THE EFFECTS OF ANIMAL-ASSISTED INTERVENTION IN COMBINATION WITH MINDFULNESS ON PERCEIVED STRESS IN COLLEGE STUDENTS

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ABSTRACT

THE EFFECTS OF ANIMAL-ASSISTED INTERVENTION IN COMBINATION WITH MINDFULNESS ON PERCEIVED STRESS IN COLLEGE STUDENTS

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Perceived stress has been shown to have a negative effect on college students' mental health and academic success. Mindfulness-based practices and animal-assisted intervention (AAI) have both been proven to be effective interventions for reducing perceived stress levels in this demographic. To address the need for brief, effective, and efficient treatment options, the current study examined the effects of AAI combined with a brief mindfulness-based intervention on perceived stress, blood pressure, and heart rate in college students. Three groups were assessed including a guided mindfulness intervention with a therapy dog present, a mindfulness group without a therapy dog, and a non-guided self-relaxation group. Perceived stress levels, blood pressure, and heart rate were collected pre- and post-intervention. It was hypothesized that a brief, mindfulness-based exercise would reduce perceived stress levels, systolic blood pressure, and heart rate, with the AAI group showing the greatest reduction. Results revealed a statistically significant difference between groups on the combined dependent variables indicating that group membership significantly influenced the combined dependent variables. When examining the dependent variables separately, the control group had a significantly lower post-intervention heart rate than the experimental group. However, post hoc analyses did not show significance

and therefore the results should be interpreted with caution due to the high likelihood of multicollinearity among the independent variables. Additionally, while not statistically significant, the experimental group demonstrated a notable 52% reduction in perceived stress, suggesting a potential trend worthy of further exploration. The primary outcome of this study is the overall success of all three intervention styles in reducing perceived stress, blood pressure, and heart rate levels. These findings highlight the potential for future research on implementing a variety of effective short-term relaxation interventions, including AAI, mindfulness, and self-relaxation.

INTRODUCTION

The unique history and relationship between dogs and humans has been present for tens of thousands of years (Cunningham-Smith & Emery, 2020; Larson et al., 2012; Spady & Ostrander, 2008). Theories suggest that wolves interacting with humans through shared environments and food waste led to the first domesticated dog diverging from its common ancestor *Canis lupus*, or the gray wolf, around 11,000 years ago (Tancredi & Cardinali, 2023). Through the co-evolution process involving the two species developing over time together (Miklósi & Topál, 2005) domestication has led to dogs developing a skillset for socializing with humans (Kotrschal, 2023; Range & Virányi, 2015). As humans have incorporated dogs in our lives, we have altered their behaviors and shaped their forms to meet our needs, which has led to hundreds of diverse breeds with thousands of variations in physical and behavioral characteristics (Kim et al., 2018; Larson et al., 2012). These alterations have resulted in dogs having some of the most phenotypic variability compared to any other mammal (Spady & Ostrander, 2008). Through these processes, dogs have filled a variety of roles such as assisting in hunting (Lupo, 2017; Perri, 2019), acting as guardians (Adams & Johnson, 1995; Ivașcu & Biro, 2020) and providing assistance for disabilities (Hall et al., 2017; Rodriguez et al., 2020) However, as time passed less was expected of dogs in terms of job performance and more emphasis was placed on companionship and emotional needs (Amiot et. al, 2016; Kotrschal, 2023).

Human-Dog Interactions and Benefits

Human-Animal Bond and Biological Benefits

The human-animal bond is an umbrella term to encompass the various social attachments that often develop between humans and animals, and particularly pets (Serpell, 2017). The American Pet Products Association's 2021-2022 National Pet Owners Survey discovered that 69 million households in the United States include a dog. The majority of dogs living in modern day households serve primarily as companion animals (Amiot et al., 2016). Companion animals are defined by Amiot et. al. (2016) as "animals we live with that have no obvious function" (p. 552). This type of human-animal relationship is predominantly emotional in nature and includes a variety of benefits for both the human and the dog. Dogs show lower levels of cortisol and a lower heart rate during interactions with humans (Lynch & McCarthy, 1969; Schöberl et al., 2012). Interacting with companion dogs provides humans a sense of meaning and purpose (Brooks et al., 2016; Wisdom et al., 2009), improved emotional regulation (Stern et al., 2013; Wells, 2009) and distraction from daily stressors and associated stress symptoms (Brooks et al., 2016; Stern et al., 2013).

Interacting with dogs has also been linked to a decrease in blood pressure and a decrease in stress-related sympathetic nervous system activity (Odendaal & Meintjes, 2003). Odendaal and Meintjes (2003) assessed the effects of positive dog interaction (petting and softly talking with the dog) on human neurochemicals and hormones. Blood samples were used to analyze concentrations of oxytocin (promotes relaxation), β-endorphin (reduces stress and maintain homeostasis), β-phenylethylamine (has rewarding and reinforcing effects), dopamine (promotes feelings of pleasure and satisfaction), prolactin (helps with stress coping), and cortisol (prepares the body for the fight or flight response). Through plasma analysis they discovered oxytocin, β-

endorphin, β-phenylethylamine, dopamine, and prolactin levels increased in both species while cortisol levels decreased in the human participants. The study also found a significant decrease in human arterial blood pressure after an average time of 15 minutes of positive human-dog interaction. Decreases in blood pressure levels after positive dog interactions have also been reported in other research studies (Cole et al., 2007; Chia-Chun et al., 2015; Vormbrock & Grossberg, 1988). High blood pressure levels, especially in the short-term, are linked to stress and can increase the likelihood of an individual developing hypertension, which can lead to cardiovascular disease or other complications (Kulkarni et al., 1998; Odendaal & Meintjes, 2003; Padmanabhan et al., 2021).

Animal-Assisted Intervention

Animal-Assisted Intervention (AAI) is defined as an "intervention, meant to improve physical, social, emotional, or cognitive functioning with animals as an integral part of the treatment" (Bert et al., 2016, p. 695). AAI includes goal-oriented and structured interventions that intentionally incorporate animals into human services, health, and education for the purpose of improving health and wellness (Etheridge, 2019). There are three distinct types of AAI: Animal-Assisted Activities (AAA), Animal-Assisted Education (AAE), and Animal-Assisted Therapy (AAT) (Etheridge, 2019). While these terms are often used interchangeably, it is important to note the behavioral health outcomes of each intervention.

AAI has been implemented with a variety of populations ranging from children (Barker et al., 2015; Stefani et al., 2015; Tsai et al., 2010) to the elderly (Abate et al., 2011; Faulk et al., 2008; Kumasaka et al., 2012) and in environments ranging from nursing homes (Machová et al., 2019; Majić et al., 2013) to therapy sessions (Barak et al., 2001; Earles et al., 2015) and hospitals (Feng

et al., 2021; Pruskowski et al., 2020). Although AAI studies use diverse populations, type of interventions, settings, and seek various outcomes; many have acknowledged a wide range of benefits in symptomatology (Bert et al., 2016) such as lowered anxiety and stress levels (Barker et al., 2015; Hoffman et al., 2009; Wołyńczyk-Gmaj et al., 2021) and decreased depressive symptoms (Ambrosi et al., 2019; Lynch et al., 2014; Souter & Miller, 2007). Studies also have identified a decrease in systolic and diastolic blood pressure levels after participating in AAI (Cole et al., 2007; Stasi et al., 2004; Tsai et al., 2010).

Research has documented AAI to produce desirable increases as well. For example, Chu et al. (2009) noted significant improvements in self-esteem, self-determination, positive psychiatric symptoms, and emotional symptoms for individuals diagnosed with schizophrenia following an 8-week AAI program. In another study individuals diagnosed with depression cared for farm animals for 12-weeks. Individuals in the study reported that the intervention made them feel like they were living an ordinary life. Through working with a farmer to complete tasks like grooming, mucking, feeding, milking, and caring for young the participants reported feeling like a colleague, feeling appreciated, and developing coping skills. Participants also reported experiencing closeness, warmth, and calming sensations through physical contact with the animals (Pederson et al., 2012).

Perceived Stress in College Students

One of the most prevalent and significant risk factors that can impact an individual's psychological functioning is perceived stress (Thorsén et al., 2022). Wang et al. (2019) defines perceived stress as "the degree to which events in a person's life are assessed as stressful, unpredictable and uncontrollable" (p. 4983). Studies have acknowledged that perceived stress

can impact an individual's neurobiological substrates and has a particular impact on the prefrontal-limbic brain regions (McEwen & Morrison, 2013; Michalski et al., 2017; Moreno et al., 2017), which is responsible for an individual's emotional responses (Moini et al., 2023). Previous research in a variety of populations found that perceived stress may serve as a predictor of depressive symptoms (Bay & Donders, 2008; Bergdahl & Bergdahl, 2002; Chao, 2014; Eisenbarth, 2012; Farabaugh et al., 2004).

College students are particularly susceptible to experiencing stress (Zhao et al., 2023). The transition to college can be an overwhelming experience for many individuals due to it being the first time living away from home for some, having to adapt to a new environment, needing to meet new academic challenges and expectations, and all the while learning how to navigate adulthood (Arnett, 2016). The 2015 American College Health Association survey found that 36.7% of college students reported average stress levels, 42.6% reported more than average stress and 11.1% reported tremendous stress within the last 12 months. The 2023 survey by the American College Health Association found that 49.8% of college students reported moderate stress levels and 29% reported high stress levels in the previous 30 days (American College Health Association, 2015, 2023).

High levels of perceived stress can have a negative impact on a student's personal and academic lives and their future success (Ward-Griffin et al., 2018). Research has shown that college students with higher levels of perceived stress have lower academic engagement, poorer adjustment skills, and are at a higher risk for developing mental health problems (Bruffaerts et al., 2018; Hoyt et al., 2021; Tasso et al., 2021). Additionally, stress was rated second only to procrastination for its negative impact on academic performance (American College Health Association, 2023).

AAI and Perceived Stress in College Students

Animal-assisted intervention has been found to decrease high perceived stress levels (González-Ramírez et al., 2013; Wijker et al., 2020) and specifically reduces perceived stress in college populations (Binfet, 2017; Chute et al., 2023; Delgado et al., 2018; House et al., 2018; Ward-Griffen et al., 2018; Wood et al., 2017). However, the college population faces scheduling conflicts and extended wait times and needs quick and efficient treatment options (Oswalt & Riddock, 2007; Dell et al., 2015). Brief AAI sessions have been explored as an effective and efficient way to apply AAI in populations with time constraints like college students (Barker et al., 2016; Binfet, 2017; Wood et al., 2017).

Barker et al. (2016) examined the effectiveness of a brief, 15-minute therapy dog program on overall well-being in 57 college students. The study identified that 92.9% of participants reported a decrease in stress levels immediately following the brief interaction with a therapy dog. Binfet (2017) conducted a randomized control trial study of the effects of brief, single-session, AAI on college students' perceived stress, homesickness, and affinity to campus. The study of the 84 students in the 20-minute AAI session found a significant decrease in perceived stress and homesickness pre- and post-intervention. Significant improvements were also seen in the student's sense of belonging.

Wood et al. (2017) also examined whether brief AAI sessions could reduce stress in college students (the PAwS study). The authors hypothesized that shortened (15 minutes) unstructured group interventions with a guide dog in training would substantially decrease stress levels in college students. Sixty-five percent of participants showed a statistically reliable change on the State Trait Anxiety Inventory (STAI) and of those 44% showed clinically significant change. Of the 52% of participants that had a pre-intervention STAI score in the clinical range,

85% showed a clinically significant change post-intervention. Systolic and diastolic blood pressure levels were also lower after the interaction. These results show that even limited unstructured AAI can reduce perceived stress and lower blood pressure in college students (Wood et al., 2017).

Mindfulness Based Interventions on Perceived Stress in College Students

Mindfulness interventions is an accepted, evidence-based treatment for reducing stress in adult populations (Aikens et al., 2014; Shapiro et al., 2007). Mindfulness-based interventions focus on remaining aware of the present moment, controlling attention, noting the mind-body connection, being aware of bodily sensations, and maintaining non-judgmental thoughts (Bamber & Schneider, 2016). Mindfulness is utilized with a variety of other psychological interventions such as Cognitive Therapy (MBCT; Segal et al., 2002), Acceptance and Commitment Therapy (ACT; Hayes et al., 1999), and Dialectical Behavior Therapy (DBT; Linehan, 1993).

An example of using a mindfulness-based interventions on perceived stress in the college population was developed by Deckro et al. (2010). Deckro created a 6-week mindfulness-based intervention to analyze its effects on college student's psychological distress, anxiety levels, and perception of stress compared to the waitlist control group. The 63 experimental group participants completed six 90-minute guided mindfulness sessions using cognitive behavioral skills to produce a relaxation response. The 6-week intervention produced significant reductions in psychological distress, perceived stress, and state anxiety levels compared to the control group.

For the college population a brief, less structured approach to mindfulness can be effective. Bamber & Schneider (2016) analyzed 57 studies examining the effects of mindfulness-

based interventions on stress and anxiety in college students. Of the studies using a less structured mindfulness intervention model, 78% found a decrease in self-reported stress levels (Deckro et al., 2010; Greeson et al., 2013; Kang et al., 2009; Warnecke et al., 2011) and 77% in anxiety levels (Kim et al., 2012; Lynch et al., 2011; Yamada & Victor, 2012) .

A study by Sousa et al. (2021) examined the effects of a brief, recorded mindfulness exercise with college students on negative and positive affect, perceived stress, state anxiety, and cortisol levels. Twenty students were randomly assigned to the mindfulness training group and completed a 30-minute audio-guided meditation intervention focused on breathing and body sensations. After the brief mindfulness exercise there was an observed decrease in perceived stress, anxiety, and negative affect, and a marginal decrease in cortisol levels. An increase in positive affect was also reported (Sousa et al., 2021). These results indicate that brief mindfulness-based interventions can be beneficial in reducing stress levels in the college student population.

AAI and Mindfulness Based Interventions in College Students

To date, there is limited research that has examined mindfulness in combination with AAI interventions. However, one study by Henry and Crowley (2015) examined the effects of adding AAI to a modified Mindfulness Based Reduction Program (MBSR). The 21 participants were experiencing psychological distress. All of the participants experienced a decrease in psychological distress, depressive and anxiety symptoms, blood pressure and heart rate levels, and an increase in mindfulness skills. However, there was no significant difference when AAI was added in the experimental group. The authors indicated that including moderate to larger effect size estimates could potentially result in a clinically significant difference with higher

ratings in the MSBR alone and MSBR plus AAI groups. The authors suggested that to increase the quality of future studies and decrease potential bias, future research should include a larger sample size and include multiple dog and handler teams (Henry & Crowley, 2015).

Purpose

Perceived stress has been shown to have a negative effect on college student mental health and academic success (Bruffaerts et al., 2018; Hoyt et al., 2021; Tasso et al., 2021). Research has indicated that while most universities offer student mental health services, students have difficulty accessing those resources due to extended wait times and scheduling conflicts (Oswalt & Riddock, 2007; Dell et al., 2015). The literature has identified mindfulness to be an effective intervention for reducing perceived stress levels in college students (Deckro et al., 2010; Greeson et al., 2013; Kang et al., 2009; Warnecke et al., 2011). Research has also addressed the effectiveness of AAI on the reduction of perceived stress levels in college students (Binfet et al., 2018; Chute et al., 2023; Peel et al., 2023) and in reducing blood pressure and heart rate, which are associated with the stress response (Cole et al., 2007; Chia-Chun et al., 2015; Odendaal & Meintjes, 2003; Vormbrock & Grossberg, 1988). To address the need for brief, effective, and efficient treatment options for college students the current study examined the effects of AAI combined with a brief mindfulness-based intervention on perceived stress, blood pressure, and heart rate in college students.

This study introduced a brief, less structured, mindfulness-based intervention within the college population for stress reduction. To test the effects of AAI the experimental group incorporated a guided mindfulness intervention with a therapy dog present and the comparison group, which included guided mindfulness without a therapy dog present. The control group

included non-guided self-relaxation techniques, such as viewing and listening to the rain, the ocean, and landscapes or self-guided relaxation, to address the effectiveness of mindfulness interventions. Perceived stress levels, blood pressure, and heart rate were collected pre- and post-intervention. Consistent with previous research, the current study hypothesized that a brief, mindfulness-based exercise will reduce perceived stress levels, systolic blood pressure, and heart rate. The study further hypothesized that AAI in combination with mindfulness will be most effective and yield significantly lower scores when compared to the comparison and control groups.

Tested Hypotheses

1a. The experimental group and comparison group will report lower levels of perceived stress compared to the control group post-intervention.

1b. The experimental group will report lower levels of perceived stress compared to the comparison group post-intervention.

2a. The experimental group and comparison group will have lower systolic blood pressure levels compared to the control group post-intervention.

2b. The experimental group and comparison group will have lower heart rate levels compared to the control group post-intervention.

3a. The experimental group will have lower systolic blood pressure levels compared to the comparison group post-intervention.

3b. The experimental group will have lower heart rate levels compared to the comparison group post-intervention.

METHOD

Participants

The sample consisted of 63 undergraduate and graduate students, at least 18 years of age, from a rural Appalachian university. Of the 63 participants, 53 were recruited through the university's General Psychology research recruitment pool (SONA) and received research credit for participation. Participants were also recruited through emails sent by faculty members and flyers posted around the campus with a QR code that provided a link to the Qualtrics sign up process. Participants who reported a fear or nervousness around dogs, allergies to dogs, a history of irregular blood pressure or heart rate conditions were excluded from the study. A power analysis was conducted by G*Power 3.1.9.2 (Faul, Erdfelder, Buchner, & Lang, 2009). Cohen's guidelines (Steyn & Ellis, 2009) of effect sizes for f^2 (V) of 0.15 were used as a benchmark for a medium effect size (57 needed participants, 19 per group).

Therapy Dog

The therapy dog and handler recruited for this study are certified by the Alliance of Therapy Dogs organization. The therapy dog involved in this study was a 3-year-old male Newfoundland weighing a little over 150 pounds. He has reached the American Kennel Club Therapy Dog Supreme title and has completed over 620 visits in various populations and settings.

Measures

Recruitment

Recruitment Survey. An online recruitment survey was given to all participants before being assigned to a group. The survey included consent to participate, confirmation of being at least 18 years old, and the exclusionary criteria of fear or nervousness around dogs, dog allergy, and a history of irregular blood pressure or heart rate conditions. If any of the exclusionary criteria was met the survey was discontinued. Participants that had not met exclusionary criteria, were asked to provide their email, race, current dog ownership (i.e., how many, what breed/s, and relationship with dog/s), if they grew up with a dog in the household (relationship with dog/s), and a brief description of their feelings toward dogs. The survey also included if the participant had a traumatic and/or negative experience with a dog and a brief written explanation of the experience (see Appendix A.1).

Personality

M5-120 Personality Questionnaire. The M5-120 Questionnaire (McCord, 2002) is a 120-item inventory of personality that measures the 5 domains and 30 facets within the five-factor model of personality. These domains include Neuroticism, Extraversion, Openness to Experience, Conscientiousness, and Agreeableness with 6 descriptive facets falling under each domain. This inventory is highly correlated with the NEO-PI-R and has been shown to possess high levels of internal reliability. On this inventory each item is scored on a five-point rating scale ranging from “1 = Inaccurate” to “5 = Accurate”. This measure was included as a stress inducer and for potential future research purposes (see Appendix A.2).

Perceived Stress

Line Marking Scale. The Line Marking Scale is a one item self-report measure asking the individual to mark on a line where their response falls between 1 and 100. For this study the scale was completed on Qualtrics where participants were asked to use a sliding scale to rate their current level of stress. The single item read "What is your level of nervousness/stress right now?" The slide was then labelled as "Very Low Stress" to "Very High Stress" with an underlying numerical scale ranging from 1 to 100 (see Appendix A.3).

Blood Pressure & Heart Rate

Withings BPM Connect Device. The Withings BPM Connect Device is an automatic upper-arm band that serves as an at-home blood pressure monitor for the general population. The device tracks systolic and diastolic blood pressure as well as heart rate. Data was documented on paper, within Qualtrics, and automatically uploaded and stored within a secure app on an electronic device (tablet). Topouchian et al. (2022) concluded that the Withings BPM Connect Device is an accurate measure of blood pressure based on the requirements of the European Society of Hypertension, the Association for the Advancement of Medical Instrumentation in the United States, and the International Organization for Standardization for both systolic and diastolic blood pressure measurements (Toupouchian et al., 2022).

Therapy Dog Engagement

Therapy Dog Engagement Scale. To measure the level of engagement between the participant and the therapy dog, a research assistant documented this information during the intervention using a rating scale and a description box. The item read "Document the level of

engagement between the participant and the therapy dog during the majority of the intervention" with a rating scale ranging from 1-4. The options read "1 = little to no engagement", "2 = some engagement" "3 = moderate engagement", "4 = a lot of engagement". A description box was also included to gather qualitative data on the engagement level (see Appendix A.4).

Interventions

Intervention Selections. Group intervention participant selections were documented through a checklist recorded by a research assistant documenting which intervention was selected by the participant. These intervention options were based on group assignment (see Appendix A.5 & A.6).

Therapy Dog Expectation

Line Marking Scale. The experimental group also received an additional post-intervention question related to the level that the therapy dog met their expectations during the intervention. This question was also implemented through Qualtrics with a sliding scale. The single item read "The dog I interacted with met my expectations." The slide was labelled "Strongly Disagree" to "Strongly Agree" with an underlying numerical scale ranging from 1 to 100. Following the item, qualitative data was collected through a single item that read "Please explain your response below" (see Appendix A.7).

Procedures

Participants registered through SONA for a specific date and time slot or selected an available date and time slot for participation through email. All participants were required to

complete the Recruitment Survey prior to participation to ensure no exclusionary criteria was met. SONA participants were sent the Qualtrics link for this survey in their email and participants who registered through a recruitment email or flyer completed the survey through the QR code on the flyer or the direct link provided in the recruitment email (see Appendix B: Procedure for recruitment email and flyer). Random assignment placed 22 participants in the experimental group, 21 in the comparison group, and 20 in the control group. Due to the study requiring potential interaction with an animal and physiological measures, prequalification screening requirements included an absence of a fear or nervousness around dogs, allergy to dogs, and no history of irregular blood pressure or heart rate condition. Once the prescreening qualifications were met the participants were able to complete the rest of the Recruitment Survey including race, dog ownership, and dog history.

Upon arrival, participants were greeted by a research assistant to go over the consent form, obtain consent, and allow an opportunity to ask questions. After obtaining consent, participants were escorted to a testing room where they were asked to complete the M5-120 Personality Inventory as a stress inducer. The research assistant observed the participant as they completed the inventory through a one-way mirror and instructed the participant to raise their hand upon completion. Once completed the research assistant immediately measured the participant's blood pressure and heart rate using the Withings BPM Connect Device and documented the reading on the corresponding Qualtrics form and a paper copy (data was also logged on the Withing app). Following this measure, the participants were then asked to complete the Perceived Stress Level Line Marking Scale to document their current level of stress. After completing the measures, the participants were led to the appropriate intervention room, based on their assigned group, to complete a stress reduction intervention.

Once in the intervention room the participants were asked to select their choice of stress-reduction intervention. Each participant was instructed to pay attention to the intervention as much as possible and phones were not permitted during the intervention. The experimental group participants were also briefly (1-2 minutes) introduced to the therapy dog and handler and were encouraged to engage with the therapy dog as they saw fit during the intervention, (e.g., sit on the chair or on the floor, pet the therapy dog at own frequency and duration). During the intervention, the experimental and comparison groups completed a 10-minute guided mindfulness exercise (video or audio only format), and the control group completed a 10-minute non-guided stress reduction intervention (video or audio only format). During the experimental group intervention, a research assistant documented the participant's level of engagement with the therapy dog using the Therapy Dog Engagement measure.

Immediately following the intervention all groups had their blood pressure and heart rate measured and completed the Perceived Stress Level Line Marking Scale again. The experimental group also completed an additional Line Marking Scale related to the level that the therapy dog met their expectations during the intervention. Participants in the comparison and control groups were also given the opportunity to interact with the therapy dog once completed or on another designated day and time.

RESULTS

To analyze the effects of the experimental group, comparison group, and the control group on perceived stress levels (Stress), systolic blood pressure (SYS), and heart rate levels (HR) a Multivariate Analysis of Variance (MANOVA) was run. The assumptions of the MANOVA were assessed. To assess the assumption of univariate normality, histograms and Q-Q

plots were examined for each dependent variable within each group. The distributions of the dependent variables (preSYS, preHR, preStress, postSYS, postHR, postStress) appeared approximately normal within each group, as indicated by visual inspection of histograms and Q-Q plots (see Figures D.1-D.12). Multivariate normality was assessed by examining the distribution of the dependent variables. Visual inspection of scatterplots revealed no major deviations from normality (see Figures D.13). To assess the assumption of multivariate outliers, Mahalanobis distances were calculated for each participant (Mahalanobis, 1936). The Malahanobis critical value was obtained for the presence of 6 dependent variables ($X^2 = 22.46$; Tabachnick & Fidell, 2013). No observations were identified as outliers based on Mahalanobis distances (max = 19.43). The assumption of linearity was assessed by examining scatterplots of the independent variables against each dependent variable. Scatterplots revealed a linear relationship between the independent variable and the corresponding dependent variable. The assumption of homogeneity of covariance matrices was assessed using Box's M Test of Equality of Covariance Matrices (Box, 1953). Box's M test was not significant (Box's M = 57.69, p = .205), indicating that the assumption of homogeneity of covariance matrices was not violated. To assess for multicollinearity, a correlation matrix was calculated on the dependent variables (preSYS, preHR, preStress, postSYS, postHR, postStress). The correlations between preSYS and postSYS ($r = .80$), prestress and postStress ($r = .86$), and preHR and postHR ($r = .89$) were relatively high, suggesting potential multicollinearity (see Table C.1). However, as the MANOVA is robust to moderate levels of multicollinearity, no further action was taken.

To investigate the effects of the experimental group, comparison group, and the control group on perceived stress levels, systolic blood pressure, and heart rate, a MANOVA was run. Six dependent variables were used: preSYS, preHR, preStress, postSYS, postHR, and postStress.

The independent variable was group assignment. The multivariate analysis revealed a statistically significant difference between groups on the combined dependent variables, Wilks' Lambda = .631, $F(12, 110) = 2.37$, $p = .009$, partial eta squared = .21, indicating that group membership significantly influenced the combined dependent variables (see Table C.2). Follow-up univariate ANOVAs were conducted to examine differences between groups on individual dependent variables. When results for the dependent variables were considered separately, the only difference to reach statistical significance was postHR, $F(2, 60) = 3.63$, $p = .033$, partial eta squared = .11 (see Table C.3). Post hoc comparisons using the Tukey's Honestly Significant Difference (HSD) test indicated that none of the pairwise comparisons between the control group ($M = 72.65$, $SD = 9.25$, $N = 20$), the mindfulness group ($M = 76.14$, $SD = 13.40$, $N = 21$), or the experimental group ($M = 82.91$, $SD = 14.34$, $N = 22$) reached statistical significance (all p-values > .05) (Tukey, 1953). These findings suggest that while group membership significantly influences the combined variables, the specific differences in postHR between groups did not reach significance in the post hoc analyses. Due to the contradictory results between the MANOVA and post hoc analysis, these results should be interpreted with caution due to the high likelihood of multicollinearity among the independent variables. (see Table C.4).

Three paired samples t-tests were conducted as exploratory analyses to assess within-group changes in perceived stress from pre- to post-intervention. All three groups showed statistically significant reductions in perceived stress. The experimental group demonstrated the greatest reduction, with a 52% decrease ($M = 37.36$ to $M = 17.73$) following the intervention. The comparison group ($M = 38.05$ to $M = 28.14$, 26%) and the control group ($M = 36.80$ to $M = 25.75$, 30 %) also showed meaningful decreases, though to a lesser extent. While these differences did not reach significance in the MANOVA, the notable reduction in the

experimental group supports the potential benefit of AAI in stress reduction and highlights the need for continued research on this intervention.

Qualitative data was gathered in the experimental group post-intervention in regard to the level that the therapy dog met the participants' expectations. A formal qualitative content analysis was not applicable due to the brevity of participant responses. Since participants were only asked to provide a brief explanation, the responses were not detailed enough for rigorous thematic analysis. Instead, qualitative themes were identified using word-based techniques, including word repetition and key words in context. This analysis identified two overarching themes and three sub-themes in the data. The most occurring overarching theme in the data was in regard to the Therapy Dog's Personality/Presence. Of the total 22 qualitative data responses 68% fell into the overarching theme of the Therapy Dog's Personality/Presence. This theme involved statements about the therapy dog's demeaner and overall presentation. Some example statements in this category include, "He was so cute and chillaxed…I love that he wasn't hyper, and I felt I had support…" and "…was calm and gentle… a warm presence to help ground me during the exercise."

Two sub-themes were identified within this category; these included Fluffy (Contact Comfort) and Easy Interaction. Fluffy (contact comfort) included statements about the therapy dog's texture and textural appearance. This sub-theme included 23% of the responses. Example statements in this category include, "Extremely fluffy and sweet dog that laid next to me the entire time" and "… like a giant teddy bear, very friendly and cuddly. It was a better experience than I expected." The second sub-theme identified under the overarching theme of the therapy dog's personality/presence was Easy Interaction, which included statements regarding the ease of interaction with the therapy dog during the intervention. Example statements include, "He was

very calm and patient with me and let me pet him wherever" and "… very good boy and let me pet him." This sub-theme included 18% of the qualitative responses.

The second identified theme referenced Positive Affect elicited by the therapy dog interaction. Out of 22 responses 41% fell within this category. This theme involves statements around a positive affect outcome after interacting with the therapy dog. Some example statements include, "He helped me be happy" and "A perfect way to relax." One sub-theme was identified within this category. The Calming sub-theme, which included 36% of the data, included statements about the therapy dog's calming effect. Examples of this sub-theme are statements such as, "The therapy dog helped me calm down, I felt the presence of being comforted" and "The dog was so calm, which helped me stay calm!" (see Table C.5).

Quantitative data was also collected regarding to what level the therapy dog met the participant's expectations. Of the 22 responses, 68% ($N = 15$) indicated that the therapy dog completely met their expectations, 98% of the participants had responses that fell at an 80 ranking or higher ($N = 21$), and one outlier was noted with a ranking of 46 (see Table C.7).

DISCUSSION

The purpose of this study was to analyze the effects of brief animal-assisted intervention in combination with less structured, mindfulness-based interventions on stress reduction within the college population. To test these effects three groups were included in this study; the experimental group that included completing a mindfulness-based intervention with a therapy dog present, the comparison group that included the same mindfulness options but without the therapy dog, and the control group which included nonguided relaxation options. To assess the

effects of the interventions, measures of perceived stress, blood pressure, and heart rate levels were documented pre- and post-intervention. It was hypothesized that the experimental group would have the lowest levels of perceived stress, blood pressure, and heart rate levels following the intervention, followed by the comparison group, and the control group.

The MANOVA indicated that group membership significantly influenced the combined dependent variables. When looking at the variables independently, there was a statistically significant finding between post-intervention heart rate in the control group and experimental group. This finding indicated that the control group had a significantly lower heart rate post-intervention than the experimental group. This finding was also seen in the study by Teo et al. (2024), where they found that dog interaction resulted in a significantly higher heart rate when compared to baseline resting, relaxation-induction exercise, petting a toy dog, and just having a real dog in the room. However, they hypothesized that this would occur due to increased engagement, movement, and arousal while petting a real dog (Teo et al., 2024).

It is also important to note the potential effects of having the therapy dog handler in the room during the intervention and the impacts of engaging with them and talking to the dog. The dog engagement qualitative data collected and intervention observations revealed that some of the participants spoke with the handler and dog during the intervention (see Table C.6). A study by Vormbrock and Grossberg (1988) found that when analyzing the effects of dog interaction on heart rate and blood pressure, the participants' heart rate was higher while touching *and* talking to a dog than just touching *or* talking to a dog. They also found that participant blood pressure was higher when talking to the dog and highest while talking to the experimenter (Vormbrock & Grossberg, 1988). Another consideration was potential dog anxiety or the therapy dog not meeting the expectations of the participant. However, when analyzing the data regarding therapy

dog expectations (see Table C.6 & C.8) almost all participants rated the therapy dog at an 80 or above on a scale from 0-100 (with one outlier ranking the therapy dog at a 46, due to the therapy dog appearing sedentary). These findings support that dog anxiety or displeasure with the therapy dog were not an impact on the results.

The primary takeaway from this study is the overall effectiveness of all three intervention styles in reducing perceived stress, blood pressure, and heart rate levels. While the hypotheses predicted greater effectiveness in the experimental group, exploratory analyses revealed significant reductions in stress measures across all groups, regardless of intervention type. Although unexpected, this finding emphasizes the effectiveness of all three intervention approaches. Additionally, while not statistically significant, the experimental group demonstrated a 52% decrease in perceived stress following the combined mindfulness and therapy dog interaction. This supports the potential benefits of AAI for stress reduction and highlights the value of making AAI and therapy animals more accessible to those who may benefit. Furthermore, our findings suggest that incorporating a therapy dog into an empirically supported stress reduction intervention, such as mindfulness, does not increase discomfort or anxiety, enhances participant engagement, and promotes a sense of calm and relaxation. Overall, these results emphasize the potential benefits of short-term (10 minute) relaxation interventions, including AAI, mindfulness, and self-relaxation, and highlight the need for further research on their implementation and comparative effectiveness.

LIMITATIONS AND FUTURE RESEARCH

Throughout this study we identified topics for future consideration and adjustments. The primary question being "how did three different styles of interventions produce very similar results?". In regard to the experimental group there are a variety of factors that could have impacted the results. The first consideration for this research design is the possibility of the participants' ability to attend to the mindfulness intervention and the therapy dog equally. When analyzing the dog engagement data many participants attended to the dog or the mindfulness, but few were able to attend to both for the duration of the intervention. A future research design to overcome this would be to include a fourth group in the study that is only interaction with the therapy dog, without the addition of mindfulness. This alteration would likely overcome the "multitasking" nature of the experimental group and analyze the effects of therapy dog interaction alone, which is a common implementation in today's practices of AAI.

Another important consideration when working with therapy dogs is the dog themselves. For this study we worked with a very large and mellow therapy dog. Dog personality, size, color, texture, age, and many other characteristics can all be confounding factors, especially if using more than one dog in the study (Mair et al., 2025; Serpell et al., 2017). Utilizing a dog like the one in this study may not be as effective for an individual who prefers a more engaged dog or one that is small to medium sized. Participant dog history can also play an important role in the success of intervention. For this study all participants were screened for fear of dogs and allergy to dog. However, general dog history and biases can impact the intervention even if that history is not traumatic or negative. While dog preference and biases can be difficult to overcome, they are important to address when implementing AAI as an intervention.

When discussing potential adjustments for future research the primary alteration is a more reliable and valid measure or physiological stress. Our results and the literature indicate that blood pressure and heart rate may not be the most effective when measuring stress reduction when working with AAI. Studies like Teo et al. (2024) found that the presence of a therapy dog can increase heart rate due to movement when petting and overall arousal when engaging with an animal. Another potential adjustment is the amount of intervention received, our study used a brief intervention style of one session with 10 minutes of intervention. Brief mindfulness sessions have been found to be equally effective to longer sessions (Fincham et al., 2023; Palmer et al., 2023). However, it is possible that a single session is not sufficient and that more than one session may be necessary for long-term effectiveness (Hofmann & Gómez, 2018; Demarzo et al., 2017; Sylvia et al., 2022).

Lastly, it is worth considering the addition of a stressor to ensure that the participants are not starting the stress reduction intervention with their stress levels at baseline. The current study was guided on the premise of most college students experiencing some level of perceived stress. To potentially increase this stress level and gather personality data for future research, the M5-120 was administered to each participant. However, there was no dependent measure to demonstrate the M5-120's ability to induce stress. In the future, all stress reduction measures should be administered before the stress inducer (M5-120 or other) as well as pre- and post-intervention to assess the inducer's ability to increase stress.

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APPENDICES

APPENDIX A: Measures

A.1 Recruitment Survey

AAI Study Recruitment Survey

Western Carolina University Consent Form to Participate in a Research Study

Project Title: The Effects of Animal-Assisted Intervention in Combination with Mindfulness on Perceived Stress in College Students

This study is being conducted by: Ezri Villiard, B.S. Psychology; Dr. Nathan Roth, Ph.D., HSP-P, Professor of Clinical Psychology

Description and Purpose of the Research: You are invited to participate in a research study about the effects of animal-assisted intervention in combination with mindfulness on perceived stress in the college population using a measure for perceived stress and a measure of heart rate and blood pressure. By doing this study we hope to learn more about the benefits of animal-assisted intervention on perceived stress within the college population.

What you will be asked to do: Participants will register through Qualtrics or SONA and be asked to fill out prescreening measures to ensure that the participant qualifies to participate in the current study. Individuals with a known heart condition, irregular blood pressure, an allergy to dogs, or a fear of dogs (cynophobia) will not be eligible to participate. A confirmation email will be sent including dates, times, and the location of the study for the participant to register. Upon

arrival, participants will be asked to complete a demographics survey that will include the individual's age, gender, ethnicity, dog ownership, dog history including past and current dog ownership, and potential negative experiences with dogs. Participants will then be asked to complete a personality assessment. All participants will then be directed to an intervention room to complete a perceived stress measure as well as have their heart rate and blood pressure measured. Once completed they will engage in a stress reduction intervention (e.g., relaxation, mindfulness) with or without a therapy dog and their handler present. Participants will engage in this intervention for approximately 10 minutes. Following the intervention participants will complete the perceived stress measure as well as have their heart rate and blood pressure measured. The entire process will take approximately 30 minutes to complete.

Risks and Discomforts: There are risks involved in participation of this study. The use of dogs and dog interaction can result in minor injury (e.g. scratches, bites) or allergic reaction. To minimize these risks all dog-handler teams involved in this study have been screened and passed a rigorous certification test through a reputable, nationally recognized therapy dog organization, the Alliance of Therapy Dogs. All dog-handler teams are insured and approved to engage in volunteer work. However, because they are animals, we cannot always predict their behavior or foresee all potential problems that may occur. Handlers will assess their dog's needs and behavior prior to, during, and following each session as required by the organizational standards and reserve the right to stop engagement to ensure the safety of the therapy dog and/or the

participant. To minimize the risk of an allergic reaction, only individuals with no known allergy to dogs are eligible to participate in this study.

Benefits: There are no direct benefits to you for participating in this research study. However, this study will help us better understand and address the need for a brief, effective, and efficient treatment option for reducing stress in college students. This study will also expand the literature and research on Animal-Assisted Intervention.

Privacy/Confidentiality/Data Security: The data collected in this research study will be kept confidential. Participation in research may involve some loss of privacy. We will do our best to make sure that the information about you is kept confidential, but we cannot guarantee total confidentiality. Your personal information may be viewed by individuals involved in the research and may be seen by people including those collaborating, funding, and regulating the study. We will share only the minimum necessary information in order to conduct the research. Your personal information may also be given out if required by law, such as pursuant to a court order. While the information and data resulting from this study may be presented at scientific meetings or published in a scientific journal, your name or other personal information will not be revealed. Data will be collected through Qualtrics and SONA. This information will be stored on an encrypted cloud-based system and deidentified for analysis purposes. Blood pressure and heart rate data will be recorded and stored within a corresponding secure application connected to the device. To protect your health information, the data will be de-identified. Identifiers might be removed from your information and the de-identified information might be used or distributed to other researchers for future research without your additional consent. The research team will

work to protect your data to the extent permitted by technology. It is possible, although unlikely, that an unauthorized individual could gain access to your responses because you are responding online. This risk is similar to your everyday use of the internet.

Voluntary Participation: Participation is voluntary, and you have the right to withdraw your consent or discontinue participation at any time without penalty. If you choose not to participate or decide to withdraw, there will be no impact on your grades or academic standing.

Compensation for Participation: Participants who register through SONA will receive one hour of research credit.

For questions about this study, please contact Ezri Villiard at ecvilliard1@catamount.wcu.edu. You may also contact Dr. Nathan Roth, the principal investigator and faculty advisor for this project, at 828-227-3368 or nproth@email.wcu.edu. If you have questions or concerns about your treatment as a participant in this study, you may contact the Western Carolina University Institutional Review Board through the Office of Research Administration by calling 828-227-7212 or emailing irb@wcu.edu. All reports or correspondence will be kept confidential to the extent possible.

I understand what is expected of me if I participate in this research study. I understand that

participation is voluntary. My selection of "I do consent to participate in this research project" shows that I agree to participate and am at least 18 years old.

- ○ I consent to participate in this research project. (1)
- ○ I do not consent to participate in this research project. (2)

Do you experience fear or nervousness around dogs?

- ○ Yes, I do. (1)
- ○ No, I do not. (2)

Do you have an allergy to dogs?

- ○ Yes, I do. (1)
- ○ No, I do not. (2)

Do you have a history of irregular blood pressure levels or a blood pressure related condition?

- ○ Yes, I do. (1)
- ○ No, I do not. (2)

Do you have a history of irregular heart rate or heart rate related conditions?

- ○ Yes, I do. (1)
- ○ No, I do not. (2)

Please enter your first and last name

_____

Please provide your email below so you may be contacted if you are selected to participate in this study.

_____

Choose one or more races that you consider yourself to be

- ☐ White or Caucasian (1)
- ☐ Black or African American (2)
- ☐ American Indian/Native American or Alaska Native (3)
- ☐ Asian (4)
- ☐ Native Hawaiian or Other Pacific Islander (5)
- ☐ Other (6)
- ☐ Prefer not to say (7)

Do you currently own a dog/s?

- ○ Yes, I do. (1)
- ○ No, I do not. (2)

If yes, how many and what breeds?

_____

If yes, Briefly describe your relationship with your dog/s.

_____

Did you have a dog living in your household growing up?

- ○ Yes, I did. (1)
- ○ No, I did not. (2)

If yes, briefly describe your relationship with the dog/s.

_____

Briefly, how would you describe your feelings towards dogs?

_____

Have you ever had a traumatic and/or negative experience with a dog?

- ○ Yes, I have. (1)
- ○ No, I have not. (2)

If yes, please briefly describe this experience

_____

A.2 M5-120 Personality Inventory

M5-120 Personality Inventory

What is the purpose of this research?

This research examines personality characteristics as they relate to attitudes toward sport psychology consulting. Results will contribute to the basic understanding of human behaviors.

What will be expected of me?

We are requesting your participation by completing a brief online personality questionnaire. There are 120 questions dealing with normal personal preferences and characteristics as well as 25 items dealing with personal attitudes and beliefs about utilizing the services of a sport psychologist. The answer format on the first 120 items is a 5-choice rating, from Inaccurate to Accurate. The answer on the final 25 items is a 7-choice rating from strongly disagree to strongly agree. There will also be a few questions regarding general demographic and experience with sport psychology services. Note: You must be at least 18 years of age to participate in this study.

How long with the research take?

The questionnaire takes 20 minutes on average.

How will you use my information?

Data collected is confidential; thus, your individual results will not be shared outside the research team. Aggregate data will be examined in order to explore broad relationships among variables

across the population.

Can I withdraw from the study if I decide to?

Your participation in this study is much appreciated but is entirely voluntary. You may withdraw at any time.

Is there any harm that I might experience from taking part in the study?

We anticipate no potential risk to you.

How will I benefit from taking part in the research?

You would be contributing new knowledge to the literature on the association, if any, between personality characteristics and willingness to seek out or utilize the services of a sport psychologist as a student athlete, as it pertains to the basic understanding of human behavior.

Who should I contact if I have questions or concerns about the research?

Contact Dr. David McCord, at 828-227-3363 (or mccord@wcu.edu) if you have questions about the study. If you have concerns about your treatment as a participant in this study, contact the chair of WCU's Institutional Review Board through the office of Research Administration at WCU (828-227-7212) (irb@wcu.edu).

By clicking the first option below and continuing, I am indicating I consent to be a part of this research study. By clicking the second option, I am indicating I do not consent to be a part of this research study and do not wish to continue.

○ I consent/agree to participate in this study (1)

○ I do not consent/ I decline (2)

Participant Code

_____

M5-120 Questionnaire Without spending too much time dwelling on any one item, just give the first reaction that comes to mind. It is important to answer every item, without skipping any. You may change an answer if you wish. It is best to respond as honestly as possible. Mark the response that best shows how you really feel or see yourself, not responses that you think might be desirable or ideal.

	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Inaccurate Nor Accurate (3)	Moderately Accurate (4)	Very Accurate (5)
Worry about things. (1)	○	○	○	○	○
Make friends easily. (2)	○	○	○	○	○
Have a vivid imagination. (3)	○	○	○	○	○
Trust others. (4)	○	○	○	○	○
Complete tasks successfully. (5)	○	○	○	○	○
Get angry easily. (6)	○	○	○	○	○
Love large parties. (7)	○	○	○	○	○

Believe in the importance of art. (8)	○	○	○	○	○
Use others for my own ends. (9)	○	○	○	○	○
Like to tidy up. (10)	○	○	○	○	○
Often feel blue. (11)	○	○	○	○	○
Take charge. (12)	○	○	○	○	○
Experience my emotions intensely. (13)	○	○	○	○	○
Love to help others. (14)	○	○	○	○	○
Keep my promises. (15)	○	○	○	○	○

Find it difficult to approach others. (16)	○	○	○	○	○
Am always busy. (17)	○	○	○	○	○
Prefer variety to routine. (18)	○	○	○	○	○
Love a good fight. (19)	○	○	○	○	○
Work hard. (20)	○	○	○	○	○
Go on binges. (21)	○	○	○	○	○
Love excitement. (22)	○	○	○	○	○
Love to read challenging material. (23)	○	○	○	○	○

Believe that I am better than others. (24)	○	○	○	○	○
Am always prepared. (25)	○	○	○	○	○
Panic easily. (26)	○	○	○	○	○
Radiate joy. (27)	○	○	○	○	○
Tend to vote for liberal political candidates. (28)	○	○	○	○	○
Sympathize with the homeless. (29)	○	○	○	○	○

Jump into things without thinking. (30)	○	○	○	○	○
Fear for the worst. (31)	○	○	○	○	○
Feel comfortable around people. (32)	○	○	○	○	○
Enjoy wild flights of fantasy. (33)	○	○	○	○	○
Believe that others have good intentions. (34)	○	○	○	○	○
Excel in what I do. (35)	○	○	○	○	○

Get irritated easily. (36)	○	○	○	○	○
Talk to a lot of different people at parties. (37)	○	○	○	○	○
See beauty in things that others might not notice. (38)	○	○	○	○	○
Cheat to get ahead. (39)	○	○	○	○	○
Often forget to put things back in their proper place. (40)	○	○	○	○	○
Dislike myself. (41)	○	○	○	○	○

Try to lead others. (42)	○	○	○	○	○
Feel others' emotions. (43)	○	○	○	○	○
Am concerned about others. (44)	○	○	○	○	○
Tell the truth. (45)	○	○	○	○	○
Am afraid to draw attention to myself. (46)	○	○	○	○	○
Am always on the go. (47)	○	○	○	○	○

Prefer to stick with things that I know. (48)	○	○	○	○	○
Yell at people. (49)	○	○	○	○	○
Do more than what's expected of me. (50)	○	○	○	○	○
Rarely overindulge. (51)	○	○	○	○	○
Seek adventure. (52)	○	○	○	○	○
Avoid philosophical discussions. (53)	○	○	○	○	○

Think highly of myself. (54)	○	○	○	○	○
Carry out my plans. (55)	○	○	○	○	○
Become overwhelmed by events. (56)	○	○	○	○	○
Have a lot of fun. (57)	○	○	○	○	○
Believe that there is no absolute right or wrong. (58)	○	○	○	○	○

Feel sympathy for those who are worse off than myself. (59)	○	○	○	○	○
Make rash decisions. (60)	○	○	○	○	○
Am afraid of many things. (61)	○	○	○	○	○
Avoid contacts with others. (62)	○	○	○	○	○
Love to daydream. (63)	○	○	○	○	○
Trust what people say. (64)	○	○	○	○	○

Handle tasks smoothly. (65)	○	○	○	○	○
Lose my temper. (66)	○	○	○	○	○
Prefer to be alone. (67)	○	○	○	○	○
Do not like poetry. (68)	○	○	○	○	○
Take advantage of others. (69)	○	○	○	○	○
Leave a mess in my room. (70)	○	○	○	○	○
Am often down in the dumps. (71)	○	○	○	○	○
Take control of things. (72)	○	○	○	○	○

Rarely notice my emotional reactions. (73)	○	○	○	○	○
Am indifferent to the feelings of others. (74)	○	○	○	○	○
Break rules. (75)	○	○	○	○	○
Only feel comfortable with friends. (76)	○	○	○	○	○
Do a lot in my spare time. (77)	○	○	○	○	○
Dislike changes. (78)	○	○	○	○	○

Insult people. (79)	○	○	○	○	○
Do just enough work to get by. (80)	○	○	○	○	○
Easily resist temptations. (81)	○	○	○	○	○
Enjoy being reckless. (82)	○	○	○	○	○
Have difficulty understanding abstract ideas. (83)	○	○	○	○	○
Have a high opinion of myself. (84)	○	○	○	○	○
Waste my time. (85)	○	○	○	○	○

Feel that I'm unable to deal with things. (86)	○	○	○	○	○
Love life. (87)	○	○	○	○	○
Tend to vote for conservative political candidates. (88)	○	○	○	○	○
Am not interested in other people's problems. (89)	○	○	○	○	○
Rush into things. (90)	○	○	○	○	○

Get stressed out easily. (91)	○	○	○	○	○
Keep others at a distance. (92)	○	○	○	○	○
Like to get lost in thought. (93)	○	○	○	○	○
Distrust people. (94)	○	○	○	○	○
Know how to get things done. (95)	○	○	○	○	○
Am not easily annoyed. (96)	○	○	○	○	○
Avoid crowds. (97)	○	○	○	○	○

Do not enjoy going to art museums. (98)	○	○	○	○	○
Obstruct others' plans. (99)	○	○	○	○	○
Leave my belongings around. (100)	○	○	○	○	○
Feel comfortable with myself. (101)	○	○	○	○	○
Wait for others to lead the way. (102)	○	○	○	○	○

Don't understand people who get emotional. (103)	○	○	○	○	○
Take no time for others. (104)	○	○	○	○	○
Break my promises. (105)	○	○	○	○	○
Am not bothered by difficult social situations. (106)	○	○	○	○	○
Like to take it easy. (107)	○	○	○	○	○

Am attached to conventional ways. (108)	○	○	○	○	○
Get back at others. (109)	○	○	○	○	○
Put little time and effort into my work. (110)	○	○	○	○	○
Am able to control my cravings. (111)	○	○	○	○	○
Act wild and crazy. (112)	○	○	○	○	○
Am not interested in theoretical discussions. (113)	○	○	○	○	○

Boast about my virtues. (114)	○	○	○	○	○
Have difficulty starting tasks. (115)	○	○	○	○	○
Remain calm under pressure. (116)	○	○	○	○	○
Look at the bright side of life. (117)	○	○	○	○	○
Believe that we should be tough on crime. (118)	○	○	○	○	○

Try not to think about the needy. (119)	○	○	○	○	○
Act without thinking. (120)	○	○	○	○	○

A.3 Perceived Stress Line Marking Scale

Please slide the scale to document your current stress level.

0 = Very Low Stress 100 = Very High Stress

	0 10 20 30 40 50 60 70 80 90 100
What is your level of nervousness/stress right now?	

A.4 Therapy Dog Engagement Scale

Document the level of engagement between the participant and the therapy dog during the majority of the intervention.

- ○ Little to no engagement (1)
- ○ Some engagement (2)
- ○ Moderate engagement (3)
- ○ A lot of engagement (4)

Describe the level of engagement below

_____

A.5 Experimental and Comparison Group Intervention Options

Select which mindfulness intervention the participant selected:

- ☐ Beach Mindfulness- Audio and visual
- ☐ Beach Mindfulness- Audio
- ☐ Landscape Mindfulness- Audio and visual
- ☐ Landscape Mindfulness- Audio

Beach Mindfulness link:

https://www.youtube.com/watch?v=syx3a1_LeFo&list=PLBzTvsXmEm4B0nuXJH8iM_RQx8XZiTOs7&index=2&pp=iAQB

Landscape Mindfulness link:

https://www.youtube.com/watch?v=ZToicYcHIOU&list=PLBzTvsXmEm4B0nuXJH8iM_RQx8XZiTOs7&index=1&pp=iAQB

Note. All videos were run for 10 minutes.

A.6 Control Group Intervention Options

Select which intervention the participant selected:

- ☐ Beach Video
  - o Just audio
  - o Just visual
  - o Both
- ☐ Landscapes Video
  - o Just audio
  - o Just visual
  - o Both
- ☐ Rain Video
  - o Just audio
  - o Just visual
  - o Both
- ☐ Self-Relaxation

Beach Video link:

https://www.youtube.com/watch?v=B6Dhz9GUTwY&list=PLBzTvsXmEm4B0nuXJH8iM_RQx8XZiTOs7&index=4&pp=iAQB

Landscapes Video link:

https://www.youtube.com/watch?v=1qo1b8t56Tg&list=PLBzTvsXmEm4B0nuXJH8iM_RQx8XZiTOs7&index=5&pp=iAQB

Rain Video link:

https://www.youtube.com/watch?v=SnUBb-FAlCY&list=PLBzTvsXmEm4B0nuXJH8iM_RQx8XZiTOs7&index=3&pp=iAQB

Note. All videos were run for 10 minutes.

A.7 Therapy Dog Expectations

Please slide the scale to document the level that the therapy dog met your expectations.

0 = Strongly Disagree 100 = Strongly Agree

	0 10 20 30 40 50 60 70 80 90 100
The dog I interacted with today met my expectations.	

Please explain your response below.

_____

Appendix B: Procedure

B.1 Recruitment Email

Hello, my name is Ezri Villiard, and I am a Clinical Psychology Masters student at Western Carolina University. For my thesis project I am conducting a research study on the effects of brief animal-assisted intervention and mindfulness on perceived stress, blood pressure and heart rate levels in college students.

Participation would involve you being randomly assigned to and completing one of three relaxation interventions: a guided mindfulness intervention with a therapy dog present, a guided mindfulness intervention without a therapy dog present, or an unguided self-relaxation intervention. Before and after the intervention you will be asked to report your perceived stress level and have your blood pressure and heart rate measured. Participation will take about 30-45 minutes. Participation is voluntary.

If you are interested in participating, please follow the link below and complete the registration survey.

Thank you for your time.

B.2 Recruitment Flyer

Graduate research study on the effects of brief animal-assisted intervention and mindfulness on perceived stress, blood pressure and heart rate levels in college students.

Participation would involve you being randomly assigned to and completing one of three relaxation interventions: a guided mindfulness intervention with a therapy dog present, a guided mindfulness intervention without a therapy dog present, or an unguided self-relaxation intervention. Before and after the intervention you will be asked to report your perceived stress level and have your blood pressure and heart rate measured. Participation will take about 30-45 minutes. There are no know risks involved and participation is voluntary.

If you are interested in participating scan the QR code and complete the registration survey.

Thank you!

Appendix C: Tables

Table C.1

Paired Samples Correlations

	N	Correlation
preSYS & postSYS	63	.795*
preHR & postHR	63	.885*
preStress & postStress	63	.864*

Note. *p <.001

Table C.2

Between Groups Multivariate Test using Wilks' Lambda

Effect		Value	*F*	df	Error df	*p*	η^2
Group	*Wilks' Lambda*	.631	2.37	12	110	.009	.21

Table C.3

Tests of Between-Subjects Effects on Group

		Type III Sum of Squares	df	Mean Square	*F*	*p*	η^2
Group	preSYS	275.49	2	137.745	.47	.629	.02
	preHR	474.62	2	237.309	1.06	.354	.03
	preStress	16.03	2	8.013	.01	.989	.00
	postSYS	112.05	2	56.026	.18	.834	.01
	postHR	1152.14	2	576.070	3.63	.033	.11
	postStress	1283.25	2	641.626	1.32	.276	.04

Table C.4

Post Hoc Descriptives

					95% Confidence Interval for Mean	
	N	*M*	*SD*	*SE*	Lower Bound	Upper Bound
Experimental	22	82.91	14.34	3.05	76.55	89.27
Comparison	21	76.14	13.40	2.93	70.04	82.24
Control	20	72.65	9.25	2.07	68.32	76.98
Total	63	77.40	13.13	1.65	74.09	80.70

Table C.5

Therapy Dog Qualitative Data

Overarching Theme	Sub-theme	Example
Therapy Dog Personality/Presence		"He was so cute and chillaxed that it made me relax. I love that he wasn't hyper, and I felt I had support there in a weird way." "Maverick was calm and gentle. He was a warm presence to help ground me during the mindfulness exercise."
	Fluffy (Contact Comfort)	"Extremely fluffy and sweet dog that laid next to me the entire time." "The therapy dog was like a giant teddy bear and very friendly and cuddly. It was a better experience than I expected."
	Easy Interaction	"He was very calm and patient with me and basically let me pet him wherever." "The therapy dog in my room was a very good boy and let me pet him."
Positive Affect		"He helped me be happy." "A perfect way to relax."
	Calming	"The therapy dog helped me calm down as I felt the presence of being comforted." "The dog was so calm, which helped me stay calm!"

Table C.6

Therapy Dog Engagement Data

Participant	Dog Engagement Score	Description
1	3	Participant is sitting on the floor with dog, gently petting, watching video while petting, pet the dog for majority of time elapsed, towards the middle the petting slowed down and participant was more focused on video but began petting again towards the end.
2	4	Participant laid down with dog, constantly petting, hugging, dog laid head on his leg, began petting a lot but then just sat next to him, little engagement with mindfulness more focused on the dog.
3	2	Participant is on the floor with the therapy dog but is mostly engaged with the mindfulness intervention.
4	4	Participant is petting and talking to dog during exercise.
5	3	Participant is focusing on dog and mindfulness/petting throughout.

6	2	Participant is focused on exercise but occasionally petting the dog.
7	1	Participant engaged with dog only a little in the beginning.
8	4	Participant is on the floor petting, paying little attention to mindfulness.
9	4	Participant is with dog on floor, stated she expected a smaller dog, more interested in dog than mindfulness, talking with handler.
10	2	Therapy dog stopped engaging at beginning of intervention. Likely tired.
11	2	Participant pet dog pretty consistently throughout but had moments where there was no engagement.
12	1	Participant focused on exercise, not interacting with dog at all.
13	4	Participant is on the floor petting dog, little attention on mindfulness.
14	2	Participant appeared very interested in beginning, touching dog's foot, focused on mindfulness.
15	2	Dog is laying on participant's foot.

16	1	Participant is engaged with intervention; dog is laying away from participant.
17	3	Participant is sitting on the floor while petting the therapy dog and engaging with the mindfulness intervention.
18	3	Participant is sitting on the floor with the therapy dog and petting him
19	1	Participant was more focused on mindfulness than on dog
20	2	Participant did acknowledge therapy dog during introduction (i.e.: petting and talking to him) but is more engaged with the video.
21	4	Participant is seated on the floor with the dog and petting him repeatedly throughout intervention.
22	2	Participant is focused on mindfulness intervention. Petting the therapy dog a little bit.

Note. 1 = Little to no engagement 2 = Some engagement 3 = Moderate engagement 4 = A lot of engagement

Table C.7

Therapy Dog Expectation Data

Participant	Dog Expectation Score	Explanation
1	100	Extremely fluffy and sweet dog that laid next to me the entire time.
2	100	A perfect way to relax.
3	100	The dog was so calm, which helped me stay calm!
4	100	Maverick was very fluffy (nice to touch) and chill. He licked my hand and laid down next to me. I enjoyed the attention and petting him.
5	85	He was not very active but was calming with nice presence.
6	98	He was so cute and chillaxed that it made me relax. I love that he wasn't hyper, and I felt I had support there in a weird way.
7	100	Maverick was calm and gentle. He was a warm presence to help ground me during the mindfulness exercise.
8	100	He was very calm and patient with me and basically let me pet him wherever.

9	100	The therapy dog was like a giant teddy bear and very friendly and cuddly. It was a better experience than I expected.
10	100	He was super sweet.
11	92	The therapy dog in my room was a very good boy and let me pet him.
12	90	The therapy dog helped me calm down as I felt the presence of being comforted.
13	80	When I found out what kind of dog it was, my expectations were that it would be very calm.
14	100	Cute bear, he felt like a stuffed animal.
15	100	He helped me be happy.
16	100	He is so cute.
17	100	I expected there to be a loving sweet dog, and he was!
18	100	Very cute dog. Would pet again, even if he falls asleep easily.
19	46	I was not expecting the dog to be sleepy; I was thinking that the dog might have been more hyper.
20	80	Coming into the study I had no prior experience with a therapy dog, but the dog was very calm which was what I expected. We did not interact too much, but I did get to pet them, and it was calming

		to be able to pet and just sit there. Very well-mannered dog and didn't even try to get up when I came into the room.
21	100	He was a good boy.
22	100	The dog was great!

Note. Dog Expectation Score Range 0-100.

Appendix D: Figures

Figure D.1

Pre-Intervention Systolic BP Distribution Histogram

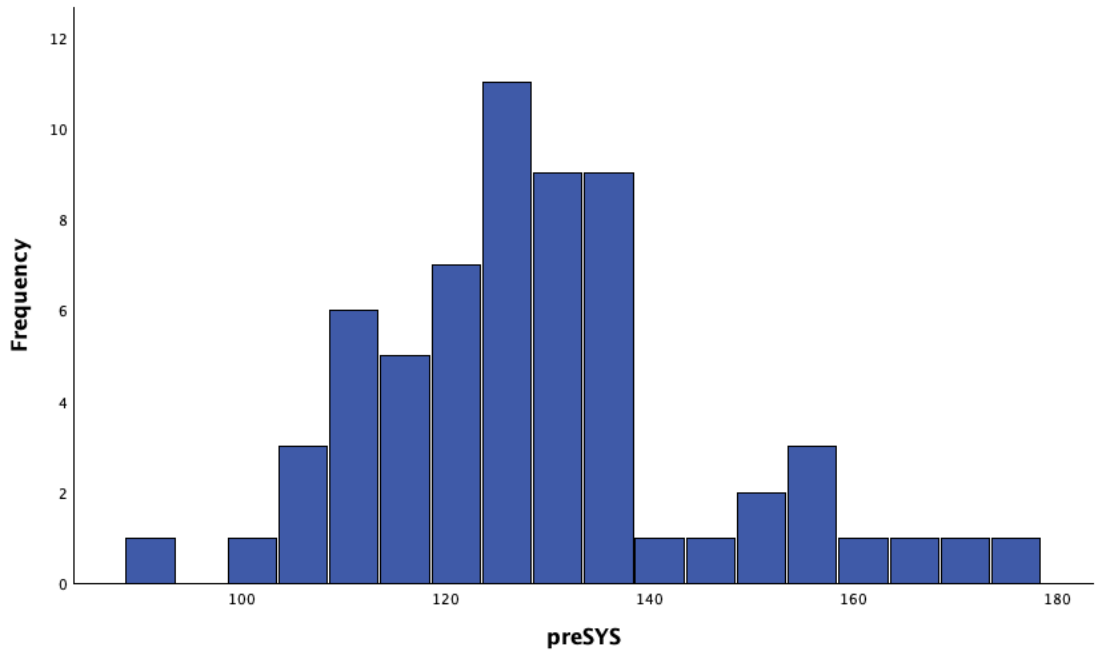


Figure D.2

Pre-Intervention Systolic BP Distribution Q-Q Plot

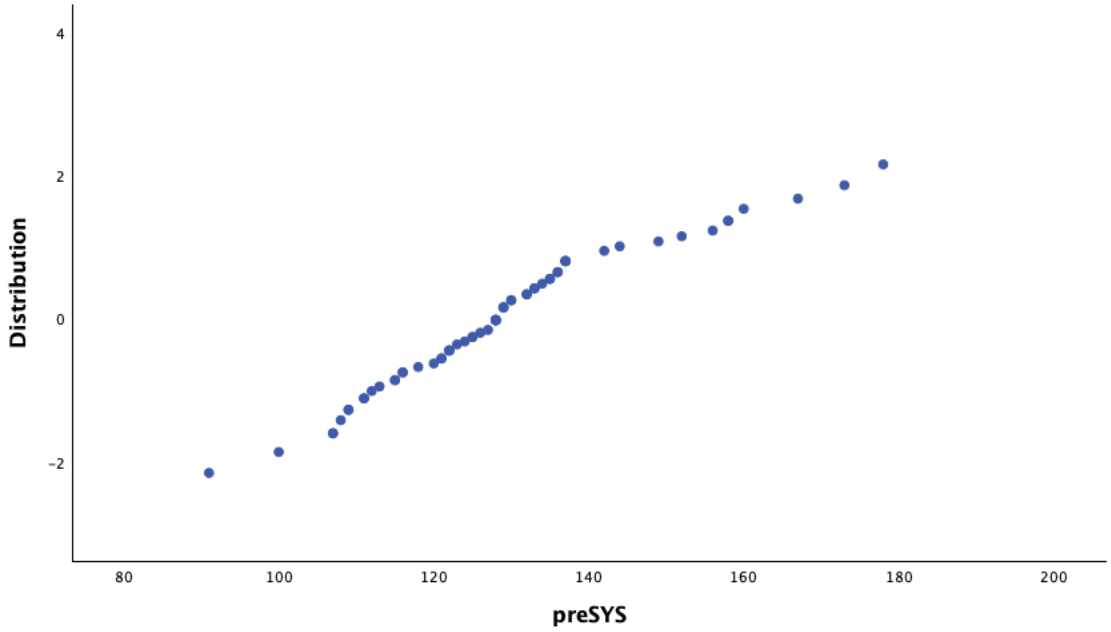


Figure D.3

Pre-Intervention Heart Rate Distribution Histogram

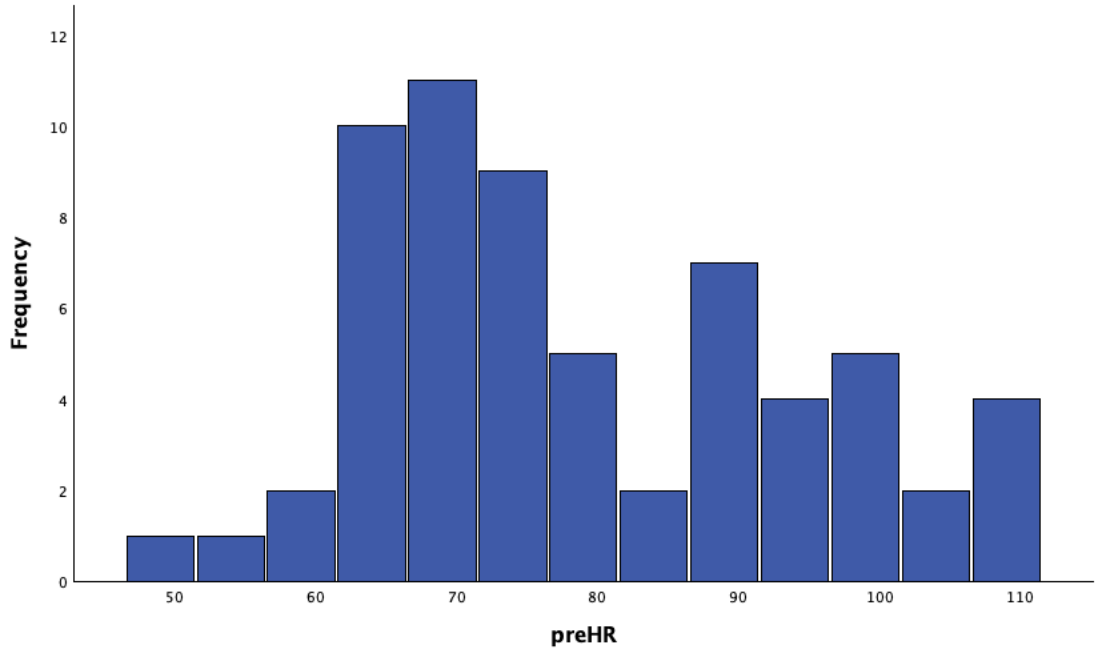


Figure D.4

Pre-Intervention Heart Rate Distribution Q-Q Plot

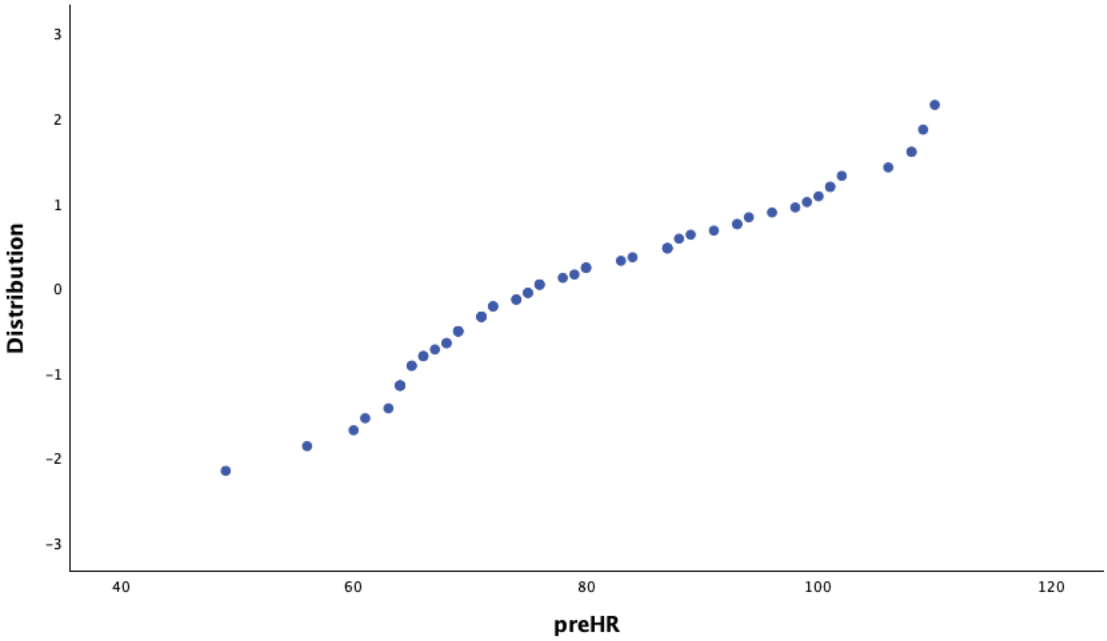


Figure D.5

Pre-Intervention Stress Distribution Histogram

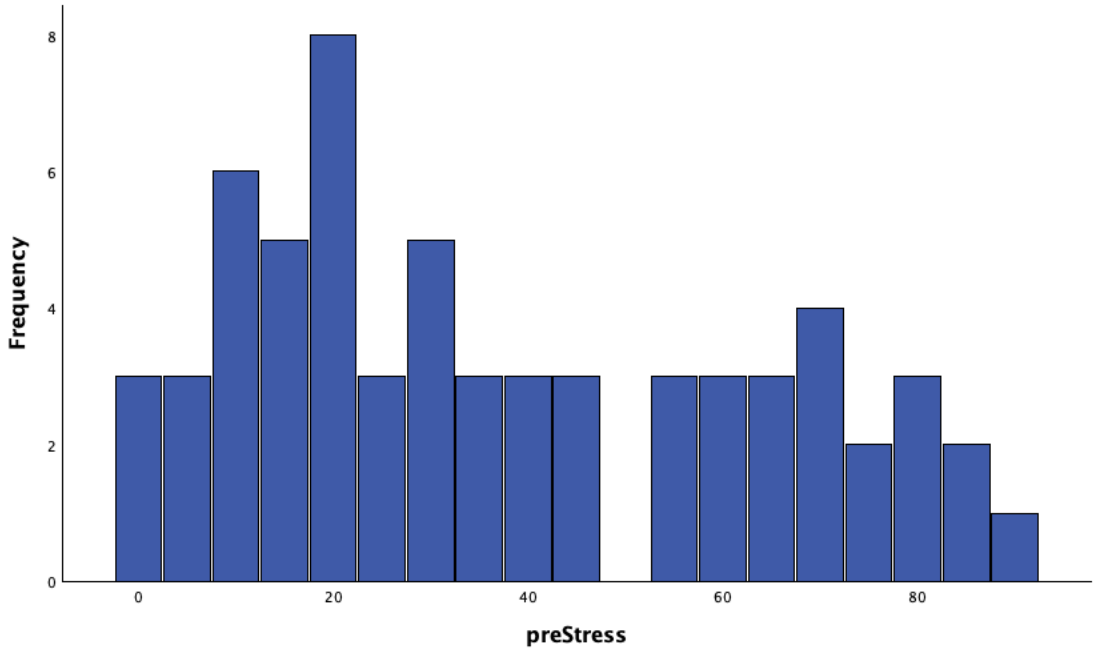


Figure D.6

Pre-Intervention Stress Distribution Q-Q Plot

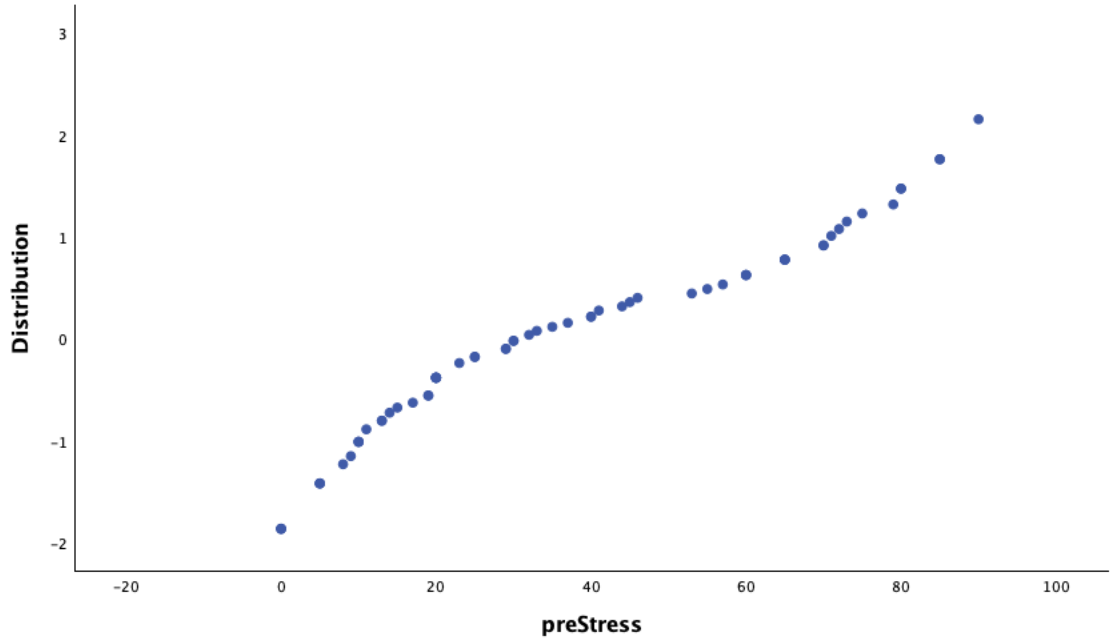


Figure D.7

Post-Intervention Systolic BP Distribution Histogram

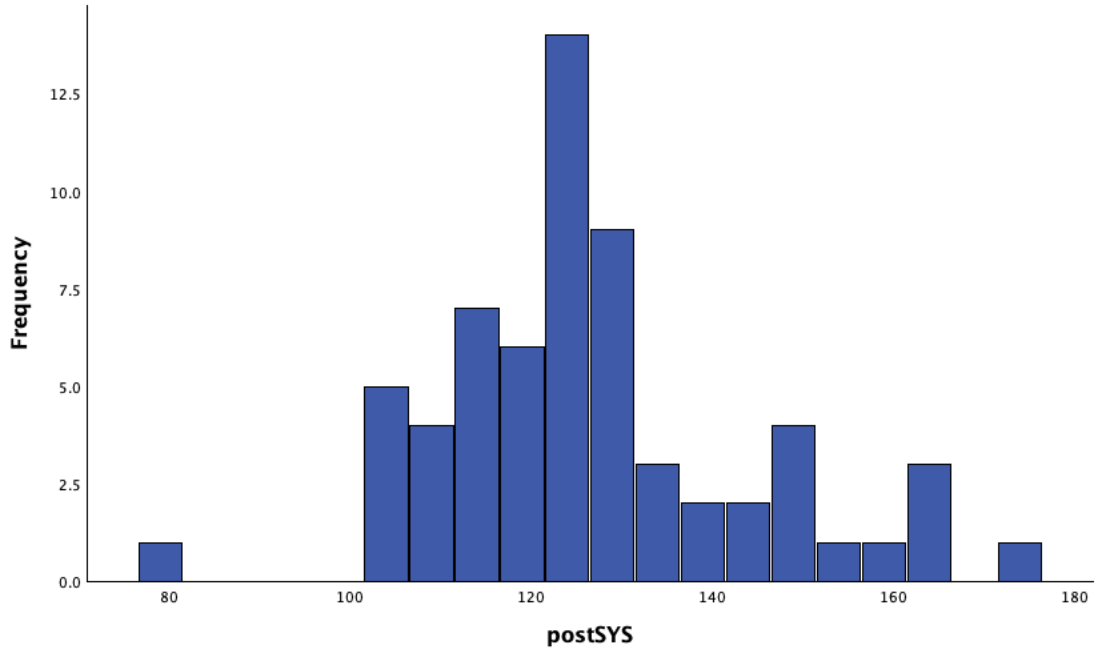


Figure D.8

Post-Intervention Systolic BP Distribution Q-Q Plot

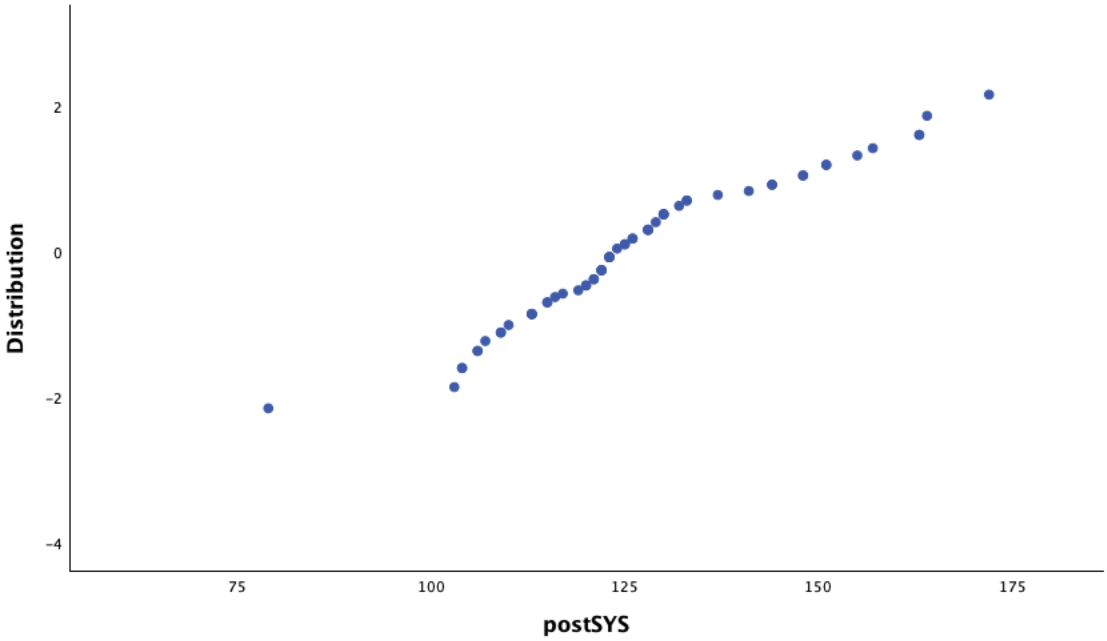


Figure D.9

Post-Intervention Heart Rate Distribution Histogram

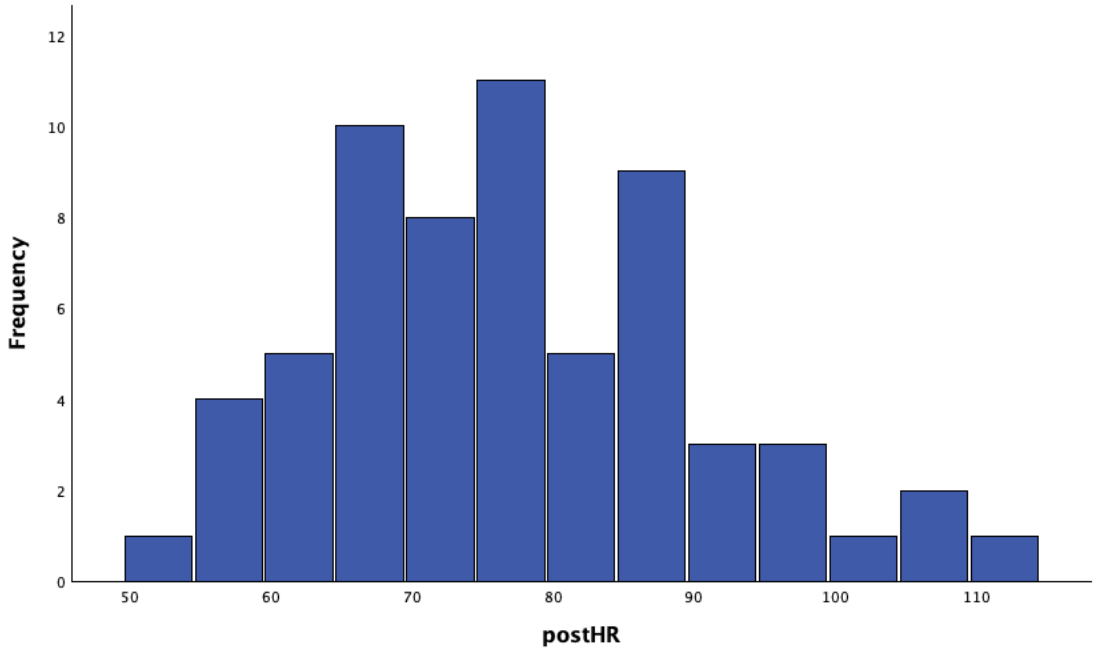


Figure D.10

Post-Intervention Heart Rate Distribution Q-Q Plot

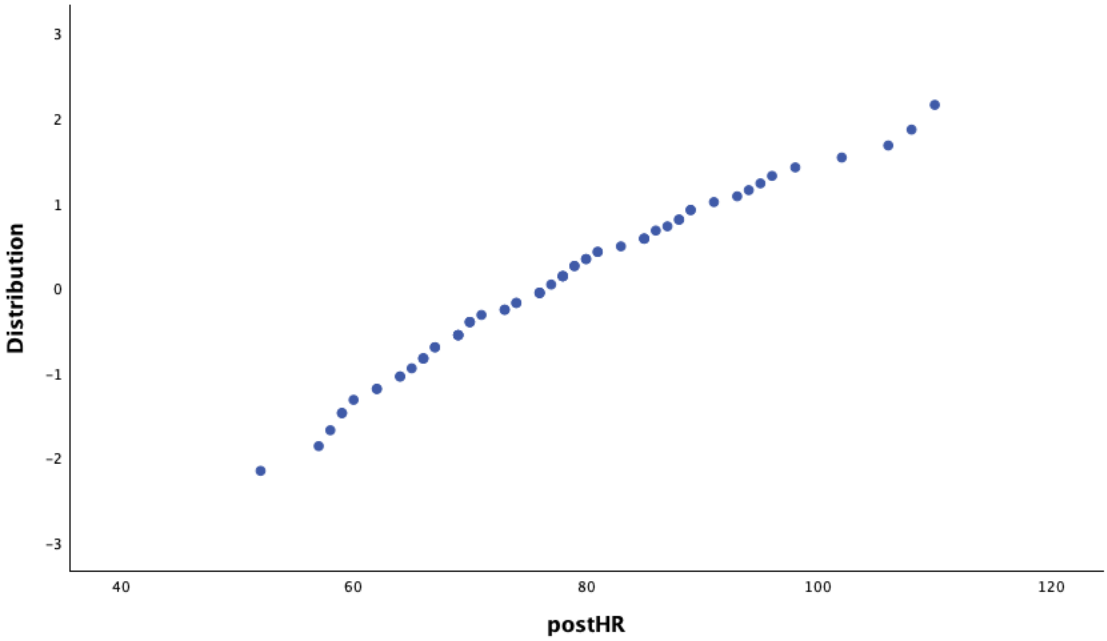


Figure D.11

Post-Intervention Stress Distribution Histogram

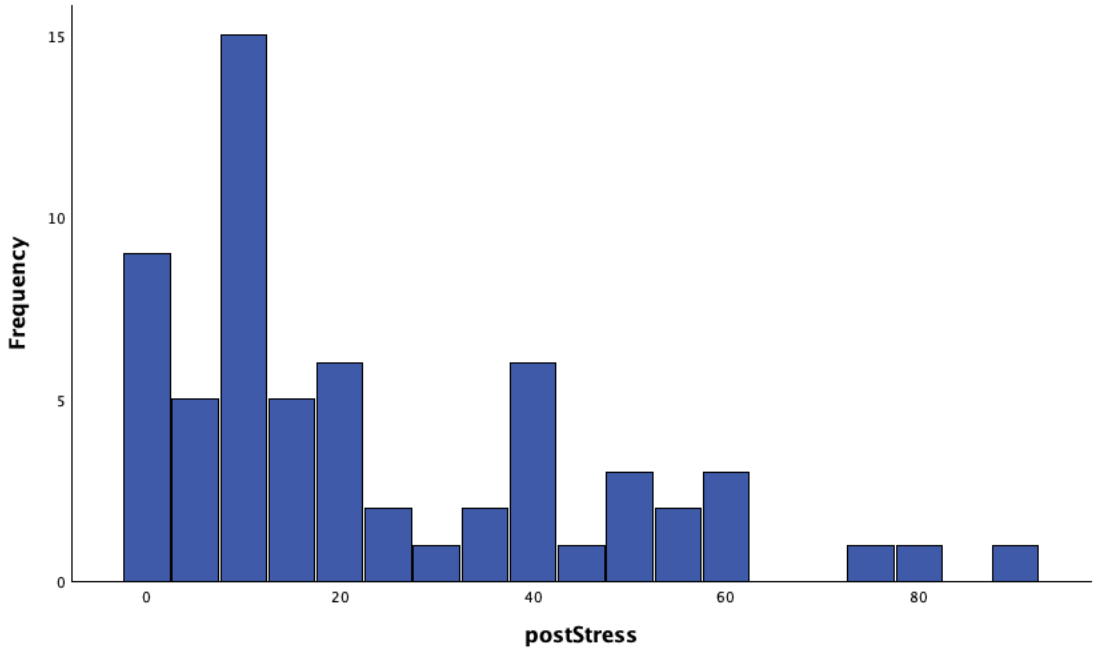


Figure D.12

Post-Intervention Stress Distribution Q-Q Plot

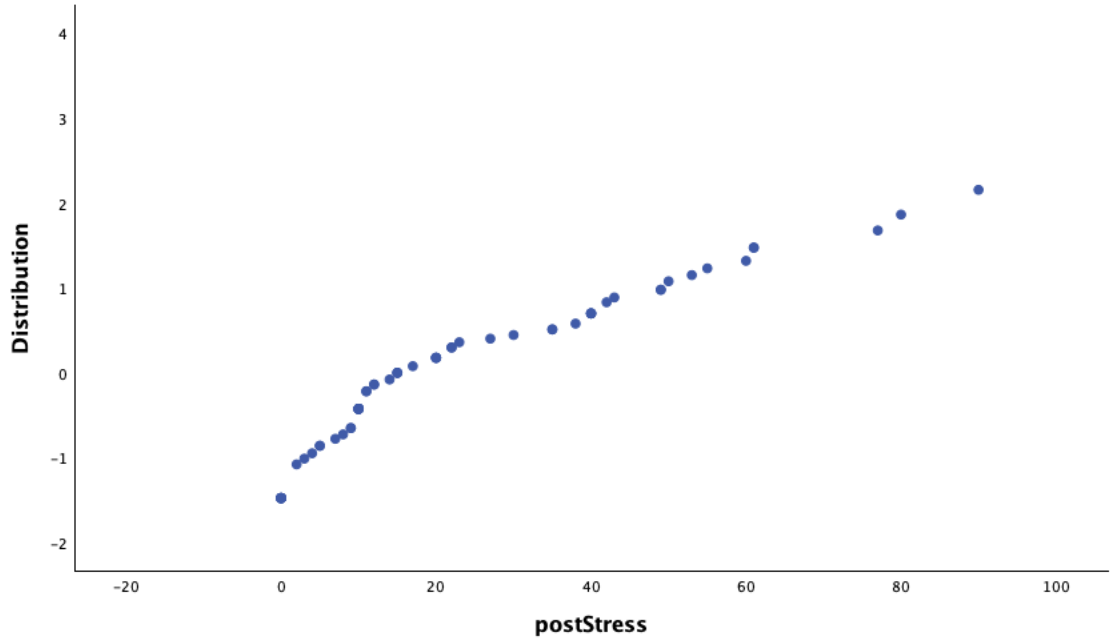
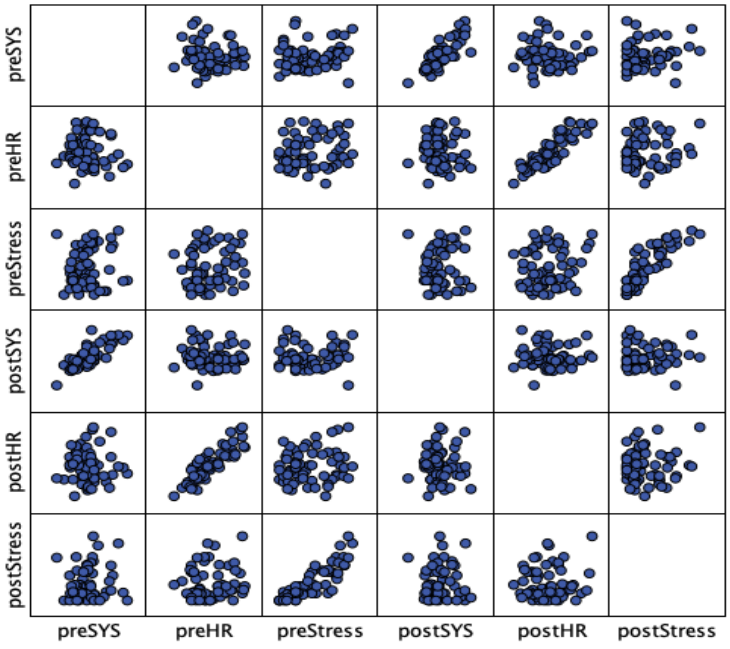


Figure D.13

Distribution of Dependent Variables



Note. Primary variables of interest are linear.

Figure D.14

Distribution of Dog Rating Score Post-Intervention