

College Canines: Investigating the Behavioral and Physiological Impacts of Various College-Housing Environments on Companion Dogs

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ABSTRACT

Companion animals are becoming a more familiar sight on college campuses, and they are often viewed as an essential element of wellness by students and institutions of higher education. While previous studies have investigated the behavioral and physiological impacts of bringing a pet to campus on the owners, impacts on the pets themselves have yet to be explored. Previous studies do suggest, however, that when dogs are left alone, they display more anxiety-related behaviors such as barking, destruction, lip-licking, body shaking, and higher levels of alertness. The present study investigated the difference in anxiety-related behaviors between on-campus dwelling dogs ($n = 18$) and off-campus dwelling dogs ($n = 12$) when exposed to a novel environment, and the physiological baseline of the dogs. Specifically, a saliva sample was collected from each dog before they were placed into a novel room for three minutes and their behavior was coded. Overall, there were no significant differences found between the two groups in either the anxiety-related behaviors observed or salivary cortisol levels. The implications of our findings for campus dogs will be discussed.

KEYWORDS

Companion Animals; Dogs; Behavior; Cortisol; Higher Education; Dog Welfare; Service Animals; Animal-Assisted Interventions; Student Mental Health

INTRODUCTION

Companion animals accompanying their owners when they go off to college encompasses a relatively new human-animal dynamic. Some colleges and universities are strict—only allowing service animals or emotional support animals—while other institutions offer entirely “pet-friendly” campuses. Regardless, the sight of companion animals on college campuses is becoming more prevalent.¹⁻²

College can be a time of distress for students. Between transitioning from home to college, dealing with academic expectations, and managing new social relationships, students often experience anxiety, depression, and loneliness.¹⁻⁴ To mitigate these challenges, it is estimated that 62% of universities in the United States implement animal-visitation programs, such as visits from therapy dogs during exam weeks.^{2,5} These programs are impactful, as previous literature suggests that human-animal interactions can have both physiological and psychological impacts on an individual, such as decreased blood pressure,⁶⁻¹⁰ increased engagement in physical activity,¹⁰⁻¹² reductions in medication,^{10, 13} greater feelings of happiness,^{10, 14} and an improved mood.^{10, 15}

Some colleges have gone as far as allowing students to bring their family pets to live with them on campus.^{2, 16} However, bringing a family companion animal to live on a college campus introduces many changes for the animal such as living in a smaller space, being exposed to many unfamiliar people and animals, being left alone for long periods of time, and having to adjust to a new lifestyle and routine. Highfill and Goodman-Wilson (2017) found that student-pet owners, on average, reported a low investment of both time and money in the care of their pet.¹⁷ Specifically, students reported spending an average of only four hours per day with their dogs or cats, which may render a more stressful living condition for animals than life in a family home.¹⁷ While other studies have yet to investigate the impacts of living in a dorm room on dogs, researchers have examined the effects of other types of housing environments on stress levels in dogs. For example, Beerda et al. (1999) investigated stress levels in fifteen beagles living either in group housing or individually.¹⁸ Overall, when living in housing that restricted their space and social interactions, dogs displayed more stress-related (*e.g.*, autogrooming, eating feces, vocalizing) and aggressive behaviors.¹⁸

Another potential issue of dogs living in a dorm setting is being left alone for extended periods of time while students are in class and at extracurricular activities. Previous studies have indicated that when left alone, dogs display more anxiety-related behaviors

such as barking,^{19–21} destruction,¹² lip-licking, body shaking and higher levels of alertness.^{19, 21} Frank et al. (2007) conducted an exploratory study investigating the behavior of puppies when left alone.¹⁹ They found that many of the behaviors that were exhibited by the puppies were compatible with anxiety or fear, such as vocalizing, yawning, scratching, licking their lips, and a heightened sense of awareness.^{19, 22}

In similar research, Rehn and Keeling (2011) investigated how dogs are affected when their owners leave them home alone during the workday.²¹ In this study, twelve dogs were tested across three conditions: being left alone for thirty minutes, being left alone for two hours, and being left alone for four hours. Upon return of their owners, the dogs who were left alone for two and four hours demonstrated significantly more attentive behaviors and physical activity than the dogs who were left for half an hour. There was no difference in the number of interactions initiated by the owners, suggesting that the dogs' post-separation behaviors were dependent on the time differences rather than on owner behaviors. Overall, the researchers concluded that dogs could perceive and be affected by the length of time they are left alone, but researchers did not find any evidence to suggest that the welfare of dogs is reduced during separation.

In addition to behavioral observations, measuring cortisol concentrations is an increasingly common method for physiologically detecting dog stress and welfare.^{23–24} Cortisol is a glucocorticoid hormone produced by the hypothalamic-pituitary-adrenal (HPA) stress response pathway. Therefore, this hormone has been used to investigate the stress of dogs in various environments such as shelters,^{24–26} kennels/pet hotels,^{27–28} laboratories,^{29–31} veterinary clinics,^{32–33} and the worksites of military, therapy, and other working dogs.^{34–37} Detecting cortisol levels in non-invasive samples such as saliva has therefore become more widely used, as it is important that the methods used for measuring the physiological stress response in dogs does not cause additional stress.²³ Salivary cortisol concentrations correlate well with plasma levels and this non-invasive sample collection is generally well tolerated by dogs.³⁸

Although companion animals are becoming an increasingly familiar sight on college campuses, previous studies have only investigated the effects of bringing a pet to college on pet owners. Therefore, the goal of the present study was to investigate the impacts of this situation on dogs by examining how on-campus and off-campus dwelling dogs respond to being left alone. We chose these two populations of dogs because they both live with college students, but they differ in their living spaces. We also measured if there were physiological differences in stress between the two groups of dogs by comparing baseline salivary cortisol levels. Based on previous literature, we hypothesized that when left alone, on-campus dwelling dogs would exhibit more anxiety-related behaviors than off-campus dwelling dogs, given that dogs who live on campus live in much smaller environments. Similarly, based on previous literature, we hypothesized that on-campus dwelling dogs would exhibit higher levels of baseline cortisol since they reside in smaller environments, suggesting that their increased stress could be detected both behaviorally and physiologically.

METHODS AND PROCEDURES

Subjects

This study was conducted at a small college in the southeastern United States and was approved by the home institution's IACUC. Thirty dogs (see **Table 1**) of varying breeds and sizes participated in the study (average age = 4.33 years; average length of ownership = 3.30 years; average length of time on-campus dwelling dogs have lived on campus = 2.33 semesters). In accordance with the previously reported effects of sex, neuter status, and age on salivary cortisol levels,³⁹ only dogs who were neutered or spayed and older than 6 months were selected for the study.

Name	Breed	Living	Age (yrs)	Length of Ownership (yrs)	Semesters Living on Campus	Analysis Type
Abby	Maltese Poodle	on	3	3	4	B; P
Apollo	Golden Retriever	off	0.75	0.75	n/a	B; P
Augie	American Eskimo Mix	on	1.5	1.5	2	B; P
Bean	Deer Head Chihuahua	on	12	2	3	B; P
Bosco	Black Lab/Rottweiler Mix	on	2	0.75	2	B; P
Callie	Mini Australian Shepherd	off	4	4	n/a	B
Chance	Border Collie	on	4	4	1	B; P
Cleo	Lab Mix	off	1.5	1	n/a	B; P
Dakota	Golden Retriever	on	5	5	2	B; P
Einstein	Pembroke Welsh Corgi	off	8	0.75	n/a	B; P
Ezra Grey	Australian Shepherd	on	1	1	1	B; P
Guppy	Cocker Spaniel	off	1.5	0.5	n/a	B
Ivy	Akita Inu	off	3	2.5	n/a	B; P
Jax	Jack Russel/Chihuahua Mix	off	3	3	n/a	B
Kona	Chihuahua Mix	on	5	2	3	B
Lexi	Lab Mix	on	12	12	1	B
Lila	Poodle Mix	on	5	5	6	B
Louie	Lab/Shepherd Mix	on	1	1	3	B; P
Luna	Pitbull Mix	on	2	2	4	B
Luna	Labrador Retriever	on	4	4	2	B; P
Luna	Golden Retriever	on	3	3	2	B; P
Molly	Husky Mix	on	8	7	1	B; P
Mookie	Pitbull/Bulldog Mix	on	2	0.5	1	B; P
Neo	Giant Schnauzer	off	9	9	n/a	B; P
Niki	Australian Shepherd	off	12	11	n/a	B; P
Padfoot	Havanese	off	3.5	3	n/a	B; P
Peanut	Chihuahua/Shih Tzu Mix	off	1	0.75	n/a	B; P
Rocky Balboa	Shih Tzu	on	5	5	2	B
Silas	Corgi Mix	on	3	1	2	B; P
Thea	Lab/Pitbull Mix	off	4	3	n/a	B; P

Table 1. Breed, living location, age, length of ownership, number of semesters living on campus, and the analysis of the subject (behavioral = B; physiological = P).

Participants were recruited via email and all dogs were owned by undergraduate students or recent alumni who were currently in graduate school and were offered either extra credit in their psychology courses or a \$5 gift card if they participated in the study. Eighteen of the dogs lived on campus in “pet-friendly” dormitories. The remaining twelve dogs lived off campus with their owners.

The college has several styles of dormitories. Traditional housing dorms are approximately 3.4 m x 4.9 m, or 18.6 sq. meters and are double-occupancy bedrooms. All of the dorm room housing is much smaller than popular off-campus apartments, which range in size from 48.8 sq. meters (one bedroom, one bath) to 103.8 sq. meters (two bedrooms, two baths).

Testing Room

Testing took place in a small, carpeted lab room (3 m x 2.4 m). Owners were instructed to bring one of their dog’s favorite items from home, such as a dog bed, a favorite blanket, or a toy, to leave in the room with their dog. Water was provided in a bowl.

The Outward Look of Fear/Anxiety/Stress	
Furrowed Brow	When the area above the dog’s eyes shows tension and there is some wrinkling.
Panting: Tongue in Mouth	When the dog pants but the tongue doesn’t protrude further than the dog’s lower incisors.
Panting: Wide	When the dog pants and his mouth is open wider than seems necessary.
Penis Crowning	When the tip of the dog’s penis sticks out of its sheath.
Spine Straight	When the dog’s back remains in a straight line.
Whale Eye	When the whites of the dog’s eyes show.
Information Gathering Signals	
Air-Sniffing (or, Leaning Forward Sniffing)	When the dog twitches and flares his nostrils, raising his nose upward or outward slightly, moves his nose from side to side. The dog’s feet and body remain stationary.
Blinking	When the dog blinks his eyes less than every two seconds or longer (<2 seconds).
Licking: Nose	When the dog’s tongue comes out the front of his mouth and completely covers his nose, so that for a brief moment you can see the underside of the dog’s tongue. The tongue comes directly out and goes back in from the front of the dog’s mouth.
Licking: Sideways	When the dog’s tongue comes out the front of his mouth, covers the nose only partially and then moves down the side of the dog’s mouth and retreats back in from the back of the lips.
Sniffing	When the dog sniffs the ground, furniture, people, objects for more than two seconds without disconnecting from scent, without chewing or eating anything (>2 seconds).
Action or Movement-Related Behaviors	
Hypervigilance	When the dog keeps in constant motion, or moves rapidly, and is constantly alert and aroused to his environment.
Hyperexcitability	When the dog’s state of arousal is out of sync with what is going on in the environment—i.e. the dog is aroused when the situation is relatively stable. The dog will most often be panting quickly, eyes will be round and open, pupils dilated, brow furrowed, tail wagging.
Jumping	When both of the dog’s hind legs leave the ground with front paws up.
Lack of Movement	When the dog’s wakeful state keeps him standing, sitting or lying down, hardly moving his feet, his spine is usually straight, and there is little movement out of any part of his body (>3 seconds).
Stereotypic Behaviors	
Circling	When the dog traces a circular motion, in one direction, over and over again.
Pacing or Route-Tracing	When the dog traces a path side to side, walking a certain distance in one direction, and then the dog walks the same distance in the other direction, repeatedly. Each change in direction is preceded by a signature head-flick.
Vocalizations	
Bark Spells	Sharp loud vocalization. Number of seconds between barking spells (>1 second).
Whine / Cry	Long, high pitched vocalization. Measured frequency of whining / crying spells with at least 2 seconds separating each spell.

Table 2. Operational definitions of anxious-type behavior variables in dogs.

Behavioral Procedure

The dog and the owner experienced a brief acclimation period of two minutes, where the dog was allowed to sniff around the lab room and become comfortable with surroundings. Next, saliva was collected from the dog’s mouth (see below for procedure).

Then, the owner was asked to do their normal routine of leaving the dog (e.g., saying good-bye, petting). The dog was left alone in the lab room for three minutes. During the separation period, the owner was asked to step outside of the building, so that their scent was no longer in the vicinity of the lab room. The dog was observed by researchers through a one-way mirror. To reduce blind spots, the dog was filmed from two-points of view: (1) a camera on a table in the lab room, and (2) through the mirror. After 3 minutes, the owner returned to the room and greeted the dog. Videos were analyzed later and coded (inter-rater reliability = 91%) using an ethogram adapted from Sternberg (2007) (see **Table 2**).⁴⁰

Physiological Procedure

All saliva samples were collected from 8:00 am-12:00 pm since cortisol levels are known to vary significantly throughout a 24-hour day.³⁹ To validate this four-hour window, mean salivary cortisol concentrations for on-campus dogs collected from 8:00 am-10:00 am (0.2564 µg/dL) versus 10:00 am-12:00 pm (0.1915 µg/dL) were compared and no significant difference was observed ($t(11) = -1.01, p = .17$). Dog owners were instructed to ensure that dogs did not eat one hour prior to sampling and did not drink 10 minutes before collection to avoid sample dilution.

Cortisol samples were only collected prior to behavioral analyses, as the goal of this measurement was to compare baseline cortisol levels, rather than to analyze any differences before and after the separation. Samples were collected using a Salimetrics SalivaBio Children’s Swab by placing it on the side of the dog’s mouth for ~30 seconds. Owners were asked to gently restrain their dog if necessary.

To facilitate salivation, the dog was presented with a small dog treat, which was given after sufficient saliva was collected (at least 0.5 g). Any samples that had visible blood contamination were discarded. The saliva was immediately frozen at -20 °C and later analyzed for cortisol using a Salimetrics Salivary Cortisol Elisa Kit according to the manufacturer's protocol. SPSS Statistics Version 26 was used to run independent-samples *t*-tests for both behavioral and physiological data.

RESULTS

Behavioral Results

A series of independent-samples *t*-tests were conducted to determine whether there were significant differences among observed anxiety-related behaviors between dogs living on-campus vs. off-campus (**Table 3**). Overall, no significant differences were found for any of the behaviors ($p > 0.05$).

Behavior	Living	Mean	Standard Deviation	t	df	p
Total # of Dog Anxious Behaviors	on	23.94	14.95	-.010	28	.99
	off	24.00	13.78			
Sum of Outward Look of Fear/Anxiety/Stress	on	6.97	6.14	.252	28	.99
	off	6.42	5.58			
Sum of Information Gathering Signals	on	5.86	3.83	-.519	28	.61
	off	6.67	4.64			
Sum of Action or Movement-Related Behaviors	on	6.14	5.73	-.177	28	.86
	off	6.50	5.04			
Sum of Stereotypic Behavior	on	3.81	5.06	-.260	28	.80
	off	4.25	3.77			
Bark Spells	on	3.75	4.95	.608	28	.55
	off	2.67	4.52			
Whine / Cry	on	5.11	5.06	-.815	28	.42
	off	6.83	6.51			

Table 3. Independent samples *t*-tests of selected observed anxiety-related behaviors between dogs living on-campus vs. off-campus.

Physiological Results

While we were able to analyze the behaviors of all 30 dogs, analyzable saliva samples were collected from 22 of the dogs, 13 of those being on-campus dwelling and nine off-campus dwelling. All saliva samples had cortisol concentrations in the range of those commonly reported for domestic canines.³⁹ Even though the mean salivary cortisol concentration was higher for dogs living off-campus in comparison to those living on-campus (0.2946 µg/dL vs. 0.2115 µg/dL, respectively; (see **Figure 1**)), the difference was not statistically significant ($t(20) = -1.46, p = .08$;). The salivary cortisol levels of on-campus and off-campus dogs collected

in the first part of our sampling window (8:00am-10:00am) were further compared to ensure diurnal fluctuations were not masking any differences. No significant difference was found (on-campus mean: 0.1915 $\mu\text{g/dL}$; off-campus mean: 0.2839 $\mu\text{g/dL}$; $t(15) = -1.54, p = .07$).

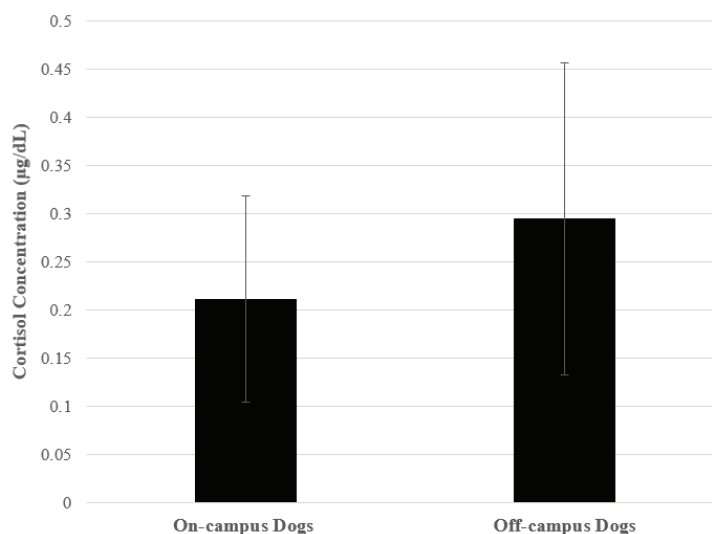


Figure 1. Comparison of salivary cortisol concentrations for on-campus ($n = 13$) vs. off-campus dogs ($n = 9$).

DISCUSSION

Based on previous research, we hypothesized that when left alone in the lab, on-campus dwelling dogs would exhibit more anxiety-related behaviors than off-campus dwelling dogs, given that dogs who live on-campus live in much smaller environments. Similarly, we hypothesized that on-campus dwelling dogs would exhibit higher levels of cortisol, suggesting that they were more stressed. Overall, our results indicate that there were no significant differences in cortisol levels and that there were no significant behavioral differences between the on-campus dwelling dogs and off-campus dwelling dogs when left alone. These results do not support our hypotheses; however, these results are positive in that they suggest that dogs living in dorm rooms on college campuses do not experience significantly different welfare conditions than dogs living in larger complexes off campus.

A confound to our research could be the duration of time that a dog has lived in their given environment. Rooney et al. (2007) suggested that dogs exhibit more anxiety-related behaviors and have higher levels of cortisol when living in a newer environment.⁴¹ This is important to note since college students have the tendency to live in a dorm for nine months at a time before returning home for the summer. In this study, the average length of time that on-campus dwelling dogs lived on campus was two-and-one-third semesters. The average length of time that off-campus dwelling dogs lived in their respective environments was not obtained. Future studies should control for the duration that an animal has lived in their environment. Additionally, a longitudinal study could be conducted to compare the number of anxiety-related behaviors and the cortisol levels of dogs before they come to campus, immediately after they first come to campus, during their time on campus, and then again right before their owner graduates. An additional facet of this could include another non-invasive approach of analyzing the cortisol levels of hair over similar timelines to correlate the results with salivary concentrations.⁴¹ Combined, this would provide more information on the impact of living on campus on dogs, as previous studies have suggested that dogs who are habituated to their environment may exhibit less anxiety-related behaviors and have lower levels of cortisol.⁴²

Even though our results indicated no behavioral or physiological differences between on-campus and off-campus dwelling dogs, it is important to consider the mental stimulation of the dogs owned by college students. Indeed, previous studies have shown that increased human interaction has led to lower cortisol levels and improved scores on behavior tests in dogs residing in shelters.^{25, 26, 43} Therefore, future studies could include a third subject group of off-campus dogs who are not owned by college students to explore possible differences in owner-lifestyle and dog welfare experiences. Additionally, to investigate the behavioral differences between on-campus and off-campus dwelling dogs when left alone in the home, future studies could utilize citizen science by asking owners to set up hidden cameras that film their dogs when left alone. Furthermore, given the limited sample size of our study—a challenge not new to comparative cognition⁴⁴⁻⁴⁶—we encourage other researchers to replicate our study to learn more about the impacts of various housing environments on companion dogs.

This study is among the first to explore the behavior and physiology of dogs living on college campuses. Since dogs are becoming an increasingly familiar sight on college campuses, it is of utmost importance to continue to research all aspects of welfare in order to ensure our furry friends are living fulfilling lives as their owners get their diplomas.

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PRESS SUMMARY

Companion animals are becoming a more familiar sight on college campuses, and they are often viewed as an essential element of wellness by students and institutions of higher education. Though previous researchers have investigated the behavioral and physiological impacts of bringing a pet to campus on the owners, the present study is the first to investigate the impact on the pets themselves. Specifically, the present study investigated the difference in anxiety-related behaviors between on-campus dwelling dogs and off-campus dwelling dogs when exposed to a novel (new) environment, and the physiological baseline of the dogs. Overall, there were no significant differences found between the two groups in either the anxiety-related behaviors observed or salivary cortisol levels, suggesting that there were no behavioral or physiological differences between these two populations of dogs.