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Article

Therapy dogs effectively reduce stress in college preparatory students

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SUMMARY

A vast majority of high school students report feeling stressed, especially in schools with a rigorous curriculum. There are many strategies for reducing students' stress and improving their mental health. Therapy dogs are particularly promising, as they've been shown to lower stress levels during a stressful test even better than a close human friend. The purpose of our study was to expand on these findings by investigating the effectiveness of therapy dogs on reducing stress levels of students who are enrolled in a school with a rigorous curriculum. We hypothesized that the time spent with a therapy dog, either before or after a stressful event, would decrease heart rate and reduce perceived stress levels. We conducted two experiments with a total of 87 high school students enrolled in advanced placement courses. In experiment one, the Sing-a-Song Stress test was followed by a therapy dog or control intervention. We observed no difference in heart rate between the dog therapy and control groups, but there was a trend towards lower State Trait Anxiety Inventory scores in the dog therapy group. In experiment two, ten minutes of dog therapy prior to three stressful Stroop tests more significantly reduced negative feelings in the Positive and Negative Affect Schedule for Children assessment compared to silent rest. These data suggest that therapy dogs could be an effective stress reliever for college preparatory students.

INTRODUCTION

Stress has become pervasive in adolescents and young adults, largely due to academic pressures. Pressure to receive good grades can cause high academic-stress in students. Across a number of countries, 66% of students reported that they felt stressed to receive good grades and 37% felt stressed while studying (1). Academic stress is caused by examinations, studying, having too much to do, and feeling like there is too much to learn (2). About one third of tenth and eleventh grade students surveyed about stress reported high levels of daily stress, and the most frequent stressor was concerns about one's future (3). University students attribute their stress to the pressure to keep up one's grades, trying to accomplish too many tasks at once, and pressure from family and teachers' expectations (4,5).

In schools that encourage high levels of academic success, it is far more likely that students will become much more stressed because of immense pressure and competition. In 2018, a study of students enrolled in an intensive program designed to prepare attendees for health sciences careers found that 69% of the students were highly motivated to rank highly amongst their classmates (6). Stress perceptions from students in this program were also significantly greater than average high school students (6). High levels of stress are also evident in students in higher education spaces dedicated to studying a specific subject area or occupation, including nursing and law (7,8).

Stress induces negative physical and mental health outcomes and often leads to poor academic performance. Stress can cause back pain, neck stiffness, and headaches, and can also inhibit the respiratory system and immune system (9). In addition, stress can affect the cardiovascular system and nervous system by causing an increase in heart rate and vasodilation in arteries. It can also increase vasoconstriction which can cause an increase in blood pressure and disorders in blood clotting. Stress can also affect the gastrointestinal system and make it more susceptible to inflammatory diseases (10). In addition to numerous physical defects, stress can also diminish students' mental health and feelings of well-being. Stress in students is highly correlated with depression, feelings of helplessness, and anxiety or panic attacks among other serious mental health problems (9). Self-reports of stress from higher education students have been correlated with poorer quality of life and well-being (11). It is, thus, unsurprising that stress can lead to poorer academic performance as well. For students in grades 7-10, positive emotions during school are associated with higher levels of student engagement and negative emotions are associated with lower levels (12). Stress similarly impacted academic performance for a cohort of medical students (13).

Effective strategies to mitigate stress in students, especially students at schools with a rigorous curriculum, are necessary to avoid the associated negative physical and mental health outcomes. Dogs are known to improve students' mental health. In a survey of college students, 92.5% reported that their pets are an integral part of their life and are effective in comforting them in times of concentrated stress (14). In addition, more dog owners felt overwhelming comfort from their pet than cat owners. Another study surveyed students on their interest in pet therapy programs; 96% of the college freshmen interviewed expressed great interest in the possibility (15). Thus, the effectiveness of trained therapy dogs in improving students' mental health is under investigation. A therapy dog and close human friend were both tested as companions in a standard stress test to determine which was more effective in lowering stress levels. The presence of the therapy dog reduced levels of the stress hormone cortisol in saliva more effectively than the presence of a close human friend (15). Interaction with a therapy dog also helped university students

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to feel immediately more socially supported and less stressed (16). The presence of a therapy dog was successful in improving social interaction in a discussion group at a nursing home by making the environment more comfortable (17). Therapy dogs also significantly reduce heart rate and blood pressure measurements in adults (18).

Here, we investigated the efficacy of therapy dogs for stress reduction in students enrolled in a school with a rigorous curriculum. We recruited high school participants from an advanced placement psychology course for two experiments with different stressors, anxiety survey criteria, and interventions schemes. In experiment one, a modified version of the State Trait Anxiety Inventory (STAI) was used to gauge stress perceptions along with heart rate measurements before a Sing-a-Song Stress Test. This modified version contained 20 items regarding state anxiety, the type of anxiety associated with an event or situation. No questions concerning trait anxiety, the anxiety related to an individual's personality or characteristics, were included. Each item is rated on a four-point scale ranging from "Not at all" to "Very much so" (19). The ratings from each item were added to find the scores for each participant. Higher scores from this scale indicated greater levels of anxiety. After the stressor, STAI and heart rate were collected, followed by 15 minutes with a therapy dog or on social media, and a final STAI and heart rate. In experiment two, stress levels were measured using the Positive and Negative Affect Schedule for Children (PANAS-C) and heart rate. The PANAS-C measured the degree of association with positive and negative feelings in the participant where low levels of positive affect and high levels of negative affect are associated with social anxiety (20). In this experiment, 10 minutes of therapy dogs or silent rest intervention were employed before the stressor followed by a second round of stress measures, then three rounds of a color-matching Stroop Test and a final heart rate and PANAS-C measure. We found that therapy dogs helped reduce students' stress perceptions.

RESULTS

To determine whether dog therapy could reduce stress in students enrolled in a rigorous school, we measured stress perceptions and heart rate changes before and after stressors in control vs. dog therapy groups. The intervention, dog therapy or social media, was given after the stressor in experiment one, whereas dog therapy or silent rest was employed before the stressor in experiment two (**Figure 1**). Participants in both studies ranged from 16-18 years old with a mean of 17. The treatment groups in experiment one did not significantly differ on any of the baseline variables or baseline measurements, including age, gender, sports participation,

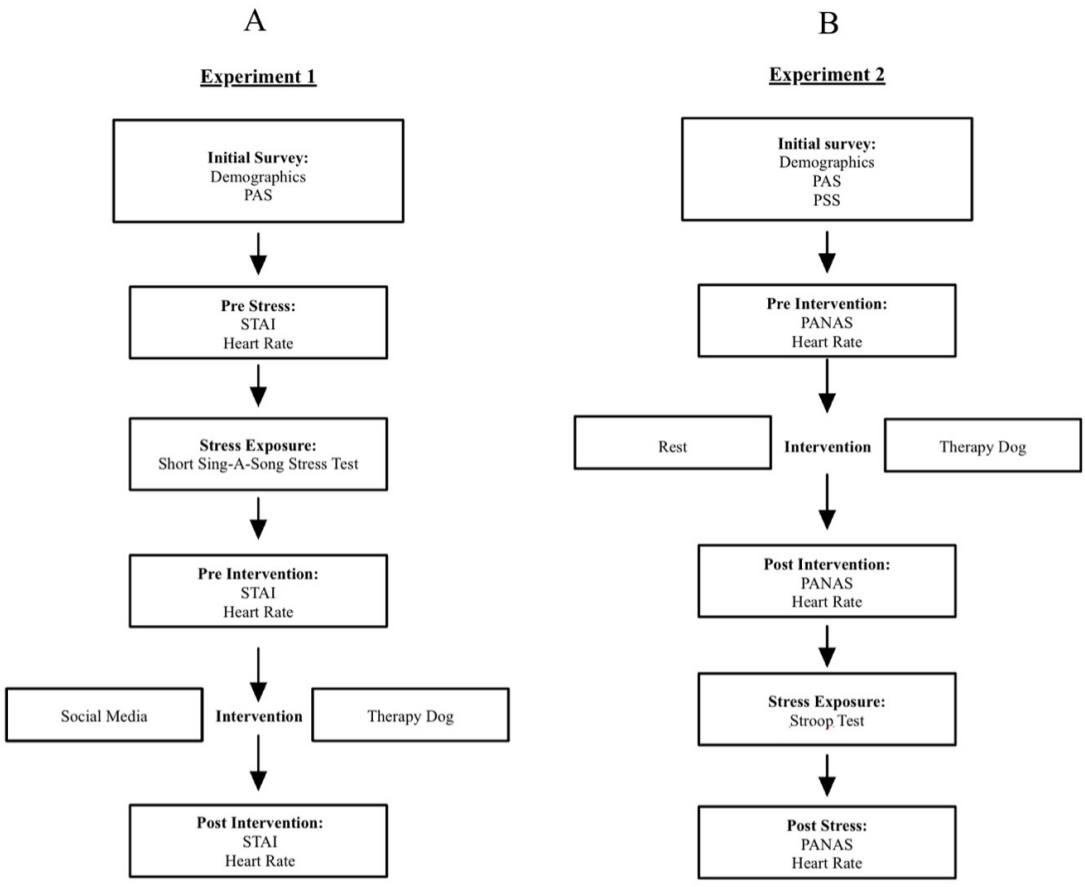

Figure 1. Flow of procedure for Experiments 1 and 2. The order of data collection, stressor input, and interventions for **(A)** experiment 1 and **(B)** experiment 2. PAS: Pet Attitude Scale; PSS: Perceived Stress Scale; PANAS: Positive and Negative Affect Schedule; STAI: State Trait Anxiety Inventory.

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Characteristic	Therapy Dog (n=12)	Control (n=13)	*p*-Value
	Mean (SD) or N (%)	Mean (SD) or N (%)	
Age, years	17.17 (0.3893)	17.00 (0.4472)	0.350
Female, N (%)	9 (36.0%)	11 (44.0%)	0.708
Sports Participation	1.333 (0.8876)	1.455 (0.8202)	0.738
Club Participation	3.666 (2.570)	4.455 (1.968)	0.422
Social Stress	0.9167 (0.7930)	1.090 (1.044)	0.655
PAS	110.8 (5.817)	104.3 (13.14)	0.136
Heart Rate	86.25 (16.18)	79.18 (13.33)	0.306
STAI	34.75 (8.863)	40.18 (11.64)	0.220

Table 1. Baseline characteristics for participants in Experiment 1. Characteristics were collected prior to beginning the experiment through self-reported survey. Heart rate was taken by a pulse oximeter. All characteristics were not significant between the groups. PAS: Pet Attitude Scale; STAI: State Trait Anxiety Inventory.

Characteristic	Therapy Dog (n = 31)	Control (n = 30)	*p*-Value
	Mean (SD) or N (%)	Mean (SD) or N (%)	
Age, years	16.97 (0.7064)	16.97 (0.6805)	0.990
Female, N (%)	24 (39.3%)	25 (41.0%)	0.388
Sports Participation	1.387 (0.7606)	1.488 (0.8275)	0.766
Club Participation	2.516 (1.363)	3.655 (1.696)	0.006
PSS	20.35 (5.030)	23.62 (5.564)	0.020
PAS	102.9 (11.65)	104.7 (15.43)	0.620
Heart Rate	74.03 (10.21)	74.55 (13.90)	0.869
PANAS			

Table 2. Baseline characteristics for participants in Experiment 2. Characteristics were determined through self-reported survey prior to beginning the experiment. Heart rate was taken by a pulse oximeter. All characteristics were not significant between the groups PAS: Pet Attitude Scale; PSS: Perceived Stress Scale; PANAS: Positive and Negative Affect Schedule

club participation, social stress, Pet Attitude Scale (PAS) scores, heart rate, and STAI scores (**Table 1**). In experiment two, participants did not vary with respect to age, gender, sports participation, PAS scores, heart rate, or PANAS-C scores (**Table 2**). Club participation and perceived stress scores did significantly differ between groups.

In experiment one, baseline STAI and heart rate were measured, followed by a Sing-a-Song stress, a post-stressor STAI and heart rate, 15 minutes of dog therapy or social media scrolling (intervention), and a final STAI and heart rate analysis. STAI levels increased from pre to post stressor before the intervention for both the control group and dog therapy group, with a slightly higher increase in the control (**Figure 2**). These data suggest that the stressor did increase participants' stress as expected. Stress states decreased more post-intervention in the dog therapy group compared to the control group, though not significantly (**Figure 3**). Heart rate decreased in the dog therapy group after the stressor and prior to the therapy intervention, whereas heart rate in the control did not change after the stressor and before the intervention (**Figure 4**). Heart rate increased further for both groups after the intervention, suggesting that stress was not ameliorated based on this metric when the intervention was introduced after the stressor (**Figure 5**).

In experiment two, state stress was measured by PANAS-C, which tracks participants' association with both positive and negative feelings. Baseline PANAS-C and heart rate were measured, followed by the intervention (dog therapy or control silent rest), post-intervention PANAS-C and heart rate, the Stroop Test stressor, and final PANAS-C and heart rate. Positive affect from pre-intervention to post-stressor decreased in the control group, yet it increased in the dog therapy group (**Figure 6**). These data point to a role for dog therapy in promoting positive emotions, even during a stressful event, although the difference between the control and therapy group was non-significant. Negative affect increased in the control group and decreased in the dog therapy group (**Figure 7**). Dog therapy significantly decreased negative affect values ($p = 0.011$), suggesting that the intervention reduced participants' negative emotions during stress. The heart rate of the therapy dog group was also unchanged from pre-intervention to post stress, whereas heart rate increased in the control, further suggesting that the intervention mitigated stress responses.

DISCUSSION

We investigated the efficacy of dog therapy as a stress buffer in adolescent students enrolled in schools with a rigorous curriculum. In a preliminary experiment, the STAI state stress metric was used along with heart rate to analyze participants' stress levels. We instructed participants to sing a song aloud to induce stress, followed by an intervention of social media or dog therapy for 15 minutes. STAI decreased from pre-to-post intervention in both groups with a trend towards greater reduction in the dog therapy group. The greater decrease in

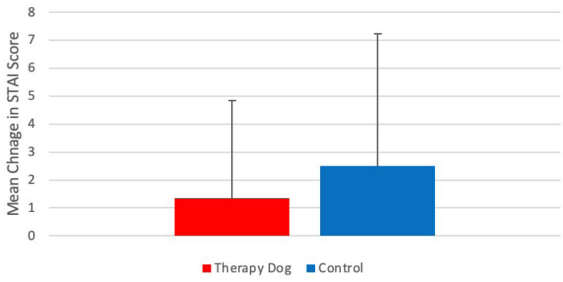

Figure 2. The Sing-a-Song stressor increased STAI levels in control and dog therapy groups prior to the intervention. The change in STAI from baseline to pre-intervention in control and dog therapy groups are plotted as mean ± SD. STAI was collected before and after participants were administered the Sing-a-Song stressor. The change in STAI was calculated. Higher STAI scores indicated higher levels of stress. There was no significant difference between the groups.

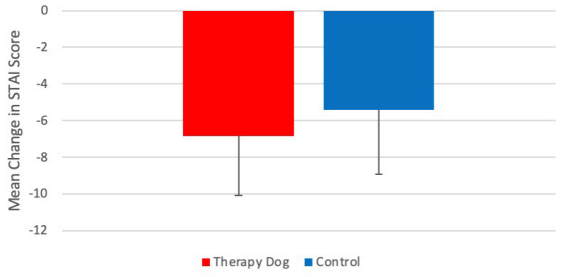

Figure 3. The intervention with either the therapy dog or social media decreased STAI levels in control and dog therapy groups. The change in STAI from pre-intervention to post-intervention in control and dog therapy groups are plotted as mean ± SD. STAI was collected before and after participants spent time with a therapy dog or on social media. The change in STAI was calculated. Higher STAI scores indicated higher levels of stress. There was no significant difference between the two groups.

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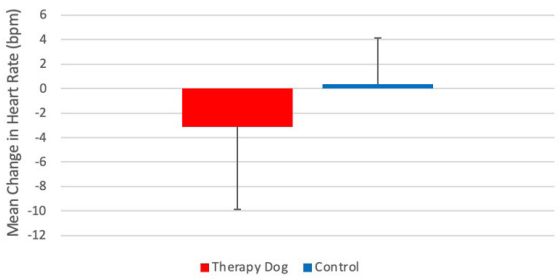

Figure 4. The Sing-a-Song stressor decreased heart rate in the therapy dog group and increased heart rate in the control group prior to the intervention. The change in heart rate from baseline to pre-intervention in control and dog therapy groups are plotted as mean ± SD. Heart rate was collected before and after participants were administered the Sing-a-Song stressor. The change in heart rate was calculated. There was no significant difference between the groups.

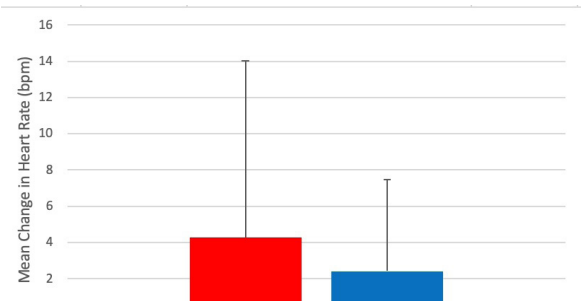

Figure 5. The intervention with either a therapy dog or on social media increased heart rate levels in control and therapy dog groups. The change in heart rate from pre-intervention to post-intervention in control and dog therapy groups are plotted as mean ± SD. Heart rate was collected before and after time with a therapy dog or on social media. The change in heart rate was calculated. There was no significant difference between the two groups.

stress levels measured by the STAI supports the hypothesis that therapy dogs would be more effective in lowering stress levels following a stressful event than social media; however, the decrease was not statistically significant. Additionally, age, gender, baseline levels of stress, attitude towards pets, and participation in extracurricular activities was not found to be statistically different between the groups and likely did not have any effect on the results found (**Table 1**). In contrast to our hypothesis, heart rate increased in both groups from pre-to-post intervention. Heart rate may have increased in the dog therapy group because the dogs caused participants to feel excited or because of the crowd in the testing room. The crowded room was corrected for as in experiment two, and participants interacted with the dogs in isolation. The increase in heart rate after the intervention was smaller, supporting this explanation. There was a decrease in heart rate for the therapy dog group after the stressor and prior to the intervention, which may account for the lack of observable effect (**Figure 4**). This showed that the short Sing-A-Song stress test did not elicit a strong enough stress response from the participants, which left little room for the interventions to show effect. Additionally, there was a greater increase in perceived state stress for the control group after the stressor, which may have left more room for the control group's stress levels to decrease after intervention, leading to a smaller overall difference in STAI levels from baseline to post-intervention between the therapy dog group and control group (**Figure 2**).

In experiment two, several experimental variables were changed. First, the control group intervention was changed from social media to silent rest. Interventions were implemented before the stressor in this modified experiment, whereas experiment one introduced the intervention after the stressor (**Figure 1**). We also used a cognitive stressor, the Stroop test, instead of the Sing-a-Song stressor and measured state stress with PANAS-C in lieu of STAI. PANAS-C measured both negative and positive feelings. Under this setting, positive affect decreased in the control and increased in the dog therapy group, whereas negative affect decreased significantly more in the dog therapy group (**Figures 6, 7**). Heart rate also increased less in the therapy dog group (**Figure 5**). These data support the hypothesis that therapy dogs are more effective at buffering stress than rest alone. The increase in positive affect in the therapy dog group supports the hypothesis that therapy dogs can induce positive emotions. The smaller increase in heart rate coincides with similar studies in university students that experienced reduced electrodermal activity, a measure of stress, after a stressful test that followed intervention with a therapy dog vs. silent rest (21).

Our work replicates these findings in college preparatory students. It is possible that the effect in experiment two was more significant than experiment one because the intervention occurred prior to the stressful event. Therapy dogs have been shown to buffer study participants from an upcoming stress more effectively than reducing anxiety after a stressful experience (15), which may explain the more tempered stress-reducing effect seen in experiment one. The control and dog therapy groups in experiment one also may not have differed in their stress mitigation because the stress was short-term and could have faded by the time the final stress measures were collected, regardless of the intervention employed. It is also important to note that baseline measures for everyday stress levels and sports participation was significantly higher for the control group (**Table 2**). This indicates higher baseline stress levels in the control group which may have made it more difficult for a significant effect to be observed between the groups for heart rate and positive affect

Both experiments had a relatively small sample size, which could make it more difficult to see the true effect of the therapy dogs on stress responses. In addition, the therapy dog experience differed between participants due to the diversity of conditions at play. Different breeders were available as handlers on each day as well as dogs of different breeds, sizes, and ages, making it difficult to decipher whether the type of dog influenced stress levels. Lastly, many of the experiment's participants were female, which may have also had an effect on the results. As mentioned, the significantly higher level of club participation and perceived stress scale scores in the control group may suggest that this group was on average more stressed than the therapy dog group to begin with, which may have allowed the intervention to have a greater effect on them.

Altogether, we found that dog therapy can mitigate stress responses in high school students enrolled in schools with a rigorous curriculum, adding to a multitude of research that supports therapy dogs as an effective strategy for alleviating

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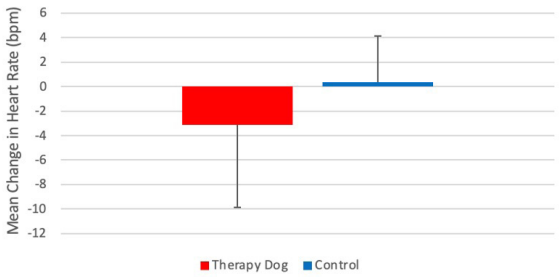

Figure 6. Positive affect scores in the therapy dog group increased after intervention with the therapy dog and the stressor and positive affect scores in the control groups decreased after silent rest and the stressor. The change in positive affect scores from baseline to pre-intervention in control and therapy dog groups are plotted as mean ± SD. Positive affect scores were collected before and after intervention and the Stroop Test. The change in positive affect was calculated. Higher positive affect scores indicated greater association with positive emotions. The mean change in positive feelings was not significantly different between the two groups.

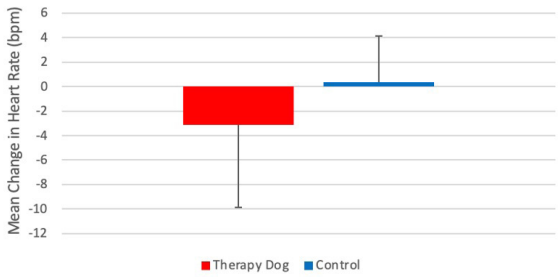

Figure 7. Negative affect scores in the therapy dog group decreased after intervention and the stressor and negative affect scores in the control groups increased after silent rest and the stressor. The change in negative affect scores from baseline to pre-intervention in control and therapy dog groups are plotted as mean ± SD. Negative affect scores were collected before and after intervention and the Stroop Test. The change in negative affect was calculated. Higher negative affect scores indicated higher association with negative emotions. There was a significantly greater decrease in negative emotions in the therapy dog group than the control group ($p < 0.05$).

stress and improving mental health in students. Future research should focus on sampling a more diverse sample set, including middle or elementary school students. Future research should also include a closer look at the different effects that different breeds of dogs may have on stress. Other inducers of stress could also be utilized such as the Trier Social Stress Test which requires the participant to give a speech and perform arithmetic in front of a group of people and may be able to elicit a stronger stress response than the Sing-a-Song Stress Test or the Stroop Test so a greater effect from the therapy dog may be observed (22).

MATERIALS AND METHODS

Participant Demographics

For both experiments one and two, volunteers were recruited through an advanced placement Psychology course consisting of high school juniors and seniors. In experiment one, 26 students were randomly placed into the therapy dog group (TD, n = 13) or the control group (C, n = 13). In experiment two, 61 students were randomly placed into the therapy dog group (TD, n = 31) or the control group (C, n = 30). Participants were unaware of which group they had been placed into and were made aware that placement was random. All participants were required to sign and have a parent/guardian sign an informed consent form before participation in the study.

Prior to beginning the experiment, participants filled out the initial survey, which included questions about their age, gender, sports, and clubs. For experiment one, participants were also asked to rate their general social stress on a 4-point scale and to complete the Pet Attitude Scale (PAS), an 18-item scale that measures the bond between humans and animals. Scores from this scale were used to determine if the affinity a student has toward animals had any effect on the results of the experiment. In experiment two, the same demographic questions and PAS were administered; however, the singular scale regarding general stress from experiment one was omitted and replaced with the Perceived Stress Scale (PSS), which was used to determine the perceived general stress of the participants by asking about feelings and thoughts during the last month. Questions were rated on a 5-point scale from "Never" to "Very Often". Scores from this scale were used to determine if general stress altered the buffer effect of either the therapy dog or silent rest (23).

Experiment 1 Schema

A flow chart of the procedure for experiment one is provided in **Figure 1A**. After the initial survey, participants completed a modified version of the State-Trait Anxiety Inventory (STAI) to determine baseline levels of state anxiety. Additionally, a baseline heart rate measure was taken using a pulse oximeter.

After the baseline tests, we administered the Sing-a-Song Stress Test to participants to induce mental stress while abiding by ethical standards. In this test, five neutral messages were shown to participants for one minute each, followed by a message which instructed the participant to sing any song aloud for a recording (24). It was not specified who, if anyone, would hear the recording. This test was conducted to simulate the circumstances of a stressful event. After the stress test, a second measure of the STAI and heart rate were taken for each participant.

After the participants completed their second stress measure, those who were a part of the therapy dog group were instructed to spend 15 minutes with a trained therapy dog from K9 Therapets of Hawaii, a volunteer group certified by the Alliance of Therapy Dogs. The dogs varied in size, breed, and age. Therapy dogs were always accompanied by their handler. Interaction involved sitting with and petting the dog or walking them around a grassy area. Participants in the control group were instructed to spend 15 minutes on any social media platform of their choosing. It should be noted that social media has been found to induce stress in that it can cause people to 1) seek approval from other users, 2) fear missing out (FoMO) on experiences they see online, and 3) read and/or spread misinformation (25). Immediately after the intervention with either the therapy dog or social media, all participants took a final STAI and heart rate measure.

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Experiment 2 Schema

A flow chart of the procedure for experiment two is provided in **Figure 1B**. The Positive and Negative Affect Schedule for Children (PANAS-C) was used in place of the STAI to better measure the perceived stress of the participants. In addition to the PANAS-C, baseline heart rate was measured for each participant as a physiological stress measure with a pulse oximeter.

After the baseline measures were collected, we administered the intervention to participants prior to the stressor in line with the order of events set out by Fiocco and Hunse (21). The therapy dog group spent 10 minutes with a therapy dog from K9 Therapets of Hawaii. Participants in the control group had 10 minutes of silent rest. Immediately after the therapy dog intervention or rest, participants completed a second measure of heart rate and PANAS-C.

Following their second stress measure, all participants took a series of three Stroop Tests, measuring heart rate a total of three times after each test. The Stroop Color Word Test (CWT) was used to simulate a stressful event in this experiment and involved matching the color of one word to the text of another for one minute. The Stroop Test has been proven to induce stress as measured by plasma and urinary adrenaline, heart rate, respiration rate, electrodermal activity, electromyography, feelings of anxiety, and decreased finger pulse amplitude (26). After participants took the Stroop Test and measured heart rate three times, participants completed a final PANAS-C stress measurement.

Data Analysis

Data was analyzed with JMP, a statistical analysis software, and results were considered significant at $p < 0.05$ (27). Baseline measures of state stress levels, positive affect, negative affect, and heart rate were controlled for in an analysis of covariance or ANCOVA. All measures were also converted into change scores by subtracting the mean baseline measures from mean post stress measures. The final heart rate measure for experiment two was calculated by averaging the three measures taken after each Stroop Test.

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REFERENCES

1. Pascoe, Michaela. "The impact of stress on students in secondary school and higher education." *International journal of adolescence and youth*, vol. 25, no. 1, 2020, pp. 104-112, https://doi.org/10.1080/02673843.2019.1596823.
2. Abouserie, Reda. "Sources and Levels of Stress in Relation to Locus of Control and Self Esteem in University Students." *Educational Psychology*, vol. 14, no. 3, 1994, pp. 323-30, https://doi.org/10.1080/0144341940140306.
3. Anda, Diane De, et al. "Stress, Stressors and Coping among High School Students." *Children and Youth Services Review*, vol. 22, no. 6, June 2000, pp. 441-463, https://doi.org/10.1016/S0190-7409(00)00096-7.
4. Hamaideh, Shaher H. "Stressors and Reactions to Stressors among University Students." *International Journal of Social Psychiatry*, vol. 57, no. 1, 1954, pp. 69-80, https://doi.org/10.1177/0020764009348442.
5. Pariat, L., et al. "Stress levels of college students: Interrelationship between stressors and coping strategies." *Journal of Humanities and Social Science*, vol. 19, no. 8, August 2014, pp. 40-46, https://doi.org/10.9790/0837-19834046.
6. Alsulami, S., et al. "Perception of academic stress among health science preparatory program students in two Saudi universities." *Advances in medical education and practice*, vol. 9, no. 159, 2018, pp. 159-164, https://doi.org/10.2147/AMEP.S143151.
7. Pryjmachuk, S., & Richards, D. A. "Predicting stress in pre-registration nursing students." *British Journal of health psychology*, vol. 12, no. 1, 24 December 2010, pp. 125-144, https://doi.org/10.1348/135910706X98524.
8. Clark, E. J., & Rieker, P. P. "Gender differences in relationships and stress of medical and law students." *Journal of Medical Education*, vol. 61, no. 1, January 1986, pp. 32–40.
9. Feld, L. D., & Shusterman, A. "Into the pressure cooker: Student stress in college preparatory high schools." *Journal of Adolescence*, vol. 41, 2015, pp. 31-42, https://doi.org/10.1016/j.adolescence.2015.02.003.
10. Habib, Y., et al. "The impact of stress on body function: A review." EXCLI J. 2017 Jul 21, vol. 16, pp. 1057-1072. https://doi.org/10.17179/excli2017-480.
11. Ribeiro, Ícaro J.s., et al. "Stress and Quality of Life among University Students: A Systematic Literature Review." *Health Professions Education*, vol. 4, no. 2, 2018, pp. 70-77, https://doi.org/10.1016/j.hpe.2017.03.002.
12. Reschly, Amy L., et al. "Engagement as Flourishing: The Contribution of Positive Emotions and Coping to Adolescents' Engagement at School and with Learning." *Psychology in the Schools*, vol. 45, no. 5, 2008, pp. 419-31, https://doi.org/10.1002/pits.20306.
13. Stewart, et al. "A Prospective Analysis of Stress and Academic Performance in the First Two Years of Medical School." *Medical Education*, vol. 33, no. 4, 1999, pp. 243-50, https://doi.org/10.1046/j.1365-2923.1999.00294.x.
14. Adamle, Kathleen N., et al. "Evaluating College Student Interest in Pet Therapy." *Journal of American College Health*, vol. 57, no. 5, 2009, pp. 545-48, https://doi.org/10.1007/s10865-013-9546-1.
15. Polheber, J., & Matchock, R. L. "The presence of a dog attenuates cortisol and heart rate in the Trier Social Stress Test compared to human friends." *Journal of behavioral medicine*, vol. 37, 2014, no. 5, pp. 860-867, https://doi.org/10.1007/s10865-013-9546-1.
16. Ward-Griffin, E., et al. "Petting away pre-exam stress: The effect of therapy dog sessions on student well-being" *Stress and Health*, vol. 34, no. 3, 2018, pp. 468-473, https://doi.org/10.1002/smi.2804.
17. "The influence of an animal on social interactions of nursing home residents in a group setting." *American Journal of Occupational Therapy*, vol. 47, no. 6, 1993, pp. 529-534, https://doi.org/10.5014/ajot.47.6.529.
18. Krause-Parello, C. A., and Kolassa, J. "Pet therapy: Enhancing social and cardiovascular wellness in community dwelling older adults." *Journal of Community Health Nursing*, vol. 33, no. 1, 2016, pp. 1-10, https://doi.org/10.1080/07370016.2016.1120587.
19. Spielberger, C., et al. "State Trait Anxiety Inventory for Children." 1973, https://doi/10.1037/t06497-000.

https://doi.org/10.59720/22-136

20. Hughes, Alicia A., and Philip C. Kendall. "Psychometric Properties of the Positive and Negative Affect Scale for Children (PANAS-C) in Children with Anxiety Disorders." *Child Psychiatry and Human Development*, vol. 40, no. 3, 2009, pp. 343-52, https://doi.org/10.1007/s10578-009-0130-4.
21. Fiocco, Alexandra, and Anastasia Hunse. "The Buffer Effect of Therapy Dog Exposure on Stress Reactivity in Undergraduate Students." *International Journal of Environmental Research and Public Health*, vol. 14, no. 7, 2017, pp. 707, https://doi.org/10.3390/ijerph14070707.
22. Crosswell, A., and Lockwood, K. "Best practices for stress measurement: How to measure psychological stress in health research." *Health Psychol Open*, vol. 7, no. 2, 2020 Jul 8, https://doi.org/10.1177/2055102920933072.
23. Cohen, S., et al. "A Global Measure of Perceived Stress" *Journal of Health and Social Behavior*, vol. 24, no. 4, 1986, pp. 386-396, https://doi.org/10.2307/2136404.
24. Brouwer, Anne-marie, and Maarten A. Hogervorst. "A New Paradigm to Induce Mental Stress: The Sing-a-Song Stress Test (SSST)." *Frontiers in Neuroscience*, vol. 8, 29 July 2014, https://doi.org/10.3389/fnins.2014.00224.
25. Wolfers, Lara N., and Sonja Utz. "Social Media Use, Stress, and Coping." *Current Opinion in Psychology*, vol. 45, June 2022, pp. 101305, https://doi.org/10.1016/j.copsyc.2022.101305.
26. Tulen, J.h.m., et al. "Characterization of Stress Reactions to the Stroop Color Word Test." *Pharmacology Biochemistry and Behavior*, vol. 32, no. 1, 1989, pp. 9-15, https://doi.org/10.1016/0091-3057(89)90204-9.
27. JMP®, Version 12.1.0. SAS Institute Inc., Cary, NC, 1989–2021.