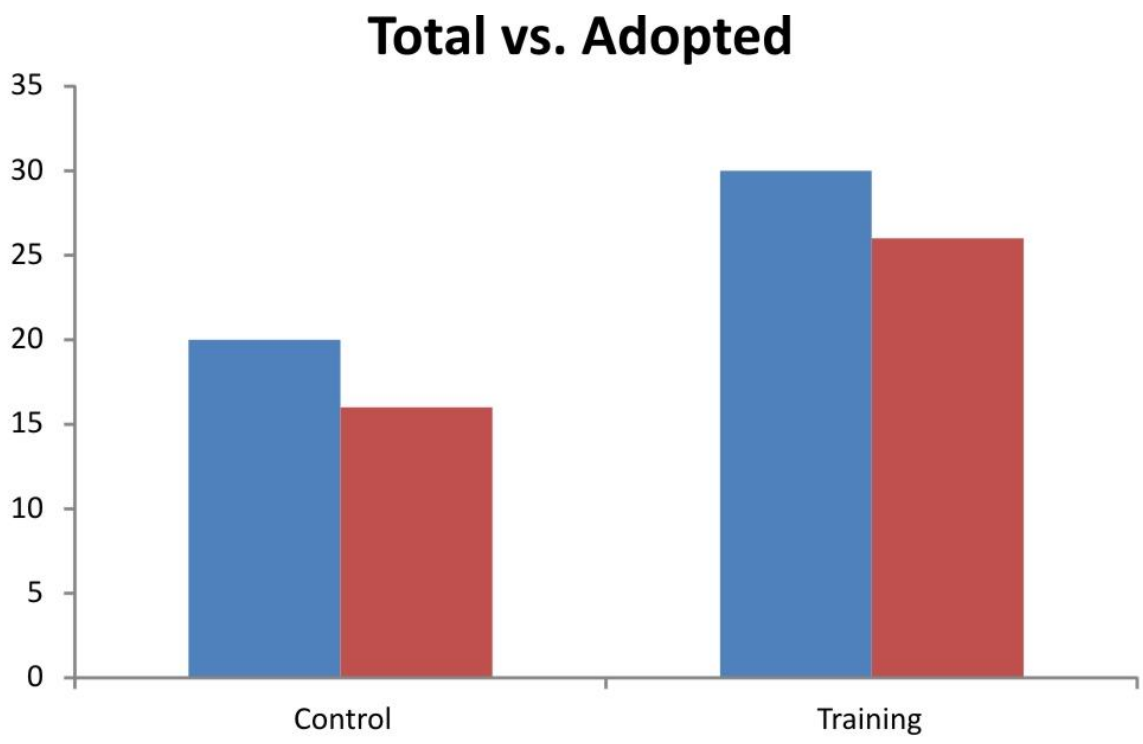

Figure 12: Total animals in Control and Training compared to the number adopted from each. The difference was not significant (p=0.65, Chi Squared). Bars on the left were total number of animals while the bar on the right represents adopted animals.

Discussion

Summary

The data from the Charlottesville Albemarle SPCA were analyzed to determine factors affecting adoption. When examining individual factors affecting adoption, source, color, and surrender reason were all found to have a statistically significant influence. A multiple regression showed that color, source, and age were significant (surrender reason was dropped because the variable only applied to owner/guardian surrenders). An F-test was used to show that color was significant while controlling for other variables. When compared to black, the standard color, colors which had a significantly shorter time until adoption were brown (11 days faster), calico (19 days faster), grey (13 days faster), seal point (47 days faster), torbie (20 days faster), and Rare (28 days faster). Using stray as the standard for source, owner/guardian surrenders (9 days faster) and transfer-ins (27 days faster) were found to take significantly less time to adopt. Finally, age was found to be significant, with an increase in adoption time of 5 days per year of age. Gender and Breed were not found to be significant in either the individual tests or the multiple linear regression. Circumstance and Incoming Spay/Neuter status were found to not be significant in the individual tests.

The training experiment at the Rockingham-Harrisonburg SPCA included 50 cats, 20 in the control and 30 in the training group. Out of the 30 cats in the training group, 5 were successfully trained to high five and 25 were in the process of being trained to high five before being adopted or transferred. When looking at adoption, 16 (80%) of the control cats were adopted during the study and 25 (83%) of the trained cats were adopted. The percentage of

returns was lower for the trained group, being close to 3% as opposed to the 15% of the control, which was significant.

Comparison to Previous Research

In a previous study by Lepper et. al. (2002), color was found to be insignificant, whereas age and gender were found to be significant factors. In contrast, when analyzing the results from the Charlottesville Albemarle SPCA, color and age were significant, whereas gender was insignificant. These differences could be due to the differences between shelters. The shelter looked at by Lepper et. al. was a kill shelter, meaning that they must accept all animals dropped off with them. The Charlottesville Albemarle SPCA is a no-kill shelter, which means that they can choose which animals they accept, turning away any extremely unadoptable animals. They do perform euthanasias, but only on animals owners bring in to be euthanized or strays which would have a poor quality of life. Differences between shelters could account for these differences. Another possible explanation is the difference in geographic location as well as demographic population. While the Charlottesville Albemarle SPCA is located in Charlottesville, Virginia, the shelter used by Lepper and colleagues was located in Sacramento County, California. There was a similar demographic for "white" (both having 69.3%); however, Charlottesville greater number of African American citizens (20%) than Sacramento (9%). These differences could influence adoption preferences (Lepper et. al., 2002).

Source was not examined by Lepper et. al. (2002). Instead, they combined the categories of source and surrender reason, forming a different set of variables. The new organization did not look at the effect of transfers and owner/guardian surrender in relation to strays, but rather looked at behavior, old/sick, and other surrender categories in relation to stray. The differences between these categories made a direct comparison impossible as there were few or no common factors.

Analysis of Results

Older animals were found to be significantly less likely to be adopted. This could be due to negative connotations society associates with older animals. Not only do they have a decreased life expectancy compared to a younger kitten, there are worries about litterbox use and other problems that can occur due to age.

Unlike the results of Lepper et. al. (2002), color was found to be significant. All of the colors that were significant took less time to be adopted relative to Black. This could be due to the stigmatism still attached to black cats, especially in rural areas. The colors that were significantly more likely to be adopted were Brown, Calico, Grey, Seal Point, Torbie, and Rare. Each of these colors could be preferred by the community, making them more likely to be adopted. For the most part, besides Brown and Grey, these colors are also rare and in some cases apply to specific breed mixes; Seal Point, for example, is usually seen on Siamese and Persian breeds, both of which comprise a small cross-section.

Source was significant, with owner/guardian surrenders and transfer-ins more likely to be adopted. Owner/guardian surrenders have a known background and do not have to wait in mandatory stray holding upon coming in. With a known history, the surrendered cats might look more attractive than strays, whose past is largely unknown. As for the small adoption time for transfer-ins, it is likely that they are transferred-in due to local demand. If not already going to a specific owner, the cat could have a trait, such as color, which the shelter knows goes quickly. Finally, surrender reason plays a role in adoption. Similar to what Lepper et. al. (2002) described as Cat Status, behavior and a few other factors such as the health of the animals could play a significant role in adoption. When people hear that a cat was surrendered due to

aggression or health reasons, they do not want to adopt an animal which might take a lot more time and money than another.

Further studies into the differences in adoption factors between kill and no kill shelters would be beneficial to determining the differences in factors affecting adoption between the two. With more shelter information, it would be possible to look at the effects of the population demographics on which cat characteristic are significant. Unfortunately, there are not enough samples to discern any significant data yet from training cats in shelters. This is due, in part, to the high rate of adoption while the cats were in the process of being trained. With more time, the effect of training could be seen in results. Training is believed increase adoption rates and decrease adoption times for a few reasons. For one, trained cats performing a behavior may add a factor of cuteness to a cat which otherwise might not stand out. If potential adopters see the cat as being smart and trainable, they may be more influenced to adopt. Being perceived as trainable could also explain the significance already seen in whether or not the cat is returned as if adopter's believe a cat can be trained they may be more willing to put in the effort to train the cat out of behaviors (like not using the litterbox) which would otherwise result in returning the cat to the shelter. More research would grant more insight, however.

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