Dog Park or a Walk in the Park? Comparing the effectiveness of surrogate dog and nature interactions on physiological stress reduction

Ashley Miller

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Approved: ___________________________ Date: __________
Thesis Director Signature
Leila Azarbad, Ph.D.

Approved: ___________________________ Date: __________
Second Reader Signature
Margaret Gill, Ph.D.
Table of Contents

Abstract ....................................................................................................................... 4
Introduction ................................................................................................................... 5
   Biophilia Hypothesis ................................................................................................. 7
   Natural Settings and Stress Reduction ................................................................. 9
      History .................................................................................................................. 9
      Theoretical Perspectives ..................................................................................... 9
      Empirical Support ............................................................................................... 11
   Animals and Stress Reduction ............................................................................. 14
      History ................................................................................................................ 14
      Theoretical Perspectives ..................................................................................... 16
      Empirical Support ............................................................................................... 18
Current Study ........................................................................................................... 20
Methods .................................................................................................................... 21
   Participants ........................................................................................................... 21
   Materials ............................................................................................................... 21
      iHealth Pulse Oximeter ..................................................................................... 21
      Videos ............................................................................................................... 22
Procedure .................................................................................................................. 22
   Baseline Phase ..................................................................................................... 23
   Stress Task Phase ................................................................................................. 23
   Intervention Phase ............................................................................................... 24
   Statistical Analysis .............................................................................................. 24
Results ....................................................................................................................... 25
   Demographic Variables ....................................................................................... 25
   Within-Subject Differences ................................................................................... 25
   Between-Subject Differences ............................................................................... 26
   Controlling for Covariates .................................................................................. 26
Discussion .................................................................................................................. 27
   Common Factors ................................................................................................. 28
   Control Group as an Intervention ....................................................................... 29
   Surrogate vs. In Vivo Experience ....................................................................... 30
Limitations .................................................................................................................. 31
   Video Selection ................................................................................................. 31
   Study Design ....................................................................................................... 31
   Participant Bias ................................................................................................. 32
Application ............................................................................................................... 33
   Future Research ................................................................................................. 33
      Video Selection ............................................................................................... 34
      Study Design ................................................................................................. 35
Conclusion ............................................................................................................... 37
References ............................................................................................................... 39
Tables ....................................................................................................................... 43
   Table 1 ............................................................................................................... 43
   Table 2 ............................................................................................................... 44
Abstract

Research indicates that interacting with nature and pets can reduce the physiological stress response. However, no studies have examined whether “interacting” with nature or pets in a surrogate environment via computer-displayed videos will produce the same effect. The purpose of this study was to compare the effectiveness of surrogate pet and nature interactions on physiological stress reduction (heart rate). One-hundred thirty-three students were randomly assigned to one of three stress reduction conditions: Dog video, nature video, or sitting quietly. Heart rate was measured using an iHealth pulse oximeter during a resting baseline phase, an arithmetic stress-inducing task, and the stress reduction condition. Although there was no main effect of condition on heart rate, results indicated a significant main effect of phase on heart rate, such that heart rate increased from baseline to stress task and decreased from stress task to intervention across all conditions. These results suggest that watching a video of a dog or of nature may be equally effective as sitting in silence for the same period of time.
Introduction

Stress is a natural response but has increasingly become a major concern in the United States and, more so, across college campuses. The American Psychological Association conducted an online survey, *Stress in America*, in 2014 and found that on average, Americans rated their stress level as a 4.9 on a given 10-point scale. Compared to this national average, the report found that young and middle-aged adults are experiencing the highest levels of stress in contrast to other age groups overall. Specifically, the Millennials and Gen Xers reported an average stress rating of 5.5 on a 10-point scale. Despite the high rates of stress across the country, an overwhelming twenty percent of Americans are still reporting that they do not take part in any activity that will relieve or help manage their stress (APA, 2014). This suggests that there is a need for stress management skills and techniques to be used across the population.

College can be a challenging time for young adults and findings continue to show the increased negative impact on their mental health. It appears that this younger demographic struggles the most with managing their stress. The APA’s report found that compared to any other age group, college students were most likely to report that stress had a very strong impact on their physical and mental health. The American College Health Association (2015) found that 85.6% of college students nationwide felt overwhelmed by all the had to do within the last 12 months, and over half of the college student population has felt an overwhelming anxiety within the last 12 months. Nearly 11% of college students feel a tremendous amount of stress on a daily basis. This is problematic because this is also contributing to poor physical health, including sleep, diet, and overall daily functioning.

Not only does America experience an increased level of stress, they also use technology increasingly more. The increase in technological products and usage has increased and evolved
drastically within the past century, and has inevitably changed people’s daily experiences. In a short period of 15 years, the number of Internet uses across the globe has increased from 400 million users in 2000 to an estimated 3.2 billion Internet users in 2015 (International Telecommunication Union, 2015). It is projected that by the year 2020, there will be more technological devices than there are Internet users (ITU, 2015). Of those Internet users, many are college students who use technology in some aspect of their collegiate life. One survey suggests that more than half of today’s U.S. college students are carrying at least two technology devices with them, and students value their laptop as the most important possession above their car, bicycle or television (AMD, 2014). The college student demographic holds technology devices as an important part of their day and opens up a possibility for targeting this unique age group with future implementations.

With the information available on the increased use of technology, there has been a shift toward “positive technologies” to help promote mental health and stress reduction. Positive technologies are technologies that are “specifically designed to foster positive emotions, promote engagement in empowering activities and support connectedness between individuals and groups” (Serino et. al, 2014, pg. 254). Two main groups of positive technologies have emerged recently to help manage psychological stress: virtual interactive environments and mobile technologies. Virtual interactive environments have been shown to allow the individual “to experience meaningful interactions with stressful environments and to learn coping abilities” and the group of mobile technologies allows for “multimedia presentation of contents are useful to provide assessment…in their everyday life” (Serino et al., 2014, pg. 254). There has been an increase in the development of mobile phone technology that incorporates the use of wearable biosensors to help collect, elaborate, and transmit real-time psychophysiological data and
identify specific trends. These positive technology applications have coincided with the projected increase in general technology and have started to change the way stress management is being incorporated in the mental health field.

The following sections will review research covering a major theory discussing nature and animals as natural stress reducers, nature acting as a stress reduction technique, and dogs acting as a stress reduction technique.

**Biophilia Hypothesis**

Dating back to the very beginning of human history, the natural environment has played a key role in the survival of the human species. There are physical features within nature that may be aesthetically pleasing, but more importantly, these are the same features our ancestors utilized for survival. For example, bodies of water served as a means of defense from enemies, trees were used as a way to climb up and determine safety or danger in a much larger area, and animals could be a sign that there was a water source nearby. These natural settings and features were important for the person’s survival in the past, but as technology has improved over time there is a question of whether human beings “have an unlimited capacity to adapt to the environment, no matter how far removed it is from that in which we evolved” (Gullone, 2000, p. 294).

Founder of sociobiology, Edward Osborne Wilson (2007) explains this phenomena by detailing that nature tends to foster “psychological well-being, reduces the stress related to modern living and promotes physical well-being” (Gullone, 2000, p. 295). In his book, *Biophilia*, he describes his biophilia hypothesis, which states that humans have the innate drive to seek life and life-like processes. He suggests that that there is a bond between animals [humans] and other living systems, which leads to human desire to have contact with or view a connection with nature. Much of the hypothesis goes in depth about many different aspects: the
evolutionary basis, difference between biophilia (approaching nature) and biophobia (avoiding nature), and the benefits that occur when an individual immerses themself in some form of nature.

Part of the biophilia hypothesis is the argument that “rewards and dangers associated with natural settings, during human evolution, favored individuals who readily learned and remembered various adaptive behaviors including both approach (biophilia) and avoidance (biophobia) responses to specific natural stimuli and configurations.” (p. 296). Biphobia refers to the idea that humans have a biological basis to respond negatively, or inherent fears and phobias, related to natural features or organisms. Humans are biologically prepared to fear stimuli that pose a threat to its survival. This innate ability to fear certain stimuli is learned through both observational and informational pathways. There will be certain geographical features of animals, such as snakes, tigers, spiders, that humans are going to naturally try to stay away from and avoid, protecting their safety. This could also explain why there may be individuals who naturally are afraid of nature or pets for unexplainable reasons at the surface level.

Reciprocally, humans also have a biological basis to respond in a positive way to natural features or organisms, biophilia. Not all natural settings and animals lead to a human’s fear response, alternatively, there are some that humans naturally find appealing and may serve as protection. There have been certain attributes of these phenomena that have been beneficial to the survival of human beings throughout our evolutionary history. The stimuli that humans have a biophilic, non-threatening, appraisal of may serve potentially as one of several functions. First, individuals may approach the stimuli with the knowledge that it can serve as a survival tool, resulting in an adaptive approach behavior. For example, a space that has spatial openness, small groups of trees, grassy covering, and a river are preferred because all these features serve as
protection from the weather, sources of food and water, and sightline for enemies. Secondly, most important for the current study, the function that biophilia continuously supports that human interaction with nature will result in relaxation and restoration. Finally, the theory states that biophilic behaviors are functioning as a way to recover from physical or psychological states that would otherwise interfere with survival behaviors.

The biophilia hypothesis addresses the biological and evolutionary basis for how nature serves as a positive aspect in reducing stress. The following two sections separately address two components of nature, natural settings and dogs, and how they effectively reduce stress.

**Natural Settings and Stress Reduction:**

*History*

As seen throughout history, humans have continued to find ways of connecting with nature in their lives. In ancient times, it was exceedingly common for homes to have elaborate gardens as an attempt to maintain contact with nature and its beauty. In today’s society, there are countless zoos, natural parks and preservation of natural landmarks for people to travel to and experience. In 2014, National Park Service reported over 292 million recreational visitors to national parks across the United States. They also forecast a 1% increase in recreational visits in the year 2016. Even with the increased use of technology in society, there is still a desire to be in and a part of the nature around us.

*Theoretical Perspectives*

In this area, there are two dominant theories about the function that nature serves in stress restoration. The two main theories include: Attention Restoration Theory (ART; Kaplan, 1995) and Stress Restoration Theory (SRT; Ulrich, 1991).
Kaplan (1995) studied the cognitive and emotional changes of individuals participating in nature-related activities. The intention was to integrate two conflicting theories at the time, to explain that the psychological benefits of nature is a result of both stress reduction and providing recovery in the capacity to focus attention. William James (1892) focuses on the concept of directed attention, referring to ‘voluntary attention’, or attention that required one “to be employed when something did not of itself attract attention, but when it was important to attend nonetheless.” (pg. 169). For James, the other type of attention people use is ‘involuntary attention’, a form of attention that does not require any effort. A problem arises when a person requires an overwhelming amount of direct attention and experiences the state of directed attention fatigue. This state of fatigue for an extended period is believed to be driving a person to feel physiological stress. This gave rise to the attention restoration theory (ART), which suggests that when an individual interacts with a natural environment that has fascinating stimuli, there is a focused attention on those particular stimuli, which will have a restorative effect on the individual. In this case, fascinating stimuli refers to James’ concept of involuntary attention, and are processes that people find engrossing, or intrinsically compelling, such as clouds, sunsets, or the motion of leaves in the breeze. By taking part in involuntary attention, there is no required effort, which allows the body to restore itself and be resistant to the fatigue. Kaplan suggests that certain natural settings, referred to as ‘Restorative experiences’ or ‘Restorative environments’, allow for the person to reflect, which is an important part of recovering from directed attention fatigue. Key components of a restorative environment include: being away from one’s directed attention, the fascinating objects found in nature, understanding the extent of nature, and the compatibility between humans and the natural environment. Nature settings, for Kaplan, are the most effective spaces to experience the restoration and recovery from experiencing stress.
On the other hand, Ulrich and colleagues (1991) proposes the Stress Recovery Theory (SRT), discussing that the person’s response to nature is affective rather than cognitive. Under this theory, stress is understood in a psychological sense as cognitive appraisal, emotions, and coping responses, as well as the physiological component of activity in numerous bodily systems. Contrary to Kaplan’s explanation of restoration, Ulrich suggests that in “contrast to a stress response, restoration or recovery from stress involves numerous positive changes in psychological states, in levels of activity in physiological systems, and often in behaviors or functioning, including cognitive functioning or performance” (pg. 203). The effects of restoration result in a positive impact on emotional responses by reducing levels of negative feelings and increasing positive affect. Ulrich states that patterns and stimuli in nature are desirable to human individuals, and this is creating positive feelings of pleasure emotionally.

Generally, there are two related perspectives that attempt to explain the relationship between the arousal level of a stimuli and the recovery process following a stressor. For this purpose, arousal consists of properties such as complexity, intensity, and movement. Arousal theories suggest that following a highly arousing or stressful event, restoration will occur more quickly in a setting that has low levels of arousal. In contrast, an overload perspective states the following a stressor, a highly arousing setting will slow down the restoration process. This suggests that low-arousal settings are the most ideal for an effective stress recovery process.

Empirical Support

The preceding theories from Wilson, Kaplan, and Ulrich, help to explain in different ways why nature is an effective tool in reducing stress for human beings. They have both been built and expanded on in later studies that support similar effects for surrogate nature experiences.
There has been continued research suggesting that nature produces a relaxing effect on an individual experiencing distress. While research has found that live (or in vivo) exposure to nature can lead to stress reduction, there is evidence to suggest that virtual exposure to nature may also produce similar results. Valtchanov, Barton & Ellard (2010) have taken into account nature’s restorative effects, which have been defined as “a reduction in cognitive fatigue, decreased stress levels, increased focus, increased positive affect, decreased negative affect, and decreased sympathetic nervous system activity.” (p. 503). In the study, they hypothesized that exposure to natural environments in a virtual reality (VR) setting would increase restoration effects on stress, cognitive fatigue, and affect. A total of 22 undergraduate students between the ages of 17 and 26 participated in one of two conditions: control or nature. Participants were instructed to put on a head-mounted display and were shown either a natural setting or abstract paintings (control group) before and after a stressful event. Throughout the study, the participant’s heart rate and skin-conductance level (SCL) were being recorded. The stress task involved the ZIPERS task, where the participants were asked to write about a stressful event they had experienced in the past 6 months, while they were wearing headphones playing loud urban noises (cars honking, jackhammers working, etc.), with the intention of measuring the participant’s affect. This was followed by two short mental-arithmetic tasks in order to measure cognitive fatigue. After completing the ZIPERS measure assessing affect, the participants were shown the abstract paintings or were exposed to the nature virtual reality depending on their condition. The study hypothesized that affect and cognitive performance would decrease following the stress task, while increasing following exposure to the nature setting in VR. Results indicated that nature in a virtual reality setting significantly reduced stress responses. As predicted, SCL decreased significantly, (F(1,11)=36.082, p<0.001) and positive affect increased
significantly (F(1,11)=8.75, \( p <0.05 \)), after the participant was exposed to the computer-generated, VR, nature scene. The article also supports previous findings that nature can produce calming and relaxing effects as well as that surrogate nature settings can also produce restorative effects.

One study by Beukeboom, Langeveld, and Tanja-Dijkstra (2012) examined and compared the effectiveness of having indoor plants and nature images incorporated into a stressful situation in reducing the stress of individuals. In the Radiology Department of a Dutch hospital, 457 patients were used as participants in this study to investigate whether nature would have a stress-reducing effect in a waiting room with indoor plants and a waiting room with posters of plants compared to a waiting room without any plants. They took into consideration the differences between the real, organic stimuli and a reproduction, artificial comparison, both resulting in stress-mediating effects. Participants were asked to fill out a questionnaire that addressed the perceived attractiveness of the waiting room and the patient’s experienced stress. Results found that both the real plants and images of plants both were perceived to be more attractive and lowered the levels of experienced stress compared to the control condition, F(2,451)=2.33, \( p=0.09 \), \( n_p=0.01 \). The perceived attractiveness of both the posters (\( B=-0.24, p=0.01 \)) and the real plants (\( B=-.024, p=0.01 \)) played a significant role in the stress-reducing effects. Further, there was no significant difference found between the real plants and images of plants (\( p=1.00 \)). By incorporating natural elements into settings where stress reactions tend to be likely, this is benefiting the patient's psychological well-being.

With the emergence of positive technologies, studies are now taking place to determine what the most effective implementation of the tools are for positive mental health promotion. One study conducted by Grassi, Gaggioli, and Riva (2009) examined the effectiveness of mobile
device multimedia use on relaxation. For their research, 3 conditions were used to evaluate effectiveness: video and audio content, video-only content, and audio-only content. They used university students who commuted to school via the local train. First they gathered baseline information, followed by participants watching the instructed mobile file, and finally participants completed an assessment. Results found that a video of a mountain lake with audio had the most effectiveness for reducing stress in commuters. The results of this study and similar studies continue to gather necessary data to help ensure the most accurate and beneficial technologies are being implemented.

In summary, research has found that an individual’s reaction to natural settings has a positive effect on their stress response. Operating under several different theories, exposures to nature, via live, virtual, and photographic means, have all been shown to decrease perceived and physiological responses to stressful situations. The proceeding section will discuss a different component of nature, animals, and the theories and research conduct to examine their effect on the stress response.

**Animals and Stress Reduction**

*History*

There are a large number of people that interact with animals in some way on a daily basis. According to the World Society for the Protection of Animals (2008), approximately 342 million dogs and 281 million cats live with people across the globe. In the United States, nearly 65% of American households own a pet, with 45% of American households owning at least one dog. Interestingly, 66.7% of Americans consider their dogs to be family members compared to the less than 1% of Americans who report considering their pets to be property (American
Veterinary Medical Association, 2012). Household pets, and specifically dogs, are an integral part of daily life for Americans, and are reportedly valued as another member of their family.

Research and empirical programs have emerged in recent years supporting the benefits of a strong human-animal relationship. Human-Animal Studies (HAS) is an interdisciplinary field concerning human relationships with, and attitudes towards animals. The emphasis is on understanding how animals play a role in human life socially and culturally (Hosey & Melfi, 2014). In addition, there is recognition that there is a mutual benefit from the bond that promotes increased well-being for not only the human, but for also the animal. In some ways, there are some “bonding-like” behaviors between humans and animals that are also evident in human relationships. Therefore, the American Veterinary Medical Association’s Human-Animal Bond committee defines the human/animal bond as “a mutually beneficial and dynamic relationship between people and other animals that is influenced by behaviors that are essential to the health and well-being of both. This includes, but is not limited to, emotional, psychological, and physical interactions of people, other animals, and the environment” (JAVMA, 1998). The human-animal bond is not a new phenomenon, it goes far back in history, but research has more recently searched to understand this unique and complex inter-species relationship.

Branching from HAS, an emerging field in psychology is animal-assisted therapy (AAT) and can be used to help reduce the physiological response to stress. Animal-assisted therapy is defined as a therapy that “utilizes the human/animal bond in goal-directed interventions as an integral part of the treatment process” (Geist, 2011, pg. 244). Speaking to the history of the human-animal relationships, non-human animals have played important roles in the origins and treatment of illness and disease. The role an animal plays in treatment depends on both the prevailing view of the animals and the supernatural or “scientific” belief systems that they were a
part of. During the Age of Enlightenment, there was a change in the animal-related attitudes and relationships, which surged the increase in domesticating and socializing animals. It was not until the late eighteenth century that animal companionship was applied to the treatment of the mentally ill. In the past 20 years, there has been a shift in theoretical emphasis away from metaphysical ideas about animals to scientific explanations for the therapeutic benefits of animal companionship. There is an agreement that animals have intrinsic attributes that help facilitate therapy because “the mere presence of the animal, its spontaneous behaviors, and its availability for interaction may provide opportunities and confer benefits that would be impossible, or much harder to obtain in its absence” (Fine, 2010, pg. 37). Several theories have emerged to try and explain what makes companion animals effective in a therapeutic position.

**Theoretical Perspectives**

When looking to explain how animals facilitate stress-relieving effects, there are a variety of theories that attempt to make a connection. In the present time, there is not enough research to make a conclusion on the most accurate theory, but the following theories each contribute a unique perspective.

According to Bowlby (1969, 1980) and Ainsworth (1989), attachment behavior is “any form of behavior that resulted in a person attaining or maintaining proximity to some other clearly identified individual who is perceived as better able to cope with the world” (Fine, 2010, pg. 8). Attachment theory, developed by Bowlby, explains the need for humans to protect and be protected. Pets and animal companions are said to serve as secure social support and pets are a way of meeting that need of protection. Research has shown that dogs have a similar positive impact on humans that is consistent with benefits of human social support (Fine, 2010).
Using attachment theory, when an individual has an insecure attachment, a therapy dog may be used to help build healthy attachment experiences that focus on the changing relationship representational processes through the human-animal bond (Geist, 2011). This theory broadens and explains why humans are drawn to companion animals in times of distress. When there are strong sources of security and comfort, these relationships will reduce stress, help regulate a person’s affect, and restore emotional balance. There are empirical neuroscience findings that suggest that by looking at a dog, stroking a dog, or talking to a dog, the hormone oxytocin is released in the individual, boosting feelings of pleasure and decreasing stress (Sable, 2012). When the owner has a secure and positive emotional bond with their dog, there are several emotional and psychological benefits that promote well-being (Payne, Bennett & McGreevy, 2015).

According to a humanistic view of the biophilia hypothesis, human interactions with companion animals are an effective tool in reducing stress. This is derived from the belief that humans have an innate tendency to focus on the living things in nature, and through evolution, there is a necessity to build relationships with other species for an adaptive purpose of enhancing our capacity for bonding, altruism, and sharing. Companion animals are also said to have a bond with humans, often time fulfilling the need for love and desire to be connected with nature (Gullone, 2000).

Social cognitive theories generally believe that there is a continuous reciprocal relationship between a person’s cognitions, behavior, and the environment in comparison to animal-assisted interventions. Animal assisted interventions are believed to help an individual learn appropriate behaviors through observation. This is based on the idea that animals are able to provide feedback on social behavior through their unambiguous and immediate responses to
pleasurable and aversive stimuli. In addition, social cognitive theories believe that animals are able to improve a person’s self-efficacy, performance accomplishment, and personal agency, all contributing to a person’s more positive mental health.

**Empirical Support**

Although there is no clear consensus on explaining how an animal facilitates an improvement in mental health, there is research that shows the relationship exists. There have been a variety of studies that have shown a restorative effect on an individual experiencing stress, following interactions with a dog.

Barker et al. (2010) explored physiological responses to stress following an interaction with familiar and unfamiliar dogs. Of interest were the interactions with unfamiliar dogs, which were intended to emulate an animal-assisted activity. Ten adult dog-owners participated in this study, 5 of which were assigned to interacting with their own dog and the other 5 were allowed to interact with an unfamiliar therapy-dog. Data was gathered by evaluating physiological stress responses, including blood pressure, heart rate, salivary cortisol and salivary amylase, prior and post the stress task and also included a Pet Attitude Scale (PAS) and State- Trait Anxiety Inventory. After the Stress Test, participants were given 30 minutes of interacting with the dog and this was followed by a 50-minute neutral video while they monitored physiological responses for post-stress data collection. Results indicated that self-report stress and anxiety were perceived to have decreased with one’s own dog ($p = 0.04$), while physiological responses decreased greater with the unfamiliar therapy dog (salivary cortisol: $p = 0.026$).

Beetz, Julius, Turner, and Kotrschal (2012) examined whether different dog or human social support, is effective in reducing a child’s stress response. The experiment was carried out using three different social supporters: a real-dog, a toy dog, and a friendly 20 to 25 year old
female. It was hypothesized that being in the presence of a friendly dog would have a greater stress alleviating effect than the presence of a friendly person when exposed to a stressor. A sample of 47 male 7 to 11 year olds were given a Separation Anxiety test prior to the Trier Social Stress Test designed for children. Following the Trier Stress Test, children were given time to interact with their assigned social support and stress was measured. Stress was measured throughout the study by collecting cortisol samples, self-report measures, and observing the participant’s behaviors. Results show that the interactions with a dog, in either a real or toy form, was more effective in post-stress relaxation than a friendly person. This was the case across each condition; the real dog condition had the greatest decrease in cortisol levels \( (p < 0.05) \), more calming effects reflected in the self-report measures \( (Z= -2.184, \text{two-tailed } p=0.020) \), and children physically interacted with the dog more than the other two conditions \( (U=5.00, p=0.001) \). Interacting with a real dog relieves significantly more stress, providing benefits for cognitive and socio-emotional learning.

Poleheber and Matchock (2013) were interested in observing the effects that a dog has on the physiological responses during a stressful situation. Two hundred and ninety four students in the undergraduate psychology program at the University participated in the study by completing the State-Trait Anxiety Inventory (STAI) and then taking part in the Trier Social Stress Test (TSST), which asked participants to prepare for and take part in an interview convincing a panel that they were the best candidate for a long, sought-after work position. After the interview, the participant was given a serial subtraction task where they were asked to subtract a prime number from a preselected number. There were three conditions: interaction with a dog, having social support from a chosen friend, and the control group with no social support; each of these social supports were present throughout the duration of the study. Those in the friend condition
were allowed to sit and talk with a good friend of their choice before and after the Trier task, while during the task the friend was allowed to stand nearby and provide social support as they deemed fit. Participants in the dog condition were able to interact with a trained therapy dog by giving them treats, talking and petting the dog before and after the task, with the dog just sitting on a pedestal within peripheral vision during the stress task. Results support the hypothesis that interacting with a pet (specifically a dog) can be a factor in improving health and decreasing a stress response. Participants in the condition with the dog had significantly lower cortisol levels than both the control condition ($p=0.024$) and the friend condition ($p=0.045$). Average heart rate during the stress task was significantly attenuated in the dog condition compared to both the friend and control groups (main effect: $p < 0.05$).

In summary, the animal/human bond has shown to serve many purposes in decreasing negative mental health traits and improving many psychological aspects. As researchers attempt to come to a general conclusion about how the animal/human bond serves as a mediating factor in stress, there are several studies that support that dogs can be used in a therapeutic way that positively impact’s an individual’s perceived and psychological responses to stress.

**Current Study**

To summarize, research has found that 1) interacting with nature can reduce stress, and 2) interacting with animals can reduce stress. Research also demonstrates support that surrogate experiences involving both nature and a dog, specifically via virtual reality methods, are both as effective as the live experiences.

Society is also increasingly more reliant on technology, specifically mobile devices. Based on the biophilia hypothesis, research has suggested that an individual engaging in a form of nature will produce stress-relieving effects. Simultaneously, research has also shown that
interacting with pets can provide stress-reducing responses in humans. Though it is known that interaction with dogs and nature themselves can produce stress-reducing outcomes, no studies to date have examined whether “interacting” with nature or pets in a surrogate environment via mobile devices will also produce stress-relieving benefits – specifically, a decrease in heart rate.

The purpose of this thesis is to compare the effectiveness of a pet video, nature video, and control group on physiological stress reduction. It was hypothesized that 1) between the phases there will be an increase in heart rate from baseline to stress task and a decrease in heart rate from the stress task to intervention and 2) One of the intervention conditions (dog or nature) will have a stronger relaxation effect on participants’ heart rate compared to the control condition.

Methods

Participants

A total of 133 participants signed-up and took part in this study. Participants for this study were recruited from the psychology department at North Central College. Participants voluntarily signed up for available research time slots on the research sign-up online website SONA and received one research credit in exchange for their participation as part of their Psychology 100 course. This study was approved by North Central College’s Research Ethics Committee in Summer 2015 and data was collected for this study during the fall term of 2015.

Materials

*iHealth Pulse Oximeter*

This study used an iHealth Wireless Pulse Oximeter which had a Bluetooth connection to a mobile telephone. This device provides a non-invasive measurement of blood oxygen saturation and pulse rate. Although it had an LED screen display on the device, this was out of sight from the participant and the researchers relied on recording data from the mobile
application that displayed the measurements. Data from the pulse oximeter was viewed on an Apple iPhone application called iHealth SPO2.

Videos

Two videos were downloaded from YouTube and edited for this research project. Each video was clipped to be 90 seconds in length.

The nature video depicted a 90-second walk through a forest on a trail from a first-person perspective of the viewer. The viewer is put in a setting of walking down the trail they are following, the green trees on either side of them, and a river that they are walking along side. In the video are the sounds of the river flowing, wind blowing in the trees, the sound of the person’s footprints along the trail, and birds chirping in the background.

The dog video depicted a 90-second interaction with a companion dog from a first-person perspective of the viewer. The viewer appears to be petting an adult golden retriever dog that is sitting next to them. There is a hand in the frame that gently stroking the dog’s head, scratching around the dog’s face, and checking his teeth. The dog is calm, presses his nose into the camera, and looks around the room. The video includes limited sounds, but the viewer could hear the dog panting, moving around, and sneeze occasionally.

Videos were selected to induce the feeling that the participant is taking part of the activity (walking through nature or petting a dog), both have been supported as a stress reducer in previous research. Videos were matched in length, natural sounds, and limited confounding variables. Videos were all shown on the same computer screen with controlled brightness, volume, and distance.

Procedure

In addition to the primary investigator, there were two research assistants (RAs) that
collected data for this study. The research assistants were trained by the PI (Miller) in the appropriate research protocol. The research assistants also underwent several mock data collection sessions to ensure familiarity with the standardized research protocol. Each RA was primarily responsible for one condition group, though there were some occasions that the PI ran studies in all three conditions.

Participants were seated at a computer with a black screen and began by giving written informed consent to take part in this study. After agreeing to move forward with the study, the pulse oximeter was placed on the index finger of the participant’s non-dominant hand. The researcher made sure to keep the digital display face down so that the participant could not see. The participant was then instructed to remain as still as possible and rest his or her hand on the armrest of the chair or their lap. There were three phases of the study: baseline, stress task, and intervention.

**Baseline Phase**

To gather baseline data, participants were instructed to face the blank computer screen for 60 seconds while they were waiting for the pulse oximeter to set-up and calibrate. At this time, the researcher was watching the mobile device application to monitor the pulse reading and record on the data collection sheet every thirty seconds. After the 60 seconds had passed, the researcher informed the participant that set-up was complete and distributed a demographics sheet to be filled out completely. For analysis, mean heart rate was calculated per each intervention phase by taking an average of the 30/60/90 second readings for each participant.

**Stress Task Phase**

In order to induce stress in the participants, the serial subtraction task was implemented from the Trier Social Stress Test for Groups (von Dawans, Kirschbaum & Heinrichs, 2010).
Participants were told that the next phase of the study was a mental arithmetic task and that accuracy and speed were both being assessed. The participant was instructed to try to be as accurate as possible, while going as quickly as they can. The instructions included to start counting backwards from 1,022 in increments of 13. Before beginning the task, he or she was asked to practice by indicating the first number after 1,022. If they were not able to answer after a few seconds, they were given the correct answer of 1009. The researcher instructed them to begin, started the timer for 90 seconds, and collected pulse measurements at thirty second intervals until the 90 seconds were over. If the participant made a mistake, they were told abruptly that they were wrong and to start again from the beginning.

*Intervention Phase*

The intervention phase of the study was dependent upon which condition group the participant was in: Control, Pet, or Nature. Each condition was a 90-second period of time spent looking at the computer screen. The control group was asked to sit silently and look at the blank computer screen until the researcher indicated that the time had finished. The pet condition watched the dog petting video and the nature condition watched the forest video.

Once the intervention phase of the study was complete, the pulse oximeter was removed from the participant’s finger. A debriefing form was distributed to the participant, in addition to the researcher providing a short summary of what the study’s mission was.

*Statistical Analysis*

For the analyses, a Repeated Measures Analysis of Variance (RM-ANOVA) was used to examine the results of the data collection and look for any interaction between the variables.
Results

Demographic Variables

Preliminary analyses examined demographic variables (age, gender, ethnicity) and responses on the short survey (like pets, like nature, stress level).

There were a total of 133 participants; 70 (52.6%) females and 63 (47.4%) males. The average age of participants was 19.08 (SD = 1.58) ranging from 18 years old (52%) to 26 years old (1.5%). The majority of participants were of Caucasian/Non-Hispanic ethnicity (75.9%), followed by Hispanic/Latino (10.5%), Biracial (5.3%), African American/Black (4.5%), Asian/Pacific Islander (3.0%), and Other (0.8%). First year students were the majority of the participant (62.4%), followed by second year (13.5%), third year (11.3%), fourth year (12%), and fifth year (0.8%).

On the 7-point Likert scale, participants rated how much they enjoy playing with pets; the mean score on this item was 6.18 (SD = 1.31). The most frequent rating for this question was 7, indicating that they strongly agree (57.1%). Participants also rated how much they enjoyed being in nature; the mean score was 5.73 (SD = 1.17). The most frequent response on this question was also a 7, indicating that they strongly agree (30.8). Finally, the participants reported their general level of stress on a weekly basis; the mean rating was 4.35 (SD=1.29). The most frequent stress rating was a 5, indicating that they agree slightly (35.3%).

Within-Subject Differences

A Repeated Measures Analysis of Variance (RM-ANOVA) was used to analyze the data in order to understand if there was a significant interaction between the intervention conditions and the phases.

In order to test sphericity, a Mauchly’s Test was conducted. The test showed that the
sphericity assumption was violated, $W = .833, \chi^2 (2) = 23.53, p = .0001$, suggesting that there were not equal variances and covariances. The violation of sphericity led to the use of the Greenhouse-Geisser test when interpreting results, which corrects for a violation of sphericity.

Consistent with the present study’s hypothesis, within-subject analyses revealed a significant main effect for phase, indicating that there was a significant change in the average heart rate across the three phases, $F(1.71,222.8)=233, p < .05$. Specifically, mean heart rate increased from baseline phase to stress phase and decreased from stress phase to intervention phase, $p$’s < .05 (Table 1). Pairwise comparisons of the three phases, baseline, stress, and intervention are shown in Table 1.

**Between-Subject Differences**

A RM-ANOVA was also used to examine whether there was a significant difference between the three conditions. Inconsistent with the study’s second hypothesis, there was no significant difference in heart rate across the dog, nature and control conditions, $F(2,130)=.86, p= .425$ (See Table 2). There was also no significant interaction between phase and the condition, $F(2)=.64, p=.53$, as shown in Figure 1. There were no significant differences in means across the conditions in each group of participants (See Table 3). Though not statistically significant, an ANOVA analysis showed that there appeared to be a trend toward lower heart rate in the intervention phase of the dog condition (Mean = 72.96, SD= 12.69) compared to the control condition (Mean = 78.09, SD= 14.44), $p = .23$.

**Controlling for Covariates**

An ANOVA analysis was conducted to identify if there were any significant differences among intervention groups with respect to their ratings of preference for dogs or nature. There
was no significant difference between the participant’s enjoyment interacting with dogs $F(2,132)=.52, p=.60$ or enjoyment being in nature $F(2,132)=.34, p=.71$.

To control for participants’ average stress levels and preferences for dogs and nature, analyses were conducted where these three variables were treated as covariates. Even after controlling for these variables, there was no significant differences in heart rate across intervention groups, $F(2,127)=.65, p=.53$. However, there continued to be a main effect for phase in all three intervention groups, $F(1.69,214.73)=7.22, p=.002$. In addition, there was no significant interaction between the participant’s average stress level and their heart rate in each condition $F(3.38,214.73)=1.09, p=.36$.

**Discussion**

Previous research has found that both directly and indirectly interacting with nature and dogs have shown to help an individual recover from a stressful event. The purpose of this study was to examine whether or not watching a video of either a dog or of nature would be a more effective tool in recovering from a stressor than no intervention. It was originally predicted that there would be a significant difference between the phases for the participant, and the results supported this prediction. Across all the conditions, the heart rate increased significantly from baseline during the stress task. This implies that the stress task used in this study was an effective tool for inducing stress in participants. The math test produced distress, resulting in an increased heart rate. In addition, heart rate across all three conditions significantly decreased following the stress task. All three conditions produced a relaxing effect during the intervention phase of the study, reflected by the slowed pulse reading.

It was also predicted that one of the intervention conditions, watching either a video of a dog or a video of nature would have a more relaxing effect on heart rate than the control
condition. However, the results did not support this prediction, as there were no significant
differences in heart rate following the three different interventions. All three conditions brought
down heart rate after the stress task, suggesting that each of the three conditions worked equally
well in reducing the heart rate following a stress task. Though there was a trend toward a lower
heart rate during the intervention phase in the dog condition than control condition, it was not
statistically significant; it is possible that this may have been significant with a larger sample
size. Therefore, the results of this study suggest that staring at a blank screen, watching a dog
video, or watching a nature video, all produce equally relaxing effects. This reinforces previous
research that shows both nature and dogs are buffers in the stress response, though it is unclear
whether viewing these stimuli on a computer provides added benefit above and beyond a control
group that does not view any stimulus. On the other hand, participants may not have followed
through on given instructions to sit silently and look at the computer screen, and instead of
focusing on their intervention they were distracted by stimuli around them. This would have
resulted in the intervention having no effect on the post-stressor relaxation.

Common Factors

There may be common factors that explain why all three of the condition groups showed
relaxation. Regardless of their condition, participants could have used the 90 seconds following
the stress task phase to cope with the stressor in their own way. This could include deep
breathing, reassuring themselves that they would get through it, or using their own mindfulness
techniques.

No significant difference could have occurred between nature settings and dogs since
they are both aspects on nature in the broad sense. In general, nature is said to have relaxing
effects on the human body’s physiological stress response. Walking through a forest and
interacting with a dog are both ways to be interactive with nature. Animals and forests may be equivalent forms of nature in the stress recovery process.

Zoccola and colleagues (2014) examined the effects of rumination and distraction on cortisol levels and inflammatory responses following a stress task. Results from this study found that ruminating on stressors prolonged the stress response, while distraction decreased the immediate cortisol and inflammatory responses to a stressor. This suggests that removing the person from the stress-inducing situation may be beneficial in the stress recovery process. When the participants in the present study were given an alternative activity from the arithmetic task, either watching a video or staring a blank screen was distracting enough to bring down the person’s heart rate.

*Control Group as an Intervention*

In regards to the control condition being equally effective as both the nature and dog conditions, although not addressed in this study, there could also be value in sitting quietly in the stress recovery process. From this study’s results, this could suggest that there was some process in the silence and removal of stimuli that makes stress recovery work equally as well as nature setting and dogs. Taking into account the procedural instructions given to those in the control group, this may have contributed to the non-significant between-condition results. In the control condition, after completing the stress task the participants were told to sit silently and look at the computer screen until they were informed that the time had finished. Unclear as to why they are being told to sit there, the participant could have used the time to not be thinking about anything else going on, specifically things that may have be anxiety-producing for them outside of the experiment. Some of the participants may not have any other time during their day to sit down and relax, so the 90-seconds that they were given to sit in silence and not be required to do
anything may have naturally brought their heart rate down lower than their average threshold heart rate.

*Surrogate vs. In Vivo Experience*

In the Biophilia hypothesis, Wilson (2007) presents the overarching theory that nature is relaxing to the human body and mind. Under this hypothesis, there is ample research supporting both nature settings and dogs in the stress recovery process. There was no previous study comparing nature and dog stimuli in a surrogate setting, which may suggest that they may just work equally well in the stress recovery process.

These results may also suggest that watching a surrogate experience may not be as successful in a person’s stress recover compared to an in vivo experience. Previous research has shown that physically interacting with a dog or nature in an in vivo format is an effective in stress recovery (Kaplan, 1995; Ulrich, 1991). By having the participants watching a video of these stimuli, there is a limited amount of sensory information present that might have aided in the connection otherwise. If the resources had been available, it would have been better to make the experience as real as possible. For the experience to be as close as it can, this could include bringing in live pets for the participants to interact with or having the participants physically take a walk through a park or forest. A more moderate option would be to create a virtual reality setting where they have some control over how they interact with the dog or natural exposure, but in a simulated environment, similar to a video game. Future studies should aim to directly compare the effectiveness of surrogate and in vivo dog/nature interactions.

A drastically different explanation for the lack of significant results could be that interacting with nature and pets in a computerized fashion does not bring any stress-reducing benefits. Watching these two video interventions could be no more effective than no intervention
at all (represented by the control group). Each condition could have reflected the natural decrease in heart rate following a stressor. This could suggest that not being involved in the in vivo experience could hinder the positive effects that nature and dogs have to offer after experiencing a stressor.

Limitations

There were several limitations that may have had an influence on the non-significant interaction results of the study. These include: video selection, intervention type, and challenges as the researcher.

Video Selection

One of the limitations of the study was the dog and nature video that were selected for the intervention conditions. Anecdotal reports from several of the participants in the nature condition suggest that during the nature condition, they were under the expectation that there was going to be something that jumped out and scared them in the video. This could have prevented the participant from recovering completely from the stressor and the heart rate from going down more than it did. There were also anecdotal reports from a few participants in the dog condition that their video was boring and was hard to hear at times. This could have interfered with their feelings of connecting to the dog as the study intended.

Study Design

There could have been problems in conducting the experiments that may have negatively impacted the results of the study. There were three people involved in collecting data for this study. Each condition often had a different experimenter conducting the studies, possibly influencing the results. Research assistants were each assigned a condition, while the PI conducted the third condition as well as additional studies in the other two conditions. Because
the conditions were primarily conducted by one experimenter, there could have been differences in the way the study was conducted, such as how assertive they were during the stress task, the calmness in their voice during the experiment, variations in any additional information given to the participant, all of which may have influenced the way that the participant perceived the situation that they were in. The differences in conducting the study could have changed how physically stressed the participant became during the stress task, how/when the experimenter recorded the data, or how the participant recovered.

The researcher was responsible for staying organized throughout the study and maintaining accurate records of the heart rate, which was often a difficult task for one person. It was hard to keep the purpose of the “fitness device” discrete and hidden from the participant. There were times that the participants would acknowledge they knew that the device was a pulse oximeter. When recording the heart rate on the data collection sheet, the researcher may have recorded the participant’s heart rate slightly inconsistently and inaccurately. The researcher could have missed the 30-second time mark and recorded the heart rate at a different time point. On occasion, there were times at the 30 second interval that the heart rate on the application switched so it became a question of which number to record. This may have made some recordings random and inconsistent with other data collections. It would have been easier if there were two researchers in the session, one to record the data and the other to administer the instructions and the device. This could have all posed a problem in the accuracy and precision of the results. Therefore, it is possible that experimenter error may have led to inaccurate recordings at times, which, if occurred, may have influenced the results.

**Participant Bias**

Lastly, if the participant came into the study with knowledge of the fitness device, their
anticipation of heart rate measurements could have influenced their measurements differently than the participants who were not aware of the variable being measured. By having knowledge of the device measuring their heart rate, the participant could have predicted that there would be a task influencing an increase or decrease in heart rate. The stress task may not have been as stress inducing because they could have predicted that the math task was not being evaluated as much as their heart rate. In addition, the intervention could have been less effective because they were concerned with how high or low their heart rate was in the present moment. This could have resulted in a heart rate that would not have reached as high or as low as it would have if they were not expecting to do something that would change it.

**Application**

The results of this study suggest that even a 90-second intervention is sufficient to reduce the physiological stress response. After being a part of a stressful situation, there may be benefit to pulling up a short video or viewing a blank computer screen to relax from the stressor. It is sometimes necessary to take a short break and use the time to reflect on what may be causing them distress. It is easy enough with the technology available to college students, and the general population, to go on their phone and find a video as a way to cope with a stressor. A mobile application could be created and developed that would have short 1-2 minute video clips of dogs and nature or a black screen that would instruct them to follow similar procedures to the intervention condition in the present study. An application that prompts the individual to watch a blank screen may also be effective. It is possible that doing something other than the stressor may be all that it takes to reduce physiological stress.

**Future Research**

There are several changes that could be made to methodology that may produce different,
and possibly significant, results. Future research should look to improving the current design, as well as finding other ways of using technology to benefit a person’s stress reduction. There are modifications to the design of the present study that would have corrected limitations. Later suggestions for future research go beyond the present study and expand to include more from the current knowledge in the subject areas of stress and positive technologies. Some of these suggestions would address the previously discussed limitations and others are areas of related interest.

**Video Selection**

To improve the current study design and try to achieve significant results, the materials and procedure of the study could be changed. There are several variables related to the videos shown during the intervention phase of the study that may have shown to be a more successful intervention for reducing stress. Variables include the length, type, and audio of the chosen videos.

The length of the video could have been too short to demonstrate the full effectiveness of the intervention. The participant may not have been allowed enough time to be absorbed into the experience and bring the heart rate down as low as it possibly could. In other words, if the video was longer, the individual’s heart rate could have continued to drop and one intervention could have been significantly lower after two or more minutes. It may take a longer duration within the experience to see its true potential at assisting a person’s stress recovery process. Usually when a person is petting a dog or taking a walk through nature, they will be taking part in that activity longer than a 90-second time period.

For this study, research was not done to determine which types of videos within each category would be the most effective for the study’s interventions. Videos were chosen broadly
and from what was available on the Internet. Instead, there may be different types of interactions with either a dog or nature that are better suited in the stress recovery process. For example, for the nature condition, it is possible that watching a scene of an ocean would be more stress relieving than a walk through a forest. In addition, there may be certain breeds of dogs that are naturally more relaxation producing than a golden retriever. More research should be done to help determine what type of scene within the dog or nature category will produce stress recovery, before comparing each category against one another.

The intervention conditions were primarily focused on giving the participant’s a visual sensation, hoping to aid in the stress recovery process. However, the intervention could have focused more on bringing in one of the other sensations. Specifically, paying more attention to the audio component of the video would have been increasingly more effective. Although each video was played at the same volume level, there were more sounds present in the nature video than the dog video. Possible solutions could include choosing a dog video that had a wider variety of sounds similar to the nature video. This could include sounds from multiple different dogs, addition sounds from toys, eating, or any other related stimuli. Another approach would be to enhance the sounds of the video by having the participant listen to the video with wearing headphones. This could make the sounds feel more realistic and a first-person experience for the participant. Lastly, only surrogate exposure was compared in this study but follow-ups could include comparing surrogate to in vivo exposure to determine whether surrogate is as effective as an actual interaction with the stimuli.

*Study Design*

Instead of comparing two well-supported stress intervention techniques, dogs to nature settings, results may have differed if a dog video was compared to a video selection not
associated with a stress-relieving effect. As discussed, it may have been hard to discriminate any differences between the two interventions because their effectiveness stems from the same theoretical background. For example, it may be better to compare either video to a video portraying children playing or a plane flying through the sky. This would allow for the determination of whether or not differences would arise between a surrogate intervention that is well supported and another intervention.

Another possible suggestion to improving the design would be informing the participant that the intervention condition is a video with the intention to produce relaxation. By informing the intervention conditions (dog and nature conditions) that the video they are watching has the purpose to reduce stress, this may help the individual be more comfortable and relax more than they would in a control condition, where there is no given purpose. This would lend more appropriately to a real world application of the intervention technique, where individuals are often informed that a particular intervention is designed to reduce their stress. To make the job of the experimenter easier, it may be beneficial to have a second experimenter conducting the study. One researcher would be responsible for instructing the participant, while the second researcher would be responsible for recording all of the data.

When analyzing the data, a decision was made to average the heart rate from 30-second intervals in each of the phases. This could have hidden a possible significant effect. Rather than averaging the three time points, it would have been better to look at each of the nine time points independently. It could have been more beneficial to look at the highest heart rate reading in the stress phase, while looking at the lowest heart rate reading during the intervention phase. Especially in the intervention phase, this could have been an important factor. It was more
important for this study to see how far the intervention lowered the participant’s heart rate than the average in the phase as a whole.

Another option, also supported in research literature, is changing the structure of the study from being a stress-recovery intervention into a stress-buffering intervention. This would involve showing the intervention condition videos prior to the stress task. This may result in a significant different in the heart rate during the stress-inducing task. The intervention may be a buffer and help keep stress levels at a minimum during the task. This would suggest that performing an intervention strategy prior to a known stressful event might have relaxing effects during the stressor.

Most participants reported fairly high ratings towards dogs and nature, with very few reporting dislike to strong dislike. One interesting aspect that could be tested would involve using participants that are screened to not favor dogs or being in a natural setting. For example, it would look to see if those who indicate a strong dislike for dogs would still benefit from watching a dog video. This would test to see if the innate stress recovery effects of nature and a dog, supported in the literature, would hold true for people who do not indicate preference for these situations.

Conclusion

In conclusion, this study suggests that surrogate interactions with dogs and nature were equally effective as a control group in reducing the physiological stress response. There were a variety of limitations in this study that could have prevented any additional significant differences from being discovered. Future research may consider choosing different videos for the intervention condition, changing the protocol of the study, and identifying additional factors such as preference for dogs or nature. Although limited significant differences were found in this
study, there are several important factors found that can be carried on to improve understanding of how to use positive technologies to aid the stress recovery process.
References

Advanced Micro Devices (2014). *Laptops move to the head of the class among college students, according to AMD back-to-school survey*. Advanced Micro Devices.


Differential effects of poststressor rumination and distraction on cortisol and C-reactive protein. *Health Psychology, 33*(12), 1606-1609. doi:10.1037/hea0000019
Table 1
*Mean Heart Rate For All Participants Across 3 Study Phases*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Means of Phases (St. Error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate</td>
<td>76.36 (1.33)</td>
</tr>
<tr>
<td></td>
<td>88.36 (1.34)</td>
</tr>
<tr>
<td></td>
<td>75.59 (1.20)</td>
</tr>
</tbody>
</table>
Table 2

*Repeated Measures Analysis of Variance*

<table>
<thead>
<tr>
<th>Effect</th>
<th>MS</th>
<th>df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase</td>
<td>7953.61</td>
<td>1.71</td>
<td>233</td>
<td>.001</td>
</tr>
<tr>
<td>Phase x Condition</td>
<td>35.06</td>
<td>3.43</td>
<td>1.03</td>
<td>.387</td>
</tr>
<tr>
<td>Error (phase)</td>
<td>34.09</td>
<td>222.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Based on violation of sphericity, analysis was conducted with the Greenhouse-Geisser test.
Table 3  
*Mean Heart Rate by Condition across Phases*

<table>
<thead>
<tr>
<th>Intervention Condition</th>
<th>N</th>
<th>Baseline (Std. Deviation)</th>
<th>Stress Task (Std. Deviation)</th>
<th>Intervention (Std. Deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>43</td>
<td>78.74 (16.25)</td>
<td>89.99 (15.66)</td>
<td>78.09 (14.44)</td>
</tr>
<tr>
<td>Nature Video</td>
<td>45</td>
<td>75.83 (15.59)</td>
<td>87.50 (16.81)</td>
<td>75.73 (14.39)</td>
</tr>
<tr>
<td>Dog Video</td>
<td>45</td>
<td>74.49 (14.17)</td>
<td>87.59 (13.78)</td>
<td>72.96 (12.69)</td>
</tr>
</tbody>
</table>
Figure 1. Estimated Marginal Means of Heart Rate. This figure illustrates the heart rate patterns across the three phases in each of the intervention conditions.