Austin Pets Alive! & Maddie's Fund

Canine Parvovirus Research Project

Retrospective Outcomes Study Final Report

Author: Dr. Kevin Horecka, April 30th, 2018

Introduction

The canine parvovirus is a viral illness known for its incredible infectiousness and infliction primarily on young dog populations. Although a vaccine exists which is highly effective in preventing infection, this vaccine takes time to generate immunity, and animal populations lacking access to the vaccine will, obviously, not be protected. Because the canine parvovirus (parvo, for short) can live on surfaces for up to a year, transmitted via the fecal-oral route, it can easily infect virtually any young dog who is unprotected. Moreover, households which are infected may assume particular cleaning methods normally utilized for infectious disease control (i.e. soap, all-purpose cleaners, etc) will kill parvo; however, the only household cleaner which kills parvo is bleach. If bleach is not used, it is likely a household will remain contaminated. All of that said, parvo is a very treatable illness. In many private practice environments, the treatment can cost more than 1,000 to 2,000 USD in the United States, and shelters are often hesitant to treat it due to the highly infectious nature of the illness - instead, choosing euthanasia to protect the rest of the shelter population.

Austin Pets Alive! has been successfully treating the canine parvovirus in a quarantine environment since 2009, treating anywhere from 200 to 800 dogs in any given year in a shelter environment with save rates consistently above 80% and often as high as 90-95%. The treatments can be performed economically due to the isolation of all animals within a section of the shelter exclusively designated for the treatment of parvo, the presence of a dedicated volunteer staff to perform treatments twice a day, and the donations of the public of blankets, food, and funds to pay for medicines and other equipment necessary for treatment.

Despite the success in treatment of these animals, some concern has been expressed in the past about developmental or other lasting effects of the disease or its treatment on health and behavior. It is the purpose of this study to assess whether or not these effects are present by comparing a population of animals which were infected with parvo from the ages of 1 to 3 months once they have reached the age of 1 year to an equivalent, matched population from the same shelter which never contracted parvo (but were successfully vaccinated against it). To accomplish this comparison, surveys were filled out by 98 post-parvo owners and 99 matched comparison owners on a variety of medical and behavioral issues which are common to animals in the 1 year age group. The remainder of this document will outline the results of this comparison.

Methods

Subjects

98 post-parvo owners and 99 matched comparison owners responded to a survey containing question about health and behavioral issues they have observed in their animals. These data were collected primarily between January 10th, 2018 and January 23rd, 2018. The animals in question were all approximately 1 year of age, with the post-parvo animals having been successfully cured of the disease between 1 and 3 months of age. The survey data was hand-cleaned by the researchers to ensure respondents successfully performed the survey, and none of the reported data contains any respondents who did not successfully complete the survey in its entirety. One respondent, not reported in the data set, no longer possessed the animal and was, therefore, excluded.

Survey Questions

The following table contains the survey questions which were analysed:

Table 1:

#	Question Type	Question	Subquestion
1	*Prerequisite* (Yes/No)	Does the dog that you adopted from APA! still live with you?	
2	(No problems, Minor problems, Moderate problems, Serious problems, Very serious problems)	We will appreciate if you could tell us more about your pet's health issue. Which of the following best describes any health problems that your pet has or had, since you adopted him/her?	
3	(Yes/No Per Issue, Free Answer)	Please select all the health conditions that your pet has or had, since you adopted him/her? Please check all that apply. Please tell us more about the health condition(s) you noted. For each health condition, please note: 1. When the condition started 2. Was it evaluated by a veterinarian 3. How serious was the condition (mild, moderate, severe) 4. Did the condition go away or is it a chronic condition? 5. If a chronic condition, how often does it reoccur?	Heart conditions Digestive conditions Skin conditions Kidney/Urinary conditions Mobility conditions Eye conditions Ear conditions Respiratory conditions Immune system conditions Allergies Neurological conditions None of the above Other (please specify)
4	(No problems, Minor problems,	We will appreciate if you could tell us more about your pet's behavioral issue.	

	Moderate problems, Serious problems, Very serious problems)	Which of the following best describes any behavioral problems that your pet has or had, since you adopted him/her?	
5	(Yes/No Per Issue, Free Answer, & Severity 1-5)	Please select all the behavior condition(s) that your pet has or had, since you adopted him/her. Check all that apply. Please tell us more about the behavior condition(s) you noted. For each behavior condition, please note: 1. When the condition started 2. Was it evaluated by a behaviorist 3. Did the condition go away or is it chronic 4. How often does it occur On the scale from 1 to 5 where 1=not at all and 5=very much how severe is/are any of the behavior problems listed below.	Peeing or pooping in the house Aggression towards people Aggression towards other dogs Aggression toward cats Chasing wildlife Shyness toward people Shyness toward dogs Excessive barking or vocalizing Excessive jumping and/or mouthing people when excited Separation anxiety Destructive behavior (destroying furniture or objects) None of the above Other (please specify)
6	(Never, Rarely, Sometimes, Frequently)	Please specify how frequently does your pet display any of the following toward people.	Growl Snap Bite
7	(Never, Rarely, Sometimes, Frequently)	Please specify how frequently does your pet display any of the following toward other dogs.	Growl Snap Bite
8	(Friendly, Scared, Hyperactive, Calm, Aggressive, My dog hasn't been to a veterinary clinic)	If your veterinarian were to use a few words to describe your dog's behavior in the veterinary clinic, what do you think they would say?	

9	(Easy to handle, Mostly easy to handle but rarely more challenging to handle, Not easy but not difficult to handle (neutral), Difficult to handle, My vet recommends that my dog be sedated for veterinary visits)	How easy is it to handle your dog at the veterinary clinic?	
10	(Yes/No)	Does anyone else live in your household?	
11	Numeric	Excluding yourself, how many people of the following ages also live in your household? Leave blank if none.	0-5 6-9 10-17 18-22 23-29 30-59 60+
12	Numeric	How many of the following many pets are there in your household? Please do not include the dog you adopted from Austin Pets Alive!. Leave blank if none.	Number of dogs Number of cats

Statistical Analyses

The questions were grouped as described in the survey. When the question involved a categorical judgement, resulting in a frequency of responses from participants, a Chi Squared Test was used to evaluate overall group differences in the response type frequencies. If this test was significant, follow-up pairwise (two-sided Welch's student t-test for unequal variance) analyses were conducted with Bonferroni correction for multiple comparisons. If the number of responses per category were sufficiently low so as to violate the assumptions of the Chi Squared Test (i.e. fewer than 5 responses per category), a Fisher's Exact Test was used instead. In the case of comparison of numerical values (i.e. non-categorical variables), a 2×N ANOVA was first used to determine if there were group

differences. If there were, two-sided Welch's t-test for unequal variance with bonferroni correction for multiple comparisons were employed.

α=0.05 was used for significance in all tests.

All analyses were conducted in a Jupyter Notebook in Python using Numpy, Scipy, Pandas, and RPy2 and using Matplotlib for visualization.

Results

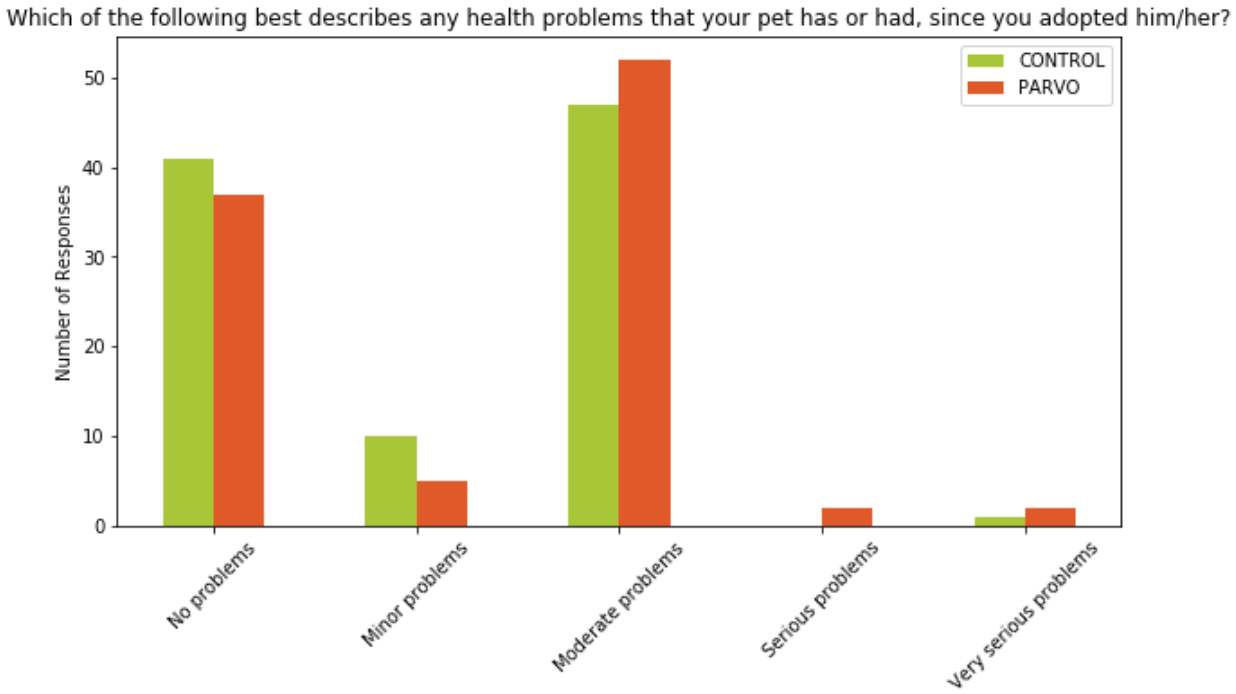
The results will be evaluated from a top-down approach, looking at the high-level, critical questions about health and behavior (2-7; **Table 1**) first, then following up as appropriate. The isolated questions (8-12; **Table 1**) will then be evaluated.

Health Results

No Significant Group Difference in Health Outcomes

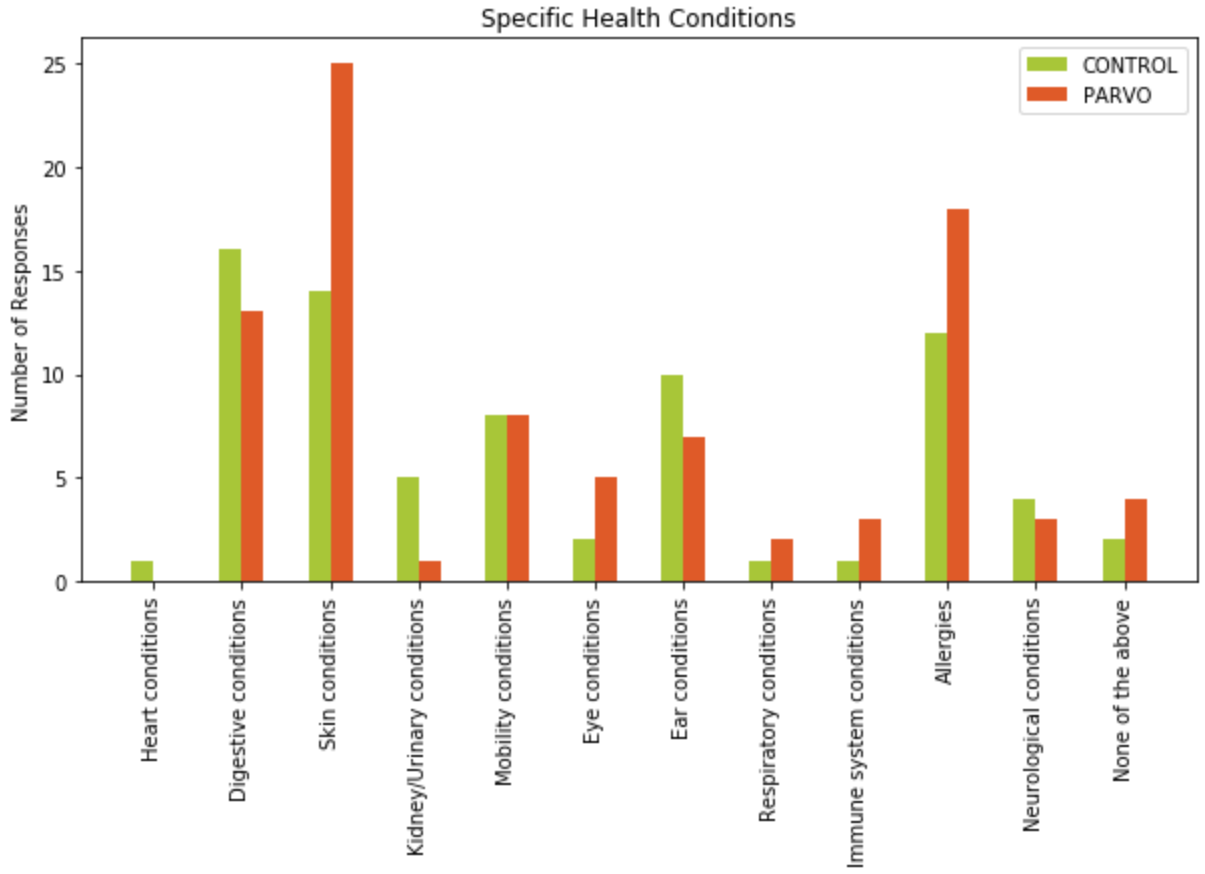
First, the high-level question of whether or not the owner believed their animal had health issues of a particular severity is evaluated.

Figure 1:



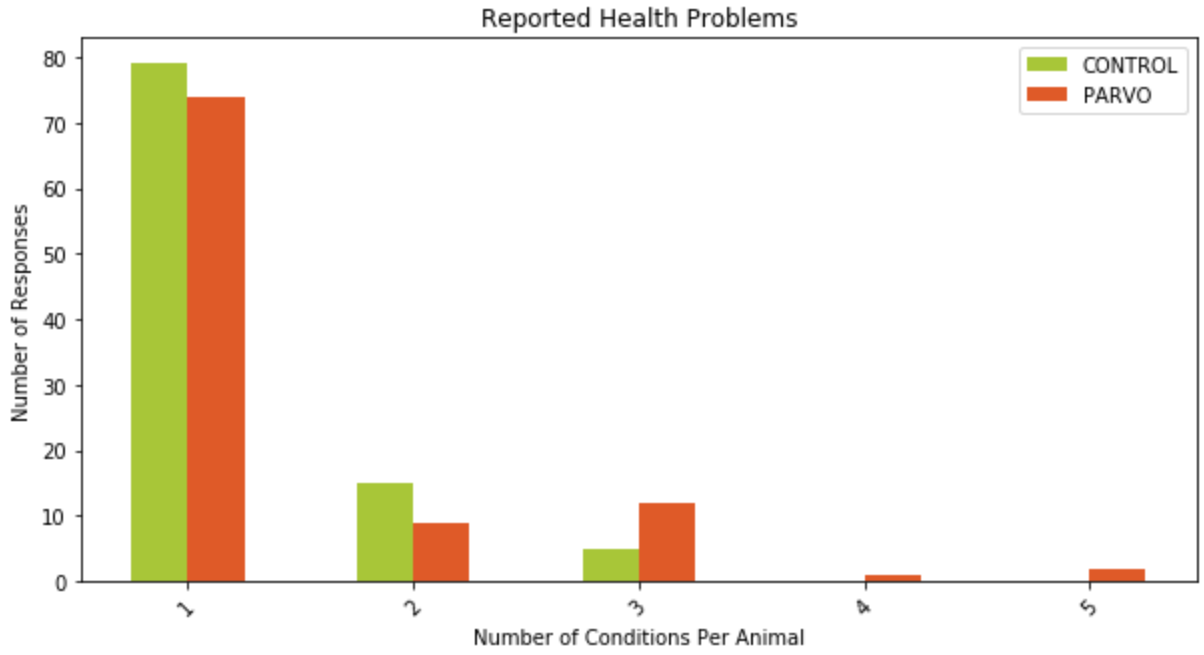
No significant difference in severity of overall health issues was found (p=0.4 via Fisher's Exact Test; **Figure 1**).

Figure 2:



When specific health issues were then examined to see if, although there was no difference in group-wise severity of health issues, there may have been differences in the types of issues being noted, no significant difference was found at the group-level ($p=0.43$ via Fisher's Exact Test; **Figure 2**).

Figure 3:



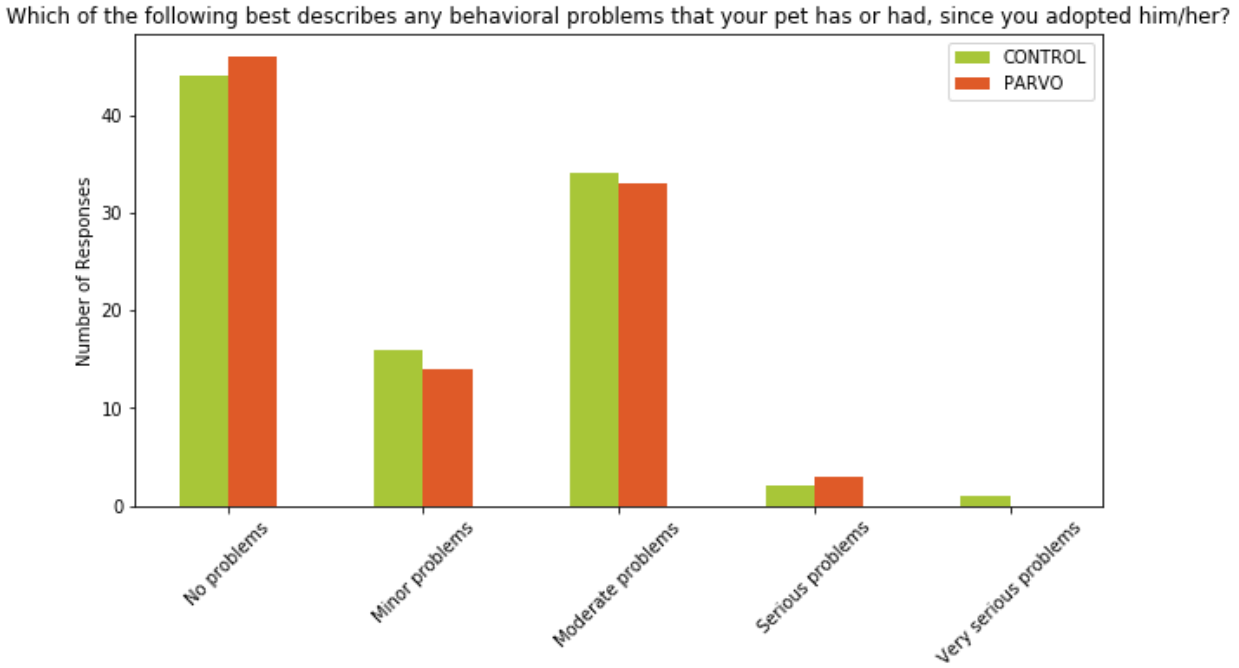
Moreover, when the number of specific health problems per animal were compared to determine if, perhaps, individual animals in a group were driving the effect, no significant difference in the number of conditions per animal was found (p=0.08; **Figure 3**).

Therefore, no group difference in health outcomes is seen for parvo vs. comparison animals.

No Significant Group Difference in Behavior Outcomes

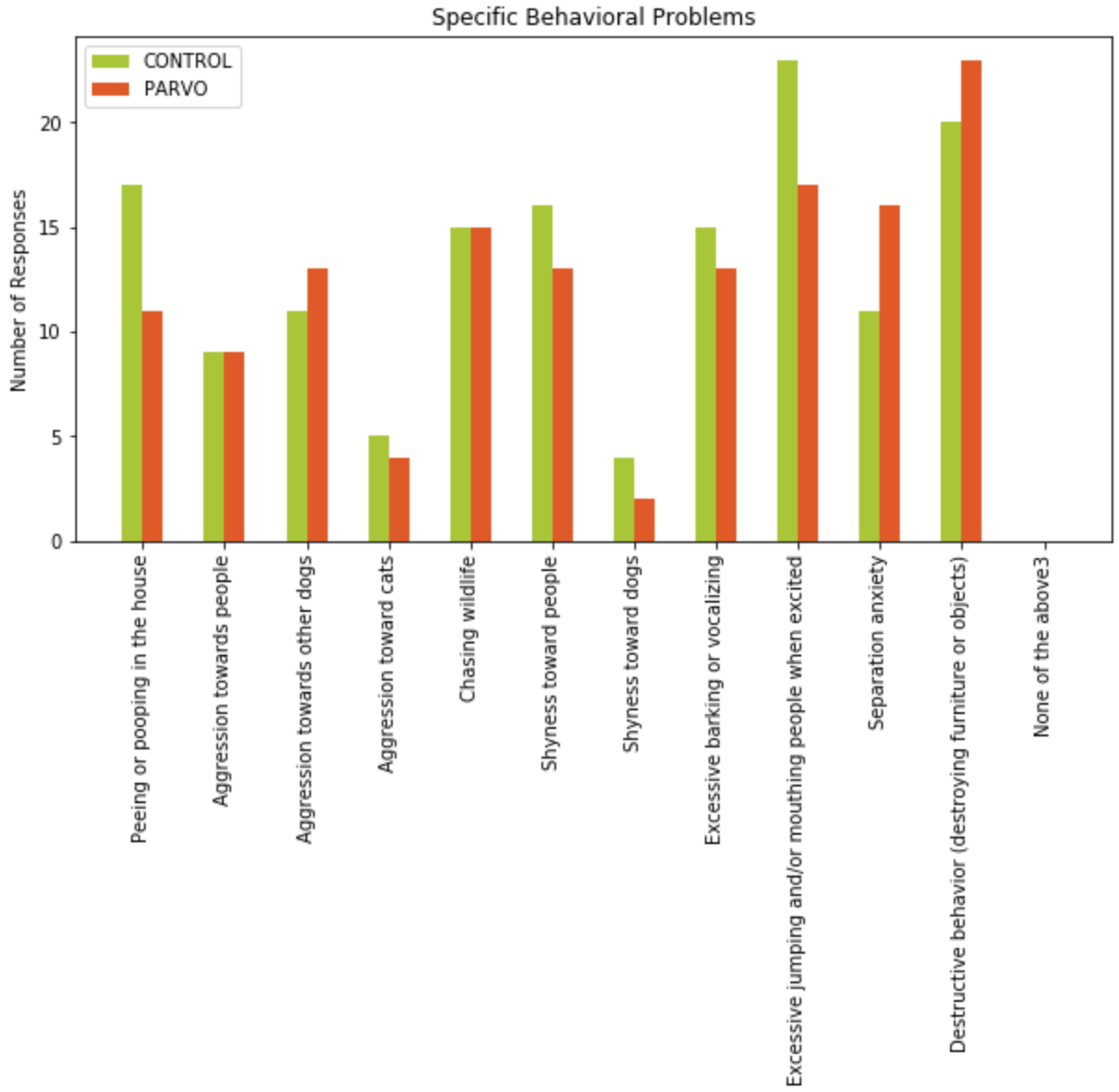
First, the high-level question of whether or not the owner believed their animal had behavior issues of a particular severity is evaluated.

Figure 4:



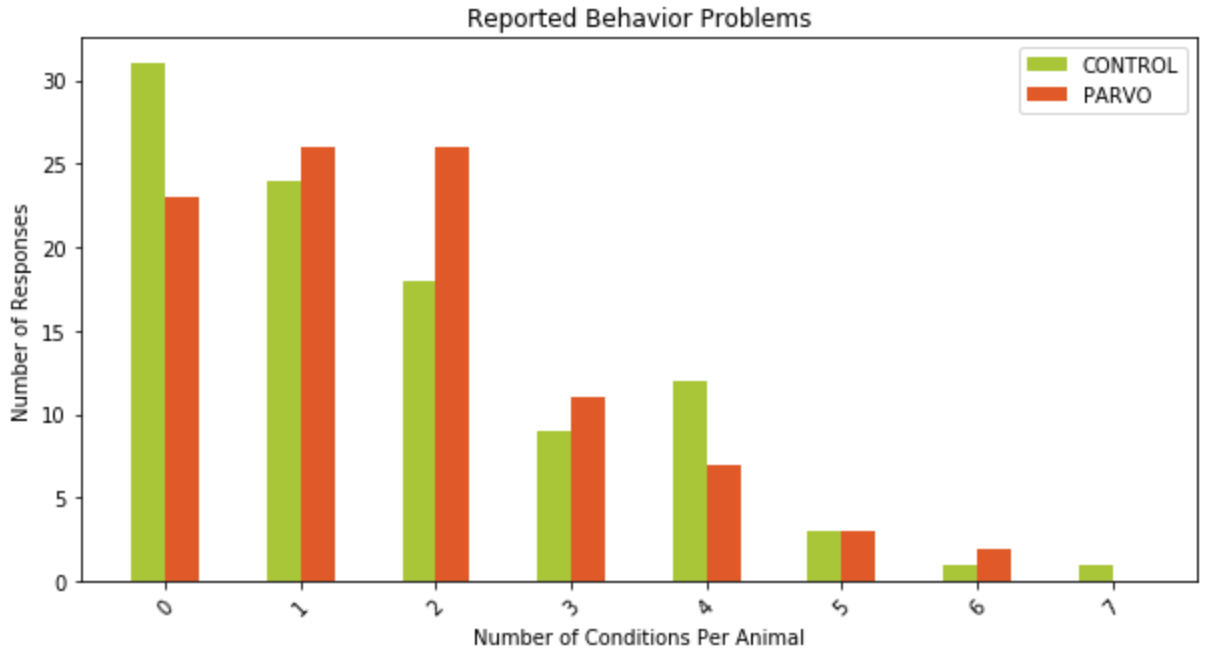
No significant difference in severity of overall behavior issues was found ($p=0.95$ via Fisher's Exact Test; **Figure 4**).

Figure 5:



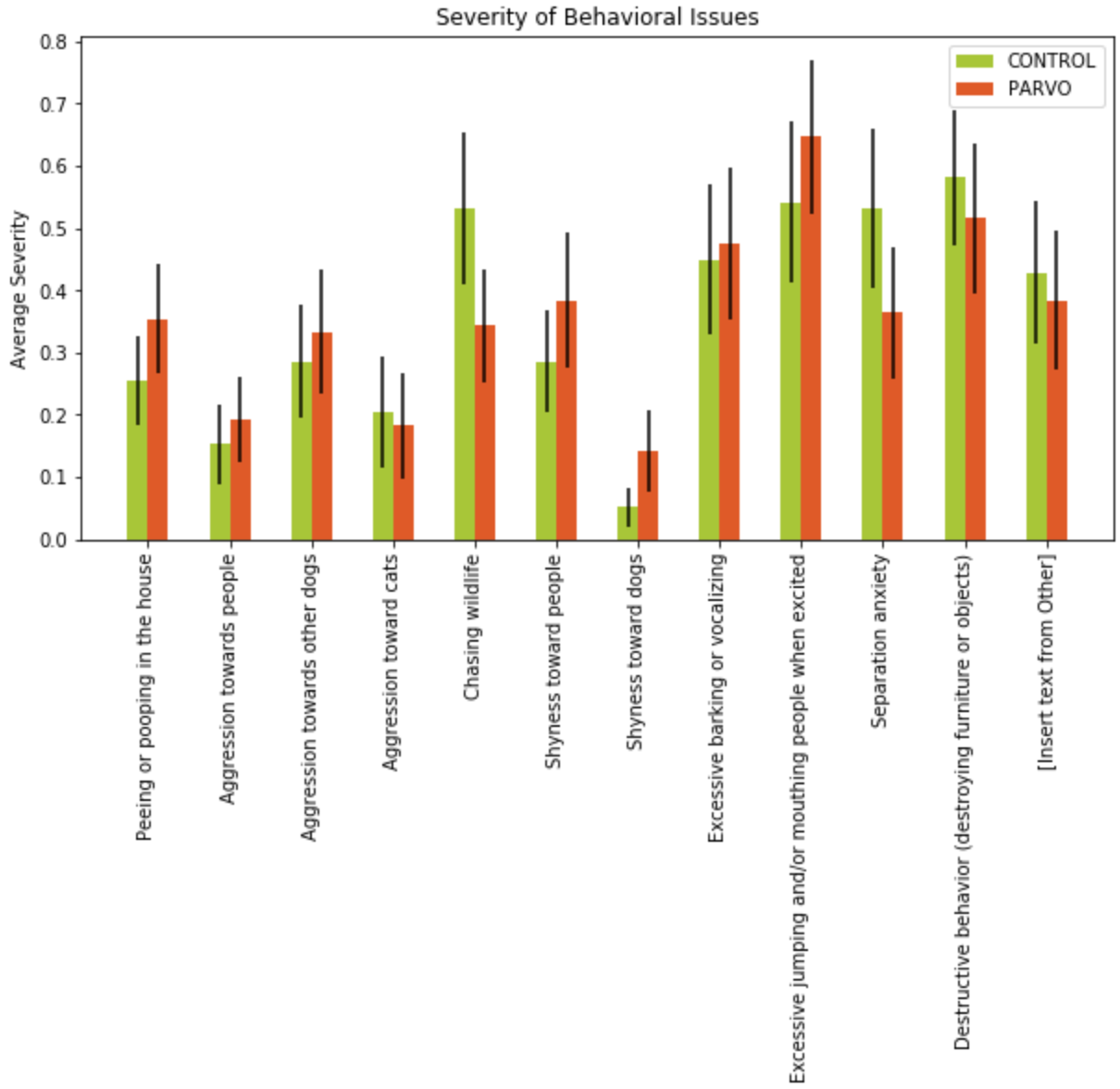
When specific behavior issues were then examined to see if, although there was no difference in group-wise severity of behavior issues, there may have been differences in the types of issues being noted, no significant difference was found at the group-level (p=0.93 via Fisher's Exact Test; **Figure 5**).

Figure 6:



Moreover, when the number of specific behavior problems per animal were compared to determine if, perhaps, individual animals in a group were driving the effect, no significant difference in the number of conditions per animal was found (p=0.60; **Figure 6**).

Figure 7:

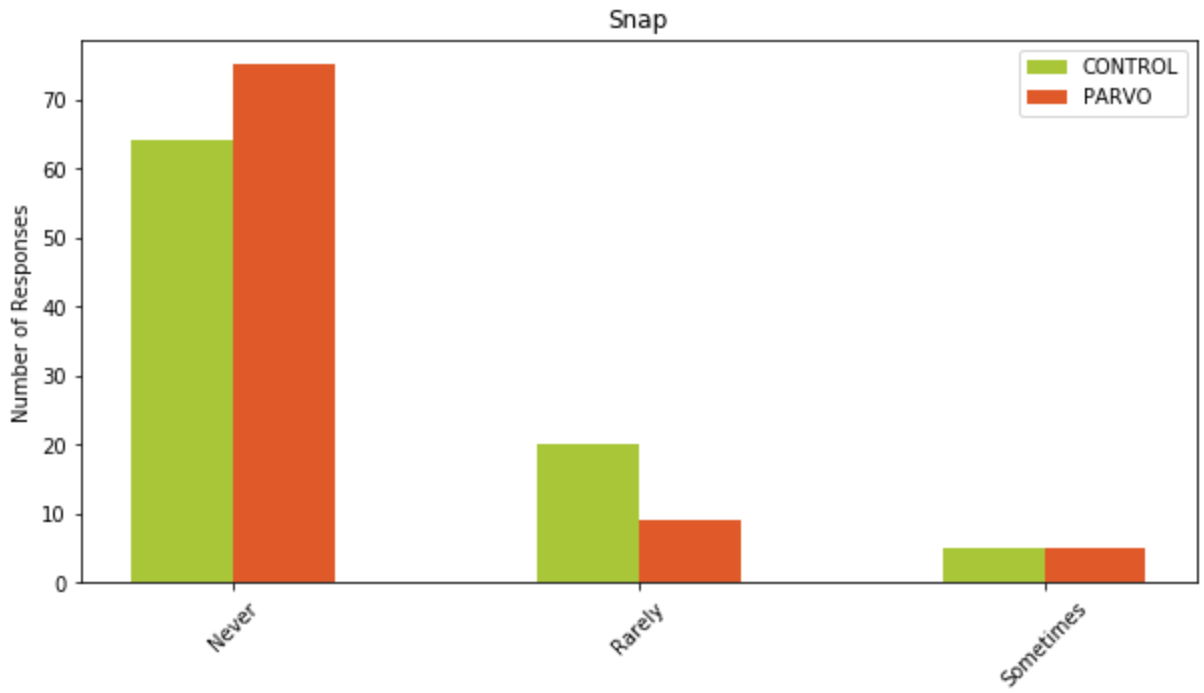


When the severity of reported behavioral issues was compared, no group difference was found between the severity of reported issues (**Figure 7**).

Significant Group Difference in Snapping Behavior Towards Humans

Parvo owners reported significantly less snapping behavior than comparisons towards humans (p=0.02, χ^2=7.94; **Figure 8**).

Figure 8:



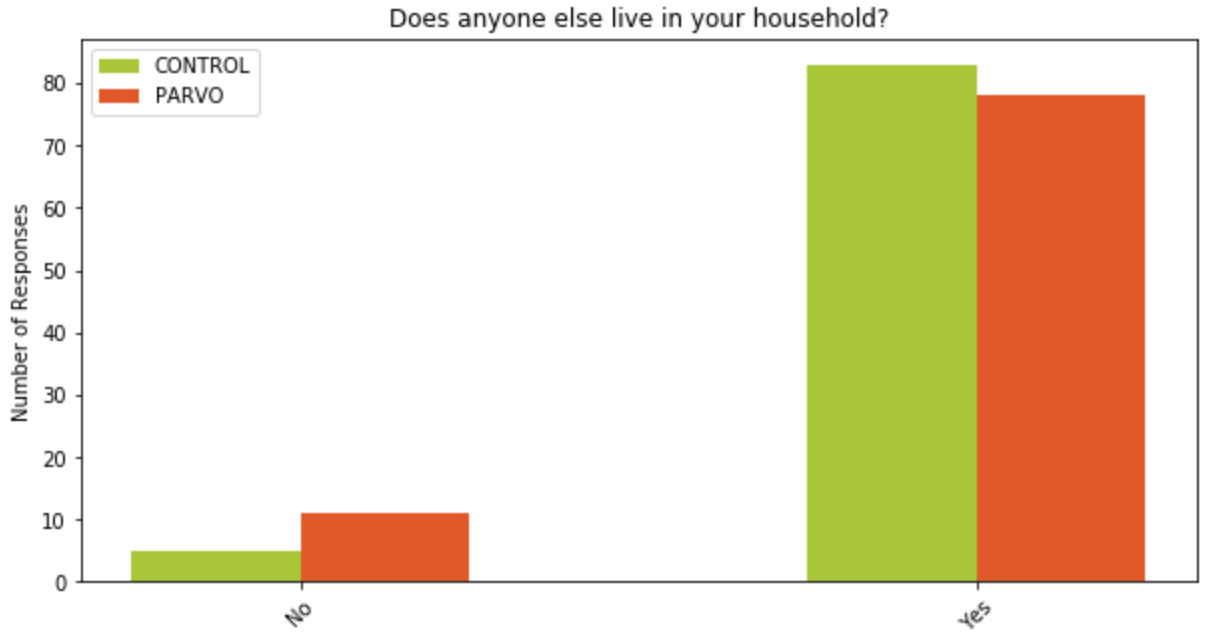
Clinic Handling

When examining the differences in clinic handling (8 and 9; **Table 1**), no significant difference was found in how animals were described (p=0.88 for 8; **Table 1** and p=0.43 for 9; **Table 1**, both via Fisher's Exact Test).

Household Configuration

When examining the differences in household configuration (10-12; **Table 1**), no significant difference in reported household ages (p=0.09, χ^2=10.99), number of dogs (p=0.18 via Fisher's Exact Test), or number of cats (p=0.36 via Fisher's Exact Test) was found, however, a control animals were more likely to live in households with more than one person (p=0.006, χ^2=7.50; **Figure 9**).

Figure 9:



Discussion

Overall, the canine parvovirus does not appear to have any significant impact on behavior or development in the currently presented population of animals. Although one significant differences in reported behavioral conditions was noted (comparison animals being reported as more likely to Snap at Humans, **Figure 8**), this specific issue will need to be addressed in an independent dataset to determine if it is truly related to this disease. Although the week of handling by volunteers (receiving injections, force feedings, and other invasive procedures) may reduce the likelihood of parvo animals snapping at humans, it is also possible that parvo owners are less mindful of these behaviors. Future studies would need to examine these issues specifically to determine their true significance.

Although it is interesting that parvo animals are more likely to end up in households with only one person (**Figure 9**), this could be due to potential adopters without other significant personal obligations being more comfortable taking on what they see as animals with a more challenged history. It could also be the case that, due to the imposition of an additional adoption fee associated with the prior treatment of parvo, single individuals are more comfortable paying the fee (suggesting parvo animals may be more desirable due to

their age, but only certain potential adopters are willing to pay the fee). This, of course, is all speculation and has no impact on the fundamental question of whether or not the disease impacts outcomes for these animals.

It is also interesting to note that although the instances of reported health conditions were not significantly different between the groups, numerical differences existed between the individual conditions which warrant further investigation. In particular, parvo animals had higher reported instances of skin conditions and allergies (**Figure 2**), potentially reflecting impacts of particular medications used or developmental effects of severe disease states at an early age. An opposite pattern can be found in digestive, kidney, and ear conditions in parvo animals (with comparison having more of these conditions) which could point to some protective mechanism due to recovery from a severe illness. This could also be a bias due to the outcome of parvo animals as only those which survived the disease could be interviewed. If robust digestive and kidney function are beneficial to fighting the disease, this difference could be a reflection of that bias.

Overall, *it is the opinion of this researcher that no significant impact on behavioral or health outcomes is present in parvo animals when compared to matched controls*, furthering the case that these animals can and should be treated and adopted out just as any other shelter animal.