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This paper introduces the ShelterViz web app, an interactive visualization platform developed to make U.S. animal shelter and rescue data accessible and easy to explore. Using a dataset provided by the nonprofit organization Shelter Animals Count, the ShelterViz project allows users to manipulate more than 100 different intake and outcome statistics collected from over 4,000 shelters and rescues across the United States.

This research project employed a design-study methodology as well as approaches grounded in visual analytics and user-centered design. The website was developed using HTML5, CSS, Javascript, and D3.js. The results of the usability testing indicate support for the project and its potential to help shelter and rescue organizations to better understand the impacts of various factors on animal outcomes, recognize trends in their data over time, and ultimately take steps to improve animal welfare.

A demo version of the website can be accessed at https://www.shelterviz.com.

Headings:

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VISUALIZING U.S. ANIMAL SHELTER OUTCOMES

by
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Introduction

Overpopulation of animal shelters has been a longstanding cause for concern in the United States. Approximately 6.5 million animals enter U.S. shelters annually; of these animals, some 1.5 million, or 23%, are euthanized each year (American Society for the Prevention of Cruelty to Animals [ASPCA], 2018). While overall shelter numbers and euthanasia rates are declining, this figure nevertheless continues to represent a large proportion of animal deaths which in many cases ought to be preventable.

Numerous efforts have been made to identify variables influencing shelter intake and outcome statistics. *Intake* refers to the number and type of animals which enter a shelter, such as strays or owner surrenders; *outcome* refers to an animal's departure from the shelter, whether via adoption, euthanasia, or other means. Factors ranging from an individual animal's coat color (DeLeeuw, 2012; Svoboda & Hoffman, 2015) to the efficacy of subsidized spay and neuter programs (White, Jefferson, & Levy, 2010; Scarlett & Johnston, 2012) have been linked to changes in intake and outcome rates, and live outcomes have been successfully improved in some parts of the country. Despite this, little cohesive guidance exists on how best to approach the systematic problem of shelter overpopulation and the correspondingly high rates of companion animal euthanasia.

Much of the information necessary to assist with a solution, however, is ready and waiting to be analyzed. As Jill Dyché, a vice president at SAS, writes in her white paper

"Big Data, One Dog at a Time," many shelters collect comprehensive data on their operations, but their systems are often outdated, making the reports difficult to parse (Dyché, 2016). For this reason, although animal-welfare organizations are now collecting and reporting data in greater volume than ever before, the many benefits of such information have yet to be fully realized. Dyché calls on shelters to make use of modern technology and big-data techniques to put their data to work.

This paper introduces the ShelterViz web app, an interactive visualization platform developed to make U.S. animal shelter and rescue data accessible and easy to explore. Using a dataset provided by the nonprofit organization Shelter Animals Count, the ShelterViz project allows users to manipulate more than 100 different intake and outcome statistics collected from over 4,000 shelters and rescues across the United States. Through interactive visualization and analysis, this tool has the potential to help shelter and rescue organizations to better understand the impacts of various factors on animal outcomes, recognize trends in their data over time, and ultimately take steps to improve animal welfare.

Background Literature

This paper will consider two key areas of related literature: research in the animal shelter and rescue domain, and research on data visualization and analysis. The first of these sections will focus on the work that has already been done not only to understand intake and outcome trends, but more importantly to find ways to improve euthanasia rates through a variety of academic studies and shelter initiatives. The second section will examine the benefits of interactive data visualization and its applications for animal welfare. Together, these two areas of scholarship should offer a framework within which to position the potential contributions of the ShelterViz project.

1. Animal Shelters and Rescues in the U.S.

1.1. Defining Shelters and Rescues

For the purposes of brevity, this paper may occasionally use the term “shelter” to refer to both shelters and rescues when the topic in question is more broadly applicable. However, it is worth clarifying the distinction between these two types of organizations. Although the terms are often used interchangeably, and the organizations themselves have many overlapping goals and processes, shelters and rescues do typically function in different ways.

In general, an animal shelter is government-operated, government-contracted, or receives supplemental government funding. Most shelters are operated out of a physical establishment, frequently with some facility space allocated to veterinary

services, and the majority of animals are housed on-premises in kennels, runs, crates, cages, or communal feline rooms. Shelters often perform community services such as animal control for lost, stray, neglected, or dangerous animals; rehabilitation of sick or injured wildlife; and trap-neuter-release of feral cat populations. Many shelters have capacity-, time-, or behavioral-based policies of euthanasia, though there has been some movement toward a “no-kill” shelter ideology.

Animal rescues, by contrast, are often smaller and independently operated, without governmental support. While some may maintain official premises, many house their animals through an extensive volunteer foster-care system. Depending on state, county, and municipal laws, rescues may or may not be permitted to accept stray or owner-surrended animals; in many cases, rescues receive the majority of their animals as transfers in from shelters. Transfer programs represent an important partnership between shelters and rescues, through which shelter animals which might otherwise be euthanized due to space, health, or behavioral constraints are instead placed with rescue organizations. Most if not all rescues are explicitly “no-kill,” and they will keep the animals in their possession indefinitely until homes are found.

1.2. Understanding Intake

In order to understand trends in animal outcomes, it is necessary first to understand how animals come to be in shelters. Shelters and rescues report four predominant forms of intake, or the means of an animal’s arrival at the shelter: found as stray, transferred in, owner relinquishment, and owner-intended euthanasia.

Strays constitute those animals brought in to the shelter (perhaps by individuals, perhaps by animal control) with no identified home or owner. Transfers are animals

which have been moved between one shelter or rescue and another; it is not uncommon for these organizations to collaborate in an attempt to optimize space or better position an animal for adoption.

Owner relinquishment refers to animals which have been voluntarily surrendered by their owners. Previous research has explored some of the reasons people come to surrender their pets. New, Salman, et al. (1999) found that “moving” was the number one cause for relinquishment of dogs and the third most-common cause for relinquishment of cats. Of interest is the fact that “friends” were the number one reported source by which owners obtained their animals, suggesting a cycle may exist in which pets that one cannot or would prefer not to keep are passed on through multiple homes before finally arriving at the shelter. Weiss, Gramann, et al. (2015) similarly found that for survey respondents who rented their homes or who were of lower income, housing issues were a primary reason for re-homing their pets. In cases where pets were re-homed, 37% were given to a friend or family member, closely followed by being taken to a shelter.

A pet which is re-homed due to a problem with the animal itself as opposed to personal family issues is more likely to be taken to a shelter (Weiss, Gramann, et al., 2015). New, Salman, et al. (1999) likewise found that undesirable characteristics, such as problem behaviors and hyperactivity, were commonly reported in animals which were relinquished. These findings are supported by Patronek, Glickman, et al. (1996), who observed that cats with behavioral problems such as eliminating inappropriately or behaving aggressively (both most common in sexually intact cats) were at the highest risk for relinquishment.

Not all relinquishments, however, necessarily represent a “failure of the bond” between owner and pet, as some papers have described it (DeLeeuw, 2012; Mondelli,

Prato Previde, et al., 2004; Marston & Bennett, 2003). Owner-intended euthanasia (OIE), the last of the principal intake categories, is an important but less critically understood component of shelter data. Kass, Scarlett, and Salman (2011) found that roughly 24% of dogs and 17% of cats were brought to the animal shelter for euthanasia due to reasons such as serious illness, old age, and extreme behavioral problems—a function not dissimilar from that served ordinarily by a veterinarian's office. The decision to euthanize at an animal shelter, as opposed to a veterinary office, may therefore be more an act of economic practicality than an explicit abandonment of the animal. It is necessary to consider these cases carefully—both at the time of intake and at the time of outcome—when analyzing animal shelter statistics.

1.3. Understanding Outcomes

At the most fundamental level, there are two possible outcomes for a shelter animal: survival or death. In practice, however, there are a variety of forms which these outcomes can take. Most desirable is the successful return of an animal to its original owner (RTO), which happens for about 710,000 strays each year, or 11% of the 6.5 million animals admitted to shelters nationwide (ASPCA, 2018). Failing this, adoption to a new owner is a highly positive outcome: roughly 3.2 million shelter animals, or 49%, are adopted annually (ASPCA, 2018).

Trap-neuter-return or trap-neuter-release (TNR) programs trap feral cats and transport them directly to a spay and neuter clinic for sterilization, vaccination, and identification ear-clipping before releasing them back to their local colonies (Million Cat Challenge [MCC], n.d.). Similarly, return-to-field (RTF) is an increasingly common practice wherein stray or community cats already admitted to a shelter are sterilized and vaccinated, then returned to their original location (MCC, n.d.). These solutions

allow otherwise-healthy unowned cats to continue to live in their neighborhoods or feral communities, reducing euthanasia while also minimizing reproduction (MCC, n.d.).

Transfer programs have also become a very important solution for shelters with limited capacity or strict euthanasia policies. In such cases, animals are typically transferred out of the shelter and into the possession of a rescue organization or shelter with a no-kill policy. While such a transfer may not represent the final outcome for the animal, it will be the outcome status reported by the original shelter. Other occasionally-reported live outcomes include “escaped,” “stolen,” and “lost in care.”

Non-live outcomes constitute roughly one quarter of animal outcomes nationally (ASPCA, 2018). Not all such outcomes are avoidable—shelter animals do die of illness, injury, and other ordinary causes, and “dead on arrival” and “died in care (not euthanized)” make up a small portion of reported shelter outcomes. As discussed previously, owner-intended euthanasia is also an important factor. The percentage of OIE outcomes is difficult to estimate: OIE is not always reported consistently, and not all owner-requested euthanasias are actually performed if the shelter deems the animal to be adoptable. On the whole, however, shelter euthanasia is the overwhelming cause of non-live outcomes, accounting for 23% of outcomes overall (ASPCA, 2018). Common reasons for euthanasia include illness and injury, behavioral aggression, and lack of shelter space (Gray, 2015).

1.4. Reducing Euthanasia Rates

There are three principal means of reducing euthanasia rates: increasing the number of animals which leave the shelter via a live outcome; decreasing the number of animals which enter the shelter in the first place; and optimizing the resources available for shelters to support the animals in their care. In the quest to improve live outcomes,

shelters and researchers have focused primarily on improving rates of animal adoption. Efforts to decrease shelter intake have emphasized spay and neuter awareness and affordability. A variety of other shelter initiatives have further assisted with the above aims, as well as improving the shelters' ability to care for displaced animals over time.

1.4.1. Factors Influencing Adoption

Numerous studies have attempted to identify factors which lead to animal adoption. To begin with, there is demonstrated human preference for certain biological and demographic characteristics in shelter animals, and these characteristics are statistically associated with changes in outcome. A survey conducted by Weiss, Miller, et al. (2012) found that appearance, social behavior, and personality were the most influential factors when it came to choosing a pet for adoption. Lepper, Kass, and Hart (2002), modeling predictors of adoption for eight thousand dogs and cats in the Sacramento County Department of Animal Care and Regulation, found that age, sex, coat color, and reason for relinquishment were influential factors across both types of animals, in addition to breed, purebred status, and injury status in dogs. Similarly, Protopopova, Gilmour, et al. (2012) found that breed type, mode of intake, and dogs' attractiveness (as rated by experimental participants) were predictive of adoption and length of shelter stay. Posage, Bartlett, and Thomas (1998) found that terrier, hound, toy, and nonsporting breeds were significantly associated with successful adoption, as were gold, gray, and white coat colors, small size, and history of an indoor living environment. More recently, Svoboda and Hoffman (2015) found that black coat color, popularly believed to impede the adoption prospects of a dog, did not significantly impact length of shelter stay or likelihood of euthanasia; however, age and breed group

did, with older dogs and bully breeds spending significantly longer in shelters and being euthanized at higher rates.

Meanwhile, certain programs and human interventions have been found to improve live shelter outcomes. A detail as simple as an animal's housing situation may be linked to its likelihood of adoption. Propotova, Gilmour, et al. (2012) found that an individual animal's kennel location within the shelter influenced adoption rates. Gourkow (2001) found that cats housed in communal and "enriched" environments (furnished with perching shelves and hiding spaces) were significantly more likely and more quickly to be adopted than those housed alone in basic stainless-steel cages. In a recent study of twenty-one thousand dogs admitted to the Pima Animal Care Center in Tucson, Patronek and Crow (2018) found that temporary placement outside of the shelter in a foster home increased the odds of adoption by five times for all dogs, and by greater than 20 times for adult dogs. Of the 1,510 dogs in this study which interacted with the foster care system, 98.9% had a live release, and dogs returned from foster care had a 70% reduction in health concerns.

Beyond optimizing an animal's environment, there are basic steps which a shelter can take to improve outcomes. Luescher and Medlock (2009) found that dogs which underwent basic obedience training were adopted 1.4 times more often than untrained dogs; "being good with other dogs" was also a statistically significant trait when it came to increased adoption rates. Multiple studies conducted in Australia (Zito, Paterson, et al., 2015; Crawford, Fontaine, & Calver, 2017) found that discounted or waived adoption fees for adult cats positively influenced adoption and were not correlated with "poor adoption outcomes" (e.g. attracting less responsible owners), suggesting that such promotions can be used to successfully increase the number of adult cat adoptions.

1.4.2. Spay & Neuter Programs

Without doubt, one of the largest undertakings in animal welfare has been the spay and neuter movement. Conventional wisdom holds that the widespread sterilization of companion animals helps to reduce the incidence of unplanned litters and, by extension, the number of unwanted animals which ultimately wind up in shelters. Shelters, rescues, and affiliated nonprofit organizations have invested millions of dollars both in educating the public on the benefits of spay and neuter and in subsidizing free or low-cost sterilization programs to make these services more accessible.

Unfortunately, the evidence to support these programs is mixed. Frank and Carlisle-Frank (2006) conducted an analysis of five communities participating in the Maddie's Fund program, one of the nation's largest animal welfare nonprofits, which provides economic incentives to increase both sterilization levels and adoption rates. The study found that the discount program did not fall prey to substitution (in which owners already planning to sterilize their pets at full cost instead simply do so at lower cost) and did successfully increase the total number of spay and neuter procedures performed. However, the study was not able to demonstrate an inverse relationship between communitywide sterilization levels and shelter intake rates.

Evaluating the impact of a subsidized spay and neuter clinic in rural North Carolina, Scarlett and Johnston (2012) found that the rate of decline in dog intake and euthanasia did not improve in the four years following the clinic's opening. Intake and euthanasia of cats decreased significantly, but the proportion of cats euthanasized did not change. White, Jefferson, and Levy's (2010) regression analysis of a low-cost spay and neuter initiative in New Hampshire had similar results: there was a significant decline in cat intake and euthanasia, but there was no impact on dog intake or euthanasia. However, these authors' concurrent analysis of the Austin-based

EmanciPET Free Spay/Neuter Program found that there was a positive impact on both dog and cat intake and euthanasia, with the program areas demonstrating a significantly lower rate of increase than nonprogram areas.

Measurable success has recently been observed with several community cat programs. With approaches such as return-to-field (RTF) and trap-neuter-return (TNR), neighborhood and feral cats are brought in for sterilization before being returned to their original colonies or trapping locations. Assessing the impact of formal RTF and TNR programs at a municipal shelter in Albuquerque, New Mexico, Spehar and Wolf (2018) reported that feline intake declined by 37.6%, feline euthanasia declined by 84.1%, and the live release rate saw a corresponding increase of 47.7%. Operation Catnip, a combined TNR and RTF program in Gainesville, Florida, has been credited with helping to reduce euthanasia at the municipal shelter from 81% to 42% over the course of 13 years (MCC, n.d.). Similarly, a study of a TNR program in Auckland, New Zealand, found that there was a considerable reduction in incoming stray felines, underage euthanasias, and unsocialized adult stray cat euthanasias in the targeted suburb as compared to the non-targeted suburb group, though the authors warned that causation could not be totally inferred due to the short-term nature of the pilot program (Zito, Aguilar, Vigeant, & Dale, 2018).

Clearly, there are many different ways of publicizing, incentivizing, and performing spay and neuter, and White et al. (2010) emphasize that different models may have varying degrees of effectiveness depending on the needs of an individual community. Frank (2004) also suggests that evaluation must be a long-term and ongoing process, since the full impact of sterilization initiatives may not be realized for thirty years or more. Still, several of the papers above noted that a lack of comprehensive data collection makes it challenging to gauge the impact of these types of programs,

highlighting the increasing importance of data-backed practices. Given the large amounts of time and money which have been invested in spay and neuter programs, it is important for communities to be able to make informed decisions so that they can put their resources to the best possible use.

1.4.3. Other Shelter Initiatives

Outside of spay and neuter programs, a number of other initiatives have sought not only to reduce euthanasia rates, but to improve shelters' ability to provide for the animals in their custody. In her paper "Managed Intake and Capacity for Care," Karsten (2015) has outlined a model for shelters to follow—focused on improved housing, reduced length of stay, managed intake, and advance criteria planning to avoid decision fatigue—to ensure the best possible care without becoming overwhelmed. A subsequent study by Karsten, Wagner, Kass, and Hurley (2017) found that implementation of the Capacity for Care (C4C) model in three target shelters led to lower daily shelter populations, shorter length of stay to adoption, increased adoption probability, and decreased probability of euthanasia. Meanwhile, the Pets for Life (PFL) program seeks to bring veterinary services and educational information out into underserved and impoverished communities, where many animals end up in shelters not because they are unwanted, but because their owners lack the basic resources to continue caring for their pets (Pets for Life, 2017). In providing these outreach support services, PFL-participating shelters are relieved of both the financial and operational burden of accepting new animals into their facilities to house, care for, and attempt to adopt out, all while helping pets to stay in their original homes.

Multiple papers again emphasized the importance of data collection. Kim (2018) discussed the difficulty of devising, implementing, and evaluating the success of new programs when shelters do not collect fundamental statistics, observing too that a lack of funding and resources means that many shelters do not have access to basic data-collection or analysis software. More promisingly, Weiss, Patronek, Slater, Garrison, and Medicus (2013) conducted a study of six communities participating in the American Society for the Prevention of Cruelty to Animals (ASPCA) Partnership, a collaborative grant program which guides community partners in collecting and sharing data using standardized metrics to reach a data-driven goal. With support from the grant, participating organizations were able to experiment with new procedures and modify their strategies based on the data that they gathered. Over the five years of the study, there was an average improvement in live outcomes of 62%; within individual communities, the improvement ranged from 18% to 96%. This is just one example of the positive impact that can be made when shelters are given the guidance and resources needed to effectively utilize their data.

2. Insight through Data Visualization

As the previous section makes clear, there have been many attempts to understand animal shelter outcomes. The majority of academic efforts, however, have taken the form of case studies rather than large-scale data analysis. In 2012, Shelter Animals Count (SAC), a nonprofit organization formed by a cross-section of animal welfare agencies, set out to aggregate a national database of U.S. animal shelter outcome statistics. The SAC 2016 Animal Sheltering Statistics report was the first of its kind to

take a comprehensive and detailed look at shelter outcome statistics across the country (Shelter Animals Count, 2016).

The SAC report helped to capture important trends and relationships within the shelter data. There is mounting evidence, however, that interactive visualizations offer greater opportunities for insight over static reports. Thomas and Cook's (2005) *Illuminating the Path* set the stage for the nascent discipline of visual analytics, in which interactive visual representations enable users to explore large and complex datasets. Today, visual analytics is well-established as a means of organizing and clarifying information for human interpretation. As Thomas and Cook discussed, visual representation encourages users to quickly and effectively engage with data, while interactivity guides them in reorganizing, interpreting, and reasoning about the information presented. Keim, Andrienko, Fekete, et al. (2008) described the role of visual analytics in transforming information overload into an improved process of analytical decision-making. Eick (2000) argued that visualization enables users to think iteratively, asking questions of the data and exploring linked events, while Yi, Kang, Stasko, & Jacko (2007) emphasized the value of the interactive component in allowing users to manipulate the data, augment cognition, and arrive at important insights.

Numerous papers have underscored the primary goal of interactive visualization as providing such "insight," a term which these same papers have agreed is difficult both to define and to quantify. North (2006) proposed five characteristics of insight: it is complex, involving large amounts of data in a synergistic way; deep, accumulating over time and giving rise to further questions; qualitative in nature; unpredictable and serendipitous in how it arises; and closely relevant to the data domain. Yi, Kang, Stasko, & Jacko (2008) positioned insight as an initial mental framework within which a person can delineate a problem and begin to better understand it. These authors

suggested that information visualization facilitates the identification of trends, patterns, and anomalies, as well as a flexible exploratory perspective, both of which are necessary to developing the aforementioned mental framework. Meanwhile, Chang, Ziemkiewicz, Green, & Ribarksy (2009) observed that visualization assists in the solving of complex problems by supporting a continuous feedback loop of deep knowledge acquisition, followed by novel connections and spontaneous moments of insight. Jankun-Kelly, Ma, & Gertz (2007) described a similarly cyclical process of achieving insight through the repeated modification of parameters to generate new visualization results.

2.1. Visualizing Shelter Data

Information visualization has already made its debut in the animal shelter domain. An open-source dataset produced by the Austin Animal Center and popularized through Kaggle has resulted in static visualizations by a variety of interested coders (Papiu, 2016; Hong, 2016) and even a few interactive dashboards (Seagraves, 2018; Nakareseisoon & Wang, 2018), all of which contribute meaningfully to our understanding of animal shelter outcomes. Like much of the animal shelter research described in this paper, however, these visualizations are limited to the data produced by a single shelter. While they offer specific and valuable insights, they cannot paint a complete picture of the state of shelter animals across the United States, nor can they facilitate individual shelters' analysis of their own unique data.

Dyché (2016) charged shelters to begin acting like businesses, leveraging data and analytics to improve efficiency and outreach. In an article published in the MIT Sloan Management Review, organizations which relied on analytics were found to consistently outperform their competition—and data visualization was regarded as the most

important emerging analytic technique, “transform[ing] numbers into information and insights that can be readily put to use” (LaValle, Lesser, Shockley, et al., 2011). There is little question that visual analysis of comprehensive shelter data has the power to provide real and lasting insight into animal shelter outcomes. To that end, the ShelterViz project undertook to design and develop an interactive visualization utilizing the nationwide data collected by Shelter Animals Count.

2.2. Visualizing Data over Time

Based on the results of the persona creation, task identification, and initial design outlined in the methodology below, the ShelterViz project focused on the visualization of data over time. Graham Wills’ (2011) book *Visualizing Time* has discussed many important considerations and ways to approach the design process. Wills described the distinction between a presentation graphic, in which known features are displayed to provide answers to specific questions, and an exploratory visualization, in which users reflect on the data, compose hypotheses, and draw conclusions based on revelations arrived at through the visualization. In an exploratory context, it may not always be known which variables or features are important, and the design should support users in making these kinds of discoveries. For time-based data, this often involves helping users to see trends and patterns over time, identify cyclical effects and relationships between variables, and spot unusual features which diverge from the overall state of the system (Wills, 2011).

Wills (2011) argued that good design is often a trade-off between ease of use and level of detail: a visualization should assume the least complex form possible which accurately presents the data. For displaying a continous variable over time, Wills claimed that “a time series line chart is a simple, common, and exellent choice,” and he

suggested a line chart as “one of the simplest charts with multiple variables” as well (Wills, 2011, p. 77-78). Wills went on to describe the benefits of interactivity in this context, allowing users to modify the parameters of the visualization as they select different subsets of the data, show and hide variables, and access further details on demand. For this last capability, Wills recommended the tool-tip, a ubiquitous and well-understood pop-up technique through which additional information is displayed only when the user’s mouse hovers or clicks on the relevant element (Wills, 2011).

Methodology

1. Research Design

The principle goal of this project was to design and develop an interactive data visualization tool which facilitates the exploration of large and complex animal shelter datasets, allowing users to visually examine the shelter intake and outcome rates and draw meaningful conclusions. To that end, this study employed an adapted version of the methodology outlined in Sedlmair, Meyer, and Munzner's (2012) *Design Study Methodology: Reflections from the Trenches and the Stacks*. In addition, the work was focused through the lens of user-centered design.

Design studies, in contrast to more traditional data-gathering and data-analyzing research, present unique challenges when it comes to assessing the study's value and efficacy: What does the project set out to accomplish? Does the design fulfill the needs of that project? How does one measure the success of a design implementation? In order to best answer these questions, Sedlmair et al. suggest a nine-stage framework for the design-study researcher to follow. While not every step proposed by these authors is applicable in the context of a master's paper, the basic procedure they establish offers comprehensive guidance for a design-based project such as this one. This study's research design thus proceeded in the following manner:

1) familiarization with visualization and domain (animal shelter) literature;

2) identification of primary users;

3) characterization of the primary problem, with associated tasks and requirements;

4) articulation of design goals;

5) development of design prototype;

6) user testing and evaluation;

7) analysis of results and corresponding plans for revision; and

8) discussion of the project and its implications.

2. Data Selection & Processing

2.1. Data Selection

The ShelterViz web app was developed using the Shelter Animals Count (SAC) 2011-2018 CSV dataset, which contains monthly animal intake and outcome statistics collected from approximately 4,000 animal shelter and rescue organizations nationwide. This dataset was selected for use in the project because it is by far the largest and most comprehensive dataset of its kind. Several other shelter datasets are freely available for use (the Los Angeles Animal Services 2012-2018 dataset and Austin Animal Shelter 2013-2016 dataset being the best-known), but each of these contains detailed information on the animals within a single organization only. Furthermore, several data visualization projects have already been conducted using these two sets. At the time of this writing, no data visualization project involving the Shelter Animals Count dataset is known to exist beyond the static visualizations present in their own 2016 report.

The SAC data is self-reported by participating organizations, collected using a basic data matrix created by SAC (Shelter Animals Count, 2019). This data matrix tracks intake and outcome numbers by species (canine and feline) and by age (adult,

Intake	Live Outcome	Non-Live Outcome
Stray / at large	Adoption	Died in care
Relinquished by owner	Returned to owner	Lost in care
Owner-intended euthanasia	Transferred out	Shelter euthanasia
Transferred in	Returned to field	Owner-intended euthanasia
Other	Other live outcome	

Table 1. Summary of intake and outcome types in the Shelter Animals Count basic data matrix.

juvenile, and unknown). In addition to tracking beginning and ending monthly total counts for each of the two animal species, the matrix tracks the intake and outcome types summarized in Table 1.

The data is aggregated by organization, location, reporting year, and reporting month, with each spreadsheet row representing one month's totals. Organization and location are distinguished because one organization may operate multiple facilities or rescue locations. There are also separate data fields for organization and location EIN, name, type, city, state, zip, county, county FIPS, open date, and close date.

2.2. Data Processing

Python's Jupyter Notebook and Pandas library were used for data processing. Some basic data cleaning was required before visualization development could begin, and the first step was to drop unnecessary fields from the spreadsheet. As the FIPS code was not needed, and the opening- and closing-date fields had frequently been left blank, these columns were removed.

There was also a question of whether the data should be accessed by organization name or by location name: because the latter is a subsidiary of the former, it seemed cumbersome and potentially redundant to include both. Analysis of the data

revealed that the spreadsheet contained 4108 unique organization names and 4153 unique location names. Of those 45 instances (1% of the total dataset) for which the organization and location name were not an exact match, many proved to be the result of a typo or other minor variation in what was clearly intended to be the same name; only a very small number of organizations were found to operate multiple locations under different names. Since little to no information would be lost, it was decided that all “organization”-related fields would be also dropped from the file, and the location name and related details would be used for identification purposes.

As development entered its initial stages, it became clear that the format of the spreadsheet’s column labels was another important detail. The visualization design included a three-part selection menu through which users could “build” a desired parameter, selecting in turn the intake or outcome type, animal group, and age group for which they wished to visualize data. The program was structured to concatenate results from each of the dropdown menus in order to pass on a single variable in the following format: [intake/outcome]_[type]_[canine/feline/all]_[adult/juvenile/unknown/all]. In order to facilitate this, the dataset’s variable names needed to match those that would be generated by selection system, and the spreadsheet’s columns were correspondingly relabelled to match this design standardization.

The next stage of data processing occurred much later in the project’s development. The design intention had always been to offer aggregate totals among the selectable parameter options: for example, the total number of canine strays across all ages; or the total number of adult euthanasias for both types of animals; or the total number of live outcomes of all types across all animals of all ages. This feature would allow users to examine individual statistics in relationship with categorical totals, which is an important functionality when it comes to assessing a given variable as a changing

proportion of the whole. The original dataset, however, did not include these cumulative sums. Each of the aggregate totals—amounting to roughly 120 new data variables—therefore needed to be calculated in order to fulfill the requirements of the design.

Several possible means of calculating these totals were considered. The most flexible method would have been to do so within the Javascript code, so that future datasets could be loaded into the web app with minimal preprocessing required. However, the differing state of the cumulative variables as opposed to the original variables began to introduce other complications in the program, and it was decided to instead hard-code these values into the original CSV file. Pandas dataframes were used to calculate the various totals and append their new columns to the spreadsheet. This process was simple but not particularly efficient, as it required manually writing the formulas for each of the many different sums. In hindsight, it would likely have been better to conduct the calculations in the live running of the program, and this issue may be revisited in the future.

The final data-processing decision to be made was how to handle the four variables for beginning and ending total canine and feline. On and off throughout development, these variables were used as placeholders for the initial view loaded each time a new location was selected to be visualized. It made sense, from a design standpoint, to always have something on the graph to invite users in (rather than load a blank chart), but it took some time to solidfy what the best starting view would be.

According to the SAC data matrix, the beginning totals are meant to be the total number of canines or felines present in the shelter at the start of each month, and the ending totals are meant to be the total number present at the end of each month. In other words, these statistics should be relatively redundant to one another: the ending total of one month should be equal to the beginning total of the month which

immediately follows it. These figures are also somewhat unique among the many other variables of the dataset, in that they represent static totals on a single day as opposed to total movement over the course of a month.

At a glance, then, the beginning and ending totals should provide a snapshot of the shelter's typical occupancy. For design purposes, this idea of total occupancy seemed like a good metric to display on initial load. It would offer users a general overview of the number of animals typically handled by the organization on a day-to-day basis, and then the myriad other parameters would be available for the user to explore with greater specificity.

The ending totals were thought to be the more appropriate choice as a representation of total occupancy, since these would have been counted *after* the effect of each month's intake and outcome numbers. In practice, however, many organizations seemed to report ending totals incorrectly: the ending totals often diverged wildly from the beginning totals, and they commonly included negative numbers, suggesting that organizations were reporting the figure by which their occupancy decreased, rather than the total number of animals remaining. Therefore, beginning totals were used as the stand-in for total occupancy. The two parameters of "total canine occupancy" and "total feline occupancy" were plotted on each initial visualization load, and they were also made available in the selection menu for users to add and remove at will.

3. Problem, Users, & Tasks

As this paper has already discussed, a wealth of animal shelter and rescue data is being actively collected, but the large volume and frequent disorganization of this

information makes it difficult for individuals to engage with in a meaningful way. Even in situations where the data is comprehensive and well understood, pages upon pages of spreadsheets can be difficult for the human brain to absorb, sort through, and translate into a narrative of what is important, what strategies work well or do not work, and what factors might influence the ability to do even better. For that reason, the fundamental problem that this project sought to address was improving the accessibility of animal shelter and rescue data.

Following a review of the research literature and relevant media coverage, it was determined that the most useful visualization tool would be one which simplified the data-exploration process for two specific stakeholder groups. First and foremost, the interactive visualization should support individual shelters and rescues in better understanding their own data. By assessing their performance and the needs of their service areas, these organizations should be able to implement data-backed practices to optimize their resources and improve their outcomes.

Second, the interactive visualization should assist governing entities in gaining a clearer grasp of the “big picture” of animal welfare, guiding them as to which steps might be taken to make further progress. Legislators and policymakers should be able to investigate trends in the data in order to identify areas most in need of intervention, conduct comparisons between like and unlike shelter and rescue situations, gauge the impact of different factors on animal outcomes, and determine which interventions will provide the most benefit under which circumstances.

In keeping with user-centered design philosophy, two distinct personas were developed to represent each of these two potential user groups. These personas were then used to determine the essential user tasks that the visualization tool would be required to support. The personas and their associated tasks are as follows:

User #1: Sebastian the Shelter Manager

Sebastian is the manager of a large municipal animal shelter. The shelter is under-funded and often over-filled, but Sebastian is passionate about the animals under his care, and he is constantly seeking ways to improve their prospects of a happy outcome. He would like to be able to view the data trends for his shelter over time, as well as evaluate how his shelter fares in comparison to others within the region. He would also like to know whether any shelters handling similar numbers and types of animals have found ways to better their own outcomes, so that he can consult them for advice and inspiration.

Task 1.1: Explore detailed time-series data for an individual shelter.

Task 1.2: Compare an individual shelter with others within the geographic region.

Task 1.3: Compare an individual shelter with other similar organizations across the country, and retrieve contact information for those organizations as desired.

User #2: Penny the Policymaker

Penny is a junior-level board member for a mid-sized county, and she has taken an interest in the animal shelters under her jurisdiction. Penny would like to familiarize herself with the current state of shelters and rescues across her service area: what do their intake and outcome statistics look like, and are there specific municipalities or neighborhoods that appear to be struggling? She has information on local animal welfare policies that have been implemented in the recent past, and she would like to be able assess whether these policies have had a corresponding impact on any of the shelters. Lastly, she would like to be able to compare the performance of her local shelters with that of other shelters across

the country, in order to make sure that needs and standards are being appropriately met.

Task 2.1: Explore county-wide and individual shelter and rescue data, identifying instances of sub-standard outcomes.

Task 2.2: Explore time-series data for individual shelters and rescues, particularly as corresponds with implementation of known policy changes.

Task 2.3: Compare specific target shelters and rescues with similar organizations across the country (matched according to factors such as geographic region, outcome statistics, average capacity, longevity, or organization type).

4. Initial Design

The design goals of the project arose very closely from the users' required tasks. Because of the number and variety of tasks that should be supported, it quickly became clear that a successful visualization tool would need to offer multiple interfaces, so that users could interact with the data in different ways depending on which questions they wished to answer or factors they wished to explore.

To begin the design process, the user tasks were clustered into groups based on their core function. These task clusters thus became the following three design goals:

Goal #1: Allow users to explore the data for an individual shelter over time.

Supported tasks: 1.1, 2.1, & 2.2.

Goal #2: Allow users to compare multiple shelters with one another.

Supported tasks: 1.2, 1.3, 2.1, & 2.3.

Goal #3: Allow users to explore and compare shelters based on filters such as geographic region, average capacity, or organization type.

Supported tasks: 1.2, 1.3, 2.1, & 2.3.

The initial project design was then developed as a series of rough pen-and-paper sketches. These took the form of three visualization "views":

1) a time-series multiple-line graph, in which users could search by shelter and then filter by intake and outcome parameters, supporting goal #1 or tasks 1.1, 2.1, & 2.2 (Figure 1);
2) a comparison multiple-line graph, in which users could compare variables across multiple organizations, filtering by organization type, geographic region, and name, supporting goals #2 & #3 or tasks 1.2, 1.3, 2.1, & 2.3 (Figure 2); and
3) a choropleth map, in which users could click to drill down by state, county, and finally individual organization, supporting tasks 1.2 & 2.1 (Figure 3).

It was subsequently determined that the map view, though perhaps visually interesting, would not contribute significantly to user understanding of the data, and this view was eliminated from the project in its current iteration.

The remaining two design views were refined through a second round of wireframe sketches, during which the interfaces and their intended functionality were further specified. Due to the inherent time constraints of a master's paper, it was decided that the time-series view (Figure 4) would take priority, since this view supported the most fundamental goal of the project: helping individual shelters and rescues to easily explore their own data. User recruitment and testing focused on the corresponding persona group (User #1, "Sebastian the Shelter Manager"). Ultimately, time did not permit for the development of the comparison view (Figure 5), but the user testing did suggest that this would be a valuable avenue for future expansion.

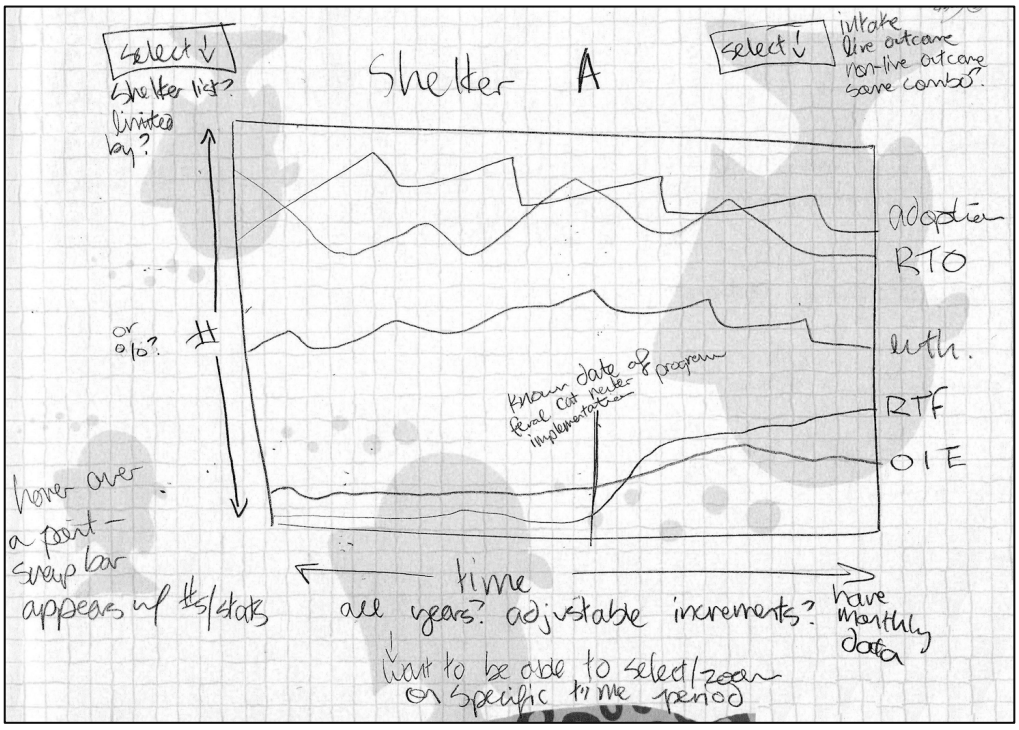

Figure 1. Initial sketch of the individual time-series multiple-line graph.

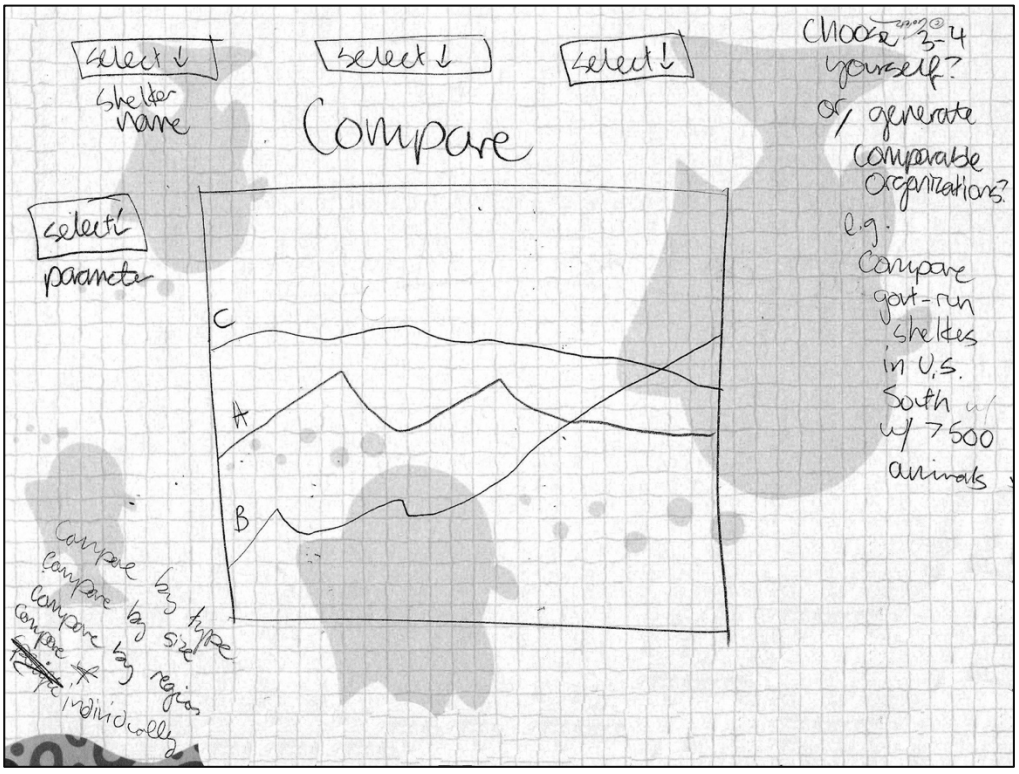

Figure 2. Initial sketch of the comparison multiple-line graph.

Figure 3. Initial sketches of the choropleth map, allowing drill-down by state (top), county (middle), and individual organization (bottom).

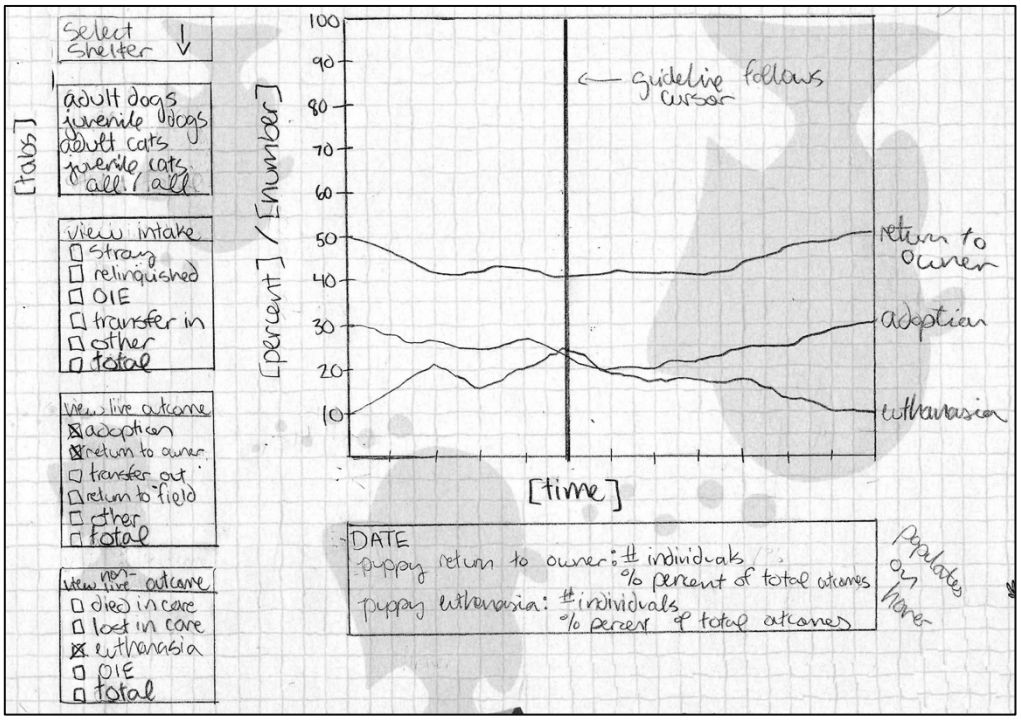

Figure 4. Refined sketch of the individual time-series multiple-line graph.

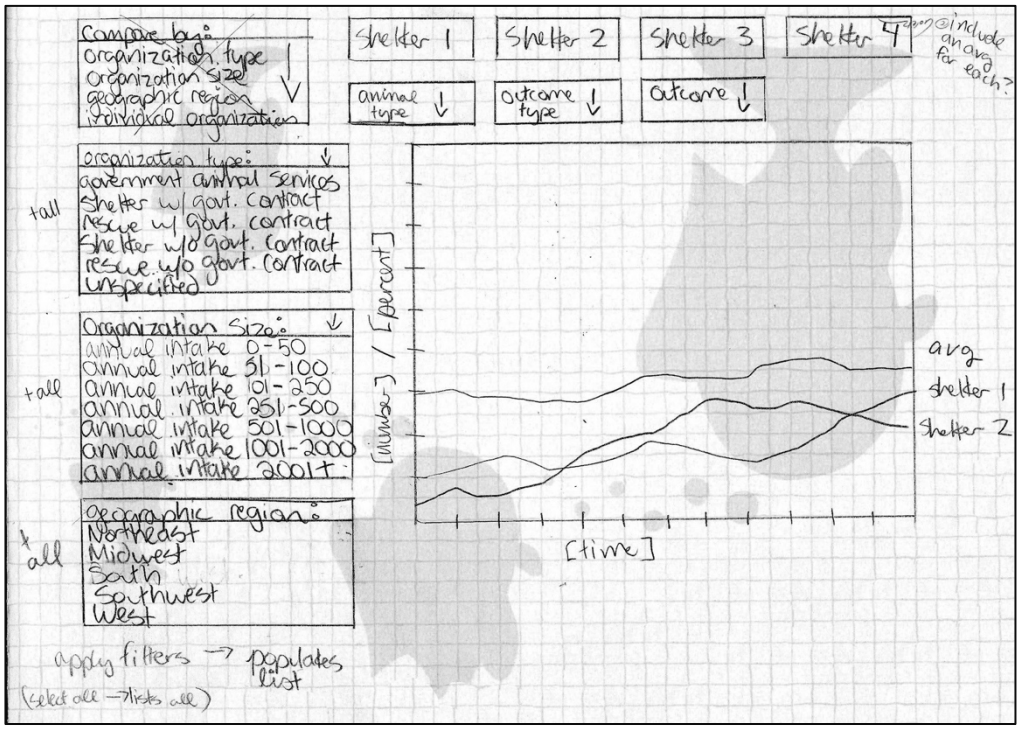

Figure 5. Refined sketch of the comparison multiple-line graph.

5. Prototype Development

The ShelterViz web prototype was developed using HTML5, CSS, Javascript, and the D3.js (Data-Driven Documents) Javascript library. The design underwent several minor changes during the development process, but overall it remained very similar to the initial specifications. A demo version can be accessed at https://www.shelterviz.com.

In keeping with the design goals, the time-series visualization is the central focus of the website. This multiple-line graph occupies approximately two-thirds of the screen, with a selection menu to the left and a navigation bar along the top. The starting page view loads data from the City of Los Angeles Department of Animal Services, inviting users to immediately interact with the visualization (Figure 6).

The chart's x-axis measures time by month and year, and the y-axis measures number of animals. Both axes re-scale automatically based on the values present in the data subset for a chosen shelter or rescue location. By default, the chart displays two parameter lines—total canine occupancy and total feline occupancy—each time a new location is loaded. When users mouse over the visualization, a guideline appears and follows the cursor, displaying the number of animals for each parameter at any given point in time (Figure 7).

Using the menu panel to the left of the visualization, users can select a new location, add and remove parameters, and view basic demographic details about the chosen shelter or rescue. The location search bar is populated with a dropdown list of locations in the dataset, which automatically refines itself as the user begins to type in a location name (Figure 8). Clicking "submit" refreshes the visualization with the new location data and updates the information in the "about" box (consisting of location name, type, city, county, and state) at the bottom of the panel (Figure 9).

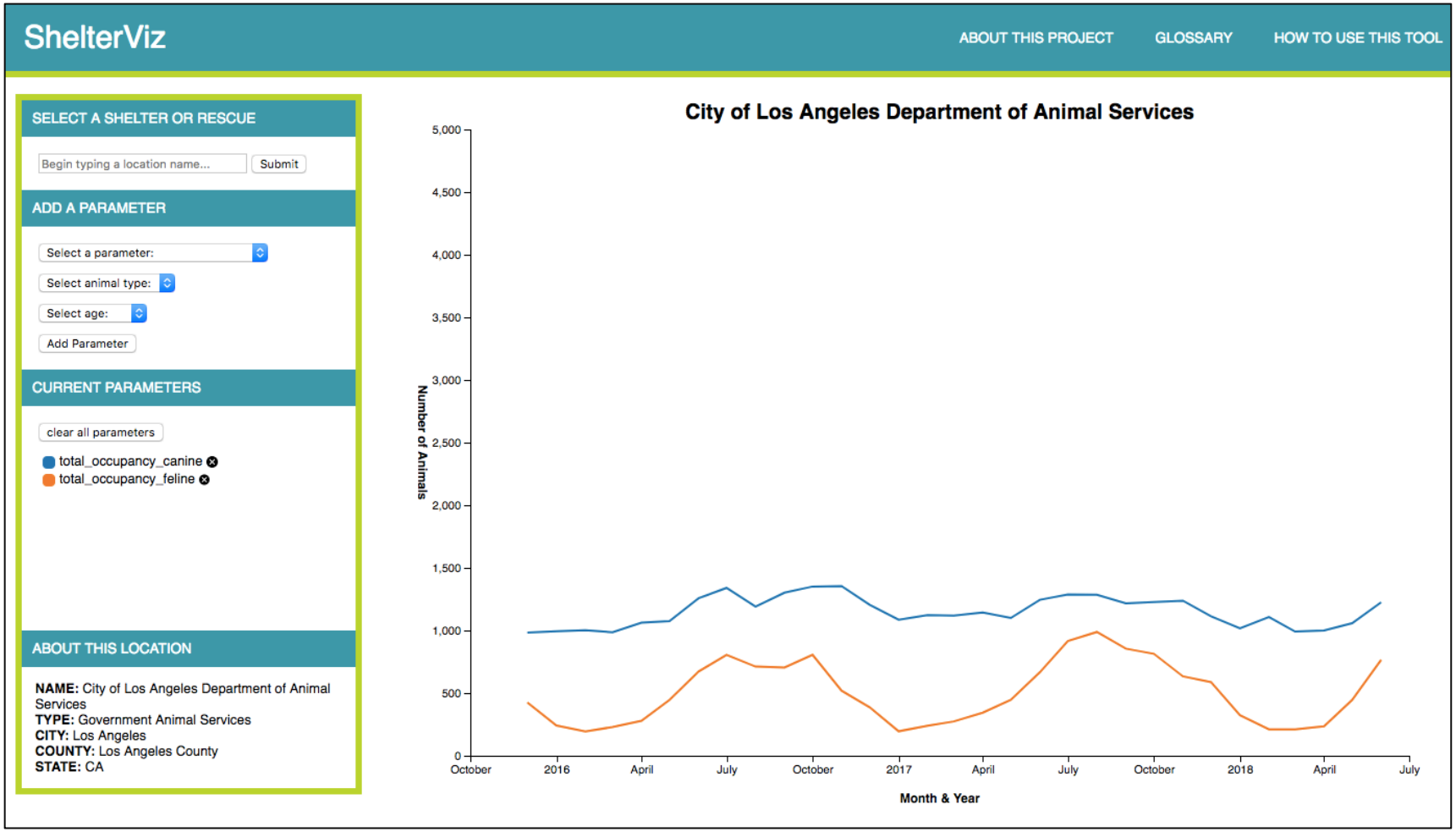

Figure 6. The starting page view of the ShelterViz web app.

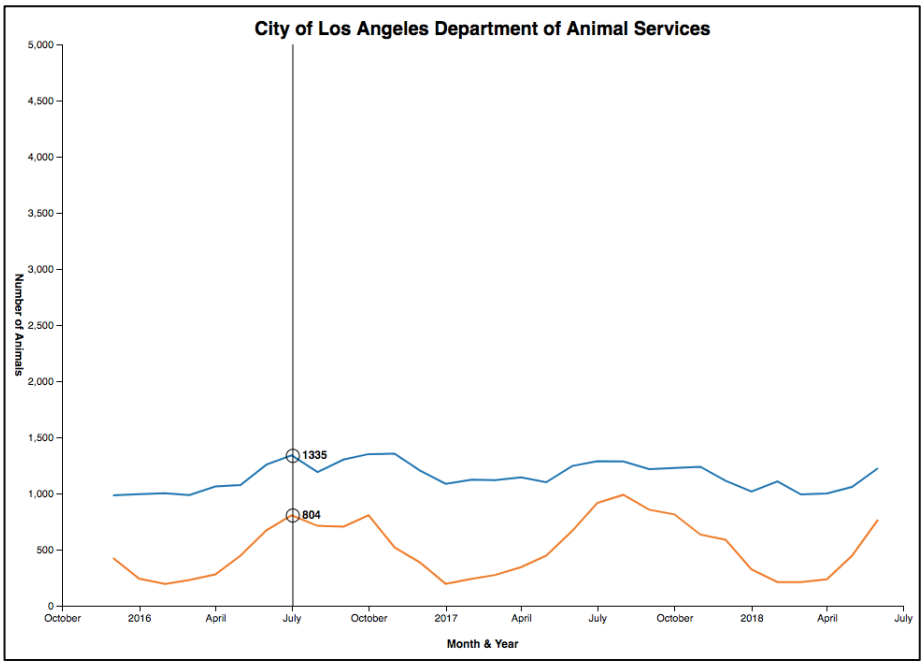

Figure 7. A cursor guideline displays the number of animals for each parameter.

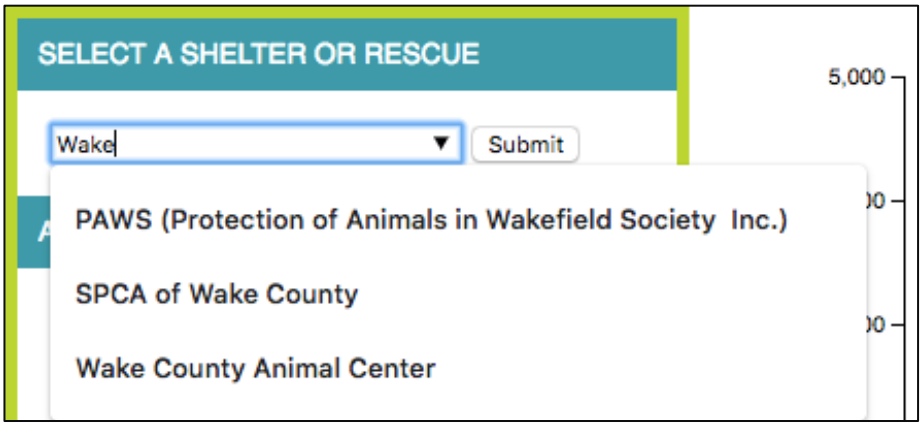

Figure 8. The location dropdown list refines automatically as the user begins to type.

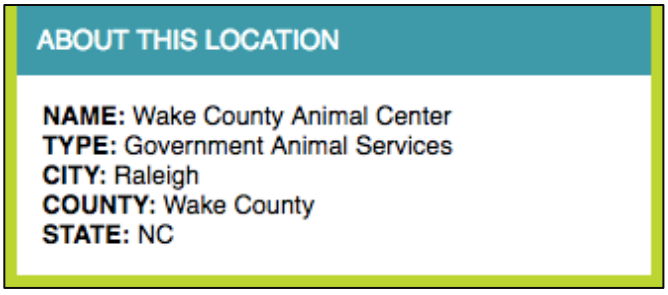

Figure 9. The “about” box provides basic location information.

Parameters can be added using the three dropdown selectors for parameter type, animal type, and animal age (Figure 10). A pop-up alerts the user if he or she fails to select a variable, or if the parameter he or she selects has already been plotted. In the box below, all active parameters are listed, with a colored icon to identify each corresponding line (Figure 11). Clicking the “x” icon beside each parameter will remove it from the visualization, or all parameters can be removed at once by clicking the “clear all parameters” button.

The navigation bar contains links to three supporting pages: “About this Project,” “Glossary,” and “How to Use this Tool.” The first of these provides background information about the ShelterViz project, Shelter Animals Count, and the author of this paper. The glossary uses definitions provided by SAC to explain the different intake and outcome variables, as well as other basic information which might be helpful to users of the tool. The how-to page provides simple instructions. Lastly, the “ShelterViz” link on the left-hand side of the navigation bar allows users to return to the home visualization.

6. User Testing & Evaluation

6.1. Recruitment

Small-scale user testing was conducted to assess the usability of the ShelterViz web app’s design. The primary aims of the testing were to:

1) identify strengths and weaknesses in the interface;

2) evaluate whether the tool was supporting the proposed tasks;

3) learn whether participants found the tool useful; and

4) discover other features that participants wanted to see in a tool of this nature.

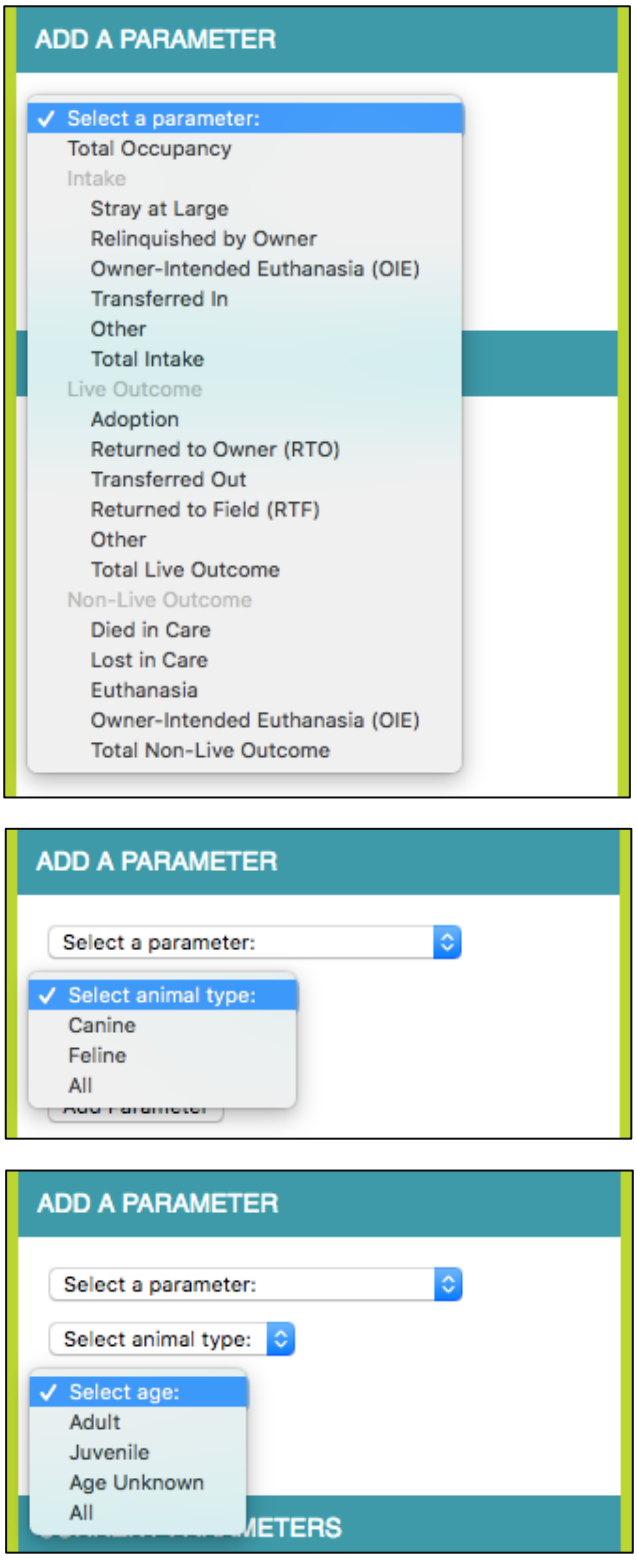

Figure 10. The three dropdown selectors for parameter type (top), animal type (middle), and animal age (bottom).

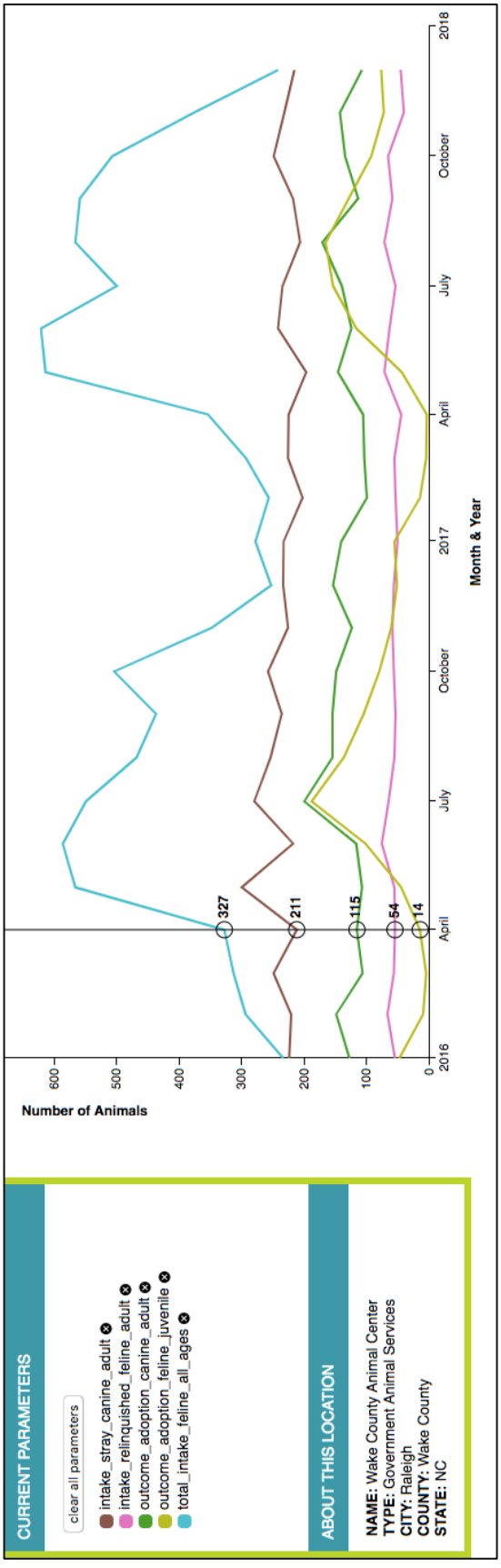

Figure 11. The "current parameters" box, where all active parameters are listed along with a colored icon to identify each corresponding line.

Given the limited scope of a master's project, the user testing was not intended to be an exhaustive foray into visualization usability (which could fill multiple studies on its own), but rather to provide a means of evaluating this particular tool. Furthermore, as Beyer & Holtzblatt (1998) discuss in their introduction to contextual inquiry, the frequency of new insights drops off dramatically following a comparatively small number of interviews.

The usability testing focused on users resembling the "Sebastian the Shelter Manager" persona. Recruitment occurred through the distribution of a template email to ten local shelter and rescue organizations (Appendix A). Four of the ten organizations were represented in the Shelter Animals Count dataset; the remaining six evidently do not report to SAC. Through a combination of targeted and snowball sampling, four study participants were recruited from among the shelter and rescue volunteers and employees. The participant types were varied: one volunteer for a governmental animal services organization represented in the dataset; two employees of a shelter with government contract not represented in the dataset; and one employee of a shelter without government contract represented in the dataset. This allowed for a reasonable distribution of perspectives on how one might use the tool.

6.2. Testing Procedure

The testing took the form of individual semi-structured interviews, which lasted between 30 and 60 minutes in length. Each interview began with a brief explanation of the purpose of the tool and what the participant would be asked to do, as well as the provision of a consent form (Appendix B). The structure of the interview then proceeded in the following manner.

Each participant was first instructed to click the “Begin Test” link on the initial blank page, which took him or her to the homepage of the ShelterViz interface. The participant was then asked to explore the interface as though it were a new website that he or she had come across. During this exploratory session, the participant was encouraged to think out loud, discuss his or her actions and decisions, and articulate any details which were helpful, interesting, confusing, or frustrating. The participant was also encouraged to ask questions, though the participant was informed that these questions may not be answered until after the exploratory session was concluded. This process provided an opportunity to observe how the tool presented itself without any outside assistance.

Following the initial exploration, the participant was instructed to select a location of his or her choice. A series of five specific tasks were then administered to help guide the participant in his or her testing. These tasks were designed to be characteristic of the tool’s intended use and were approximately the same for each participant, though the details were tailored slightly to match the individual organizations which had been selected. (For example, rescues rarely have animals “transferred out,” and instead are the ones receiving “transfers in” from government shelters.) Depending on the information yielded by each task, the participant was prompted to discuss anything interesting or insightful about it, and occasionally was asked to perform additional tasks which stemmed naturally from the discussion.

To conclude the study, each participant was asked several specific follow-up questions. In cases where the participant had already discussed the topic of a question, that particular question was omitted. Elaborating questions were asked as appropriate.

6.3. Results

The usability testing provided very useful feedback, both in terms of verbal discussions with the participants and tacit observation of their interaction with the tool. Overall, response to the ShelterViz app was enthusiastic and encouraging, and a number of elements were helpfully identified as facilitating or hindering the information-seeking process. The feedback tended to fall into one of three groups: technical details of the interface and its functionality; conceptual approach to the tool as a whole; or desired areas for additional development. The full interview notes are available in Appendix C.

6.3.1. Interface Functionality

All four participants spoke positively about the interface, and several described it as being intuitive to use. However, though the participants were each navigating the tool quite comfortably by the end of their interviews, there was some trial and error at the beginning. Not all of the participants immediately understood that they could select a new location to visualize, and three out of the four left off the “age” variable when adding a parameter for the first time. Both of these problems suggest that the requirements and capabilities of the menu are not entirely clear. Possible solutions could include making the location selection menu more prominent, as well as introducing a numbered hierarchy to more explicitly guide users through the different selection steps.

Once aware of the location search, participants seemed pleased with how the dropdown list of locations populated based on text entry. However, two of the four participants were interested in scrolling through the list of names, which was not possible; the datalist automatically truncates midway through the letter “B” when no

text search has been entered. Given that there are over 4,000 location names, scrolling through them all is rather cumbersome, and this is what the autofill feature was meant to help circumvent. It may be that scrolling itself was only desired as an alternative to name-based lookup, since the participants expressed that they would like to be able to search by means other than having a particular location in mind. Either way, scrolling should be better supported, but the introduction of other ways to search (geographic, shelter or rescue type, capacity, etc.) should also help to mitigate the need to scroll.

The participants were generally comfortable adding and removing parameters once they understood how the three-variable system worked. The pop-up alert for incomplete parameters did confuse some participants, who did not know to click “OK” to dismiss the message before resuming their activities. This could be improved by replacing the pop-up with a text alert embedded directly in the selection menu, which would be shown or hidden based on the same criteria but not require any response for the user to continue. Only occasionally did participants click the “clear all parameters” button, though they frequently removed parameters one-by-one. It is unclear whether this is because the button was often overlooked, or because participants simply did not wish to remove parameters all at once, preferring instead to follow each line separately.

There was some confusion about the parameter for “total occupancy.” This metric had to be explained several times, and even once participants understood how it was calculated, there seemed to be a little bit of uncertainty regarding the relationship between this statistic and the other parameters. Part of the problem is that the figures for beginning and ending total canine and feline each represent counts on a single day of the month: they are a snapshot of total occupancy, whereas the other parameters represent cumulative numbers throughout the month. While it seems worthwhile to be able to consider the various parameters in light of a location’s average capacity, it is

possible that simply using “total intake” would be a clearer metric for understanding a location’s size.

The participants enjoyed interacting with the visualization chart, and they found the hover line helpful with its specific numbers. In cases where there were multiple parameters plotted closely together, these numbers could overlap and be difficult to read, so the program code should be tweaked to spread them apart more responsively. The visualization’s ten-point color scale seemed to work well with the exception of one instance where the participant, having added more than ten different parameters to the chart, removed most of them and was left with two overlapping red lines, which were difficult to distinguish. Expanding the color scale would assist with this, as would adjusting the program code so that a parameter could be re-added in a different color.

Multiple participants voiced a desire to be able to zoom in and out on the visualization chart. In addition to clarifying the user’s view of parameters with overlapping data points, this would help with an occasional problem of the y-axis scale. Because the possible parameters include aggregates for total intake, total live outcome, and total non-live outcome, these values are often much larger than those of the individual intake and outcome types. This results in a comparatively large scale for which only a few lines approach the top of the y-axis, while the rest are clustered in the bottom half of the chart.

Participants also wanted to be able to select a specific date range on the x-axis. This could be accomplished through the zooming feature described above, or through the implementation of a slider filter for the desired dates. Meanwhile, the testing revealed a few quirks with the rescaling of the x-axis which should be corrected. If a selected location contains less than one year of data, the x-axis tick marks will consist of months and days only, with no year visible. This was confusing for participants, since

they had no way to know which year of data had been reported. By contrast, when the selected location contained many years of data, it was difficult for participants to determine which month of the year was represented at a given data point. This could be resolved by including the active month in the hover display.

Only one of the four participants demonstrated any interest in the “about” box, which provides basic demographic information on the location currently being visualized. This participant paid a fair amount of attention to those details, so they do appear to add at least some value. It is possible that this information may become more relevant once a comparison view is introduced.

For the most part, participants did not make use of the supplementary navigation links, though they did find the glossary to be helpful once directed toward it. Given sufficient improvements to the main interface, the “how to” page should hopefully become redundant and can be removed. A clearer “home” button could be added in its place, since the title link was not immediately apparent to all participants.

6.3.2. Conceptual Approach

Each of the participants valued the ability to visualize and interact with their data. Two of the four described themselves as data enthusiasts, with one saying of the web app, “as a numbers person, [it’s] really nice to have it at my fingertips,” and the other describing herself as “really into” data visualization and analysis. Both of these participants discussed the current tools they use to analyze their data, which primarily involve static reports and spreadsheets, and lamented the lack of resources to create visualizations of their own.

All of the participants felt that data visualization would benefit their organizations, saying variously that the tool “is really great,” “would be great to have access to,” and

"would make for easier reporting and would be useful to visualize the data." One participant stated that it was "really awesome" to be able to track not just by monthly count but by trends visually over time, adding, "I think this could be incredibly valuable in terms of tracking trends, what people are interested in and what times. You *know*, working in a shelter, that summers are busy, but it's cool to see it visually." When asked how they envisioned this sort of tool being used, the participants demonstrated a clear interest in tracking the success of various shelter initiatives: the effect of foster and transfer programs on euthanasia rates, the effect of summer adoption events on adoption and return rates, and changes in the spay and neuter statistics of incoming animals. This desire to evaluate and respond to the impact of different organizational procedures reflects exactly the kind of data-driven practice that the ShelterViz project was designed to facilitate.

Even in the context of a relatively brief interview, the participants were able to make a number of interesting observations about the data that was visualized. All four participants immediately noticed the extreme peak-and-valley trends corresponding with kitten season, the period running from approximately March through October during which a majority of kittens are born. Though most shelter and rescue affiliates are already familiar with the phenomenon of kitten season and the increased occupancy pressures that it heralds, the participants still seemed to benefit from the visual representation, and they were interested in exploring the kitten season trends via the chart.

One participant observed an annual uptick in adult cat intake around the month of October, which she interpreted as coinciding with the point in time at which many of the felines born during kitten season transition to being counted as adults (typically around 5-6 months of age). This participant also noticed an increase in adoption rates during

the summer months. She speculated that this might be linked to her organization's summer promotional events, during which adoption fees are reduced or waived, and expressed curiosity to learn more about whether this trend was correlated.

A different participant observed that although kitten season drove a steep spike in intake during the late spring and early summer months, adoptions did not rise until later in the summer. The number of animals transferred out of the shelter, however, increased in a pattern which closely mirrored that of the intake rates. In other words, this participant discovered that while adoptions do eventually rise over the summer, many animals have to be transferred out to other rescues first in order to cope with the demands of kitten season. The participant recognized this relationship as a direct result of her ability to visualize multiple parameter trends. Insights such as this can help shelters and rescues to better understand their operations and decide how best to allocate their resources.

6.3.3. Additional Development

All of the participants had ideas for other features that they would find useful in a tool of this nature. Chief among these was the ability to compare multiple locations side-by-side with one another, whether on a county or an individual level. One of the participants even stated that part of her organization's updated strategic plan is to visit other shelters with similar intake numbers in order to see what they are doing and learn from one another. Since a comparison view was one of the original design aims of this project, it is encouraging to have this functionality confirmed to be a valuable area for future development.

Another common request was for additional means of location searching, since right now a user must generally know the name of a specific shelter or rescue in order

to look it up. As noted above, the datalist scrolling could be improved, but participants also wanted to be able to search geographically. One participant noted that it would be helpful to separate out shelters and rescues, since these two types of organizations typically operate in quite different ways. Particularly with the addition of a comparison view, it seems logical to introduce a way for users to search by region, size, organization type, or other variables.

Participants frequently mentioned other categories of data that they would like to see visually represented. While the availability of data is not something which can be controlled from a development standpoint, it is useful to identify areas where SAC as well as the individual organizations themselves might consider increased data gathering and analysis. One participant was interested in comparing the spay and neuter rates of incoming stray and owner-relinquished animals. Another participant wanted to see data on other animal species, in particular wildlife: she stated that government shelters are often responsible for handling injured or diseased wildlife, and these euthanasias count against the shelter's overall metrics. A third participant mentioned that she would like more granularity from SAC's "other intake" category.

Several participants wanted to visualize data on their foster care programs. One of the participants described how her organization's current software has no way of tracking fosters: the number of fosters at a given time can be calculated from the total inventory, but there are no foster statistics over time, and no formal way of tracking the progress of an individual animal and its outcome. Interestingly, a different participant said that her organization's software tracks very detailed information on each animal's foster and outcome history, but she has no way to visualize any of the SQL reports and wishes she could link them up to the ShelterViz tool. Fostering is widely attributed to improved live outcomes (and corresponding declines in euthanasia), so being able to

better evaluate the success of these programs with concrete data would be a worthwhile visual analytics application.

Lastly, one participant expressed a desire to see other representations of the data, such as bar or pie charts. This project's first design goal was to allow users to explore data over time, for which the multiple-line graph has worked effectively, but different types of visualizations are naturally suited to different types of data and analysis. With any future development of the ShelterViz project, it will be worth considering alternative ways to engage with the information available in the Shelter Animals Count dataset.

Conclusion

The ShelterViz project provided an opportunity to conduct an original design study through the development of an interactive web-based data visualization. This process offered valuable experience in user-centered design, Javascript programming, and usability testing, while at the same time creating a tool to benefit nonprofit organizations working in animal welfare. Based on the results of the user testing, shelter and rescue affiliates are enthusiastic about analyzing their data to improve their current practices, and they perceive a number of practical applications for interactive data visualization. The ShelterViz tool was well-received by the study participants as a means of better exploring, understanding, and gaining insight about their data.

1. Challenges & Limitations

A variety of challenges were encountered during development. Chief among these was recognizing the amount of time truly needed to write and debug a program. For every stage of the coding that went smoothly, there were inevitably multiple components that were more complicated than they appeared. Design concepts which may seem straightforward at the highest level can quickly become intricate and time-consuming as they are broken down into their constituent parts, even if the building blocks themselves are not necessarily difficult to construct.

The asynchronous, multi-threaded nature of web programming also introduced unexpected complexity. While there is seldom one “best” way to write a program, a lot of trial and error went into solving different small-scale problems and connecting the many moving parts into one cohesive whole. Good program design is definitely a matter of practice, and a lack of experience often results in one’s having to learn new techniques and processes on the fly, reevaluate based on the knowledge acquired, and then backtrack to redesign and begin again. All in all, this project was an excellent lesson not only in the technical skills of web programming, but also the conceptual flexibility necessary to design and execute a complete project.

The project also faced several limitations. Due to the time constraints of a master’s paper, the original design plans had to be substantially scoped down. This resulted in the development of only one visualization view, as opposed to the three different views that were initially drafted. While this primary time-series view was very successful during user testing, the study participants expressed strong interest in having access to a comparison view as well. It would have been nice to test a more complete version of the ShelterViz tool as it was originally conceived.

As part of the reduction in scope, study recruitment was limited to volunteers and employees of shelter and rescue organizations. Members of this group are the main target users of the ShelterViz tool, but the inclusion of other users, such as animal welfare policymakers, might have offered a greater variety of perspectives and insights. Limitations of time also meant that only four study participants were able to be interviewed, despite the interest of additional persons who responded to the study recruitment email. That being said, the four interview participants provided ample and detailed feedback regarding interface revisions and potential expansions for the tool.

With continued development of the project, a second round of usability testing could be conducted to broaden the number and diversity of test users.

A third limitation was this author's position as an animal welfare outsider. Though personal experience and an extensive review of the literature helped to inform this paper, it nevertheless arose from an information-science perspective rather than one of authority on animal shelter and rescue needs. The study participants provided valuable firsthand input on the visualization tool, but project-level collaboration with other domain experts would have inarguably benefited the work of research as a whole.

2. Future Work

The usability testing provided many valuable suggestions for future work on the ShelterViz project. The first step will be to revise and improve the current interface based on the user feedback: clarifying the selection menus, fixing a few problems with the color and axis scales, and introducing the ability to zoom in on the chart. Users also want to see additional functionality, such as comparing multiple shelters with one another and searching for different shelters by geographic region, so expanding the web app to include a new comparison visualization would be a logical next step. Third, the ShelterViz website is currently optimized for desktop browsing only; future development should include responsive design to make the app accessible on all screen sizes and device types.

Beyond this project, there is plenty of work ahead for those interested in improving animal outcomes. The results of this study indicate that shelters and rescues are enthusiastic about data collection and are actively looking for new ways to put their data to use. Continued efforts to encourage data reporting to organizations such as

Shelter Animals Count will assist in building an even more robust and informative dataset. Shelters, rescues, and their affiliates should also consider tracking new types of data, particularly as pertains to specific initiatives—namely foster, transfer, and spay and neuter programs—and their corresponding outcomes.

Finally, data is nothing without analysis. The inferences drawn by this study's participants are only a small preview of the types of insight that can arise when people are given the tools to engage critically with the information that they have. It is hoped that the ShelterViz project can serve as an example of visual analytics in action, inspiring both researchers and shelter and rescue affiliates to seek out new and meaningful ways to leverage their data toward improving animal outcomes.

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Appendix A: Recruitment Email

Hello! My name is Carmen Dolling and I am a master's student in the Information Science program at UNC-Chapel Hill. I am conducting a research study for an online tool which visualizes animal shelter and rescue data.

I am seeking research study participants to assist in evaluating the usability of this interface. The tool is intended to make animal shelter and rescue data accessible and easy to explore, helping to facilitate insight and decision-making which can lead to improved animal welfare.

I am looking for participants 18 years or older who are employees, volunteers, or other affiliates of an animal shelter, rescue, or similarly interested organization. No prior experience with research studies or with data visualization is necessary to participate.

Participation in this study involves:

- -Meeting for approximately one hour at a location convenient to you
- -Using an online tool to explore animal shelter and rescue data
- -Answering questions about your experience with the tool
- -Potentially gaining insight into the performance of your organization
- -Contributing to a project focused on animal welfare.

To sign up to participate or to get more information about this study, please contact the Principal Investigator, Carmen Dolling, by email at [email address] or by telephone at [telephone number].

Sincerely,
Carmen

M.S. in Information Science, 2019
School of Information and Library Science
University of North Carolina-Chapel Hill

Appendix B: Consent Form

University of North Carolina at Chapel Hill
Research Information Sheet
IRB Study #: 19-0341
Principal Investigator: Carmen Dolling

The purpose of this research study is to assess the usability of an online tool which visualizes animal shelter and rescue data. This tool is intended to make the data accessible and easy to explore, helping to facilitate insight and decision-making which can lead to improved animal welfare. You are being asked to take part in the research study because you are an employee, volunteer, or other affiliate of an animal shelter, rescue, or similarly interested organization.

Being in a research study is completely voluntary. You can choose not to be in this research study. You can also say yes now and change your mind later.

If you agree to take part in this research, you will be asked to visit the tool via a web browser and interact with the data while in the presence of the principal investigator. You will be encouraged to explore the different visualization options, adjust parameters, and perform a few specific tasks. You may be asked to explain an action or describe what you find to be useful, interesting, difficult, or lacking about the tool.

Your participation in this study will take about 60 minutes. We expect that between four and eight people will take part in this research study. You must be at least 18 years old to participate. If you are younger than 18 years old, please stop now.

The possible risks to you in taking part in this research are:

- feeling uncomfortable while reviewing data that may involve animal mortalities
- someone else learning that you participated in this research study

The possible benefits to you for taking part in this research are:

- learning about animal welfare statistics and trends
- gaining insight into the performance of the organization with which you are affiliated

To protect your identity as a research subject, the research data will not be stored with your name, and the researcher will not share your information with anyone. In any publication about this research, your name or other private information will not be used.

If you have any questions about this research, please contact the investigator named at the top of this form by calling [telephone number] or emailing [email address]. If you have questions or concerns about your rights as a research subject, you may contact the UNC Institutional Review Board at 919-966-3113 or by email at IRB_subjects@unc.edu.

Appendix C: Interview Notes

1. Participant #1 (volunteer, government animal services)

Exploratory Session:

I began this participant's study by asking her not to click any of the links at the top of the page. I did this because I wanted to see how someone interacted with the tool when given zero guidance. For the remaining studies, I did not make this stipulation, but none of those participants clicked on the instructional links initially anyway.

This participant began the "free explore" by looking at the two initial Los Angeles lines (total occupancy feline and canine). Her first thought was that they were intake, so I explained how the occupancy is calculated.

She noticed seasonal trends in the lines, especially for cats, corresponding to kitten season.

She then looks to the sidebar and clicks OIE – does not add animal type or age, so she gets the pop-up alert. She then tries a few times to add the other parameters before realizing she has to click "ok" on the pop-up. Then she adds "all", which shows as 0, so I explain that some shelters do not have or do not correctly report all parameters.

She adds relinquished for all, then clicks to remove some of the lines on the chart. She notices again that relinquishment spikes with the season.

I then instruct her to read the "how to use" page, which is brief. She reads it and says that she had not realized she could choose different shelters: she was more focused on the live graph, and adding parameters to it, and hadn't noticed she could change the organization.

I ask her to return to the main page. She is not sure about how to navigate back, and asks if she should press the "back" button. I tell her to click the ShelterViz name, which she then is happy she can do (but evidently this is not obvious enough).

I then ask her to search for her affiliated organization. She does so, and adds parameters of OIE for all and euthanasia for all. She notices some spikes in the outcomes: "Why is it high in the fall?" She also asks if the graph will tell her what year, and I point out the year label on the axis. She says she is not wearing her glasses, which may be why she did not notice.

She adds parameters for canine and feline euthanasia all. So far she is not removing any other parameters. She observes that dogs are euthanized less often than cats, perhaps because there are more resources to work with dogs. I explain that since these are numbers rather than percentages, it may also be that overall cat numbers are higher

than dog numbers. I ask how she would compare this. She removes some of the existing lines to clear up the visualization, keeping canine and feline euthanasia all. She then adds the parameters for feline and canine total intake. The feline is higher, with clear spikes that correspond with kitten season. She adds lines for total intake for adult cats and kittens, and observes that the kitten line has huge spikes, while the adult line is less extreme in its variations. She says this makes sense with the seasonal birth spikes, and that more cats are euthanized than dogs because more are taken in.

Tasks Session:

Location chosen: her own

T1. Find the month with the highest adoption rates for adult dogs.

She clears parameters, selects the new parameters, and identifies it as July 2016, with 199 animals. She notices that this as well as the following summer are peaks for adoption, and says that at her organization, there are often specials over the summer for reduced or waived fees, and the shelter nearly gets cleared out, with a low return rate.

T2. Find how many juvenile cats were transferred out in April 2017.

She again clears the parameters and identifies the answer as 56, with the second-most of 43 being in April 2016. I ask what she knows about transfers. She states for her organization, it is when the SPCA and rescues pull from their shelter, but that she's not sure what is meant by it here. I point her to the glossary, where she reads the definitions for transfers. She says that it is helpful in terms of reading the visualization menu, but she is not sure if she would have gone to it on her own, since she tends to like to figure things out for herself.

T3. Compare the intake rates for stray and owner-relinquished adult cats.

She is interested by this comparison. She says that more strays are picked up by animal control, but that the owner-relinquished category can be tricky, because when someone brings in their own cat, they can falsely claim that it is a stray (perhaps to avoid guilt or perceived penalties). She describes how the shelter always checks for microchips, and sometimes finds that the cat belonged to the person who dropped it off, or to someone else.

She notices an October spike in the adult cat intake, which she is curious about. She suggests that it is because this is the approximate time when all of the kittens born during the previous kitten season become adults. I ask what her sense of the age category is, and she states that her organization considers 6 months to be the switching point from kitten to adult. I inform her that this dataset treats the changing point as 5 months, and we discuss how prospects differ for kittens versus adult cats.

T4. Compare the euthanasia rates for adult dogs and juvenile dogs.

She views these and is surprised to find they are lower overall than she thought they would be. The juvenile line has a spike in April and June. She isn't as familiar with dogs as with cats and says she isn't sure if the dogs are breeding more, or if perhaps they are being euthanized for parvo, which maybe rises at this time of year. She says again that she assumed the adult euthanasia numbers would be higher, but maybe there are just fewer dogs overall than she thought.

T5. Find the most prevalent outcome type for all cats in October 2017.

She adds all of the live and nonlive parameters, including the totals by mistake, which she then removes. She sees that adoption is the highest outcome, with 179 on this date. Euthanasia, with 145, is second-highest.

She remarks about the difficulties of RTO: even when the shelter successfully gets in contact with the owner of a missing cat, the owner doesn't always pick their cat up, because they have to pay fees to reclaim it.

Questions:

Q1. Do you notice any trends or points of interest?

She says that it is cool to see the spike that correlates with kitten season.

Q2. Is there any information here that is surprising to you?

She was surprised by the number of OIE animals. She states that sometimes the shelter will just do it when requested, but often when an animal is brought in for that purpose, the shelter will do an assessment and not necessarily proceed with euthanasia if the animal is deemed healthy and adoptable.

She was also surprised by the difference in dog/cat euthanasia numbers, and the visible spikes for the cats as kittens matured. She also liked seeing the dog summer adoption spikes – she is curious to check about cats, which she then proceeds to do, and sees that they too have summer peaks likely due to adoption events.

Q3. What do you find useful about this information?

She thinks it would be great to have access to this tool, especially for people new to a shelter environment, so that they can begin to understand the trends and situations. She doesn't necessarily feel it would be useful for ordinary people unaffiliated with shelters and rescues.

Q4. What do you find difficult or frustrating about the interface?

She found the interface "very cool, very intuitive, didn't take me long to figure out."

Q5. Is there any additional information that you wish you could see?

She thinks it would be cool to see how many incoming strays and relinquished animals are already spayed and neutered—most are not, but sometimes they are, and she is curious about those statistics.

She says that geographic searching would be cool—as it is now, you have to know the name of the shelter.

Other Notes:

She says she likes the tool and wants to play with it more.

2. Participant #2 (employee, shelter with government contract)

Exploratory Session:

She begins the session by looking at the populated LA County interface for a moment, seeming to think about it. She hovers over the graph briefly before the snap line and numbers have loaded (the internet connection may be slow), so she doesn't realize that they are there for her to interact with.

She clicks a parameter—total live outcome—but leaves off age, so she gets the popup. She clicks OK and goes back to add age as all. She looks at the visualization but is still not mousing over it. She states that she would expect live outcome to be a subset of total occupancy rather than a larger number. I explain how the occupancy is calculated—the number of animals at the beginning of the month—and how the total intake (and other parameters) over the course of the month can exceed that. She understands, but I can tell that this metric is a bit confusing and misleading, and should be revisited.

She looks at some other parameters (now she is mousing over and the line is working) and laughs when she identifies the kitten season spikes. She asks if these are real numbers, to which I answer yes and explain a bit about the dataset. She observes that the feline relinquishment and canine stray lines are flat, while the feline stray line has strong peaks and valleys. She clicks for feline juvenile total intake and observes that it is very similar to the stray line. She deletes a few parameters by clicking on them individually but does not click "clear all".

She describes the current software that her shelter uses. With the current software, they don't have a way of tracking fosters—"per animal, if it went to foster care, tracking the progress." The software is called Chameleon, which she believes is the most-used shelter software. It can pull manual reports, but tracking fosters is not an option, and there are no dynamic reports. She can see the number of fosters at a given time (they are taken out of inventory), but no time series of the data. She states that they send around 500 kittens into foster care each year, and they attribute the decline in cat

euthanasia to this foster program, but they would like to see clearer data evidence of that.

She says that she would be interested in seeing data on other animals, such as small pets and wildlife. Her organization as well as other government shelters are often responsible for handling injured or roaming wildlife, and if the animal is a rabies vector, the shelter is required to euthanize it. These euthanasias count against the shelter's metrics, which can be frustrating. She notes that in some counties, shelters are able to eliminate the wildlife out in the field, but her county does not allow that, so the shelter has to bring the animal back and count it as a euthanasia.

Tasks Session:

Locations chosen: independent rescue, government shelter (her own is not represented)

T1. Find the month with the highest adoption rates for adult dogs.

February 2016, with 25 animals – she notes that it would be good if the hover function showed the exact month and year, as well as the number of animals.

T2. Find how many juvenile canines were transferred in.

She clears the visualization and then adds the above parameter. (Because the organization she is viewing is a rescue that handles only dogs, it does not make sense to look at feline statistics or transfers out, which was the default question.) She also adds the adoption line for juvenile canines to compare the two.

T3. Compare the intake rates for stray and owner-relinquished adult cats.

She switches her view to a larger government shelter since it fits the questions better. She is surprised by how low the numbers are—based on her knowledge of the organization, she thinks they should be higher, including the total intake for adult cats, which she adds. She notes that she thought "age unknown" meant "all", so when she adds "all" in she gets more, but still not as much as she thought.

T4. Compare the euthanasia rates for adult dogs and juvenile dogs.

Again she finds the numbers to be very low, but she explains something interesting regarding how shelter reporting strategies can differ. She says that this particular shelter reports all of its intake and outcome only as they apply to "adoptable" dogs—dogs deemed to be good candidates for adoption—so that many animals are ruled out and not included in the statistics. In other words, these numbers do not account for every single individual; the euthanasia rates are the number of "adoptable dogs" euthanized, not total dogs euthanized.

T5. Find the most prevalent live outcome type for all cats.

Adoption is by far the highest.

Questions:

Q1. Do you notice any trends or points of interest?

She stated that she really liked being able to have this visualization. She did not mention specific trends, but “as a numbers person, really nice to have it at my fingertips.”

Q2. Is there any information here that is surprising to you?

We discussed some of the points she had noticed earlier.

Q3. What do you find useful about this information?

Uses: we can see over time: “when we implemented the foster program, how live outcomes are hopefully increasing, likewise relationships for transfer.”

She also thinks OIE is really important to account for; the “no-kill movement” challenges shelters to have live release rates greater than 90%, which can be complicated when shelters are also performing a euthanasia service similar to that offered by veterinary offices. She described a situation where a shelter in MD, being pressured to reduce its reported euthanasia rates, started requiring everyone who surrendered an animal to mark it as OIE even if that wasn’t true, so that the euthanasia numbers went down. This of course was arguably unethical, and very controversial.

Q4. What do you find difficult or frustrating about the interface?

She says that one thing she would like is to be able to compare county to county. She did note that if not all shelters and rescues are enrolled, this could skew how the data appears, but that at least it would offer access and allow shelters to compare themselves with what others are doing. For example, she stated that part of her organization’s strategic plan is to visit other shelters with similar intake numbers, to see what they are doing, and try to learn and improve.

Q5. Is there any additional information that you wish you could see?

She recapped that she would like to see more info on foster numbers, other animal species, and the option for geographic comparison.

Other Notes:

She looked at the glossary at the end and said “oh I should have looked at this before”. She was interested in the RTF/TNR distinction, and said she thinks that TNR should be its own category, which might help to give greater validity and awareness to those kinds of programs. She said that for her shelter, they must legally own an animal in

order to perform any surgery including sterilization/alteration, so they are not currently able to participate in any TNR programs.

I asked if she thought this tool would be useful for her organization to have access to. Her first response suggested she slightly misunderstood my question, as she stated that they did not have the resources themselves to develop so many visualizations based on their data. I then clarifed that what I meant to ask was whether they would use this service if Shelter Animals Count provided it publicly. She then asked about cost, so I clarified that I meant if the tool was freely available for them to use based on data that was already being reported to SAC. She said that in that case probably yes; “it would make for easier reporting and would be useful to visualize the data.”

The organization with which she is employed does not currently report to SAC, so it is not included in the dataset. I asked her whether she knew anything about why, or whether she thought access to a tool such as this would increase their likelihood to report, and she said she did not know why and couldn’t really speak for the organization in that capacity. She said that they do collect many stats and use the Chameleon software, but that seems to be mostly internal.

3. Participant #3 (employee, shelter with government contract)

Exploratory Session:

She begins by looking at the default visualization, reading “City of LA” out loud. She mouses over the hover section and asks “is this intake or just numbers over time?”, which I do not answer for the time being. She then looks to the total occupancy link in the current parameters box. She asks aloud how occupancy is defined and seems surprised that the numbers are so high—over a thousand—at one shelter. She and I briefly discuss the fact that one organization (especially if it is a city/countywide shelter) might have multiple locations, and these organizations may report data for all of the locations together as opposed to separately.

She starts scrolling through the list of location names—the first of my participants to do so of her own accord during the initial exploration—and says aloud “wow there’s a lot” before choosing one at seeming random (though perhaps she is familiar with the name). She then looks through the parameters, picks stray-feline, and hovers her mouse but nothing happens; she goes back to the menu and adds the “all” ages and clicks the “add parameter” button, says “ok” and observes the giant kitten-season spikes. Then she notices that the chart still says LA, realizes that she never hit submit to update the shelter, says “duh” and does so.

She scrolls through the location list some more, then decides to start typing in a shelter name, clicks and submits it. She clears some parameters, scrolls through the shelter list again. She says out loud “Okay, so you hit submit and it automatically does total occupancy, okay let’s do RTF, oh but you have to have all of them right” (this last part in reference to each dropdown for parameter type, animal type, and age.) She adds the

other dropdowns and submits to view it. She compares the selected shelter's total intake to the RTO, observing that the RTO is very low.

She then looks at the location information box in the bottom right, reading the type of shelter and geographic location information out loud. She is the first participant to take a noticeable interest in this box. She wonders aloud if there is a way to do a live side-by-side comparison of multiple locations. She also notes that it would be helpful to separate out shelters and rescues—says that comparing them is kind of like apples and oranges sometimes, since they function rather differently.

She returns to the location list and scrolls as far as she as able—only into the B's. She verbalizes that the tool can't keep scrolling, you can only search by name, and says that it would be good if there were other ways to search.

Tasks Session:

Locations chosen: government shelter (her own is not represented)

T1. Find the month with the highest adoption rates for adult dogs.

She selects the new location, submits it, picks the T1 parameters, clears out the old ones, identifies the answer as July 2016.

T2. Find how many juvenile cats were transferred out in Oct 2017.

She clicks through the dropdowns, adds the parameter, finds the answer as 68.

T3. Compare the intake rates for stray and owner-relinquished adult cats.

She adds the two parameters, says that it is "really awesome" to be able to track not just by number but trends visually over time.

T4. Compare the euthanasia rates for adult dogs and juvenile dogs.

She does so, says that it is not surprising, looks right to her.

T5. Find the most prevalent live outcome type for all cats.

She spends some time looking at these parameters. She says that what is interesting is that during kitten season, a lot more are transferred out than adopted, and that adoptions don't spike until July. The same thing happens the following year – so adoption does increase over the summer, but many animals have to be transferred out first, because the adoption doesn't start to rise until a bit after the kitten season peak.

Throughout all of these tasks, she does not use the "clear all" button, only removes parameters individually.

Questions:

Q1. Do you notice any trends or points of interest?

“I think this could be incredibly valuable in terms of tracking trends, what people are interested in and what times – you *know*, working in a shelter, that summers are busy, but it’s cool to see it visually.”

Q2. Is there any information here that is surprising to you?

“Not particularly.”

Q3. What do you find useful about this information?

(skipped this question since we had covered it somewhat)

Q4. What do you find difficult or frustrating about the interface?

She says it would be nice if you could scroll through all of the locations and not be cut off.

Q5. Is there any additional information that you wish you could see?

She says she would like to see side-by-side comparisions. She also adds that if you could confine the time scale to certain years or months, it would let you drill down to more minute details. I ask whether she would like to see any other data; she says that she thinks this is pretty comprehensive.

Other Notes:

I ask if she has other thoughts, and she says “I think this is really great,” continues to click through and play around with it.

She spends quite a bit of time looking at the box with type of organization and location—definitely more interested in it than the other participants were.

When viewing the organization (selected at random) 3Hearts4Paws, she notices that the time scale doesn’t show the year, just the months and dates (because it is so short a time frame), so that is somehing that could be corrected.

There is a problem at one point where she is viewing four parameters, and two of them have the same red color, and it is very difficult for her to distinguish them. She tries to remove and re-add them, but they just reappear with the same color. In the end she has to compare one red and one other, then the second red and other, so that the two reds don’t confuse each other. It’s not completely clear to me why this is the case; they must have been generated at some point when she had many (more than the 10 colors) added to the vis, and then she deleted other parameters off. Apparently if you re-add a

parameter, it always gets the same color? This is something I will have to look into and try to fix.

4. Participant #4 (employee, shelter w/o government contract)

Exploratory Session:

She starts by looking for a minute at the list of parameters in the dropdown menu. She chooses stray and feline, clicks “add parameter”, gets the popup about making sure all parameters have been selected, clicks “ok”. She then goes back and chooses “adult” but does not click to add the parameter.

She removes the total canine occupancy line, “hmm”, starts mousing over the orange feline occupancy line and looking at it. Then she goes back and hits “add parameter” and gets the new line she had selected above, says “wow, okay, cool.” She clicks the “add parameter” button again, gets the popup saying that the parameter had already been visualized. She then adds a parameter for transferred feline juvenile (there are 0 – “hmm ok”) and returned to owner feline juvenile (“very interesting”).

She states that one thing that’s frustrating is that the y-axis is so large, in proportion to the data clustered at the bottom, and she’d like to be able to adjust it. She says it also would be nice to have other representations of the data, such as a bar chart.

I instruct her to find her organization. She starts scrolling through the list of locations, then types the first word in her org’s name, then scrolls down through a handful of places to find it.

Tasks Session:

Location chosen: her own

T1. Find the month with the highest adoption rates for adult cats.

She adds the parameters and mouses over the visualization for a minute. Because her organization has 6 years of data reported, the axis only shows the years, and not the months. This is clearly an area for improvement, since she can only guess at which points in the line correspond to which months of the year.

T2. Find how many juvenile cats were transferred in.

She adds the parameter easily. I do not ask for a month since that was clearly an issue already.

T3. Compare the intake rates for stray and owner-relinquished adult cats.

She starts with selecting total intake, feline, all, then goes back and switches to stray, adds it, relinquished, adds it.

T4. Compare the total live and nonlive outcomes for all cats.

She does so. She is pleased to see that live is much higher, as expected.

Questions:

Q1. Are there other things that you'd like to see or particular cases you would use this for?

She'd like to see bar charts, pie graphs – she says she is really into data visualization and analysis. Right now she works almost strictly with numbers and Excel, and does not have access to a good visualization tool like Tableau. She asks what platform this website was built with, and I tell her HTML/CSS/Javascript.

Q2. Do you notice any trends or points of interest?

She says that most of her data concerns are with intake—for outcomes, her organization hopes to have mostly adoptions, and the other outcomes don't apply as much to them as to governmental shelters, etc. She says she would like to see more granularity from SAC's nebulous "other" category.

Q3. Is there any information here that is surprising to you?

Not really

Q4. What do you find difficult or frustrating about the interface?

"I think it's very intuitive"

Q5. Is there any additional information that you wish you could see?

The different types of visualization, as discussed earlier, and also the ability to compress the amount of data, for instance to view only 1 year at a time.

Other Notes:

We briefly discussed Animal Shelter Manager, which is a tool out of Britain that her organization uses to collect data and track the animals in their care. She showed me the site on her phone—there is very detailed information on all of the animals, e.g. notes put in by the shelter or fosters, tracking of movement into foster or surgery, adoption history, etc. She says that she can pull reports using SQL, which is useful up to a point but starts to get very technical, and there's no way for her to visualize any of the reports. She says it would be nice if Animal Shelter Manager could link up to this visualization tool.