Evaluating Student Stress in an Animal Science Course with Unsupervised Livestock Experience

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Abstract

In recent years, Animal Science demographics have been shifting from many students having an abundance of animal experience towards a majority of students having little to no prior animal experience. It's important to note this demographic shift and to consider how this shift could be impacting student mental health. Throughout a semester long parturition management course with unsupervised animal experiences, physiological and psychological stress data were collected along with student demographic data and prior animal experience levels (novice, beginner, mid-level, and advanced). Participant experience level played a role in psychological stress where students of different levels had differing levels of stress. Similarly, student experience level effected their physiological stress where students in the second lowest categorization of animal experience tended to have a lower stress than those in the next, more experienced category. All other demographic variables were not different for both psychological and physiological stress. Future studies should investigate student stress in introductory animal courses to better understand their initial stress when working with animals at the collegiate level.

Keywords: animal science, stress, heart rate variability, perceived stress

Student stress at the university level is a long-studied topic. In a literature review completed by Robotham and Julian (2006), several categories of stressors were identified such as examinations, financial pressures, transitioning to university, study-related stressors, as well as a variety of other categories for students at the university level. Another study from Yikealo et al. (2018) found that a majority of students in their study had moderate to high levels of stress as a result of various causes. The American College Health Association (2015) reported that 42.8% of students experienced more than average stress levels and 37.3% of students felt they experienced average stress levels in college.

The Animal Science field in undergraduate programs has seen a shift from students that have hands-on experience prior to attendance, to students that have little to no large animal experience at all (Boerngen and Rickard, 2020; Buchanan, 2008; Bundy et al., 2019). In the early days of Animal Science, articles make frequent reference to "men teaching boys", but as time went on there was a shift from this to a demographic with more female students (Bucanan, 2008). Buchanan (2008) stated that since 1983, there has been a continuation of this shift where there are more urban students, females, and students with future plans that differ from returning to a family farm. Some research has continued investigating this change, such as Boerngen and Rickard (2020) who examined student perception of their background in an introductory agriculture course. In this paper, the authors reported the perceptions that students have of their backgrounds and where they fall in a more defined manner of what a "farm background" can entail (Boerngen & Rickard, 2020). Bundy et al. (2019) looked at the addition of an introductory animal handling course and its effects on student comfort level with large animals, as well as if student demographics played a role in student performance. They found that students that had farm backgrounds outscored students that did not in course pre-exams, however, their

background had no impact on their post exam scores (Bundy et al., 2019).

Generally, stress can be measured in different ways depending on the context and goal of the measurement, including both physiological and psychological stress. One way to measure psychological stress is through the Perceived Stress Survey (PSS), which is a commonly utilized and well proven measure of the extent to which respondents perceive their life's predictability, level of control and overloading (Cohen et al., 1983). This survey consists of 10 Likert-scale questions that are then scored for an overall stress score of the survey. There are a wide variety of studies that have used this specific survey as a tool to determine stress levels in different populations (Anwer et al., 2020; Denovan et al., 2019; Maroufizadeh et al., 2018; Torales 2011). Validity and accuracy of this survey have been proven in studies over time and different researchers have continued to support its accuracy and applicability in different populations and in comparison to other similar scales (Juarez-Garcia, 2021; Lee, 2012; Taylor, 2015).

An additional mechanism for measuring stress is heart rate variability (HRV), which has been shown to measure the physiological stress response. Kim et al. (2018) noted that, in most studies, HRV measurements changed when the stressor was introduced and reflected changes in the parasympathetic nervous system. Heart rate variability measures the changes in time intervals between consecutive heart beats and has been said to reflect regulation by the autonomic nervous system, which in turn can portray stress levels (Shaffer & Ginsberg, 2017). Heart rate variability values are inversely related to stress levels (Kim et al. 2018). The nervous system is divided into two different sections, the sympathetic and parasympathetic systems. The sympathetic system is dominant during "fight or flight" situations and the parasympathetic nervous system is dominant during "rest and digest" circumstances (Tindle and Tadi, 2022).

To the author's knowledge, there have been no studies investigating student stress levels in the animal science discipline. The purpose of the present study was to investigate student psychological and physiological stress in an animal science course to determine effects of prior animal experience and demographic data on student stress.

Methods

The Illinois State University Institutional Review Board approved all study experimental methods prior to conducting the study (IRB: 2022-172). This study took place in a Parturition Management course (AGR 236) at Illinois State University in spring semester of 2023. In this class, students are responsible for taking material that is presented to them in class and applying it during unsupervised six-hour shifts at the Illinois State University farm in Lexington, Illinois. Shifts at the farm occur between the hours of 18:00 to 0:00 and 0:00 to 06:00 every night throughout the majority of the semester. Students are required to take an Introduction to Animal Science course prerequisite where they have a laboratory section that introduces them to the species that are worked with in this course. Students are asked to assist pregnant mothers, as needed, through the process of parturition (birth) in sheep (lambing), pigs (farrowing), and cattle (calving). They then process any newborns and keep records. Students in this course are partnered with a minimum of one partner, and a maximum of three and are never allowed to be on the farm alone. Prior to on-farm shifts, students are given lectures where they learn expectations, potential situations, and the chain of command for who they should contact if something were to go wrong (teaching assistants, farm staff). They are also given hands-on laboratories with models that allow them to learn positioning of animals and how to properly assist a birth, if necessary. Students are taken to the barns to be shown the placement of different items, as well as the use of tools that may be necessary for the parturition process.

The study was introduced in the first class session of the semester, where students were given consent forms and demographic surveys. To be eligible for the study, participants were required to be studying Pre-Veterinary Medicine (PVM), Animal Industry Management (AIM) or Animal Science (ANSC). Student participation was voluntary and did not affect their grades in the course. The professor did not have access to data from the study until all data had been de-identified and final grades had been submitted.

Study Participants

Results of the participant demographic surveys are summarized in Table 1. This survey consisted of questions including age, ethnicity, academic sequence, academic classification, hometown population, and level of large animal experience. The demographic survey was a hard copy survey that was later transcribed into a protected spreadsheet. All participants were classified as either juniors or seniors with ages ranging from 19-27 years old and estimated hometown populations ranging from rural to greater than 160,000. There was one male and 15 female participants, with 12 being Caucasian and four non-Caucasian, and a range of prior large animal experience from none to advanced (n =16). Students were asked to rank their large animal (livestock) experience on a 4-point scale in categories of: novice (no prior experience), beginner (little experience), mid-level (some experience), or advanced (moderate to abundant experience). Participants self-identified the category to which their prior experiences with large animals best fit within.

Study Design

The present study was divided into two time periods for each of the species: baseline which occurred on campus prior to the first shift for each species, and on-shift which took place at the Illinois State University Farm immediately prior to their first shift for each species (Figure 1). All measurements were completed by the graduate research assistant on the project, where on campus measurements took place in their office and on-shift measurements took place in the farm conference room. The goal of the baseline measurements was to capture student stress levels outside of the course and took place throughout the day, in an office on campus. Baseline measurements took place on week zero of the study (prior to starting lamb watches), week four of the study (between lamb and calf watch), and week eight of the study

Table 1

Summary Of Participant Demographics in an Unsupervised Animal Science Course

Characteristic	# of students	% Students
Sex		Data
Female	15	94
Male	1	6
Ethnicity		
Caucasian	12	75
Non-Caucasian	4	25
Age		
19	1	6
20	6	38
21	3	19
22	3	19
25	1	6
26	1	6
27	1	6
Major		
Pre-Veterinary Medicine	8	50
Animal Industry Management	3	19
Animal Science	5	31
Year in School		
Junior	8	50
Senior	8	50
Hometown Population		
Rural (<10,000)	4	25
Small (10,001-20,000)	3	19
Mid-sized (20,001-40,000)	4	25
Large (40,001+)	5	31
Animal Experience Level		
Novice (no experience)	2	13
Beginner (little experience)	7	44
Mid-Level (some experience)	4	25
Advanced (moderate experience)	3	19

Note. Participant demographics and the percentage of each demographic in the overall population of the present study

(between calf and piglet watch). Lamb watch was the first species shifts, followed by calf watch, then piglet watch, however, the calving window was significantly longer than the other species, so some participants continued to have calf watch shifts after the piglet watch portion. On-shift measurements were taken at the Illinois State University farm on their first shift (first lamb watch shift; week one of the study), seventh shift (first calf watch shift; week five of the study) and 14th shift (first piglet watch shift; week nine of the study), 15 to 30 minutes prior to the start of their shifts.

Study Implementation

Measurements were taken by a graduate research assistant in the same manner in each meeting. For this, participants were asked to sit in a chair and fill out a paper copy of the PSS survey, allowing their heart rate to slow to a resting rate. The PSS survey was modified, this included changing the time period from “In the past month…” to “In the past week…” (See Figure 2; as previously described by Lawrence et al., 2024). After completion of the PSS survey, participants were given the HRV chest strap (Polar H9, Polar Electro, Kempele, Finland) that was lubricated with water, and placed on the bare skin just below their sternum. A smart phone app (Elite HRV Inc., Asheville, NC, USA) was utilized to connect to the HRV chest strap via Bluetooth to the participant’s smart device for collecting heart rate data. This app also gave the participants breathing cues to keep the heart rate at a resting, consistent rate. This HRV data was collected over a period of 2.5 minutes and recorded. When data was collected, all participants were assigned a number that was connected to their demographic data, allowing for the correlation between participant demographics and stress levels, while keeping participant data de-identified. After completion of both the HRV and the PSS survey, the surveys were scored. The survey utilizes 10 Likert scale questions with options from 0-4 and is scored by adding the scores of the questions. There were four “negative” questions where the scores were reversed, and the remaining six “positive” questions were added as is. For the questions that required reverse scoring, responses of a 4 were counted as a 0, responses of a 3 were counted as a 1, responses of 2 were left, responses of 1 were counted as 3, and responses of 0 were counted as 4. The scores of this survey can range from 0-40, with 0 being no perceived stress to 40 being the highest perceived stress score.

Statistical Analysis

Data were analyzed utilizing the mixed procedure of SAS (version 9.4; Cary, NC 27513), with a statistical difference determined when $P < 0.05$. Two models were utilized to analyze these data: one with HRV and other with PSS as the dependent variables. Both models utilized the independent variables ethnicity (Caucasian, non-Caucasian), academic year (junior, senior), experience level (novice, beginner, mid-level, advanced), animal species (lamb, calf, piglet), and baseline HRV and baseline PSS (corresponding baseline measurements for each species measurement). Additionally, the interaction between the experience level and animal species was included. Repeated measures were utilized with participant as the subject. Tukey adjustments were used for pairwise comparisons, when appropriate. Residual panels were analyzed for normality and homogeneity of variance assumptions.

Results

Summary statistics of the data are included in Table 2. Throughout the whole study, the average PSS scores were: overall, 15.5 ± 7.7 (mean ± standard deviation); lamb, 15.1 ± 8.3; calf, 14.6 ± 7.2; and piglet, 16.3 ± 8.3. The average HRV results were: overall, 57.7 ± 10.7; lamb, 58.6 ± 10.4; calf, 59.3 ± 13.7; and piglet 56.9± 8.9.

The PSS results are summarized in Table 3. Main effects of species, ethnicity, and academic year were not different ($P \geq 0.52$). Prior animal experience influenced PSS ($P < 0.01$), where participants with advanced level experience (17.8 ± 1.3) had higher perceived stress scores than participants with novice and beginner level experience (12.2 ± 1.4 and 12.1 ± 0.8, respectively; $P \leq 0.04$). Participants with mid-level experience (17.2 ± 1.4) had a higher perceived stress score than those in the beginner level ($P = 0.03$) and tended

Figure 1

Timeline of measurements

Note. At each time period, Perceived Stress Surveys were given, and Heart Rate Variability data was collected. The Baseline measurements were taken in a controlled setting on campus, the species measurements (lamb, calf, and piglet watch) were taken at the farm prior to students having an overnight shift of observing animals in a Parturition Management Course.

Figure 2

1.	In the past week, how often have you been upset because of something that happened unexpectedly?
2.	In the past week, how often have you felt that you were unable to control the important things in your life?
3.	In the past week, how often have you felt nervous and stressed?
4.	In the past week, how often have you felt confident about your ability to handle your personal problems?
5.	In the past week, how often have you felt that things were going your way?
6.	In the past week, how often have you found that you could not cope with all the things that you had to do?
7.	In the past week, how often have you been able to control irritations in your life?
8.	In the past week, how often have you felt that you were on top of things?
9.	In the past week, how often have you been angered because of things that happened that were outside of your control?
10.	In the past week, how often have you felt difficulties were piling up so high that you could not overcome them?

Note. Students participants in the study were given this 10-question Likert scale survey that was adapted from the Perceived Stress Scale (Cohen et al. 1983). They were given this a total of 7 times, 4 baseline measurements and 3 experimental measurements in a Parturition Management course. For this, the participants chose one of the following that they felt best fit them: 0 – never, 1 - almost never, 2 – sometimes, 3 - fairly often, or 4 - very often. Questions 4, 5, 7, and 8 had reverse scoring where responses of 0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0. All other questions (1, 2, 3, 6, 9, 10) were added as they were, to the reversed scored questions for a final total out of a possible 40.

Table 2

Summary Statistics for Heart Rate Variability and Perceived Stress in an Unsupervised Animal Science Course

Measurement	Variable	N	Mean	Standard Deviation	Minimum	Maximum
Overall	HRV	111	57.5	10.7	30	89
	PSS	111	15.5	7.7	1	35
Lamb	HRV	16	58.6	10.4	45	80
	PSS	16	15.1	8.3	4	35
Calf	HRV	16	59.3	13.7	36	89
	PSS	16	14.6	7.2	3	25
Piglet	HRV	16	56.9	8.9	43	75
	PSS	16	16.3	8.3	1	3

Note. Summary Statistics of participant Perceived Stress (PSS) and Heart Rate Variability (HRV) scores throughout an unsupervised animal science course and overall including the number of measurements, mean, standard deviation, minimum and maximum.

to have a higher perceived stress than those in the novice level experience (P = 0.08). However, all other pairwise comparisons within experience level were not different ($P \geq$ 0.97).

Model findings concerning HRV are summarized in Table 4. There were no effects of animal species, ethnicity, and academic year on HRV ($P \geq 0.13$). There was a tendency for prior animal experience to effect HRV (P = 0.08), where participants with beginner level experience (60.8 ± 2.1) tended to have a higher HRV than those with mid-level experience (48.6 ± 3.6; P = 0.06). However, no other differences were detected in the pairwise comparisons ($P \geq 0.32$).

Discussion

In the parturition management course for the present study, the first species that participants interacted with was sheep. They had two lectures prior to the first set of unsupervised watch shifts that showed them what to expect and look for, as well as what would be expected of them. It is intuitive that their first animal shift would be the most stressful, and over time their confidence would build. Anecdotally, calf watch was expected to cause a z level of stress due to the size and danger associated with cattle, particularly around calving time, but the current results did not support this idea. Results of the present study show that animal species did not play a role in student stress levels. The PSS results for all 3 species and the baseline (see Table 2) fall into the moderate stress category (14-26; Graves et al.; Table 5). This means that throughout the study, participants did not reach a point of severe perceived stress, but with no difference between their baseline measurements, this is likely where their stress is on average.

Ethnicity results of the present study did not indicate a difference between the two categories of ethnicity (Caucasian and non-Caucasian) in the present study. Lawrence et al. (2024) looked at student stress levels while studying abroad and found that Caucasian participants

Table 3

Effect Of Demographic Variables and Animal Species On Perceived Stress

Variable	Level	Estimate	Standard Error	P-Value
Prior Animal Experience	Novice (None)	12.2^{ab}	1.4	0.01
	Beginner	12.1^{a}	0.8	
	Mid-Level	17.2^{bc}	1.4	
	Advanced	17.8^{c}	1.3	
Species	Lamb	14.3	1.6	0.92
	Calf	15.2	1.5	
	Piglet	15.1	1.5	
Ethnicity	Non-Caucasian	14.2	1.5	0.52
	Caucasian	15.4	0.6	
Academic Year	Junior	15.3	0.7	0.53
	Senior	14.4	1.1	

Note. Prior animal experience, species, ethnicity, and academic year effects on participant Perceived Stress (PSS) in an unsupervised animal science course. Estimates represent the LS means. ^{abc} Estimates within each variable with differing letter superscripts are different (P < 0.05).

Table 4

Effect Of Demographic Variables and Animal Species On Heart Rate Variability

Variable	Level	Estimate	Standard Error	P-Value
Prior Animal Experience	Novice (None)	56.5	3.9	0.08
	Beginner	60.8[x]	2.1	
	Mid-Level	48.6[y]	3.6	
	Advanced	55.9	3.4	
Species	Lamb	55.7	3.2	0.97
	Calf	55.8	3.1	
	Piglet	54.9	3.0	
Ethnicity	Non-Caucasian	51.5	4.0	0.13
	Caucasian	59.4	1.7	
Academic Year	Junior	57.57	2.0	0.24
	Senior	53.33	3.1	

Note. Prior animal experience, species, ethnicity, and academic year effects on participant heart rate variability in an unsupervised animal science course. Levels with variables were considered different when P < 0.05. [xy] Estimates within each variable with differing letter superscripts tend to differ (P < 0.10).

Table 5

Perceived Stress Scale Mean Score Comparisons

Article Author	Average	Standard Deviation	PSS Stress Category
Present Study	15.5	7.7	Moderate
Adamson et al. 2020	20.14	7.26	Moderate
Shaw et al. 2017	17.90	7.0	Moderate
Cohen and Janicki-Deverts 2012	16.78	6.86	Moderate

Note. Perceived Stress Scores (PSS) in college aged students in different studies in comparison to the present study.

were more psychologically stressed than non-Caucasian participants. Anderson (2004) reported contradictory results, where Caucasian participants were the least stressed of the ethnicities they observed. This was also noted in a study completed by Sternthal (2011), where they found Caucasian participants were the least stressed. Differences between the present study and conflicting studies could be due to a relatively low number of participants and an imbalance between the number of Caucasian (12) and non-Caucasian (4) participants in the present study. Additionally, the study completed by Sternthal (2011) was composed of participants of a variety of ages that averaged 43.84 years, with 3105 participants. When compared to the present study, which had an average age of 21.63 years and 16 total participants, it is a challenge to make generalizations with this population. The present study results came from a participant pool that was not reflective of the general population, making it difficult to compare the results to other studies that have larger participant numbers and are more representative of the general population. Current study demographics, however, were representative of the animal science field (Bundy et al. 2019; Boerngen & Rickard 2020).

Participant experience levels were based upon self-reporting with the range from no experience to an advanced level of prior animal experience. To be admitted into this course, students were required to take the prerequisite Introduction to Animal Science course, so all students had a minimum experience level coming from the prerequisite course. However, there was a time period where a lab section was not required due to the global pandemic restrictions, so it is possible that some students did not have any prior large animal handling experience.

Participants ranked their own experience, making experience level subjective, which could have caused variation. Participants that self-reported advanced prior animal experience likely took a leadership role and the responsibility that came with it, resulting in relatively high levels of perceived stress. The advanced experience group was more psychologically stressed than participants in the novice and beginner groups, but was not different from those in the mid-level group. Similarly, those in the mid-level group had a greater perceived stress than the beginner group and tended to have a greater perceived stress than the novice group. The students that self-identified in the advanced and mid-level groups likely took on leadership roles while on shift with less experienced partners. It is counterintuitive that the students with less prior animal experience would be less stressed than those with more experience. However, they may have felt comforted and less responsible when partnered with others that had more prior experience. Another explanation could be that students with little animal experience may have been naïve in expectations of issues that could arise when handling livestock, whereas those with more experience better understood the challenges ahead of them.

A study completed by Adams et al. (2015) looked at student backgrounds and their perceptions of livestock practices. This study surveyed two sections of students, the first section had 30% with no prior livestock experience (310 students total), and the second section had 26% with

no livestock experience (328 students total), whereas the remainder of the students in each section reported having experience in one of the following species: horses, cattle, poultry, swine, sheep, or goats. The present study had 12.5% of the participants that reported no experience, and 43.8% of them reporting beginner level experience, accounting for more than half of the participants in the study. Another study completed by Rickard et al. (2017), reported that 77.8% of their students in an animal management program had farm or ranch experience outside of their home. They also reported that 17.1% of animal science students, and 11.1% of their pre-veterinary science students had farm or ranch experience outside their home. This finding is larger than the present study, which found just under half of the participants had on farm experience. Lastly, a study completed by Bundy et al. (2019) evaluated student experience with livestock prior to their introductory course and found that 56.3% of their students did not have experience handling beef cattle, 59.8% sheep and 48.3% swine. These findings agree with the present study, however, the present study did not count for individual species.

The present study found lower results in comparison to others that have utilized PSS in college aged participants. Table 5 compares PSS results from the present study to similar studies. The overall average score of the present study was 15.5 ± 7.7. A study completed by Adamson et al. (2020) reported that their participants ages 18-24 had an average perceived stress score of 20.1 ± 7.3, and their participants that had "some college experience" had an average score of 19.7 ± 7.5. This study observed perceived stress in participants of varying ages during the COVID-19 pandemic, in connection with their demographics, so there may be a slight increase in stress score, due to stress caused by COVID-19. Shaw et al. (2017) evaluated perceived stress in college students and found an average of 17.9 ± 7.2. Lastly, a study completed by Cohen and Janicki-Deverts (2012), evaluated PSS among different demographics in 1983, 2006, and 2009. This study reported in 2009 that average PSS in participants less than 25 years of age was 16. 8 ± 6.9. Overall, the present study had a lower score than the studies above, which may have been due to the range of ages (19-27), or the differences in what the studies were looking at in comparison to the present study. The present study also adjusted the time period of the PSS to a shorter time period, which may also explain these differences.

Some studies take their participants' PSS and allocate them to 3 categories; mild 0-13, moderate, 14-26, and severe 27-40 (Graves et al., 2021; Table 6). Graves et al. (2021) examined gender differences in PSS in college students and found that a majority of their respondents fell within the moderate stress category, followed by severe, while present study had a majority of respondents in the mild stress category. Differences between the two may be due to adjustments made in the present study where the time period was not the same. They could also be due to the study completed by Graves et al. (2021) having more males (35.5%) in comparison to the present study (6%).

Table 6

Perceived Stress Scale Categorical Distribution Comparison

	Mild (0-13)	Moderate (14-26)	Severe (27-40)
Present Study	42 (43)	50 (52)	5 (5)
Graves et al. 2021	6 (1.4)	348 (82.3)	69 (13.3)

Note. Number of responses (percent of the total responses) that fall within the category listed in the present study and those reported in Graves et al. (2021)

Throughout the entire study, there were no differences in physiological stress between species, or demographic variables included in the model, although a tendency in prior animal experience was observed. Mid-level experienced participants tended to have a lower HRV compared to participants with self-reported beginner level experience. This correlates to those in the mid-level category having a greater physiological stress compared to those in the beginner level. Interestingly, no other differences were detected. As mentioned previously, this could be a result of those with slightly more prior experience feeling the pressure of responsibility and leadership when paired with less experienced partners. Intuitively, those that identified with mid-level or moderate experience may have felt that pressure, while also having feelings of insecurity with their animal experience, resulting in more physiological stress, as well as the increased perceived stress, as mentioned previously. This could be explained by the timing of shifts, and the idea that HRV measurements are ideally taken in the morning and at the same time every day (Vila, 2019). The nature of this class did not allow for measurements to be taken consistently in the morning with shifts occurring overnight, which could also partially explain the present results.

Heart rate variability was not different between ethnicities in the present study. This is similar to those reported by Lawrence et al. (2024), a study that also found similar results in regards to ethnicity between their participant's HRV in a study abroad program. However, results of the present study differ from a study completed by El-Wazir (2019) where they reported that, due to genes involved in cardiac function, there are generally differences between different ethnic groups. For example, that study suggested that, in general, HRV is higher in African Americans than those of European descent (El-Wazir, 2019). A difference in the present study is that those that fell into the non-Caucasian category did not identify as African American, which is the most prominently studied non-Caucasian ethnicity.

At Illinois State University, there are many students that come with little to no prior animal experience. In Introductory Animal Science courses, students often have their first interaction with livestock species. These initial interactions may play a vital role in a student's decision to continue studying in animal sciences or pursuing that career field. The present study investigated student stress in an upper-level animal science course, where all students enrolled previously had taken the introductory animal science

prerequisite. Future research in introductory level animal science courses are important to pursue to investigate the initial student stress in animal science.

Summary

In summary, the species of animal that participants were working with had no impact on their stress levels. Participant prior animal experience played a role in their perceived stress levels throughout the study. However, there were minimal differences in physiological stress. Some limitations include a small, unbalanced participant pool, as well as differential timing due to the shifts taking place overnight. Future research is needed in student stress in animal science, specifically, in introductory level courses where students are first interacting with animals at the collegiate level.

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