



# The Effect of an Animal-Assisted Intervention on Physiological Measures of Stress and Anxiety in Graduate Professional Physical Therapy Students

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**How to cite this paper:** Williams, C.L., Dagnan, E., Miner, K.M. and Sells, P. (2018) The Effect of an Animal-Assisted Intervention on Physiological Measures of Stress and Anxiety in Graduate Professional Physical Therapy Students. *Open Access Library Journal*, 5: e4364.

<https://doi.org/10.4236/oalib.1104364>

**Received:** January 23, 2018

**Accepted:** February 20, 2018

**Published:** February 23, 2018

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## Abstract

**Introduction.** Graduate professional educational programs are very rigorous and challenging, often leading to increased physiological stress and perceived anxiety for the enrolled student. Stress and anxiety levels in physical therapy students are higher than that in their age and gender matched peers. The purpose of this study was to assess the impact of an animal-assisted intervention on stress and anxiety of entry-level physical therapist (PT) students prior to a laboratory practical exam. **Subjects.** Twenty-three first-year PT students (mean age  $23.4 \pm 1.70$ ) participated in this study. **Methods.** A 15 - 20-minute intervention which either included a therapy dog or no therapy dog was performed prior to the students' laboratory practical exam. Following the intervention, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and state anxiety measures using the State-Trait Anxiety Inventory (STAI) were obtained. Results were compared to baseline measures as well as between each of four intervention trials using repeated measures ANOVA or Friedman test (alpha level of  $p < 0.05$ ). A post-participation questionnaire was administered at the end of the study. **Results.** Statistical significance was found between the no dog trials (Trial 1 & Trial 4) and the dog trials (Trial 2 & Trial 3) for state anxiety ( $p = 0.000$ ), indicating that state anxiety scores were lower when students were exposed to the therapy dog compared to when no dog was present. No statistically significant effects of the therapy dog were observed for HR, SBP or DBP ( $p > 0.005$ ). **Discussion and Conclusion.** The results of this study indicate that animal-assisted interventions may be beneficial in reducing perceived anxiety for students in graduate professional educational programs prior to an examination.

## Subject Areas

Kinesiology, Nursing

## Keywords

Therapy Animal, State-Trait Anxiety Inventory, Test Anxiety, Animal-Assisted Interventions

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## 1. Introduction and Review of Literature

The prevalence of anxiety in the population is reported to be between 10% - 30% [1]. Students in graduate level educational programs are especially susceptible to increased anxiety and stress [2] [3] [4] related to academic performance, the fear of failing, finances/debt, and poor work/school-life balance [5]. Obtaining a graduate level degree is a challenging process that can result in significant stress and anxiety for many students [2] [3] [4]. Over 70% of graduate students report a stressor that has interfered with their optimal functioning [5], and approximately 47% of college students seeking counseling services report moderate to high levels of anxiety, with 33% experiencing stress that is significant enough to interfere with their academic performance [6].

While many students are able to adapt to the increased stress and demands of pursuing a graduate level degree, some students are not able to effectively manage the increased pressure and begin to develop test anxiety [7]. Gerwing [8] *et al.* found that 38.5% of students (30.0% of males, 46.3% of females) self-reported that they suffered from some level of test anxiety throughout their university career. Test anxiety can lead to high levels of worry and physical discomfort [9], and disrupts a person's ability to think, perceive and learn [1]. A person suffering from anxiety usually experiences difficulty in concentrating, remembering materials, and establishing necessary relations among events or people [1]. Anxiety related to taking an exam has been negatively associated with overall test performance, and therefore overall academic achievement [4] [10] [11]. In addition to poor performance, acute anxiety has negative consequences on general health and well-being such as compromised immunity [10] [12]. Long-term effects of chronic stress and anxiety increase the risk of developing hypertension and coronary heart disease [13] [14] [15].

One method of reducing stress and anxiety that is gaining popularity on college campuses is animal-assisted interventions, in which volunteers bring their registered therapy animals to visit with students on campus. Several studies have indicated that interacting with a therapy animal has been shown to reduce stress and anxiety, as well as promote other positive health benefits [16]-[22]. While much of the information related to the benefit of animal-assisted interventions is anecdotal in nature, there are several studies that have examined the effect of an animal intervention on various physiological measures of stress. For example,

Boyer & Mundschenk [23] noted decreased salivary cortisol levels in the presence of a dog both during and after a stressful task. Friedmann *et al.* [24] found that the presence of a novel friendly dog in children's homes lowered blood pressure while resting and while reading. Allen *et al.* [25] compared autonomic responses in women during a backward subtraction task in which three conditions were compared: female friend present, pet dog present, or no social support control. Participants in the dog condition demonstrated lower heart rate, skin conductance, and blood pressure than the other two groups [25]. In a similar study by Polheber & Matchock [26] examining 85 undergraduate students, heart rate, anxiety and cortisol levels were recorded during a social stressor by comparing three conditions: a novel dog in a laboratory condition, a supportive friend and no social support. The researchers found that non-human social support in the form of a dog served to attenuate salivary cortisol levels and heart rate when compared to the friend (human social support) and control (no social support) conditions [26].

Interacting with a therapy dog can lead to significant changes in oxytocin, b-endorphin, prolactin, phenyl acetic acid, dopamine, various immune factors, as well as reductions in cortisol, all of which are associated with overall well-being and reduction of subjective stress [13] [27] [28]. There are many documented benefits of animal-assisted interventions in patient-care settings, such as a reduction in heart rate [20] [29] [30], anxiety [19] [20] [21] [31] [32], stress [3], fear [33], depression [20] [32], pain [20] [34], and use of medication [29]. In addition, evidence suggests that animal-assisted interventions in healthcare settings have served to increase patient motivation [33] and compliance [35], as well as demonstrate improved cardiovascular measures [31] and physical activity [36]. Animal-assisted interventions have led to improved social interactions [23] [37] and communication [33], which has been shown to improve the moods of both patients as well as healthcare employees [33]. It is speculated that implementing animal-assisted interventions into a healthcare setting may actually decrease the overall cost of healthcare [35].

There is little research that focuses on the benefits of animal-assisted interventions specific to graduate student populations [38]. Prior research has found that the stress and anxiety levels in physical therapist (PT) students is higher than that in their age and gender matched peers [10], and that 81% of PT students perceived their stress levels to be moderate or severe [39]. Given the many benefits of animal-assisted interventions in various populations and settings, it seems reasonable that exposure to an animal intervention in a graduate professional educational program may help reduce stress and anxiety in students. The purpose of this study was to assess whether an animal-assisted intervention would benefit PT students by reducing physiological stress and perceived anxiety prior to taking a laboratory practical exam. It was hypothesized that students who were exposed to a 15 - 20-minute animal-assisted intervention prior to their laboratory practical exam would demonstrate a reduction in heart rate, blood

pressure and self-reported anxiety.

## 2. Subjects

Twenty-three first-year doctorate of physical therapy students (21 females and 2 males) at Belmont University's School of Physical Therapy program in Nashville, Tennessee consented to participate in the study throughout the spring semester (January - April) of their kinesiology course. The study was approved by the Belmont University Institutional Review Board (protocol #151). All students were in the second semester of the first year of a three-year entry-level physical therapist educational program, were over the age of 18 (mean age  $23.4 \pm 1.70$ ), and were enrolled in a kinesiology course which included four laboratory practical exams assessing various entry-level clinical skills. Participation was voluntary and was presented to them by an outside instructor, neither related to the research study itself or the kinesiology course in which they were enrolled. Interested students signed an informed consent prior to participation. Exclusion criteria included being fearful of dogs, being under the age of 18 years old, being allergic to dogs and/or expressing any concerns about participating in the study. There were no enrolled participants excluded from this study.

## 3. Methods

### 3.1. Measurements of Stress and Anxiety

The State-Trait Anxiety Inventory (STAI) is one of the most widely used self-report measures of anxiety in clinical and research settings [1] [40] [41], and has been found to be both reliable and valid [40]. The STAI clearly differentiates between the temporary condition of "state anxiety" which is a subjective fear experienced by an individual in a stressful situation [1] and the more general and long-standing quality of "trait anxiety" which is a predisposition of an individual to anxious living [1]. The state anxiety scale has been used extensively to assess the level of anxiety induced by a stressful situation, such as an important test in school [40]. In the present study, only state anxiety was measured since the information needed was the perceived anxiety level of the individual at a specific point in time, which was just prior to the laboratory practical exam. The state anxiety scale is scored as follows: 1 = not at all, 2 = somewhat, 3 = moderately so, and 4 = very much [1] [40]. The weighted scores for each question are calculated for a total score that can range from a minimum of 20 to a maximum of 80, with higher scores indicating a greater level of anxiety [40]. Normative state anxiety values under non-stressful conditions for undergraduate college students are 36.47 for males and 38.76 for females [40]. There are no normative values established for graduate students.

To assess physiological stress, measurements of heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded since increases in these measures are good indicators of increased physiological stress due to an increase in sympathetic nervous system activity [28] [42] [43]. Prior studies have

demonstrated that SBP, DBP and HR increase significantly in response to taking an examination [44] [45]. Heart rate, SPB and DBP were measured using a portable automatic blood pressure cuff (model #BP3MU1-1E). All measurements were taken by the same researcher for all trials.

### **3.2. Therapy Animal**

A six-year-old, 65 lb. yellow Labrador Retriever, owned and trained by a faculty member in the physical therapy program participated in this study. The dog and handler were evaluated and registered through Pet Partners (formerly the Delta Society), which requires that the animal demonstrates obedience, completes a specific therapy training course and passes a test with set standards and registries [46]. The dog received a rating of “complex” meaning she was qualified for the most complex and unpredictable settings (Pet ID# 685129). In accordance with the rules and regulations of Pet Partners, the dog was cleared by a veterinarian to be in good health and appropriately groomed [46]. A single therapy dog was used in this study to avoid confounding variables, as well as for general feasibility. The therapy dog had one year of experience prior to participating in this study which included visits to various sites, such as outpatient clinics, hospitals and educational settings. Registered therapy animal teams are found throughout the United States and provide services on a volunteer basis.

### **3.3. Intervention**

Baseline measurements of HR, SBP, and DBP were recorded for each subject two weeks prior to the first intervention. For the intervention, subjects entered a room that was designated for the study in groups of two (and one group of three students) for a 15 - 20-minute session immediately prior to the start of their laboratory practical exam. The subjects participated in groups of two to avoid disrupting the normal process of exam testing since they are scheduled for the laboratory practical exam in pairs and at a specific time. Subjects were allowed to interact with the therapy dog in a manner of their choice (petting, hugging, playing ball, etc.) during this session, or when in the control condition, subjects were allowed to use this time as they chose (study, sit quietly, etc.) since no dog was present. The time frame of 15 - 20 minutes was selected in part because a longer intervention period was not logistically feasible without interrupting the flow of the examination process, and also because prior studies have found that 10 - 15 minutes was sufficient time for an animal-assisted intervention to reduce state anxiety [28] [31] and blood pressure [28] [47].

The same study room was used for both the experimental and control conditions of the study. The experimental condition included two researchers from the occupational therapy department, and the registered therapy dog. The control condition was the same as the experimental condition, however the therapy dog was not present. Researchers were selected from a different department intentionally so that the students did not have a prior relationship with them.

During the intervention the researchers were present to observe the behavior and interaction between the subjects and the therapy dog to ensure that the interaction was a positive one and that the therapy dog did not demonstrate any signs of distress. Following the 15 - 20-minute intervention, post-session heart rate, blood pressure, and state anxiety measures were obtained by the researchers for all participants during the period just after the respective session and prior to the laboratory practical exam.

The process for all 23 participants was repeated prior to each of four laboratory practical exams throughout the semester, therefore allowing each subject two exposures to the control condition and two exposures to the experimental condition throughout the study. Exposures were randomized throughout the four exams to minimize the impact that the exam material itself might have on the results. At the conclusion of the study (and the kinesiology course), all participants were given an additional questionnaire to complete that included several Likert-based questions as well as open-ended qualitative questions to reflect on their experience.

### 3.4. Statistical Analysis

SPSS Version 22 was used for all quantitative data analyses. Repeated measures ANOVA (alpha level of  $p < 0.05$ ) examined the differences in HR, SBP and DBP between baseline and the four intervention trials. A Friedman Test was used for the non-parametric data collected using the self-report STAI. When significance was found, post-hoc pairwise comparisons were conducted to determine which of the specific times of assessment (baseline, trial 1 (no dog), trial 2 (dog), trial 3 (dog), or trial 4 (no dog)) were contributing to the difference. Post-hoc assessments for STAI which did not include a baseline measure utilized a Bonferroni-corrected alpha level of  $p < 0.008$  ( $0.05/6$  possible comparisons) to control the overall Type I error rate of the analyses, and for HR, SBP and DBP in which baseline measures were included, a Bonferroni-corrected alpha level of  $p < 0.005$  ( $0.05/10$  possible comparisons) was used to determine significance.

## 4. Results

### 4.1. Heart Rate (HR), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP)

**Table 1** shows the mean values and standard deviations for HR, SBP and DBP across baseline and the four intervention trials. A repeated measures ANOVA (alpha level of  $p < 0.05$ ) determined a significant difference for HR when comparing the baseline measures and the four intervention trials ( $p = 0.006$ ), however post-hoc paired samples t-test with Bonferroni correction and alpha level of  $p < 0.005$  indicated that the only significant differences existed between the baseline measure and trial 1 (no dog) ( $p = 0.002$ ) and baseline measure and trial 2 (dog) ( $p = 0.003$ ), in which the baseline measures of HR were statistically significantly lower than the trial 1 and trial 2 intervention measures of HR. There was no significant

**Table 1.** Descriptive Statistics and p-Values<sup>a</sup> for Heart Rate (HR), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) for Baseline Measures and Experimental Trials (N = 23).

	Baseline	Trial 1 (No Dog)	Trial 2 (Dog)	Trial 3 (Dog)	Trial 4 (No Dog)	p-value
<b>HR</b>						
<b>Mean (SD) bpm</b>	73.30 (11.97)	84.13 (18.80)	83.74 (14.26)	78.91 (17.24)	80.39 (17.09)	0.006 <sup>b,c</sup>
<b>SBP</b>						
<b>Mean (SD) mmHg</b>	117.39 (12.09)	126.65 (13.85)	123.35 (15.15)	125.48 (7.79)	123.00 (15.22)	0.023 <sup>b,d</sup>
<b>DBP</b>						
<b>Mean (SD) mmHg</b>	73.52 (6.42)	78.91 (10.41)	79.35 (10.70)	78.91 (8.89)	78.87 (10.21)	0.071

<sup>a</sup>Repeated Measures ANOVA ( $p < 0.05$ ). <sup>b</sup>Indicates statistical significance. <sup>c</sup>Post-hoc analysis revealed that the baseline measure of HR was significantly lower than trial 1 and trial 2. No significant difference was found between the dog trials and no dog trials. <sup>d</sup>Post-hoc analysis revealed that the baseline measure of SBP was significantly lower than trial 1 and trial 3. No significant difference was found between the dog trials and no dog trials.

difference when comparing the four trials without the baseline measures ( $p = 0.285$ ), indicating that the presence of the dog did not have a statistically significant effect on HR.

A significant difference was also found for SBP when comparing the baseline measures and the four intervention trials ( $p = 0.023$ ), however post-hoc paired samples t-test with Bonferroni correction and alpha level of  $p < 0.005$  indicated that the only significant differences existed between the baseline measure and trial 1 (no dog) ( $p = 0.001$ ) and baseline measure and trial 3 (dog) ( $p = 0.004$ ), again indicating that the baseline measures of SBP were statistically significantly lower than the trial 1 and trial 3 intervention measures of SBP. There was no significant difference found between other comparisons ( $p > 0.005$ ), indicating that the presence of the dog did not have a statistically significant effect on SBP.

There were no statistically significant differences noted for DBP when comparing the baseline measures and the four intervention trials ( $p = 0.071$ ).

#### 4.2. State Anxiety—STAI

Descriptive statistics of mean, standard deviation and mean ranks for the non-parametric data from the STAI state anxiety scores are summarized in **Table 2**. A Friedman Test was performed and statistically significant effects of the therapy dog intervention were found for STAI ( $p = 0.000$ ). A Wilcoxon Signed Ranks Test was performed as a post-hoc analysis with Bonferroni correction ( $p < 0.008$ ). Statistical significance was found between the no dog trials (Trial 1 & Trial 4) and the dog trials (Trial 2 & Trial 3), ( $p < 0.000$ ), as demonstrated in **Table 3**. These findings indicate that the students had less anxiety when the dog was present during the intervention compared to trials when the dog was not present (**Figure 1**).

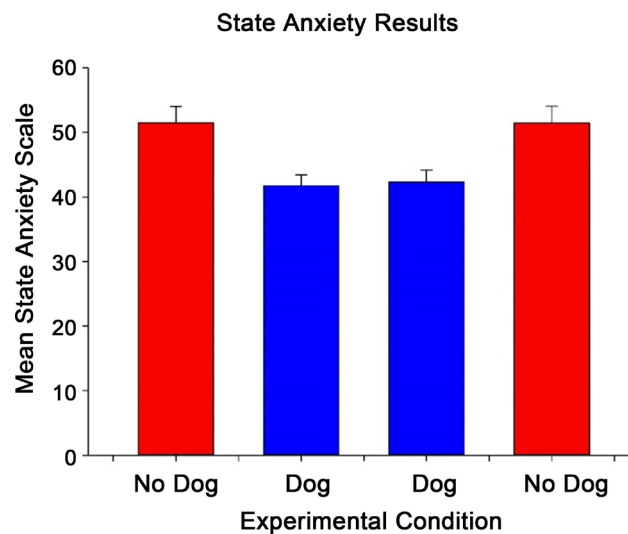
**Table 2.** Descriptive Statistics for STAI-State Anxiety (N = 23).

Trial	Mean	Mean Ranks (Friedman Test)	Standard Deviation
Trial 1—No Dog	51.48	3.13	12.25
Trial 2—Dog	41.74	1.93	8.08
Trial 3—Dog	42.30	1.83	8.95
Trial 4—No Dog	51.43	3.11	12.65

**Table 3.** State Anxiety Post-hoc Analysis<sup>a</sup>.

Trial Comparisons	p-value
Trial 1 (No Dog) vs. Trial 2 (Dog)	p = 0.001 <sup>b</sup>
Trial 1 (No Dog) vs. Trial 3 (Dog)	p = 0.001 <sup>b</sup>
Trial 1 (No Dog) vs. Trial 4 (No Dog)	p = 0.909
Trial 2 (Dog) vs. Trial 3 (Dog)	p = 0.875
Trial 2 (Dog) vs. Trial 4 (No Dog)	p = 0.001 <sup>b</sup>
Trial 3 (Dog) vs. Trial 4 (No Dog)	p = 0.000 <sup>b</sup>

<sup>a</sup>Wilcoxon Signed Ranks Test with Bonferroni Correction  $p < 0.008$ . <sup>b</sup>Indicates statistical significance.



Trial 1 (No Dog) vs. Trial 2 (Dog)  $p = 0.001$ ; Trial 1 (No Dog) vs. Trial 3 (Dog)  $p = 0.001$ ; Trial 2 (Dog) vs. Trial 4 (No Dog)  $p = 0.001$ ; Trial 3 (Dog) vs. Trial 4 (No Dog)  $p = 0.000$ .

**Figure 1.** Mean STAI-State Anxiety Scores for Dog vs. No Dog Experimental Trials.

### 4.3. Qualitative Findings

Twenty of the twenty-three subjects completed the post-study questionnaire for a response rate of 87%. This questionnaire included several open-ended qualitative questions, as well as five Likert-based questions utilizing a scale of 1 - 10, where 1 indicated the response 'Not at All' and 10 indicated the response "Significantly". **Table 4** shows the results of the Likert questions as well as the two yes/no responses.

Overall 100% (20/20) of the responses on the questionnaire indicated that



**Table 4.** Post-Participation Questionnaire Results (N = 20).

	1 Not At All	2	3	4	5 Neutral	6	7	8	9	10 Significantly	Yes	No
To what extent did your interaction <i>decrease your stress?</i>	0	0	0	0	1	2	5	9	2	1		
To what extent did your interaction <i>increase your stress?</i>	17	2	0	1	0	0	0	0	0	0		
To what extent did your interaction <i>enhance your performance?</i>	4	0	2	0	5	4	3	1	0	1		
To what extent did you <i>enjoy</i> this experience?	0	0	0	0	0	0	1	6	1	12		
To what extent do you feel that a therapy dog would <i>benefit PT students?</i>	0	0	0	0	0	1	3	3	5	8		
Based on your experience, <i>would you recommend</i> continued use of a Therapy Dog prior to lab practical examination testing?											20	0
Were there any <i>unexpected benefits</i> that you encountered when interacting with a Therapy Dog prior to lab practical examinations?											4	16
Were there any <i>unexpected disadvantages</i> that you encountered when interacting with a Therapy Dog prior to lab practical examinations?											0	20

based on this experience, the subjects would recommend continued use of animal-assisted interventions prior to laboratory practical exams, and that there were no disadvantages encountered with this experience (Table 4). While it did not appear that the subjects felt like their performance was enhanced on the examination when exposed to the therapy dog interaction, the majority of the subjects indicated that it was a positive experience that they felt would benefit students in a physical therapist educational program, and that perceived stress levels prior to an examination were at least moderately to significantly reduced (Table 4).

Open-ended questions on the post-participation questionnaire asked for further explanation for the selections the participants chose for each question. A common theme reported by the students throughout the series of questions was that the therapy dog helped to decrease their perceived stress, calm their nerves and serve as a distraction to take their mind off of worrying about the upcoming practical exam. One student noted, “*The program is so high stress, and we tend to get wrapped up in school and the work we have to put in. The time with the dog brought in a little bit of fun and distraction to reset our brains and help us to refocus.*”

## 5. Discussion and Conclusion

The purpose of this study was to assess whether an animal-assisted intervention would benefit PT students by reducing physiological stress as measured by HR, SBP and DBP, as well as perceived anxiety prior to taking a laboratory practical exam. The results support the hypothesis that animal-assisted interventions may be beneficial in reducing perceived anxiety, however results did not support that animal-assisted interventions would have a significant effect on physiological stress as measured by HR, SBP and DBP.

Statistical significance was achieved in this study for a reduction in state anxiety prior to a laboratory practical exam, as measured by the self-report State-Trait Anxiety Inventory, during trials in which the therapy dog was present. This finding is consistent with other studies that have found a reduction in anxiety following animal-assisted interventions in various populations and settings [20] [48] [49]. For example, Nepps *et al.* [20] found a significant reduction in state anxiety as measured by the STAI in patients in a mental health inpatient unit following a one-hour group session with a therapy dog, and Hoffmann *et al.* [48] found a significant reduction in state anxiety in patients hospitalized with major depression following a 30-minute intervention in the presence of a dog compared to a control group. A study by Barker *et al.* [50] examining the effects of a therapy dog on college student stress prior to final exams found that perceived stress as measured on a stress visual analog scale was significantly reduced following the therapy dog intervention compared to the control condition.

Reducing anxiety in PT students is important given that graduate healthcare educational programs produce high levels of anxiety in students [10] [39] [51], and students in higher education are already at a greater risk of experiencing anxiety [2] [3] [4] [52]. One potential reason that healthcare students experience higher levels of anxiety is likely due to the fact that the clinical tasks and practical skills of a healthcare provider are tested in oral or practical formats with open-ended questioning and these types of testing situations produce higher levels of anxiety compared to a multiple-choice type of examination [51]. Regardless of the specific cause for the increased anxiety, it stands to reason that finding ways to reduce anxiety in students is much needed in the educational setting given that anxiety can lead to both psychological and physiological changes [52] [53], can decrease immunity and when chronic in nature, anxiety can be a precursor to the development of hypertension and coronary heart disease [13] [14] [15].

Mean values for state anxiety in this study prior to a laboratory practical exam ranged from 41.74 to 42.30 (average of 42.02) when the dog was present and 51.43 to 51.48 (average of 51.46) when the dog was not present. While normative values for state anxiety measured by the STAI have not been established specific to graduate students or students prior to an examination, normative values for state anxiety have been established for undergraduate college students under non-stressful conditions and the values range from 36.47 for males to 38.76 for females [40], (average of 37.61). While it would be expected that state anxiety scores remain elevated prior to an examination compared to a non-stressful situation, it is important to note that the difference in state anxiety values following the therapy dog intervention in this study from that of the average normative values for undergraduate students under non-stressful conditions was only 4.41, whereas the difference between the average state anxiety score when the dog was not present prior to the laboratory practical exam was much greater (13.85) when comparing to the average normative values for undergraduate students in non-stressful conditions.

Findings from this study did not support the hypothesis that an animal-assisted intervention would decrease physiological stress as measured by HR, SBP and DBP prior to a laboratory practical exam. Prior studies examining the effects of animal-assisted interventions have reported conflicting results related to these measures, in which some studies have demonstrated a reduction in heart rate and blood pressure while other studies have demonstrated no significant change [20] [31] [34] [47]. For instance, Nepps *et al.* [20] found a significant reduction in heart rate in mental health patients following an interaction with a therapy dog, however there were no significant reductions in systolic or diastolic blood pressure. Braun *et al.* [34] did not find a significant reduction in heart rate or blood pressure in children in an acute care pediatric setting following a 15 - 20 minute animal-assisted intervention. A study by Cole *et al.* [31] found that patients hospitalized with advanced heart failure who received a visit from a therapy dog had lower cardiopulmonary pressures, neurohormone levels and state anxiety levels compared to patients who received a visit from a volunteer without a dog and the control group, however despite these changes in cardiopulmonary pressures, there were no significant differences found in heart rate, blood pressure, cardiac index and systemic vascular resistance. [31] These findings vary from those of Friedmann *et al.* [24], Allen *et al.* [25], and Polheber & Matchock [26] who found reductions in blood pressure [24] [25] [47] and heart rate [25] [26] in otherwise healthy populations when interacting with a dog.

One potential reason for the lack of significant reductions in physiological measures of stress in this study may be related to the type of activities that the subjects engaged in with the dog. For instance, subjects were allowed to interact with the therapy dog in a manner of their choosing because animal-assisted interventions are intended to be spontaneous in nature with various activities such as petting, combing, talking and playing with the animal [54]. In this study, some subjects sat quietly petting the dog, while others engaged in active play, such as throwing the ball and playing catch. The active play activities may have contributed to elevated HR, SBP and DBP whereas more passive or calming interactions that include tactile touch, such as petting or cuddling with the dog would have likely demonstrated greater reductions in these measures [13] [28] [53] [55]. Braun *et al.* [34] found that children interacting with a therapy dog demonstrated an increased respiratory rate, likely due to excitement and anticipation of interacting with a therapy dog and it's possible in this study as well that HR, SBP and DBP did not significantly decrease due to a level of excitement for the interaction.

Another possible reason for a lack of reduction in HR, SBP and DBP in this study may be due to the fact that subjects were in groups of two, which minimized the amount of time they were able to spend with the therapy dog independently. One study found a significant reduction in SBP when subjects were in groups of five, however each individual had three to five minutes of independent time with the animal [47]. In regards to the overall length of time of the inter-

vention, several studies have shown a significant reduction in these measures with an intervention duration of 10 - 15 minutes [31] [34] [47] [56] while other studies found reductions in these measures following a longer intervention, sometimes lasting up to one-hour in length [20] [48] [49]. Zhang *et al.* [44] found that heart rate and blood pressure were not only elevated during an examination, but were also elevated for a period of time before and after the examination. Given this information it may be beneficial in future studies looking at the effects of a therapy animal on physiological measures of stress specifically related to an examination to allow for a greater period of time for the intervention to occur, as well as assuring that each subject engages in some level of independent interaction with the therapy animal if the intervention is performed in groups. It would also be beneficial to control for the type of activity that occurs during the intervention, in which passive activities such as petting and cuddling are the focus of the intervention rather than active play.

In this study, we chose to assess first-year PT students only, which limited our overall sample size. While we still had enough statistical power to demonstrate a change on three of the four variables measured, we did not have enough statistical power to demonstrate a change in DBP (observed power of 0.58). Given that the sample was one of convenience and was limited to first-year PT students only, there certainly are limitations related to generalizability to students in the second or third year of a physical therapist education program because they may not be as affected by anxiety prior to a laboratory practical exam given they have had more exposure to these situations. In addition, the findings from this study reflect changes that occur at a specific time and therefore cannot predict long-term effects of reducing anxiety prior to taking examinations in a physical therapist educational program. Stasi *et al.* [57] looked at long term effects of a therapy animal on blood pressure and found a significant reduction in blood pressure of nursing home residents following a six-week pet therapy intervention. Future research may want to include following a cohort of students in a longitudinal study to determine the long-term effects of having a therapy animal as part of a physical therapist education program.

In addition to the small sample size, the participants in this study were predominately female students. While it is not atypical to have a higher percentage of female students in a physical therapist educational program [58], the fact that females tend to exhibit greater levels of anxiety compared to males [1] [3] [4] [10], may have had an impact on our results and therefore future studies may want to further examine gender differences on anxiety outcomes. Another limitation to this study is that activity prior to the intervention was not controlled, such as engaging in exercise, consuming caffeine, smoking or other activities that can cause an increase in heart rate and blood pressure [59] [60]. Future studies may want to control for pre-intervention activity level as well as control for a history of hypertension and/or medications that may influence heart rate and blood pressure [59]. General atmosphere is another consideration for future re-

search given that post-survey results indicated that several students perceived the room itself as uncomfortable because the students sat on the tile floor to interact with the dog, suggesting that the environment itself may have influenced the results of this study to some extent. Future research may want to include exam performance to provide additional insight into the potential benefits of animal-assisted interventions on college and university campuses.

It is not likely that graduate professional programs will become any less stressful in the future, and therefore healthcare educators should be advocates for any services that may improve the health and well-being of students. Animal-assisted interventions may serve as a cost effective [61] method to reduce anxiety that extends beyond patients and healthcare employees [33], to include students enrolled in graduate professional programs, such as a physical therapist educational program.

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