# HEART TO HEART:
# CONNECTING EMPATHY, ATTACHMENT, AND PHYSIOLOGY

by

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B.Sc. (Hons.), University of Northern British Columbia, 2009

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE
IN
PSYCHOLOGY

UNIVERSITY OF NORTHERN BRITISH COLUMBIA

April 2013

*Your file Votre référence*
*ISBN: 978-0-494-94156-0*

*Our file Notre référence*
*ISBN: 978-0-494-94156-0*

## Abstract

Previous research has shown that there are relationships between empathy and attachment, attachment and physiology, and physiology and empathy in response to affective or stressful exposure; however, research has not looked at these three components together during affective exposure. The hypothesis of the current study was that affective stimuli can cause changes in HRV that can be predicted by empathy and adult attachment. Participants were exposed to three 5-minute categories of affective video clips (happy, sad, and physical pain) while physiological data were recorded. Heart rate (HR) and respiratory sinus arrhythmia were extrapolated from the data as measures of autonomic nervous system activity; corrected respiratory sinus arrhythmia scores were calculated for the analyses (cRSA). Participants also completed dispositional measures of empathy (Interpersonal Reactivity Index; IRI) and adult attachment (Experience in Close Relationships-Revised; ECR-R). Each of the categories of affective clips was effective in eliciting a physiological change with different patterns of responding for each category and different patterns or prediction and correlation between variables. There was support for the predictive ability of the IRI and ECR-R for a change in HR but not for cRSA. Higher scores of Personal Distress and Empathic Concern predicted a change in HR in each affective condition. Another finding was that, in general, individuals with higher maladaptive dispositional scores (e.g., increased Personal Distress) also showed signs of unhealthy cardiovascular responding (e.g., increased HR and decreased cRSA). Implications and future directions for research are discussed.

# Table of Contents

## List of Tables

## List of Figures

## Acknowledgement and Dedication

I would like to thank everyone that has been a part of my life, as you have all played some sort of roll in where I am today, how I think, how I behave, what I know, what I think I know, and even what I don't want to know. To my loved ones, family, friends, thank you for surviving my lasting tenure as a student and staying by my side the whole time, your support has been invaluable and has really helped me keep a smile on my face.

This thesis has been a long and challenging journey that involved many unplanned self-studies along the way and it was quite a memorable adventure. I would like to thank Dr. Cindy Hardy and Dr. Ken Prkachin for this amazing opportunity, all of the support, and for ensuring my sanity along the way. As well to the rest of the faculty, colleagues, classmates, thank you for joining me on this adventure and for being fantastic colleagues and teammates, I look forward to crossing paths in the future (especially on the soccer field or basketball court – hint, hint). I have learned a lot in the process of my thesis, much of which would not be contained in any text book, edited book, scholarly publication, or other professional/educational literature, and that is of the greatest value to me. Thank you to UNBC for funding my research.

I am often asked if I could do it all again would I pick something easier. My response has always been that I would love to say yes but that is not who I am and life is boring without a challenge, so no, easy is not how I roll!

So I dedicate this thesis to all of you that have left your footprint as we crossed paths.

Heart to Heart: Connecting Empathy, Attachment, and Physiology

## Introduction

In 2004, cardiovascular disease accounted for approximately 32% of all deaths in Canada (Health Canada, 2008) and in 2006, heart disease and stroke were two of the top three causes of death in Canada accounting for approximately 30% of all deaths (Statistics Canada, 2010). The Heart and Stroke Foundation of Canada states that in Canada someone dies from heart disease or stroke every 7 seconds and the costs of heart disease and stroke are over $22 billion per year (Heart and Stroke Foundation of Canada, 2010). Efficient and effective cardiovascular functioning is imperative to our survival and societal economic health; therefore, understanding the factors that can influence cardiovascular functioning is of vital importance on both an individual and a societal level.

At the heart of the cardiovascular system lies the heart muscle. The heart muscle is vital for survival and is responsive to both physical and psychological events. The heart is responsible for providing oxygenated blood to the body (tissues and organs) and deoxygenated blood to the lungs (for oxygenation and transmission through the body). Blood also contains vital nutrients and substances needed for survival, such as hormones and cells that protect the body from infection, in addition to oxygen. Thus, the heart relies on its network of branches to efficiently and effectively transport the nutrients and substances throughout the body. The heart muscle functions in response to the autonomic nervous system (ANS). Increased sympathetic nervous system (SNS) arousal increases heart rate (HR) and force of contraction and increased parasympathetic nervous system (PNS) arousal decreases heart rate and force of contraction.

Since blood is important to survival, it is important to ensure that both the cardiovascular system and the ANS are functioning in an efficient and effective manner.

Overactive physiology can lead to overuse or damage to the cardiovascular system. For example, blood pressure is a variable related to both cardiovascular health and physiology. If arteries are clogged by plaques, causing increased blood pressure, there can be additional stress put on the cardiovascular system as blood is forced to pump through the system at a greater frequency and force. This means that the effects are exacerbated bi-directionally in that a cardiovascular system can be negatively impacted by an overactive physiological response and a poorly functioning cardiovascular system can cause a physiological response to increase to potentially damaging levels. In Canada, approximately 19% of Canadian adults have high blood pressure and another 20% have pre-hypertension (Wilkins et al., 2010). Further, approximately 34% of Canadians with hypertension are not controlling the problem (Wilkins et al., 2010). The Heart and Stroke Foundation of Canada also reports that 40% of Canadians have high cholesterol, a factor linked to fatty plaques and deposits found in arteries (Heart and Stroke Foundation of Canada, 2010). This blood pressure and cholesterol data would suggest that approximately 40% of Canadians are potentially at risk for cardiovascular events and could develop or have already developed altered physiological responding.

Although numbers of cardiovascular related deaths in Canada have been decreasing, they still remain the leading source of mortality. The cardiovascular system is codependent on physiology that is responsive to psychological events; therefore, it makes sense to explore the cardiovascular effects of psychological events. Activity and regulation of ANS is considered an evolutionary adaptation that is implicated in promoting social behaviors (Porges, 2001). Humans are social beings and live in a social world, we interact with others on a daily basis and with technological advances we are able to interact socially without being in the physical presence of others. Television and Internet allow individuals to see and hear the emotional events that are occurring to other individuals that they might not have otherwise ever witnessed. We are often presented with the emotional experiences of others, be it family, friends, acquaintances, or complete strangers, and respond internally, externally, or both. During social interactions one's body can react physiologically and can sometimes be uncomfortable, for example, the uneasy, uncomfortable feeling that can occur when someone talks about the loss of a loved one. The ANS can also be activated in vicarious affect-inducing situations (i.e., empathy situations). In an early study, Craig and Wood (1969) explored the effects of direct and vicarious arousal and found that vicarious arousal led to increased skin conductance response and decreased HR. Work by Lacey in 1967 suggested that decreased HR is related to increased environmental processing, whereas increased HR is related to avoidance of stimuli. A study by Liew et. al., (2003) discovered that young boys that responded with increased skin conductance to negative emotional stimuli were also reported by parents and teachers as being better regulated, less emotionally intense, and more socially adjusted.

The current study aims to explore the interactions between empathy (i.e., our ability to vicariously experience another person's situation), one's adult attachment style (i.e., the way we bond with and view our relationships with others), and one's physiological changes while witnessing video clips of others in moments of happiness, sadness, and physical pain.

**Measuring Cardiovascular System Functioning**

As mentioned earlier, the system within the body that is responsible for physiological changes such as increased HR is the ANS. The ANS is responsible for the fight or flight response by acting on the sympathetic (SNS) and parasympathetic systems (PNS). The SNS increases alertness and prepares for action, whereas the PNS is responsible for recovery and returns the individual to baseline by producing the opposite effects of the SNS (commonly referred to as the gas and the brakes respectively). The ANS influences various organs including the heart, eyes, lungs, stomach, and bladder. The cooperation of SNS and PNS can be important for organ functioning. Chronic or intense activation of the ANS can lead to various health problems as the organs involved become overused and stressed. Recovery from intense activation is considered to be at least as important as the activation itself (Forcier et al., 2006). A meta-analysis by Forcier et al. (2006) showed that fit individuals demonstrate increased, attenuated reactivity and a greater recovery to stressors than unfit individuals, although the recovery was generally found in HR rather than blood pressure. Individuals with chronic heart failure have been found to exhibit abnormal values for HR measurements such as heart rate variability (HRV) and heart rate recovery (Piotrowicz, Baranowski, Piotrowska, Zielinski, & Piotrowicz, 2009).

There are various ways to measure the functioning of the cardiovascular system (i.e., cardiac output, blood pressure, blood volume, blood flow, and HR). One common method is by measuring the electrical activity of the heart by attaching electrodes to the skin and utilizing an electrocardiogram (EKG); this is referred to as an endogenous procedure as the electrical activity exists within the body and is not applied from an external source. The EKG mirrors the electrical activity of the heart as the wave of myocardial activation passes from the sinoatrial node in the right atrium (triggers contraction of the heart) through the atria to the atrioventricular node, then to the common bundles of His and the Purkinje Network, and throughout the ventricular system. This process allows the heart to pump blood from the atria to the ventricles and then throughout the body (Stern, Ray, & Quigley, 2001). Each phase of polarization and depolarization within activity of the heart produces different waves on the EKG (see Figure 1). The pronounced variations in the heart's activity are labeled and referred to by wave (i.e., P, Q, R, S, T, and U) as shown in Figure 1. The cardiac cycle is defined as the area from the first R wave to the second R wave.

HRV is measured based on beat-to-beat differences in the cardiac cycle. In time domain analyses, HRV can be represented as either the time between each R wave which is referred to as the heart period. HRV is usually measured in milliseconds (ms) or the number of cycles present in a given amount of time, which is referred to as the heart rate (HR) and is usually measured in beats per minute (bpm). With spectral power domain analyses the ANS exhibits frequency differences wherein the high frequency (HF) output (0.15-0.4 Hz) is predominantly influenced by the PNS and the low frequency (LF) output (.04-.15 Hz) has been suggested to be a result of the influence of both the PNS and SNS (American Heart Association, 1996; Thayer, Yamamoto, & Brosschot, 2010). The HF output is often referred to as vagal tone as it is a used as a measure of the ability of the vagus nerve to suppress sympathetic activity (Berntson et al., 1997; Porges, 2001). The respiratory cycle also activates the PNS resulting in differences within the cardiac cycle (e.g., increased vagal activation leads to decreased HR during exhalation compared to inhalation where vagal control is decreased); this is known as respiratory sinus arrhythmia (RSA) and is measured with the HF output. RSA is a cardiorespiratory measure because it involves the cardiovascular and the respiratory systems as they work together and exert their influence on the sinoatrial node.

When reviewing studies on HRV, Malliani and Montano (2002) indicated that it could prove to be a useful noninvasive tool in assessing the autonomic modulation of the heart period and it can provide important and detailed information for various cardiovascular conditions.

Researchers have found significant relationships between coronary artery disease, HRV, and heart rate recovery (Evrengul et al., 2006). For coronary artery disease, there was a noted reduction in HF HRV and an increase in both LF and LF:HR ratio values (Evrengul et al., 2006). Another study found temporary LF changes but not HF changes following an acute myocardial infarction, indicating increased sympathetic influence, suggesting that LF changes might be indicative of a future risk of sudden death for individuals with chronic stable angina pectoris (Bjorkander et al., 2009).

**Empathy**

Empathy is what is experienced in response to another person's situation; for example, feeling sad for someone who has just lost his or her loved one. Empathy should not be confused with sympathy, as sympathy simply refers to understanding and responding to the condition or state of another individual without a sense of personal distress (Fabes et al., 1994). Empathy has been described as being comprised of two main components: cognitive empathy and affective empathy. Cognitive empathy refers to thinking about another person's situation and being able to put yourself into their situation. Affective empathy refers to feeling the emotions of the other person. Goubert et al. (2005) define empathy as "a sense of knowing the experience of another person with cognitive, affective, and behavioral components" (p.285). Harmon-Jones and Winkielman (2007) state "shared neural representations, self-awareness, mental flexibility, and emotion regulation constitute the basic macro components of empathy, which are mediated by specific neural systems" (p.247). More recent definitions of empathy combine the affective responses to others, the cognitive capacity for perspective taking, and the self-regulation and monitoring of one's own internal state (Harmon-Jones & Winkielman, 2007) and depend on both bottom-up processes (i.e., stimulus features such as facial expression) and top-down processes (i.e., the observer's experience, knowledge, and dispositions; Goubert et al.).

Empathy is a psychological phenomenon that for many years was debated in terms of measurement and construct definitions. Davis (1980) developed a tool called the Interpersonal Reactivity Index (IRI) with four scales to measure four different aspects of empathy: perspective taking (PT), empathic concern (EC), personal distress (PD), and the fantasy scale (FS). The four scales were found to be independent of each other and therefore are said to measure four independent aspects of cognitive and affective empathy (Davis, 1983a; Davis, 1980). The Perspective Taking scale refers to an individual's ability to immerse himself or herself in the perspective of another (non-fictional) person, which is linked to cognitive empathy (Davis, 1983b). The Empathic Concern scale refers to an individual's degree of compassion and concern for another person, which is linked to emotional or affective empathy (Davis, 1983b). The Personal Distress scale refers to an individual's negative emotions and feelings in response to the negative situations of others, which is also a measure of emotional or affective empathy (Davis, 1983a). The Fantasy Scale refers to the ability of an individual to imagine themselves as a fictional character as depicted in movies or books which is said to be a measure of both cognitive and affective empathy (Davis, 1983b). Through development, individuals learn to separate themselves from others and therefore there should be a decrease in personal distress and an increase in empathic concern in response to another individual's experience, which was reflected in the intercorrelations found between the Perspective Taking, Empathic Concern, and Personal Distress scales of the IRI (Davis, 1980, 1983a); again suggesting the need for self-awareness as part of the construct of empathy.

**Empathy and physiology.** Empathy-based affective responding can be distinguished from responding to our own personal distress in that there are different patterns of cortical activity. Jackson, Brunet, Meltzoff, and Decety (2006a) found that when participants were asked to rate the pain of others there was activation in the parietal operculum, anterior cingulate cortex, and anterior insula; whereas, when participants were asked to imagine that they were experiencing the pain there was activation in the secondary somatosensory cortex, anterior cingulate cortex, and insula proper. Jackson et al. (2006a) also noted that participants took longer to respond when imagining pain in others (empathy) rather than imagining one's self in pain. It is suggested by Jackson et al. (2006a) that this different pattern shows that a complete overlap of the self and other is not necessary for empathy and helps differentiate responding to another person's stress state from responding to one's own state. This means that an individual does not have to imagine the event as occurring to themselves in order for a response to occur. Jackson, Rainville, and Decety (2006b) believe that there is a "proximo-distal continuum of triggers for the representation of pain" (p.6), meaning that the closer the pain is to being physically experienced by the individual, the greater the psychological experience will be, with the greatest experience being for somatic events (e.g., nociceptive pain). Research by Botvinick et al. (2005) also supported the findings of Jackson et al. (2006a) by utilizing fMRI to detect the activation in the dorsal anterior cingulate cortex and bilateral insulae during the presentation of noxious thermal stimulation and during the presentation (and processing) of facial expressions of noxious pain. It is suggested that the responses to viewing pain in others are an evolutionary adaptation that functions to obtain assistance from others. This is evidenced by activation of areas when witnessing pain that are also activated in motivation or avoidance/aversive learning and in fear conditioning (e.g., when an individual is experiencing pain themselves) or empathy-based affective responding rather than sensory responding (Botvinick et al, 2005). Other research has provided support for the importance of different regions of the brain for cognitive (i.e., ventromedial prefrontal) and affective (i.e., inferior frontal gyrus) components of empathy (Shamay-Tsoory, Aharon-Peretz, & Perry, 2009).

Since psychological events are related to changes in ANS activity (e.g., stress) it may be possible to correlate physiological responses to empathy, such as HR and skin conductance, to psychological responses via a non-invasive self-report measure, such as the IRI. For example, one study examining the relationship between empathy and error processing found a correlation between one's event-related potential amplitude (electroencephalographic output) and one's self reported empathy including the Fantasy Scale of the IRI (Larson, Fair, Good, & Baldwin, 2010). Another study addressing the relationships between measures of affective empathy in children found that although the relationship between self-report and physiological measures was inconclusive, there was a relationship between verbal and facial measures and facial and physiological measures (Anastassiou-Hadjicharalambous & Warden, 2007). The authors noted that the discrepancy in the results could be due to developmental and age issues (i.e., limited emotional vocabulary) in researching children or methodological issues (i.e., measuring HR during the presentation of stimuli and then doing a reflective self-report; Anastassiou-Hadjicharalambous & Warden). Another study exploring the empathic responses towards human and non-human (i.e., primates, companion mammals, utilitarian mammals, and chickens) stimuli found that there was a relationship between self-reported empathy (as measured with the Balanced Emotional Empathy Scale) and physiological responses (i.e., activity of corrugator muscles, which are located under the eyebrows, and skin conductance), which was not anthropocentric but was more pronounced with increasing similarity to the human species

(Westbury & Neumann, 2008). The results of this study indicated a positive relationship between self-reported empathy and corrugator muscle activity, and a greater skin conductance response for individuals in the moderate empathy group than in both the high empathy group and to a lesser degree the low empathy group. The discrepancy in the skin conductance response is proposed to be a result of gaze aversion in attempt to avoid distress by individuals with high empathy scores and the authors suggest that measuring HR might assist in exploring a defensive response (Westerbury & Neumann, 2008).

**Adult Attachment**

Attachment style describes how an individual defines their interactions with others in close relationships (e.g., infant-caregiver, peer, or romantic relationships) throughout life. Attachment is thought to assist in the development of emotion regulation and resilience and attachment style has been reported as a risk factor for various health conditions including heart attack and stroke (McWilliams & Bailey, 2010). Attachment theory is based on the idea that infants form bonds with caregivers in an attempt to increase survival and decrease threats. Bowlby's (1969) attachment theory is based on the dynamic interplay between individuals and their significant others, especially in infancy to their mother figure during times of need. In infancy behavioral systems that are a product of evolution and environmental interactions are activated with the goal of proximity to the attachment figure (i.e., mother, father, or other significant primary caregivers) and the reliability of this attachment figure is a source of security (Ainsworth & Bowlby, 1989).

Attachment can include biological reactions (i.e., physiology), psychological interactions (i.e., thoughts and feelings) and behavioral interactions (e.g., approach and avoidance). As individuals go through childhood, they become more independent and start exploring with less emphasis placed on proximity to the mother (Bowlby, 1969), a pattern that then carries on throughout the subsequent developmental stages. The stages of adolescence and early adulthood are filled with mental, physical, and social transitions and attachment can be diverse in these stages of development, as attachment behaviors are directed at different attachment figures that can include other adults, peers, groups, or institutions. According to Allen (in Cassidy and Shaver, 2008) adolescence and early adulthood is a time when an individual transitions from being a "receiver of care to becoming a self-sufficient adult and potential caregiver to peers, romantic partners, and offspring." (p.419).

Work by Hazan and Shaver (1987) extended early attachment theory by exploring adult attachment styles, especially in reference to romantic attachments, which led to further interest in the concept of adult attachment. Adult attachment is often viewed in terms of thoughts and behaviours related to attachment avoidance and anxiety. Four patterns of attachment in adulthood based on models of self (dependence) and models of other (avoidance) as described by Bartholomew and Horowitz (1991) are: secure, dismissing, preoccupied, and fearful. The four patterns of attachment can be mapped onto the dimensional view of attachment avoidance (AV) and anxiety (AX). Individuals with a secure attachment style are comfortable with intimacy and autonomy (Bartholomew & Horowitz) and experience low attachment avoidance and anxiety (Mikulincer & Shaver, 2007). Individuals with secure attachment styles experience: confidence about and comfort with themselves and relationships, resilience, ability to self-soothe with internal and external resources, and are able to seek emotional support when needed (Maunder & Hunter, 2009).

Unlike the secure attachment style, the insecure (i.e., dismissing and preoccupied) and disorganized (i.e., fearful) styles of attachment do not show mutually low avoidance and anxiety. Individuals with a dismissing attachment style are characterized as dismissing of intimacy and are counter-dependent (Bartholomew & Horowitz, 1991). They experience high avoidance and low anxiety in relationships (Mikulincer & Shaver, 2007). This style is also referred to as a dismissing avoidant style. Individuals with a dismissing attachment style are characterized as very independent, self-reliant, and distanced interpersonally. They participate in non-reciprocal relationships, are likely to appear non-genuine in social behavior, and are able to cope with stress by using cognitive distancing from emotions, denial, or disengaging/distracting from emotions (Maunder & Hunter, 2009).

In contrast with the dismissing attachment style, individuals with a preoccupied attachment style are preoccupied with relationships (Bartholomew & Horowitz, 1991) and experience low Avoidance and high Anxiety in relationships (Mikulincer & Shaver, 2007). Individuals with a preoccupied attachment style are characterized as dependent, excessively expressive, and emotionally needy. They engage in non-reciprocal relationships, are not likely to feel resilient or capable and are not able to self-soothe effectively. They are likely to use emotion-focused coping (Maunder & Hunter, 2009).

A more recent addition to the adult attachment styles is the fearful attachment style. Individuals with a fearful attachment style are the polar opposite of the secure attachment style in that they fear intimacy, are socially avoidant (Bartholomew & Horowitz, 1991), and experience high Avoidance and Anxiety in relationships, also referred to as fearful avoidant (Mikulincer & Shaver, 2007). Individuals with a fearful attachment style are characterized as isolated (undesirably), are conflicted between approach and avoidance, and are non-assertive and socially inhibited. They are often in non-reciprocal relationships, are not likely to gain a sense of security from physical or emotional closeness, and often experience intense negative affect. They are over regulating and suppressive of emotions but in times of intense stress might use emotion-focused coping (Maunder & Hunter, 2009).

**Attachment and physiology.** Attachment insecurity has been found to be related to deficits in emotion regulation (Allen & Miga, 2010) and physiology as shown by increased cortisol reactivity and recovery time with general stressors (Powers, Pietromonaco, Gunlicks, & Sayer, 2006). In a study by Feeney and Kirkpatrick (1996), the presence of a romantic partner during stressful events was shown to differentially affect HR as a function of the anxiety domains. In this study individuals with an avoidant attachment style displayed higher HR than individuals with a secure attachment style when their partner was not present (Feeney & Kirkpatrick). For individuals with an avoidant attachment style there is increased blood pressure and skin conductance with general stressors (Carpenter & Kirkpatrick 1996; Diamond, Hicks, & Otter-Henderson, 2006; Feeney & Kirkpatrick, 1996; Kim, 2006), increased cortisol reactivity with romantic conflicts (Laurent & Powers, 2007; Powers et al., 2006) and increased cortisol reactivity with abandonment related imagery (Rifkin-Graboi, 2008). Another study found that the preoccupied category (on the Adult Attachment Inventory) was correlated with an increased HR, dismissing with an increase in skin conductance, and secure with an overall lower level of skin conductance reactivity during romantic conflicts (Roisman, 2007). Although this study did not find any correlations between attachment and RSA, the authors note that the situations in the study might not have been enough to evoke a strong attachment response as would be found in loss or trauma (Roisman, 2007). Maunder et al. (2006), when looking at the relationship between attachment insecurity in romantic relationships and stress, found a negative correlation between Avoidance (on the ECR-R) and HF HRV, even after controlling for respiration. Maunder and Hunter (2006) suggested that vagal tone (HF HRV) is related to resilience. When looking at the relationship between attachment and physiology, Diamond and Fagundes (2010) caution that researchers should make note of the aspects of attachment explored and the methodology used when attempting to compare the results of various studies. This can be a potential problem with older studies (e.g., Feeney & Kirkpatrick, 1996 and Carpenter & Kirkpatrick, 1996) that use self-designed or combined definitions rather than empirically tested measures (e.g., ECR-R or the Adult Attachment Interview).

**Attachment and empathy.** Attachment theory asserts that attachment processes interact with emotional and social development in an individual; therefore, it could be further presumed that attachment also interacts with the development and expression of empathy. Mikulincer et al. (2001) found in a series of studies that there is a negative correlation between Anxiety and Avoidance and empathy as well as a positive correlation between Anxiety and personal distress. In studying emotional empathy in counseling students, Trusty, Ng, and Watts (2005) found a complex relationship in that the highest levels of empathy (on the Mehrabian and Epstein measure of emotional empathy) were associated with low Avoidance and high Anxiety (measured with the Attachment Styles Questionnaire regarding close relationships).

Joireman, Needham, and Cummings (2001) found positive correlations between trust and comfort with closeness and empathic concern and perspective taking as well as Anxiety and personal distress on various scales. The study by Joirman et al. utilized the Adult Attachment Scale, Experiences in Close Relationships - Revised (ECR-R) scale, Adult Attachment Styles Questionnaire, and the Relationship Questionnaire to measure adult attachment and the Interpersonal Reactivity Index and Relational-Interdependent Self-Construal Scale for empathy.

The following relationships were found between the ECR-R and the scales of the IRI: 1) decreased Avoidance and increased Empathic Concern, 2) increased Anxiety and increased Personal Distress, and 3) increased Avoidance and increased Personal Distress (Joirman et al.). Burnette, Davis, Green, Worthington, and Bradfield (2009) found a significant negative correlation between empathy (measured with the IRI) and Avoidance (measured with the ECR-R). In exploring various aspects of adult attachment (i.e., childhood attachments, parental bonds, and romantic attachment) Britton and Fuendeling (2005) found (using the ECR-R with respect to romantic relationships and the IRI): 1) negative correlations between both Avoidance and Anxiety and Empathic Concern, 2) a negative correlation between Avoidance and Fantasy Scale, and 3) positive correlations between Anxiety and both Perspective Taking and Personal Distress. Britton and Fuendeling suggest that with respect to empathy, one's attachment style might be more of an emotional rather than cognitive association and that attachment style might actually have a negative not positive influence on empathy.

**Purpose**

The purpose of this study was to further explore the relationships between physiology, empathy, and adult attachment as they pertain to vicarious exposure to affective situations. The hypothesis was that affective stimuli can cause changes in HRV that can be predicted by empathy and adult attachment. This hypothesis is based on the previous literature that showed various correlations between empathy, attachment, and physiology. Based a review of the literature, we also expected to find correlations between each of these variables. One expectation was that there would be an inverse relationship between attachment avoidance and RSA (Maunder et al, 2006). From the literature, I also expected attachment avoidance to be positively correlated with Personal Distress and negatively correlated with Empathic Concern and Fantasy

Scale, and attachment anxiety to be positively correlated with Perspective Taking and Personal Distress and negatively correlated with Empathic Concern.

# Methods

## Participant Sampling and Characteristics

Participants were recruited from the University of Northern British Columbia as part of the Psychology Participant Pool. Participants were informed of the study by word-of-mouth (e.g., fellow participants, classmates, and professors), classroom presentations and advertisements, and on the Psychology Participant website. All participants received $10 and a bag of popcorn for participation. Participants were asked to refrain from consuming any substances that might alter their physiological responses (e.g., no caffeine or other stimulants 2 hours and no alcohol 12 hours prior to the study) and not eat or exercise within 30 minutes of participation. All participants were fluent in English and did not have any major vision or hearing impairments. Participants were screened for any current medical conditions (e.g., arrhythmia) that might affect their physiological recordings; none were indicated.

There were 157 participants in this study. All data for 3 of the participants were removed from analyses, as described in the missing and outliers section, therefore the data reported below refers to the final sample of 154 participants. Participants ($N$ = 154; 89 female, 65 male) were undergraduate students at UNBC ranging from 16 to 36 years of age ($M$ = 19.96, $SD$ = 1.42). Majority of the participants self-identified as Caucasian (116), followed by Asian (8), East Indian (7), Aboriginal (6), and other (17; this included participants that identified with one or more ethnicity). Participants were predominantly in their first year of undergraduate studies (46.80%), followed by second year (27.30%), third year (14.90%), fourth year (9.70%), and fifth year (1.30%). Most of the participants were pursuing a major in biomedical/science or psychology programs (39.00% and 29.90% respectively). Majority of the participants were not in a relationship at the time of participation (62.30%) and there were 13 participants that reported smoking (5 females, 8 males).

**Apparatus and Materials**

There were two lab rooms used for this study, one for the researcher and an adjacent room for the participant. The researcher's room contained a Dell Optiplex GX620 personal computer with AcqKnowledge 3.9.0 software to display and record the data and the BioPac physiological recording system to obtain the HR and respiration recordings. A window connected the two rooms to ensure that the researcher could see the participant and video stimuli at all times. Participants were seated in a reclining chair with their back towards the researcher. An Apple Macbook pro was used to play the videos and was connected to a 20-inch flat screen monitor for increased visibility and sound. The participants' attention was directed at the monitor by turning off all lights, closing the blinds, closing all doors and separating the participant from the rest of the room via a curtain. A Biopac inductive plesthysmography respiration band (TSD 201) was attached to the participants' chest and VersaTrode disposable Ag/AgCl ECG electrodes were attached to the participants on each wrist and their right ankle. Physiological data were extrapolated from the ECG data as described in the analysis section by using Mindware software.

**Visual stimuli.** The clips selected for the study were procured from various open-source websites (e.g., Youtube and eBaums World) depicting happiness (H), sadness (S), and physical pain (P). The clips were selected based on the whole situation presented rather than focusing on facial expressions of emotions. Video clip selection was guided by their similarity in content to the emotionally evocative film clips reported by Gross and Levenson (1995) and Danziger, Prkachin, and Willier (2006), when possible. For example, Gross and Levenson (1995) stated that the most effective clips for eliciting sadness included the death of the mother deer in the film Bambi and a boy crying at the loss of his father in the film The Champ. Therefore, the sadness clips selected for this study involved various situations of grief and loss. The pain clips selected for this study involved a variety of painful situations ranging from sports to leisure to unintentional accidents; similar to the clips with high pain ratings in the study by Danziger, et al. (2006). There was no basis for the happiness clips prior to selection; the clips included laughter (from both infants and adults), weddings, and a marriage proposal.

In a pilot study, approved by the UNBC Research Ethics Board, senior undergraduate, graduate, and doctoral students ($N = 10$) at UNBC rated the collection of clips in order to reduce bias and subjectivity in final clip selection. The video clip ratings were based on an 11-point likert scale (where 0 = "not at all" and 10 = "very much so") to rate each clip on happiness, sadness, physical pain, and "other", as well as a section to provide any technical issues or concerns with the clip (e.g., difficult to see or hear). This led to the final selection of clips that were rated as being the most appropriate for depicting happiness, sadness, or physical pain (see Appendix 3 for the average ratings obtained). Final clips were selected based on their means (rank ordered) and were not permitted to have a rating of greater than 5 on opposing affective category scales.

From the pilot study there were a total of 25 video clips (7 happiness, 7 sadness, and 11 physical pain) selected for use in this study. The goal was to obtain 4 minutes of clips for each of the categories to ensure adequate sympathetic responding (American Heart Association, 1996) and to provide equal stimuli times for each category. The clips within each affective category were randomly placed (i.e., not in rank order of their ratings) and were separated by a 6 to 12 second blank screen. The 4 minutes of affective clips plus the separating blank screens resulted in a 5-minute series of clips for each category. Each affective series of clips was separated by a 5-minute recovery period. Six sequences of clips were used to provide counterbalancing of the presentation of stimuli (i.e., HPS, HSP, SHP, SPH, PHS, and PSH).

## Questionnaires

**Empathy.** Empathy was assessed by using the four component scales of Davis' IRI (Fantasy Scale, Empathic Concern, Perspective Taking, and Personal Distress). This tool measures components of empathy rather than an overall empathy score allowing for a more in-depth look at the relationships between empathy, attachment, and physiology (see Appendix 1). Each scale consists of seven items on five-point likert scales (where A = "does not describe me well" and E = "describes me very well"). The sum of each of the items within a component scale represents the total score for that component. Davis (1983a) reported that the weak correlations between each of the scales (the greatest being $r = .39$ from two samples totaling over 600 males and 600 females) indicate that these are indeed four separate constructs within empathy. Each of these component scales was reported to have a different relationship to various aspects of physiology and interpersonal relationships.

**Attachment.** Attachment style was assessed by using the scales of the ECR-R (Avoidance and Anxiety) that is based on the original Experience in Close Relationships scale by Brennan, Clark, and Shaver (1998; see Appendix 2). The ECR was devised by a statistical analysis of 60 self-report measures of attachment that led to a collection of 36 items that were significantly correlated with attachment avoidance and anxiety. The questions were worded to reflect general close relationships of the participants (e.g., "I prefer not to be too close to significant others" or "I often worry that my significant others will not want to stay with me). The ECR-R is rated on a 7-point likert scale (where 0 = "completely disagree" and 7 = "completely agree"). Norms are available for the ECR-R based on gender and age. The ECR-R shows similar statistics to the original ECR (Cronbach's alpha around .90 and test-retest reliability between 0.50 and 0.75) and accurate discrimination between the anxiety and avoidance scales (Mikulincer & Shaver, 2007). In an analysis of the validity of self-report attachment scales, Fraley, Waller, and Brennan (2000) report that the ECR and ECR-R had the best psychometric properties. The ECR-R is cited by Ravitz et al., (2010) as being one of the most commonly used scales for psychosomatic research.

**Procedures**

Informed consent was provided both verbally and in written form before the collection of any data for this study (see Appendix 4). During this process all participants were informed of the purpose of this study, potential benefits and risks (i.e. minor temporary physical or psychological discomfort) of participation, and the confidential data collection and secure storage procedures. Participants were reminded of their right to withdraw participation at any time without penalty. Participants were provided with contact information for any questions or concerns. Prior to giving consent each participant was asked if they have any questions, concerns, or would like further information.

The researcher completed the General Questionnaire with the participant at the beginning of the lab session (see Appendix 5). Participants were then asked to remove their jackets as well as any jewelry or watches that might impede the measurement of physiology and turn off any cell phones or other electronic devices. Participants were asked to make any necessary bathroom visits prior to being seated. Participants were then seated comfortably in a reclining chair and hooked up to the monitoring system. Proper connectivity, comfort, and ability to view and hear the stimuli were ensured before presentation of stimuli. Then participants were introduced to the stimuli and procedures (see Appendix 6). Participants were assured that the clips were of real people experiencing real situations that could happen to anyone. Due to the affective nature of the clips, participants were permitted to ask any questions prior to commencement of the recording period as well as at the end of the recording period (for debriefing purposes); none of the participants expressed any concerns with the clips.

The recording phase began with a 10-minute baseline period where baseline physiology was obtained. Participants were instructed to focus their attention on the blue light at the bottom of the screen during the baseline and recovery phases (the screen was blank). With approximately 30 seconds left in the baseline period a comfort adjustment message appeared on the screen (for 20s) indicating to the participants that they were permitted to make comfort adjustments while the message was on the screen. This was done to ensure that the participants were seated comfortably and to limit movement during the presentation of the stimuli. The blank screen returned for another 10s. Participants were then shown a series of affective video clips depicting other individuals in situations involving H, S, or P. Following the last stimuli in each series a message appeared on the screen asking the participants to rate aloud the series of clips on the degree of affective content (i.e., how much H, S, and P was depicted in the series of clips overall and how much H, S, and P did the participant feel while viewing the series of clips). The ratings were on a 7-point likert scale where "0" indicated "none at all" and "6" indicated "the most possible". Each category of stimuli was separated by a 5-minute recovery period. With 30 seconds left in the recovery period the comfort adjustment message appeared on the screen (for 20s), followed by the blank screen for 10s. This process was repeated until all 3 categories of clips and recovery periods were presented. Participants were not informed as to the length or placement of the clips, nor the order of the series in order to attempt to minimize anticipatory effects. Once the final recovery phase was completed, participants were disconnected from the recording unit and asked to complete the IRI and ECR-R.

# Results

## Data Preparation

Prior to analysis, physiological data were entered into MindWare Technologies Heart Rate Variability Analysis Software (version 2.0) to extract the physiological variables (HR, respiration rate - RR, and RSA). Physiological data were quantified with Fast Fourier Transformations and averaged in 1-minute intervals across each epoch (i.e., baseline, happiness, sadness, physical pain, and the associated recovery periods) in order to obtain values for HR, RR, and RSA. Default power band settings were used. RSA values were calculated as the average power spectral density for the HF HRV. The baseline dependent variable measurements were controlled for, as recommended by Forcier et al. (2006), by calculating change scores (subtracting the baseline scores from the activity/recovery scores). The RR and RSA values were used in within-subjects regressions to obtain RR corrected RSA (cRSA) values for each participant. These corrections are recommended with affective manipulations that do not include experimentally controlling respiration and result in changes in respiration (Grossman & Taylor, 2007).

IRI subscale scores were calculated by adding the individual item scores within each subscale together. ECR-R subscale scores were calculated by taking the average of the individual item scores within each subscale. Two participants missed questions (1 each) on the IRI and these values were replaced with their average score on the respective subscale.

The general questionnaire and pre-session questionnaire were analyzed to provide descriptions of the participants in this study and to develop variables to be controlled in the regression analyses (i.e., Sex, Age, Waist, Hip, Waist-to-Hip Ratio, and overall Physical Activity). Physical activity was measured by calculating cardiovascular fitness activity with the Paffenbarger Physical Activity Questionnaire (see Appendix 4) that calculates the average weekly energy expenditure based on the average distance walked, stairs climbed, and sports/activity participation of an individual (Lee, Paffenbarger, & Hsieh, 1992) and has shown an association with longevity (Lee & Paffenbarger, 2000). The values for the metabolic rates of physical activities were calculated based on the 2011 Compendium of Physical Activities provided by Ainsworth et al. (2011).

**Missing data and outliers.** Missing data were excluded from analyses as the default setting in SPSS. Complete physiological data were removed for a total of 11 participants. Data were removed for 10 participants as there was construction occurring directly above the lab during data collection and the noise potentially interfered with the accuracy of the physiological data collected. Data were also removed from 1 participant due to excessive movement during data collection. It was expected that there would be outliers with such a large dataset and data were removed when scores were deemed outliers. A cut-off z-score of +/- 4.00 was used for all variables in identifying outliers that should be removed. Participants were excluded from all analyses if they had outlying scores on independent (predictor) variables; there were 3 participants who did not meet the criteria for inclusion due to age (i.e., 37, 39, and 39) and 1 due to their Waist and Weight measurements. Participants were only excluded from specific analyses if they were outliers on a dependent (outcome) variable; there were 7 participants whose data did not meet the criteria for inclusion for individual dependent variable analyses, none of whom were outliers on more than one DV. Of these 7 participants 2 reported health conditions and current medications and all 7 reported eating and/or exercising within 30 minutes prior to participating.

**Variable Descriptives**

All data were analyzed using SPSS v.20. Means and standard deviations for the health variables, physiological variables, and IRI and ECR-R are presented in Tables 1-3 respectively. Descriptive data are presented for each of the predictor variables and outcome variables used in the regression analyses. Independent samples t-test indicated gender differences on several of the variables, therefore, the descriptive data are presented for the whole sample as well as by gender.

Table 1

*Means and standard deviations of the cardiovascular health variables.*

| Variable | Total ($N = 154$) M | SD | Female ($n = 89$) M | SD | Male ($n = 65$) M | SD |
|---|---|---|---|---|---|---|
| | [95% CI] | | [95% CI] | | [95% CI] | |
| Age (yrs) | 19.96 | 3.05 | 20.13 | 3.65 | 19.72 | 1.96 |
| | [19.47 – 20.45] | | [19.36 – 20.91] | | [19.24 – 20.21] | |
| Waist (in.)** | 32.06 | 4.78 | 30.52 | 4.02 | 34.14 | 4.96 |
| | [31.30 – 32.82] | | [29.67 – 31.38] | | [32.91 – 35.37] | |
| Hip (in.) | 38.66 | 3.80 | 38.84 | 3.73 | 38.41 | 3.91 |
| | [38.05 – 39.26] | | [38.05 – 39.63] | | [37.44 – 39.38] | |
| WHR** | 0.83 | 0.08 | 0.79 | 0.06 | 0.89 | 0.07 |
| | [0.82 – 0.84] | | [0.77 – 0.80] | | [0.87 – 0.91] | |
| Weight (lbs)** | 159.86 | 34.02 | 148.24 | 29.56 | 175.77 | 33.48 |
| | [154.79 – 165.24] | | [141.72 – 154.27] | | [167.47 – 184.07] | |
| Physical Activity (kcal/wk)** | 5433.31 | 4564.68 | 4226.54 | 3037.50 | 7085.67 | 5685.71 |
| | [4722.87 – 6183.69] | | [3601.65 – 4893.44] | | [5676.82 – 8494.52] | |

*Note:* WHR = waist-to-hip ratio

** significant difference between females and males, $p < .01$

Table 2

*Means and standard deviations of the physiological variables.*

| Variable | Total | | Female | | Male | |
|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD |
| HR (beats/min) | | | | | | |
| Baseline | 71.23 | 10.81 | 72.16 | 10.91 | 70.00 | 10.65 |
| ΔH | 1.04** | 4.32 | 1.15 | 4.33 | 0.90 | 4.33 |
| ΔS | -0.85* | 3.89 | -0.84 | 4.04 | -0.86 | 3.72 |
| ΔP | -1.11** | 4.58 | -0.81 | 5.13 | -1.50 | 3.73 |
| RR (breaths/min) | | | | | | |
| Baseline | 15.61 | 3.20 | 16.01 | 3.18 | 15.07 | 3.18 |
| ΔH | 2.14** | 2.98 | 2.18 | 2.87 | 2.09 | 3.14 |
| ΔS | 1.28** | 2.43 | 1.38 | 2.59 | 1.14 | 2.21 |
| ΔP | 1.97** | 2.90 | 1.93 | 2.76 | 2.02 | 3.08 |
| RSA (ms) | | | | | | |
| Baseline | 6.78 | 1.09 | 6.88 | 1.12 | 6.65 | 1.04 |
| ΔH | -0.30* | 0.68 | -0.39 | 0.64 | -0.18 | 0.72 |
| ΔS | -0.06 | 0.62 | -0.05 | 0.65 | -0.08 | 0.58 |
| ΔP | -0.05 | 0.62 | -0.06 | 0.60 | -0.04 | 0.65 |
| cRSA (ms/RR) | | | | | | |
| Baseline | -0.93 | 1.47 | -0.90 | 1.56 | -0.99 | 1.35 |
| ΔH | 1.23** | 2.23 | 1.01 | 2.12 | 1.51 | 2.35 |
| ΔS | 0.83** | 1.85 | 0.89 | 1.96 | 0.74 | 1.71 |
| ΔP | 1.54** | 2.38 | 1.43 | 2.42 | 1.70 | 2.34 |

*Note.* HR = Heart Rate, RR = Respiration Rate, RSA = Respiratory Sinus Arrhythmia, cRSA = Respiratory Sinus Arrhythmia corrected for Respiration Rate, ΔH = Change in the happy condition, ΔS = Change in the sad condition, ΔP = Change in the pain condition. Independent samples t-test found no significant differences between males and females at $p < .05$ for any of the variables.

* significantly different than baseline, $p < .05$

**significantly different than baseline, $p < .01$

Table 3

*Means and standard deviations of the IRI and ECR-R subscale scores.*

| Variable | Total ($N$ = 154) M | Total SD | Female ($n$ = 89) M | Female SD | Male ($n$ = 65) M | Male SD |
|---|---|---|---|---|---|---|
| | M (Cronbach's alpha) | SD | M | SD | M | SD |
| IRI | | | | | | |
| Perspective Taking | 17.54 ($\alpha$ = .79) | 4.72 | 17.61 | 4.61 | 17.45 | 4.90 |
| Fantasy Scale* | 17.64 ($\alpha$ = .79) | 5.31 | 18.55 | 4.95 | 16.40 | 5.58 |
| Empathic Concern** | 19.46 ($\alpha$ = .80) | 4.48 | 20.82 | 3.74 | 17.60 | 4.76 |
| Personal Distress** | 11.85 ($\alpha$ = .77) | 4.88 | 13.03 | 5.11 | 10.23 | 4.08 |
| Total Empathy** | 66.49 | 12.28 | 70.00 | 11.66 | 61.68 | 11.53 |
| ECR-R | | | | | | |
| Avoidance | 2.99 ($\alpha$ = .93) | 1.14 | 2.89 | 1.12 | 3.12 | 1.17 |
| Anxiety† | 2.98 ($\alpha$ = .94) | 1.13 | 2.84 | 1.09 | 3.17 | 1.16 |

*Note.* Significant differences between genders are noted beside the subscale names.
† $p < .10$ * $p < .05$ ** $p < .01$

**Manipulation Check**

Manipulation checks were performed first by analyzing the participants' verbal ratings of the video clips followed by analyzing the participants' physiological changes (e.g., HR, RR, and RSA) for each condition.

**Category of clip and affective ratings.** Means and standard deviations for the participants' ratings of the affect depicted and felt across each condition (i.e., category of clip) are reported in Table 2. Repeated measures ANOVAs were performed to evaluate differentiation of each affect (happiness, sadness, and physical pain) across all conditions, followed by pairwise comparisons. The levels of each affect depicted within each condition were analyzed to evaluate the purity of the affect (i.e., the degree of overlap among affects) felt in each condition. For these analyses, Mauchly's Test of Sphericity was not passed with $p < .05$, therefore the Greenhouse-Geisser adjusted values are reported.

There was a significant difference in ratings of happiness depicted across each of the conditions, $F(1.82, 220.95) = 2490.16$, $MSE = 0.57$, $p < .01$, with significantly greater happiness ratings associated with the happy condition than for the sad ($M_{diff} = 5.27$, $SEM = .07$ , $p < .01$, 95% CI [5.13, 5.41]) or physical pain conditions ($M_{diff} = 4.99$, $SEM = .09$, $p < .01$, 95% CI [4.81, 5.18]). There was also a significant difference in ratings of the sadness depicted across each of the conditions, $F(1.32, 184.83) = 865.25$, $MSE = 1.76$, $p < .01$, with significantly greater sadness ratings for the sad condition than for the happy ($M_{diff} = 5.33$, $SEM = 0.69$, $p < .01$, 95% CI [5.19, 5.46]) or physical pain ($M_{diff} = 2.28$, $SEM = 0.15$, $p < .01$, 95% CI [1.98, 2.59]) conditions. Finally, there was a significant difference in ratings of the amount of physical pain depicted across each of the conditions, $F(1.28, 184.99) = 944.14$, $MSE = 1.88$, $p < .01$, with significantly greater physical pain ratings for the physical pain condition than for the happy ($M_{diff} = 5.57$, $SEM = 0.06$, $p < .01$, 95% CI [5.44, 5.69]) or sad ($M_{diff} = 2.90$, $SEM = 0.15$, $p < .01$, 95% CI [2.60, 3.20]) conditions. Therefore the most happiness was shown in the happy condition, the most sadness in the sad condition, and the most physical pain in the physical pain condition.

ANOVAs were also performed on differences among affects within each condition to determine if more than one affect was depicted in each condition. Within the happiness condition, there was a significant difference, $F(1.79, 266.44) = 3988.08$, $MSE = 0.39$, $p < .01$, with significantly greater ratings of happiness than sadness ($M_{diff} = 5.24$, $SEM = 0.08$, $p < .01$, 95% CI [5.09, 5.40]) or physical pain ($M_{diff}$ = 5.30, *SEM* = 0.07, $p < .01$, 95% CI [5.17, 5.43]). Within the sadness condition, there was a significant difference, $F(1.36, 200.21) = 799.44$, *MSE* = 1.95, $p < .01$, with significantly greater sadness ratings than happiness ($M_{diff}$ = 5.35, *SEM* = 0.08, $p < .01$, 95% CI [5.20, 5.50]) or physical pain ($M_{diff}$ = 2.78, *SEM* = 0.16, $p < .01$, 95% CI [2.47, 3.09]). Finally, within the physical pain condition, there was a significant difference, $F(1.71, 250.87) = 809.32$, *MSE* = 1.50, $p < .01$, with significantly greater physical pain ratings than happiness ($M_{diff}$ = 5.28, *SEM* = 0.10, $p < .01$, 95% CI [5.09, 5.48]) or sadness ($M_{diff}$ = 2.44, *SEM* = 0.15, $p < .01$, 95% CI [2.15, 2.73]). Therefore, happiness was the greatest affect shown in the happy condition, sadness in the sadness condition, and pain in the pain condition.

The levels of affect elicitation were also explored. There was a significant difference in the amount of happiness felt across each of the conditions, $F(1.66, 244.31) = 1559.54$, *MSE* = 0.74, $p < .01$, with significantly greater happiness ratings in the happy condition than in the sadness ($M_{diff}$ = 4.51, *SEM* = .09, $p < .01$, 95% CI [4.34, 4.69]) or physical pain conditions ($M_{diff}$ = 4.27, *SEM* = .11, $p < .01$, 95% CI [4.06, 4.48]). There was a significant difference in the amount of sadness felt across each of the conditions, $F(1.67, 243.62) = 550.74$, *MSE* = 1.45, $p < .01$, with significantly greater sadness ratings for the sad condition than for the happiness ($M_{diff}$ = 4.22, *SEM* = 0.10, $p < .01$, 95% CI [4.03, 4.41]) or physical pain ($M_{diff}$ = 1.61, *SEM* = 0.13, $p < .01$, 95% CI [1.35, 1.88]) conditions. Likewise, there was a significant difference in the amount of physical pain felt across each of the conditions, $F(1.65, 239.83) = 150.21$, *MSE* = 2.05, $p < .01$, with significantly greater physical pain ratings for the physical pain condition than for the happiness ($M_{diff}$ = 2.63, *SEM* = 0.18, $p < .01$, 95% CI [2.27, 2.99]) or sad ($M_{diff}$ = 1.51, *SEM* = 0.15, $p < .01$, 95% CI [1.21, 1.81]) conditions. Similar to the affect depicted, the most happiness was elicited in the happy condition, the most sadness in the sad condition, and the most physical pain in the physical pain condition.

Comparing the amount of affect felt within each of the conditions, there was a significant difference in the happiness condition, $F(1.17, 174.93) = 2441.95$, $MSE = 0.73$, $p < .01$, with significantly greater happiness ratings than sadness ($M_{diff} = 4.50$, $SEM = 0.09$, $p < .01$, 95% CI [4.31, 4.68]) or physical pain ($M_{diff} = 4.59$, $SEM = 0.09$, $p < .01$, 95% CI [4.42, 4.76]). There was a significant difference within the sadness condition, $F(1.90, 282.99) = 704.79$, $MSE = 1.08$, $p < .01$, with significantly greater sadness ratings than happiness ($M_{diff} = 4.19$, $SEM = 0.10$, $p < .01$, 95% CI [3.99, 4.40]) or physical pain ($M_{diff} = 3.21$, $SEM = 0.13$, $p < .01$, 95% CI [2.96, 3.46]). Finally, there was a significant difference in the amount of each affect felt within the physical pain condition, $F(1.87, 278.06) = 106.66$, $MSE = 2.70$, $p < .01$, with significantly greater physical pain ratings than happiness ($M_{diff} = 2.25$, $SEM = 0.19$, $p < .01$, 95% CI [1.88, 2.63]) but not sadness ($M_{diff} = -0.13$, $SEM = 0.20$, $p = .36$, 95% CI [-0.52, 0.27]). Happiness was the greatest affect elicited in the happy condition and sadness in the sad condition. Both sadness and physical pain were elicited in the physical pain condition.

Together the ratings of affect depicted and felt indicated successful affective manipulation in terms of participant's perceptions.

Table 4

*Means and standard deviations of the affect ratings of the video clips.*

| Condition | Happy | | Sad | | Physical Pain | |
|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD |
| Depict | | | | | | |
| Happy[a,b] | 5.46 | 0.64 | 0.20 | 0.57 | 0.46 | 1.02 |
| Sad[a,b] | 0.22 | 0.60 | 5.54 | 0.58 | 3.30 | 1.73 |
| Physical Pain[a,b] | 0.16 | 0.48 | 2.78 | 1.84 | 5.72 | 0.61 |
| Elicit | | | | | | |
| Happy[a,b] | 4.63 | 1.04 | 0.14 | 0.47 | 0.38 | 0.81 |
| Sad[a,b] | 0.13 | 0.41 | 4.34 | 1.17 | 2.75 | 1.74 |
| Physical Pain[a,b,c] | 0.03 | 0.18 | 1.12 | 1.47 | 2.66 | 2.21 |

*Note.* "Depict" refers to participants' ratings of the affect they thought was depicted in the video; "Elicit" refers to participants' ratings of the affect they personally felt when they watched the video. Ratings were made on a 7-point scale, where 0 indicates "none at all" and 6 indicates "the most possible"

[a] significant difference in ratings across conditions, $p < .01$

[b] significant difference in ratings within the condition, $p < .01$

[c] no significant difference in sad and physical pain ratings within the condition, $p > .05$

**Category of clip and physiology.** The next step in the manipulation check was to determine if there were differences in the physiological changes observed between the different conditions to determine whether the manipulations led to physiological changes or not. Change scores were calculated for physiological data by subtracting the baseline score from the activity and recovery scores for each condition. Recovery scores were calculated for HR to ensure that the recovery periods adequately allowed for return to baseline. ANOVAs were first run to see if there were differences in HR, RR, and RSA across the conditions. Pairwise comparisons were then run to determine where the differences occurred between the conditions. One-sample t-test determined if the changes for each condition were greater than 0.

***Heart rate.*** The means and standard deviations are presented in Table 3. A 3 (condition: happiness, sadness, and pain) X 2 (phase: activity change score and recovery change score) ANOVA was run for HR, see Figure 2. Mauchly's Test of Sphericity was passed with $p > .05$. There was a significant main effect of condition, $F(2, 270) = 15.07$, $MSE = 7.36$, $p < .01$ and a significant interaction of condition X phase, $F(2, 270) = 29.59$, $MSE = 2.99$, $p < .01$. Pairwise comparisons showed a significantly greater increase in heart rate in the happiness condition when compared to the decrease in HR for the sadness condition ($M_{diff} = 1.08$, $SEM = 0.24$, $p < .01$, 95% CI [0.60, 1.55]) and the physical pain condition ($M_{diff} = 1.13$, $SEM = 0.24$, $p < .01$, 95% CI [0.66, 1.60]), but there was no significant difference found between sadness and physical pain conditions. One-sample t-tests indicated a significant increase in HR for the happy condition, $t(143) = 2.89$, $M_{diff} = 1.03$, $p < .01$, 95% CI [0.33, 1.75], and a significant decrease in HR for both the sad condition, $t(141) = -2.59$, $M_{diff} = -0.85$, $p < .05$, 95% CI [-1.49, -0.20], and the physical pain condition, $t(141) = -2.88$, $M_{diff} = -1.11$, $p < .01$, 95% CI [-1.86, -0.35], during the activity phase. One-sample t-tests indicated that the HR for the recovery phases were not significantly different than baseline for the happy condition, $t(143) = -1.53$, $M_{diff} = -0.43$, $p = .13$, 95% CI [-.098, 0.13], or the physical pain condition, $t(141) = -1.73$, $M_{diff} = -0.44$, $p = .09$, 95% CI [-0.95, 0.06]. HR was significantly lower than baseline for the recovery period for the sadness condition, $t(141) = -2.52$, $M_{diff} = -0.66$, $p < .05$ , 95% CI [-1.17, -0.14]; however, when a one-sample t-test was run on the last two minutes of the recovery period this difference no longer existed, $t(142) = -0.94$, $M_{diff} = -0.24$, $p = .35$ CI [-0.75, 0.27], indicating that the participants had recovered to baseline by the end of the recovery period. These analyses indicate that there was a significant and unique change in HR for each condition and that participants returned to baseline following each condition.

***Respiration rate.*** A repeated-measures ANOVA was run to determine if there was a difference in the change in RR across conditions (see Figure 3). Mauchly's Test of Sphericity was passed with $p > .05$. There was a significant difference between the change in RR across conditions, $F(2, 282) = 11.94$, $MSE = 2.48$, $p < .01$. Pairwise comparisons indicated that compared to sadness condition, the increase in RR was significantly greater for the happiness ($M_{diff} = 0.86$, $SEM = 0.20$, $p < .01$, 95% CI [0.47, 1.26]) and physical pain ($M_{diff} = 0.69$, $SEM = 0.17$, $p < .01$, 95% CI [0.36, 1.02]) conditions, but no significant difference was found between the happiness and physical pain conditions. One-sample t-tests indicated that the increase in RR was significant across all conditions; happy category, $t(143) = 8.61$, $M_{diff} = 2.14$, $p < .01$, 95% CI [1.65, 2.63], the sadness category, $t(143) = 6.30$, $M_{diff} = 1.28$, $p < .01$, 95% CI [0.88, 1.68], and the physical pain category, $t(141) = 8.10$, $M_{diff} = 1.97$, $p < .01$, 95% CI [1.49, 2.45]. There was a significant increase in RR across all conditions with a greater increase for the happy and physical pain conditions.

***Respiratory sinus arrhythmia.*** A repeated-measures ANOVA was run to determine if there was a difference in the change in RSA across conditions. In the analysis of the change in RSA, Mauchly's Test of Sphericity was not passed with $p < .05$, therefore corrected Greenhouse-Geisser values are reported. There was a significant difference between the changes in RSA across conditions, $F(1.91, 271.00) = 18.64$, $MSE = 0.16$, $p < .01$. Pairwise comparisons indicated that the decrease in RSA for the happiness condition was significantly greater than it was for the sadness ($M_{diff} = 0.24$, $SEM = 0.05$, $p < .01$, 95% CI [0.14, 0.33]) and physical pain ($M_{diff} = 0.25$, $SEM = 0.05$, $p < .01$, 95% CI [0.16, 0.34]) conditions, but no significant difference was found between the sadness and physical pain conditions. One-sample t-tests indicated that the RSA changes were significantly decreased from baseline for the happy condition, $t(143) = -5.20$, $M_{diff} = -0.30$, $p < .01$, 95% CI [-0.41, -0.18], but not for the sad or physical pain conditions.

The respiration rate was not experimentally controlled for, changed for each condition, and correlated with the changes in RSA for the happy ($r = -.36$ $p < .01$), the sad ($r = -.36$ $p < .01$), and the pain ($r = -.37$ $p < .01$) conditions. Therefore, residual values were calculated for RSA using within-subjects regressions in order to control for respiration rate (cRSA; Grossman & Taylor, 2007). A repeated-measures ANOVA was then run to determine if there was a difference in the change in cRSA across conditions (see Figure 4). In the analysis of the change in cRSA, Mauchly's Test of Sphericity was not passed with $p < .05$, therefore corrected Greenhouse-Geisser values are reported. There was a significant difference between the changes in cRSA across conditions, $F(1.90, 269.73) = 8.61$, $MSE = 1.94$, $p < .01$. Pairwise comparisons indicate that the increase in cRSA was significantly greater for the happiness ($M_{diff} = 0.37$, $SEM = 0.16$, $p < .05$, 95% CI [0.04, 0.69]) and physical pain ($M_{diff} = 0.67$, $SEM = 0.14$, $p < .01$, 95% CI [0.38, 0.95]) conditions than it was for the sadness condition. The difference between the happiness and physical pain conditions approached significance ($p = 0.09$). One-sample t-tests indicated that the cRSA changes were significantly increased from baseline for the happy condition, $t(143) = 6.61$, $M_{diff} = 1.23$, $p < .01$, 95% CI [0.86, 1.60], the sad condition, $t(143) = 5.35$, $M_{diff} = 0.83$, $p < .01$, 95% CI [0.52, 1.13], and for the physical pain condition, $t(144) = 7.81$, $M_{diff} = 1.54$, $p < .01$, 95% CI [1.15, 1.94].

The rating and video manipulation check data combined show that the video clips utilized in this study were depicting and eliciting different affects in each condition and each condition led to significant (and distinct) physiological responses. Therefore the conditions could not be combined for hypothesis testing.

## Variable Correlations

Bivariate correlations were run to determine the unique relationships occurring between the variables (i.e., each of the predictor and outcome variables) that were used in the regression analyses.

**IRI and ECR-R.** Tables 5 and 6 (by gender) show the bivariate correlations between the two scales. The possible range of scores for the IRI subscales is 0 – 28.00 and in this sample ranged from 7.00 – 28.00 (Perspective Taking), 3.00 – 28.00 (FS), 4.00 – 28.00 (Empathic Concern), and 0.00 – 24.00 (Personal Distress). The possible range of scores for the ECR-R subscales is 1.00 – 7.00 and in this sample ranged from 1.06 – 6 (Avoidance) and 1.11 – 6.06 (Anxiety). The significant correlations found within the IRI subscales were for Perspective Taking and Fantasy Scale, Perspective Taking and Empathic Concern, Fantasy Scale and Empathic Concern, and Fantasy Scale and Personal Distress (none were greater than $r = .40$), and some gender differences occurred. The greatest significant correlation between the IRI and ECR-R subscales was $r = -.41$ (Empathic Concern and Anxiety) and the smallest significant correlation was $r = -.16$ (Perspective Taking and Anxiety).

Table 5

*Correlations for the IRI and ECR-R subscales.*

| *Measure* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|
| 1.Perspective Taking | - | .26** | .29** | -.05 | -.29** | -.16* |
| 2. Fantasy Scale | | - | .38** | .19* | -.01 | -.26** |
| 3. Empathic Concern | | | - | .13 | -.18* | -.41** |
| 4. Personal Distress | | | | - | .26** | .06 |
| 5. Avoidance | | | | | - | .33** |
| 6. Anxiety | | | | | | - |

**p* < .05. ***p* < .01

Table 6

*Correlations for the IRI and ECR-R subscales by gender.*

| *Measure* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|
| 1.Perspective Taking | - | .23** | .49** | .07 | -.31** | -.16 |
| 2. Fantasy Scale | .29* | - | .34** | .14 | -.01 | -.34** |
| 3. Empathic Concern | .11 | .34** | - | .01 | -.26* | -.37** |
| 4. Personal Distress | -.26* | .16 | .07 | - | .29** | .06 |
| 5. Avoidance | -.26* | .04 | -.05 | .34** | - | .32** |
| 6. Anxiety | -.16 | -.13 | -.41* | .18 | .32** | - |

*Note.* Females are represented above the diagonal and males below the diagonal.
**p* < .05. ***p* < .01

**Empathy, attachment, and physiology.** There were only a few significant correlations found between the IRI and ECR-R scales and physiology and all were weak (see Table 7).

Perspective Taking was correlated with ΔHR and ΔRSA in the happy condition. Personal Distress was correlated with ΔHR in the physical pain condition. There were no physiological correlations for Fantasy Scale, Empathic Concern, Avoidance, or Anxiety. The correlations for each gender are shown in Table 8.

Table 7

*Correlations between physiology and the IRI and ECR-R subscales.*

| | IRI | | | | ECR-R | |
|---|---|---|---|---|---|---|
| Physiology | Perspective Taking | Fantasy Scale | Empathic Concern | Personal Distress | Avoidance | Anxiety |
| HR | | | | | | |
| Baseline | -.11 | -.04 | .06 | -.06 | .04 | .02 |
| ΔH | .17* | .07 | -.05 | .15 | -.06 | -.11 |
| ΔS | .13 | .03 | -.10 | .13 | -.00 | -.04 |
| ΔP | .07 | .04 | -.02 | .25** | -.06 | -.11 |
| cRSA | | | | | | |
| Baseline | .12 | -.04 | .10 | .10 | .02 | -.06 |
| ΔH | -.22** | -.01 | -.14 | -.00 | .03 | .08 |
| ΔS | .01 | .08 | -.01 | -.08 | -.12 | .03 |
| ΔP | -.11 | .04 | -.16† | -.10 | .05 | .10 |

*Note.* HR = Heart Rate, RR = Respiration Rate, RSA = Respiratory Sinus Arrhythmia, cRSA = Respiratory Sinus Arrhythmia corrected for Respiration Rate, ΔH = Change in the happy condition, ΔS = Change in the sad condition, ΔP = Change in the physical pain condition.
† $p < .10$. * $p < .05$. ** $p < .01$

Table 8
*Correlations between physiology and the IRI and ECR-R subscales by gender.*

| Physiology | IRI: Perspective Taking | IRI: Fantasy Scale | IRI: Empathic Concern | IRI: Personal Distress | ECR-R: Avoidance | ECR-R: Anxiety |
|---|---|---|---|---|---|---|
| HR | | | | | | |
| *Females* | | | | | | |
| Baseline | -.09 | -.13 | -.07 | -.19 | .05 | .07 |
| ΔH | .18 | .03 | -.02 | .27* | -.09 | -.08 |
| ΔS | .20† | .10 | -.04 | .20† | -.04 | -.08 |
| ΔP | .11 | .11 | -.00 | .37** | -.06 | -.15 |
| *Males* | | | | | | |
| Baseline | -.14 | -.01 | .13 | .05 | .04 | -.01 |
| ΔH | .16 | .09 | -.10 | .03 | -.03 | -.14 |
| ΔS | .04 | -.06 | -.20 | .03 | .05 | .01 |
| ΔP | .01 | -.11 | -.14 | -.05 | -.05 | -.03 |
| cRSA | | | | | | |
| *Females* | | | | | | |
| Baseline | .10 | -.05 | .09 | .24* | .09 | -.02 |
| ΔH | -.17 | .26 | -.08 | -.10 | -.04 | .01 |
| ΔS | .02 | .03 | -.03 | -.21† | -.21† | -.01 |
| ΔP | -.13 | .10 | -.21† | -.19† | .03 | .13 |
| *Males* | | | | | | |
| Baseline | .15 | -.04 | .10 | -.18 | -.07 | -.11 |
| ΔH | -.27* | .00 | -.14 | .23† | .10 | .13 |
| ΔS | -.01 | .13 | -.02 | -.12 | -.02 | .09 |
| ΔP | -.08 | .01 | -.07 | .10 | .05 | .05 |

*Note.* HR = Heart Rate, RR = Respiration Rate, RSA = Respiratory Sinus Arrhythmia, cRSA = Respiratory Sinus Arrhythmia corrected for Respiration Rate, ΔH = Change in the happy condition, ΔS = Change in the sad condition, ΔP = Change in the physical pain condition.
† $p < .10$. *$p < .05$. **$p < .01$

**Prediction of Physiological Change**

Regression analyses were performed for each physiological change score (i.e., HR and cRSA) in each condition (i.e., H, S, and P) totaling 6 regressions. The first two steps of the regression analyses included control factors that are related to cardiovascular fitness and the third step included the IRI and ECR-R subscales. Jurca et al (2005) found that cardiorespiratory fitness can be assessed by accounting for certain variables such as sex, age, body mass index (BMI), resting heart rate, and self-reported physical activity and provide similar results to exercise testing (i.e. oxygen volume). Waist-to-hip ratio (WHR) is a more recent measurement of physical health and is just as effective as other measures (i.e., BMI) in predicting cardiovascular health. An international study looking at over 27,000 individuals concluded that WHR showed a greater association with myocardial infarction than BMI (Yusuf et al., 2005). Waist and hip measurements alone were also significant predictors of cardiovascular health (Yusuf et al., 2005). Physical activity can affect cardiovascular health by increasing vagal tone, resulting in changes such as a lower resting HR and faster HRR (Forcier et al., 2006). Therefore, the first step in these analyses included the biological factors of Age and Gender. The second step included physical health factors (i.e., waist and hip measurements/WHR, weight, and self-reported physical activity).

Table 9 shows the correlations between HR and cRSA to the biological and health factors (Tables 10 and 11 show the information by gender). To limit multicollinearity between WHR, Waist, and Hip, the variables with the greatest correlations with the outcome variables were used; WHR was used for HR regressions, whereas Waist and Hip were used for cRSA regressions. Weight was excluded from the cRSA regression as the correlation between Waist and Weight was high (see Table 12; Table 13 shows the information by gender). Smoking was excluded from the regression analyses with only a few participants reporting smoking; the exclusion did not impact the outcomes of the regression analyses. The regression analyses included all subscales for IRI (Fantasy Scale, Empathic Concern, Perspective Taking, and Personal Distress) and ECR-R (Avoidance and Anxiety).

Table 9

*Correlations between cardiovascular health variables and physiological variables*

| Variable | BHR | ΔHHR | ΔSHR | ΔPHR | BcRSA | ΔHcRSA | ΔScRSA | ΔPcRSA |
|---|---|---|---|---|---|---|---|---|
| Age | .09 | -.21* | -.25 | -.13 | -.15† | .08 | .10 | .04 |
| Gender | -.10 | -.03 | .00 | -.08 | -.03 | .11 | -.04 | .06 |
| Waist | .12 | -.06 | -.06 | -.16† | -.22** | .24** | .11 | .21* |
| Hip | .18* | -.09 | .02 | -.04 | -.27** | .21* | .21* | .25** |
| WHR | .00 | .00 | -.07 | -.20* | -.05 | .14† | -.05 | .05 |
| Weight | .11 | -.04 | .00 | -.11 | -.22** | .22* | .12 | .19* |
| PA | -.04 | .02 | .08 | .10 | -.05 | -.02 | -.06 | -.07 |
| Smoking | -.10 | -.04 | -.04 | -.09 | -.05 | .08 | -.03 | .09 |

*Note:* BHR = Baseline Heart Rate, ΔHHR = Change in Heart Rate in the happy condition, ΔSHR = Change in Heart Rate in the sad condition, ΔPHR = Change in Heart Rate in the pain condition, BcRSA = Baseline corrected Respiratory Sinus Arrhythmia, ΔHcRSA = Change in corrected Respiratory Sinus Arrhythmia for the happy condition, ΔScRSA = Change in corrected Respiratory Sinus Arrhythmia, ΔPcRSA = Change in corrected Respiratory Sinus Arrhythmia for the pain condition, WHR = Waist-to-hip ratio; PA = Physical Activity
† $p < .10$. * $p < .05$. ** $p < .01$

Table 10

*Correlations between health variables and physiological variables for females*

| Variable | BHR | ΔHHR | ΔSHR | ΔPHR | BcRSA | ΔHcRSA | ΔScRSA | ΔPcRSA |
|---|---|---|---|---|---|---|---|---|
| Age | .13 | -.24* | -.01 | -.14 | -.23* | .18 | .13 | .11 |
| Waist | .28* | -.28* | -.16 | -.25* | -.19† | .12 | .06 | .23* |
| Hip | .33** | -.22* | -.05 | -.06 | -.22* | .16 | .12 | .22† |
| WHR | .07 | -.18 | -.19† | -.32** | -.05 | .01 | -.04 | .12 |
| Weight | .35** | -.23* | -.14 | -.22* | -.25* | .13 | .17 | .27* |
| PA | .02 | .09 | .21† | .08 | -.08 | .01 | .01 | -.02 |
| Smoking | .06 | -.09 | -.04 | -.06 | .01 | .06 | -.05 | -.02 |

*Note:* BHR = Baseline Heart Rate, ΔHHR = Change in Heart Rate in the happy condition, ΔSHR = Change in Heart Rate in the sad condition, ΔPHR = Change in Heart Rate in the pain condition, BcRSA = Baseline corrected Respiratory Sinus Arrhythmia, ΔHcRSA = Change in corrected Respiratory Sinus Arrhythmia for the happy condition, ΔScRSA = Change in corrected Respiratory Sinus Arrhythmia, ΔPcRSA = Change in corrected Respiratory Sinus Arrhythmia for the pain condition, WHR = Waist-to-hip ratio; PA = Physical Activity
† $p < .10$. *$p < .05$. **$p < .01$

Table 11

*Correlations between health variables and physiological variables for males*

| Variable | BHR | ΔHHR | ΔSHR | ΔPHR | BcRSA | ΔHcRSA | ΔScRSA | ΔPcRSA |
|---|---|---|---|---|---|---|---|---|
| Age | -.03 | -.15 | -.07 | -.13 | .08 | -.08 | .02 | -.11 |
| Waist | .03 | .20 | .03 | .00 | -.28* | .30* | .23 | .17 |
| Hip | .00 | .06 | .01 | -.02 | -.36** | .27* | .33** | .31* |
| WHR | .06 | .25† | .03 | .02 | -.01 | .16 | -.03 | -.12 |
| Weight | -.04 | .19 | .19 | .11 | -.19 | .24† | .14 | .10 |
| PA | -.04 | -.01 | -.01 | .21† | .17 | -.10 | -.19 | -.16 |
| Smoking | -.07 | 0.1 | -.03 | -.11 | -.12 | .09 | -.01 | .19 |

*Note*BHR = Baseline Heart Rate, ΔHHR = Change in Heart Rate in the happy condition, ΔSHR = Change in Heart Rate in the sad condition, ΔPHR = Change in Heart Rate in the pain condition, BcRSA = Baseline corrected Respiratory Sinus Arrhythmia, ΔHcRSA = Change in corrected Respiratory Sinus Arrhythmia for the happy condition, ΔScRSA = Change in corrected Respiratory Sinus Arrhythmia, ΔPcRSA = Change in corrected Respiratory Sinus Arrhythmia for the pain condition, WHR = Waist-to-hip ratio; PA = Physical Activity
† $p < .10$. *$p < .05$. **$p < .01$

Table 12

*Correlations for the predictor variables*

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1.Age | - | -.07 | .05 | .21** | -.12 | .11 | -.01 | .19* |
| 2.Gender | | - | .38** | -.06 | .60** | .40** | .31** | .12 |
| 3.Waist | | | - | .70** | .72** | .87** | -.00 | .16* |
| 4.Hip | | | | - | .02 | .71** | -.10 | .10 |
| 5.WHR | | | | | - | .55** | .11 | .15† |
| 6.Weight | | | | | | - | .12 | .11 |
| 7.PA | | | | | | | - | -.06 |
| 8.Smoking | | | | | | | | - |

*Note:* WHR = Waist-to-hip ratio; PA = Physical Activity. The smoking variable was not used in the regression analyses.
† $p < .10$. *$p < .05$. **$p < .01$

Table 13

*Correlations for the predictor variables by gender*

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *M* | *SD* |
|---|---|---|---|---|---|---|---|---|---|
| 1.Age | - | .08 | .23* | -.14 | .16 | .14 | .25* | 20.13 | 3.65 |
| 2.Waist | .09 | - | .76** | .65** | .83** | .02 | .20† | 30.52 | 4.02 |
| 3.Hip | .18 | .81** | - | .01 | .84** | .15 | .25* | 38.84 | 3.73 |
| 4.WHR | -.04 | .69** | .14 | - | .31** | -.13 | .00 | 0.79 | 0.06 |
| 5.Weight | .19 | .88** | .77** | .53** | - | .10 | .21* | 148.24 | 29.56 |
| 6. PA | -.10 | -.23† | -.25* | -.07 | -.08 | - | -.06 | 4226.54 | 3037.50 |
| 7. Smoking | .17 | .08 | -.02 | .19 | -.05 | -.14 | - | | |
| *M* | 19.72 | 34.14 | 38.41 | 0.89 | 175.77 | 7085.67 | | | |
| *SD* | 1.96 | 4.96 | 3.91 | 0.07 | 33.48 | 5685.71 | | | |

*Note.* Females are represented above the diagonal and males below the diagonal. WHR = Waist-to-hip ratio; PA = Physical Activity. The smoking variable was not used in the regression analyses.
† $p < .10$. *$p < .05$. **$p < .01$

The assumptions of regressions were met in all cases. Results of the regressions are shown in Tables 14 (HR) and 15 (cRSA). The overall model accounted for 14% of the variance in HR in the happy condition. Step 1 (age and gender) was significant in accounting for 4% of the variance in HR in the happy condition, with age accounting for 3% of the variance. This indicates that younger individuals showed a greater increase in HR when exposed to happiness. Step 3 (IRI and ECR-R subscales) was significant in accounting for an additional 10% of the variance in HR, with Perspective Taking accounting for 4%, Empathic Concern accounting for 3% and Personal Distress accounting for 4% of the variance. These results suggest that individuals with greater Perspective Taking, less Empathic Concern, and greater Personal Distress showed a greater increase in HR when exposed to happiness.

The overall model accounted for 13% of the variance in HR in the sad condition. Step 3 (IRI and ECR-R subscales) was significant in accounting for 11% in the variance in the sad condition, with Perspective Taking accounting for 4%, Empathic Concern accounting for 6%, and Personal Distress accounting for 3% of the variance. This suggests that individuals with greater Empathic Concern, lower Perspective Taking, and lower Personal Distress showed a greater decrease in HR when exposed to sadness.

The overall model accounted for 21% of the variance in HR in the physical pain condition. Step 2 (waist-to-hip ratio, weight, and physical activity) accounted for a 6% change in the variance, with waist-to-hip ratio accounting for 4% and physical activity accounting for 4% of the variance. This suggests that individuals with a larger WHR and that are less physically active showed a greater decrease in HR when exposed to other's physical pain. Step 3 (IRI and ECR-R subscales) accounted for an additional 13% change in the variance, with Empathic Concern accounting for 4%, Personal Distress accounting for 9%, and Attachment Anxiety accounting for 2% of the variance. This suggests that individuals with greater Empathic Concern, lower Personal Distress and greater attachment Anxiety showed greater decrease in HR when exposed to physical pain.

The overall model was the most appropriate for predicting change in cRSA for the physical pain condition accounting for 12% of the variance in cRSA, however this did not meet a cutoff of $p < .05$. Step 2 (waist measurement, hip measurement, and physical activity) accounted for 7% of the variance in cRSA, with hip measurement accounting for 3% of the variance.

Step 3 (IRI and ECR-R subscales) was not significant in explaining the variance in cRSA in any of the conditions, however there were some variables that were significant or approached significance. Perspective Taking accounted for 3% of the variance in the happy condition, attachment Avoidance accounted for 3% of the variance in the sad condition, and the Fantasy Scale approached significance accounting for 2% of the variance in the pain condition. In the sadness condition, a change in RSA was predicted by Avoidance and hip measurement.

There were several significant differences found between the predictor variables for males and females (e.g., see Tables 1 and 4). Therefore, post-hoc regressions split by gender were run using a Bonferroni corrected cut-off of $p = .025$ (for 2 genders). The model for the change in HR for females in the physical pain condition was the only analysis that passed the stringent cut-off ($p = .003$). The model significantly predicted 30.1% of the variance in HR (corrected $R^2 = .21$), with Personal Distress accounting for 13% and waist-to-hip ratio accounting for 7% of the variance. There were two other models for females that were close to the adjusted cut-off and worthy of mention: prediction of the change in HR in the happy condition ($R^2 = .23$,

$p = 0.04$; Personal Distress = 6%) and RSA in the physical pain condition ($R^2 = .23$, $p = 0.03$; Fantasy Scale = 9%, Empathic Concern = 4%).

Table 14

*Hierarchical Multiple Regression Analyses Predicting Change in HR From Empathy and Attachment*

| | Vicarious Affective Condition | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Happy | | | Sad | | | Physical Pain | | |
| Predictor | $\Delta R^2$ | $\beta$ | $sr^2$ | $\Delta R^2$ | $\beta$ | $sr^2$ | $\Delta R^2$ | $\beta$ | $sr^2$ |
| Step 1 | .04* | | | .00 | | | .02 | | |
| Age | | -.19* | .03 | | -.03 | .00 | | -.13 | .01 |
| Gender | | -.07 | .00 | | -.01 | .01 | | .02 | .00 |
| Step 2 | .00 | | | .02 | | | .06* | | |
| WHR | | -.06 | .00 | | -.22† | .02 | | -.30** | .04 |
| Weight | | .12 | .01 | | .17 | .02 | | .13 | .01 |
| PA | | .14 | .01 | | .19* | .03 | | .24** | .04 |
| Step 3 | .10* | | | .11* | | | .13** | | |
| PT | | .23* | .04 | | .22* | .04 | | .13 | .01 |
| FS | | .07 | .00 | | .10 | .01 | | .05 | .00 |
| EC | | -.23* | .03 | | -.32** | .06 | | -.25* | .04 |
| PD | | .22* | .04 | | .21* | .03 | | .34** | .09 |
| AV | | -.04 | .00 | | -.00 | .00 | | -.07 | .00 |
| AX | | -.15 | .01 | | -.15 | .01 | | -.19* | .02 |
| Total $R^2$ (adjusted) | .14* (.07) | | | .13† (.05) | | | .21** (.14) | | |
| Intercept | 6.50 | | | 5.05 | | | 13.46* | | |
| *n* | 143 | | | 141 | | | 141 | | |

*Note:* WHR = Waist-to-Hip Ratio, PA = Physical Activity, PT = Perspective Taking, FS = Fantasy Scale, EC = Empathic Concern, PD = Personal Distress, AV = attachment Avoidance, AX = attachment Anxiety
† $p < .10$. *$p < .05$. **$p < .01$

Table 15

*Hierarchical Multiple Regression Analyses Predicting Change in cRSA From Empathy and Attachment*

| | Change in cRSA for each condition | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Happy | | | Sad | | | Physical Pain | | |
| Predictor | $\Delta R^2$ | $\beta$ | $sr^2$ | $\Delta R^2$ | $\beta$ | $sr^2$ | $\Delta R^2$ | $\beta$ | $sr^2$ |
| Step 1 | .02 | | | .01 | | | .01 | | |
| Age | | .07 | .00 | | .04 | .00 | | -.01 | .00 |
| Gender | | .07 | .00 | | -.01 | .00 | | .05 | .00 |
| Step 2 | .05† | | | .04 | | | .07* | | |
| Waist | | .15 | .01 | | -.06 | .00 | | -.05 | .00 |
| Hip | | .06 | .00 | | .27† | .02 | | .28* | .03 |
| PA | | .01 | .00 | | -.02 | .00 | | -.05 | .00 |
| Step 3 | .05 | | | .05 | | | .05 | | |
| PT | | -.20* | .03 | | -.00 | .00 | | -.05 | .00 |
| FS | | .13 | .01 | | .16 | .02 | | .16† | .02 |
| EC | | -.08 | .00 | | -.08 | .00 | | -.16 | .01 |
| PD | | .03 | .00 | | -.09 | .01 | | -.12 | .01 |
| AV | | -.13 | .01 | | -.20* | .03 | | -.06 | .00 |
| AX | | .05 | .00 | | .10 | .01 | | -.08 | .00 |
| Total $R^2$ (adjusted) | .12 (.04) | | | .11 (.02) | | | .12† (.05) | | |
| Constant | -2.00 | | | -3.30 | | | -3.23 | | |
| *n* | 143 | | | 143 | | | 144 | | |

*Note:* cRSA = Respiratory Sinus Arrhythmia corrected for respiration rate, PA = Physical Activity, PT = Perspective Taking, FS = Fantasy Scale, EC = Empathic Concern, PD = Personal Distress, AV = attachment Avoidance, AX = attachment Anxiety
† $p < .10$. * $p < .05$. ** $p < .01$

# Discussion

## Manipulating and Predicting Physiological Change

The purpose of this study was to further explore the relationships between physiology, empathy, and adult attachment as they pertain to vicarious exposure to affective situations. Physiology was measured by exploring changes in heart rate (HR) and corrected respiratory sinus arrhythmia (cRSA) in response to vicarious exposure to happiness, sadness, and physical pain. The sympathetic (SNS) and parasympathetic (PNS) branches of the autonomic nervous system influence HR, whereas cRSA is influenced by the PNS (and the respiratory system) in homeostatic/recovery processes and reflects cardiac vagal tone (Berntson et al., 1997; Porges, 2001). Increases in cRSA during manipulation are indicative of healthy vagal tone (the ability of the vagus nerve to regulate the heart rate).

Empathy was measured by having participants complete the Perspective Taking, Fantasy, Empathic Concern, and Personal Distress subscales of the Interpersonal Reactivity Index (IRI). Adult Attachment was measured by having participants complete the Avoidance and Anxiety subscales of the Experiences in Close Relationships - Revised (ECR-R) questionnaire. These data were used to explore the question: Do our thoughts, feelings, and actions towards the situations of others (i.e., empathy) and our close personal relationships (i.e., adult attachment) predict our physiological responses (HR and cRSA) during vicarious affective exposure (i.e., happiness, sadness, and physical pain)? In general, for the participants in this study the answer to this question is yes, to some extent.

The hypothesis that affective stimuli can cause changes in heart rate variability (i.e., HR and cRSA) that can be predicted by empathy and adult attachment was somewhat supported. The manipulation of affect was significant in every condition for every measure, including the participant ratings of depicted and felt affect. The HR, respiration rate, and cRSA activity indicates healthy responding of the autonomic (both sympathetic and parasympathetic) and cardiovascular systems in order to control cardiovascular changes to psychologically evocative situations as shown in a sample of healthy adolescents and young adults. However, the pattern of responding was dependent on the type of exposure. Exposure to vicarious happiness was associated with increased HR that is consistent with arousal. Exposure to vicarious sadness and physical pain caused decreased HR that is consistent with attentional processes. These divergent patterns of results were to be expected based on previous research on physiological responses to positive and negative stimuli (Kreibig, 2010). Exposure to all stimuli resulted in increased cRSA activity. It is possible that the increased cRSA activity during the negative conditions could be due to increased self-regulation of the emotional response (Beauchaine, 2001). The increased cRSA activity found during the positive (happy) condition does not lend itself easily to explanation, however, it is possible that the participants were attempting to control their laugher or were even giggling which could also result in the associated increase in HR and respiration rates. More research will be needed in order to fully explore the effects of vicarious exposure to happiness on HRV.

These results together indicate that during vicarious exposure to happiness there was increased parasympathetic activity (as indicated by increased cRSA) along with an increase in sympathetic activity (as indicated by the concurrent increased HR). The decreased HR during the sad and physical pain exposure conditions showed increased parasympathetic activity (as indicated by increased cRSA) and perhaps sympathetic withdrawal resulting in the decreased HR. Therefore these results support previous research showing that vicarious exposure leads to physiological changes, which can be attributed to either attentional or protective responses, (Craig, 1968; Craig & Lowry, 1969; Craig & Wood, 1969; Graham & Clifton, 1966), and expand previous research by showing there are different patterns of responding for different types of affective exposure.

The regression analyses in this study showed interesting relationships between the biological, cardiovascular health, empathy, attachment, and physiological variables. When faced with vicarious exposure to happiness, individuals who were younger, and had a greater tendency to take the perspective of others, less compassion, and greater personal distress, showed a greater increase in HR. These results do not lend themselves to interpretation. Previous research tends to relate empathy to negative situations (e.g., pain) rather than positive situations; therefore, some subjective interpretation is needed in the case of happiness. Arousal in response to exposure to happiness, which is a state of arousal itself, indicates an adoption of the psychological and physiological perspective of another and increased self-oriented responding. Davis (1983a) reported that higher scores on the Personal Distress subscale were associated with self-oriented responding rather than other-oriented responding. Therefore, during exposure to happiness the Personal Distress subscale could possibly be described as the amount of arousal one feels rather than how much happiness one sees or perhaps viewed as an indication of perceived threat in even happy situations. However, the interpretations between Personal Distress and happiness are not clear as the Personal Distress sub-scale is designed to explore responses in negative situations and therefore should be made with caution. In contrast, high scores of Empathic Concern reflect other-orientation rather than self-orientation (Goubert, et al., 2005). From this, Empathic Concern in a positive situation could be interpreted as an inhibitory process in that increased concern for someone else hinders one's ability to share the other person's positive experience, whereas decreased concern allows an individual to be more focused on their own self-oriented experience of arousal.

Emotional contagion could further explain the self-other distinction of responding to affective stimuli. Emotional contagion refers to adopting the emotion of another individual, a loss of self-other distinction with respect to the situation itself. It is described as a primitive and automatic process wherein an individual, consciously or not, mimics the emotional state of the other person (e.g., facial expression) and then begins to feel or "catch" the same emotion (Hatfield, Cacioppo, & Rapson, 1994). Doherty (1997) created a scale known as the Emotional Contagion Scale (ECS) that was designed to measure an individuals' susceptibility to mimic the emotions of others. The ECS was related to reactivity (as measured with the Passionate Love Scale, Self-Conscious Scale, and the Shyness Scale) emotionality, sensitivity to others, and measures of empathy (Doherty, 1997). For empathy, the relationship to emotional contagion susceptibility was stronger for the affective measures on the IRI (e.g., Empathic Concern and Personal Distress ) with feelings of warmth, compassion, and concern rather than discomfort and anxiety in negative situations (Doherty, 1997). Therefore, in the case of exposure to happiness it is possible that the increased arousal is related to Personal Distress not in terms of how an individual reacts in negative situations but in terms of how an individual mimics and "catches" the affect of others. This is also in line with the concept of Personal Distress being a measure of self-orientation (Davis, 1983a).

When exposed to sadness and physical pain individuals with a larger waist-to-hip ratio, less physical activity, greater tendency to take the perspective of others, increased compassion (for sadness), and less personal distress in response to others' situations showed a greater decrease in HR. The relationships between empathy and the change in HR again may reflect the act of engaging and processing the meaning of the situation versus self-distancing. Individuals that are more likely to feel distressed when viewing others in either sad or physically painful situations and are less likely to recognize the situation as belonging to someone else will respond in a manner that will be self-protective rather than engaging themselves in the situation. The results of this study suggests that these self-protecting individuals will show increased HR rather than decreased HR when exposed to others in negative situations. The ability to differentiate our experience from others allows us to connect more with others (Goubert et al., 2005). These findings are also in line with overlap of the self and other which leads to over-arousal (as if they are the one in the negative situation which would cause arousal; Craig & Wood, 1969) when it is the other person that is in a negative situation and one's self is not (Decety & Jackson, 2006; Jackson et al., 2006a).

With respect to prediction, Empathic Concern and Personal Distress predicted changes in HR in each condition of affective manipulation. This is consistent with the fact that these scales (Empathic Concern and Personal Distress) are designed to measure affective components of empathy. Perspective Taking predicted changes in HR in only the sad condition and Attachment Anxiety predicted changes in HR in only the physical pain condition. The most prominent psychological variables in predicting HR were Perspective Taking, Empathic Concern, and Personal Distress.

Contrary to the HR regressions, the ability to predict changes in cRSA from indices of empathy and attachment was not found to be significant in this study. Perhaps the ability to physically feel one's own change in HR (e.g., heart racing) allows for the development of the basis for a HR mechanism to understand and relate changes in HR to psychological experiences. The lack of significant results suggest that vagal tone (i.e., cRSA) might not be easily relatable to self-reported measures of reactivity in that the measurement of activity (i.e., HR) was more informative than the measure of recovery/homeostasis (i.e., cRSA). There are different mechanisms that can affect vagal tone; therefore, RSA can be an indicator of cardiorespiratory, ANS, psychological, behavioural, or digestive functioning (Grossman & Taylor, 2007). Grossman and Taylor (2007) suggest that RSA *reflects* cardiac vagal tone but is not the *same as* cardiac vagal tone. It is also possible that the physical feeling and awareness of an increased HR (e.g., arousal) throughout ones lifetime could develop the basis for a mechanism that allows for understanding the psychological link between self-reported Personal Distress and the increased HR. Studies have found relationships between the awareness of one's physiological processes (interoception) and HR activity empathy, emotional expressiveness, and emotional ratings (Barrett, Quigley, Bliss-Moreau, & Aronson, 2004; Dunn et al., 2010; Ludwick-Rosenthal & Neufeld, 1985). Thus, it is possible that self-report items such as Personal Distress reflect a summary of one's lifetime introspective experiences, which are stronger for explicit outcomes that are more likely to reach awareness. For example, an individual that feels their heart race while watching scary movies might be more self-aware of the change in HR due to the distress that they feel towards the movie. However, they might not be aware of the physiological systems that are attempting to control the change in HR (e.g., cRSA). HR changes occur in response to both sympathetic and parasympathetic influences but what is most likely to be noticed is the resulting change in HR (e.g., heart racing) rather than the individual factors attempting to exert control over it. Therefore, perhaps we base our lifetime experiences of Personal Distress on overt activity and outcomes rather than recovery/homeostasis or background processes. Although this current study did record felt affect in response to the video clips, which is more related to the idea of emotional contagion, there was not a measure to look at "arousal" in general; therefore, the data in this study are not sufficient to determine whether or not participants were aware of their level of overall arousal.

***Gender differences in prediction.*** An interesting finding of this study was that when the regressions were run for each gender, the prediction was greater for females. Gender differences were not found for the physiological measures (i.e., HR and cRSA); however, there were gender differences found for the cardiovascular health variables (i.e., waist measurements, waist-to-hip ratio, weight, and physical activity) and the IRI and ECR-R subscales, as would be expected. Gender differences on the cardiovascular health variables are to be expected, as males in North America are generally larger and more active than females. Davis (1980) suggested that the IRI, like other measures of empathy, tends to result in higher scores for females than for males. The Perspective Taking subscale yielded the smallest gender difference in the current study with the greatest differences occurring in the affective component scales (i.e., Empathic Concern and Personal Distress). Davis (1980) reported that greater affective differences and fewer cognitive differences are consistent with Hoffman's (1977) suggestion that females tend to be more empathic but not necessarily more cognitively attuned than males. Males in this sample had slightly higher Anxiety scores on the ECR-R subscale than females, which is in contrast to other research (Del Guidice, 2011; Fraley, 2005). When these gender differences were taken into consideration and the regression analyses rerun, there was an increase of 10% of the variance in HR that was accounted for in the physical pain condition. For females it would appear that a greater waist-to-hip ratio and less Personal Distress were associated with a greater decrease in HR with vicarious exposure to physical pain, indicating greater processing of information and a healthy response. The analyses for HR in the happiness condition and cRSA in the physical pain condition were also significant but did not reach the stringent cut-off of the post-hoc analyses.

**Correlational Expectations**

**Physiology and empathy.** As mentioned above, various relationships were found for empathy and physiology in the regressions; however, only a few unique relationships were found to be significant, although weak with the greatest being $r = .25$, in the overall sample. Perspective Taking was significantly correlated with both a change in HR and RSA in the happy condition and Personal Distress was significantly correlated with a change in HR in the pain condition. The relationship between Empathic Concern and cRSA approached significance in the pain condition. This means that participants who reported they often adopt the perspectives of another individual also experience an increased HR due to sympathetic activation, parasympathetic deactivation, or a combination of both. The participants that reported increased personal distress to the negative situations of others showed greater physiological distress when viewing others in pain, as indicated by an increase in HR. The participants that reported greater compassion showed greater parasympathetic activation, suggesting greater processing of the situation and healthier responding. The results of this study show support between physiological responding (situational responses) and self-reported empathy (with the IRI looking at dispositional empathic responding).

However, similar to the regression analyses there were several gender differences that occurred. Once the data were split by gender there were different and stronger correlations, with the greatest being $r = .37$. For example, women who reported increased Personal Distress showed increased HR in the happy, sad (approached significance), and pain conditions and decreased cRSA in the sad and pain conditions (both approached significance) indicating less healthy patterns of responding. In contrast, for males, increased Personal Distress was only associated with an increase in cRSA in the happy condition. Again, the results of increased cRSA activity in the happy condition require further study in order to attempt to explain this relationship (e.g., due to laughter, attempt to control laughter, increased respiration, or some other factor). These results indicate different patterns and strengths of variable relationships based on gender and suggest that empathy-based gender differences do exist when using the IRI in this research design.

**Physiology and adult attachment.** Attachment theory allows for the possible explanation of physiological reactivity and emotional reactivity/control from a developmental perspective. Bowlby (1969) suggested that infants create "internal working models" based on the responsiveness of their caregiver to their safety and needs. Therefore, it is theorized that the pattern of physiological reactivity to distress in infants is influenced by caregivers' responsivity. These interactions are suggested to develop the infant's ability to self-regulate in times of distress and can impact future social relationships. According to Mikulincer and Shaver (2007; Mikulincer & Shaver in Cassidy & Shaver, 2008) unavailability of the attachment figure can lead to maladaptive strategies (hyperactivation or deactivation) to deal with the pain and frustration. These maladaptive strategies can then affect future attachment relationships. For example, if an infant is crying and their caregiver responds to their needs they learn to decrease their crying but if the caregiver responds inconsistently, the infant will then have more difficulty in developing effective self-regulation. Therefore, this infancy self-regulatory experience, like attachment itself, uses the internal working models as a basis for future relationships and social interactions and is broadened and built upon throughout development. Over the years, studies have found various maladaptive physiological responses related to attachment, such as deficits in emotion regulation and attachment insecurity (Allen & Miga, 2010), increased blood pressure and skin conductance in response to general stressors and attachment avoidance (Carpenter & Kirkpatrick

1996; Diamond et al., 2006; Feeney and Kirkpatrick, 1996; Kim, 2006), increased cortisol reactivity and recovery and attachment insecurity (Powers, Pietromonaco, et al., 2006), decreased HF HRV and attachment avoidance during relationship stressors (Maunder et al., 2006), increased cortosol reactivity during relationship conflict and avoidant attachment (Laurent & Powers, 2007; Powers et al., 2006) increased cortisol reactivity with abandonment related imagery (Rifkin-Graboi, 2008), and increased HR and preoccupied attachment and increased skin conductance and dismissing attachment during romantic conflicts (Roisman, 2007).

Unlike previous research, the expectation that there would be a difference in physiology relative to the measures of adult attachment avoidance and anxiety was not confirmed in this study. As discussed previously, the regression on the change in HR for the sad condition was the only time that one of the ECR-R subscales (Anxiety) was significant in the regressions. When looking at the correlations, no relationships were found between any of the physiology measures and adult attachment avoidance or anxiety. Even when the data were split by gender there was only one weak relationship that approached significance (increased Avoidance and decreased cRSA in the sad condition for females). It is possible that individuals that were distressed by the presentation of affective stimuli were using attentional processes to distract themselves from the stimuli, which could result in alleviating their distress during exposure (Diamond et al., 2006). Gaze aversion was also suggested as a process used by individuals with high levels of empathy (Westerbury & Newman, 2008). Another explanation of this null finding could be that the measurement of attachment was too vague and lacked attachment relationship specificity, perhaps targeting a specific relationship (e.g., romantic or parent-child) would have provided a more sensitive elicitation of adult attachment reponses; a practice suggested by other researchers (Cook, 2000; Diamond et al., 2006; La Guardia, Ryan, Couchman, & Deci, 2000; Mikulincer et al., 2001; Shaver & Mikulincer, 2002). This study did not use explicit attachment specificity by asking participants to imagine this happening to a specific person in their lives (the same person and relationship that the questionnaire would be directed towards) or by using attachment priming (by giving participants attachment related information prior to experimental manipulation). Attachment specificity and priming are procedures that could have been used to draw more attention to attachment both for the video clip responses and the ECR-R responses. Mikulincer et al. (2001) found that secure-attachment priming can help to optimize empathic responding and decrease personal distress by showing images of an individual consoling someone (versus an image of a dog dressed up or country scenery) or by telling a secure attachment story (e.g., involving supportiveness and consolation from others). Further research employing priming (e.g., asking participants to imagine a specific person, such as a romantic partner, in the situations depicted and when completing the questionnaires) is suggested in order to fully explore the interactions between empathy, attachment, and physiology.

**Empathy and adult attachment.** The final expectation was based on the theorized links between attachment, emotional development, and social development and previous research linking empathy and attachment (Britton & Fuendeling, 2005; Burnette et al., 2009; Joireman, et al., 2001; Mikulincer et al., 2001; Trusty et al., 2005). The expectation that there would be a relationship between measures of empathy and measures of adult attachment was supported in this study with several weak to moderate correlations. Previous research suggested that attachment avoidance was positively correlated with Personal Distress and negatively correlated with Empathic Concern and Fantasy subscales of the IRI. In this study, Attachment Avoidance was positively correlated with Personal Distress and negatively correlated with Perspective Taking and Empathic Concern. This suggests that individuals who are more likely to avoid getting close to others are also more likely to have less compassion for others, less likely to adopt their perspective, and more likely to express distress when exposed to situations of emotional provocation. Attachment Anxiety was expected to be positively correlated with Perspective Taking and Personal Distress and negatively correlated with Empathic Concern; however, in this study anxiety was negatively correlated with Perspective Taking, Fantasy Scale, and Empathic Concern. This suggests that individuals who are more anxious (or less confident) in their relationships are more likely to show less compassion for others, less interested in fantasy (or perspective imagination, role-playing), and less able to adopt the perspectives of others.

Diamond et al., (2006) found that individuals who were high in attachment avoidance showed increased physiological reactivity to stressors but reported low distress. They suggested that these individuals were actively suppressing their thoughts and emotions, which actually led to increasing and prolonged physiological responding. Therefore, it is possible that there is a physical disconnect or lack of experience for individuals that are high on avoidance, which could affect their ability to accurately self-report their emotional or physiological state. The current study did not find any significant correlations between physiology and Attachment Avoidance or Anxiety; however, there was a positive correlation between Attachment Avoidance and Personal Distress and several correlations between Personal Distress and physiological responding. Individuals who scored high on Attachment Avoidance reported responding to the negative situations of others with a greater degree of Personal Distress, indicative of a self-oriented perspective. The negative correlations between Perspective Taking, Fantasy Scale, and Empathic Concern also implicate a greater self-oriented perspective for individuals high on Attachment Avoidance and/or Anxiety. Individuals with self-oriented perspectives were shown in this study to have more maladaptive physiological responding (e.g., lower cRSA). Together these results indicate that there is a possible link between measures of attachment and physiology that this study design was not able to directly expose.

**Limitations**

The participants in this study were limited in range of age; therefore it is unclear how the results of this study would apply to individuals in other developmental stages. The results of the adult attachment data should not be interpreted to indicate no relationship to the other variables as the study design lacked some key components that could have been more appropriate in exploring these relationships. For example, the study explored "very close relationships" rather than specific relationships and did not use attachment priming (as described earlier). As with any research utilizing self-report measures there is the potential for response bias (e.g., attempting to adhere to social norms) and that other variables might affect their relationship with the physiological responses. For example, behavioral inhibition is a factor that has been shown to potentially affect the relationship between attachment and cardiac reactivity in children (Stevenson-Hinde & Marshall, 1999).

**Implications and Future Directions**

This study was designed to explore relationships and provoke future research. There were several interesting findings that warrant further investigation. The affective manipulations were effective in manipulating affect, both subjective (i.e., ratings) and objective (i.e., physiology). The fact that each vicarious affect condition led to physiological changes shows how responsive autonomically mediated physiological systems are. The long-term effect of such exposure warrants further study. Research has shown that exposure to trauma or extreme situations can have negative effects on individuals (e.g., anxiety and depression) but what are the long-term effects of exposure to readily available sources of affective arousal such as those shown in this study? Are the long-term outcomes of these types of exposure affected by the order of the exposure, for example exposure to physical pain sandwiched between exposures to happiness? Or are individuals that are more reactive to certain situations more likely to avoid encountering such situations, for example, by not watching certain movies?

This research indicates that individuals who take a self-orienting approach to affective exposure could potentially experience aversive physiological responses and therefore health concerns. Upon reviewing the literature, Maunder and Hunter (2006) found that research has already shown that individuals with high personal distress and insecure attachment are potentially at risk for negative health outcomes and diseases such as recurrent otitis media, cystic fibrosis, epilepsy, asthma, and congential heart disease (in children) and idiopathic spasmodic torticollis, ulcerative colitits, heart disease, and poor general physical health (in adults). This current study provides further support for these implications as it shows patterns of activity that can lead to health problems if continued. Although direct clinical implications should not be taken from this research, there are suggested directions for clinical-related research. Possible future research could explore the effect of behavioral interventions designed to harbor more adaptive affective responses. For example, based on the attachment literature, encouraging and supporting secure attachment relationships could foster more adaptive physiological responding by decreasing the self-oriented responding and therefore decreasing the level of personal distress felt. A research paradigm involving this type of secure attachment training could allow greater insight into the influence of attachment on physiological responding. Depression literature tends to focus on the effects of exposure to sadness, whereas this research found that exposure to pain resulted in a similar response of greater magnitude. Therefore it would appear that exposure to negative affect rather than just sadness should be taken into consideration.

The self-awareness aspects of the physiological responses are also intriguing. The correlations between increased Personal Distress and increased physiological responding were significant but were not as strong as was expected. The stimuli used in this study were rated as being high in the respective affects and represented real situations as suggested to obtain optimal relationships (Anastassiou-Hadjicharalambous & Warden, 2007). However, the weak relationships between reported and physiological responses were similar to those found in other research (Anastassiou-Hadjicharalambous & Warden, 2007; Diamond et al., 2006; Sonnby-Borgstrom, Jonsson, & Svensson, 2008), pointing to a disconnect between subjective and objective affective responding. Diamond et al. (2006) suggest that research needs to be done in order to explore whether individuals are truly aware of their physiological responses and how this relates to their methods of coping and emotion regulation. One way to explore this is to look at how the self-reported situational feelings of affect relate to the actual physiological changes and whether these self-reported situational feelings mediate the relationship between the dispositional measures of empathy and physiology.

Another future direction for research would be to replicate this study with a focus on the gender differences. There were several gender differences found for the physical health, IRI, and ECR-R variables. Although only one post-hoc regression met the corrected cut-off criteria for statistical significance there were several other regressions that were still below $p = .05$, mainly for females. This is worth further exploration to determine why the regression models and correlations were better for females than for males, especially considering that the regression model in the physical pain condition predicted almost 1/3 of the variance in the change in HR for females.

**Conclusions**

The cardiovascular activity of healthy individuals was shown to change in response to vicarious exposure to happiness, sadness, and physical pain. The physiological changes that were incurred were in response to video clips that are readily available to the public and showed real people in real situations; some of these clips had hundreds of thousands of viewers around the world. The physiological response changes were dependent on the category of exposure and was predicted by variables related to cardiovascular health (i.e., age, WHR) as well as dispositional measures of empathy (i.e., Empathic Concern, Personal Distress, and Perspective Taking) and to a lesser degree adult attachment. The maladaptive dispositional measures of empathy corresponded with maladaptive physiological responding (e.g., increased Personal Distress with increased HR), which can be related to self-oriented responding. There were also different patterns of responding for males and females related to empathy and attachment suggesting that gender differences should be taken into consideration when conducting studies on these topic areas. Some of the results of this study were not as strong as expected but with methodological changes future research can further explore these relationships. This study provided a wealth of information that can be used to inspire and direct future research.

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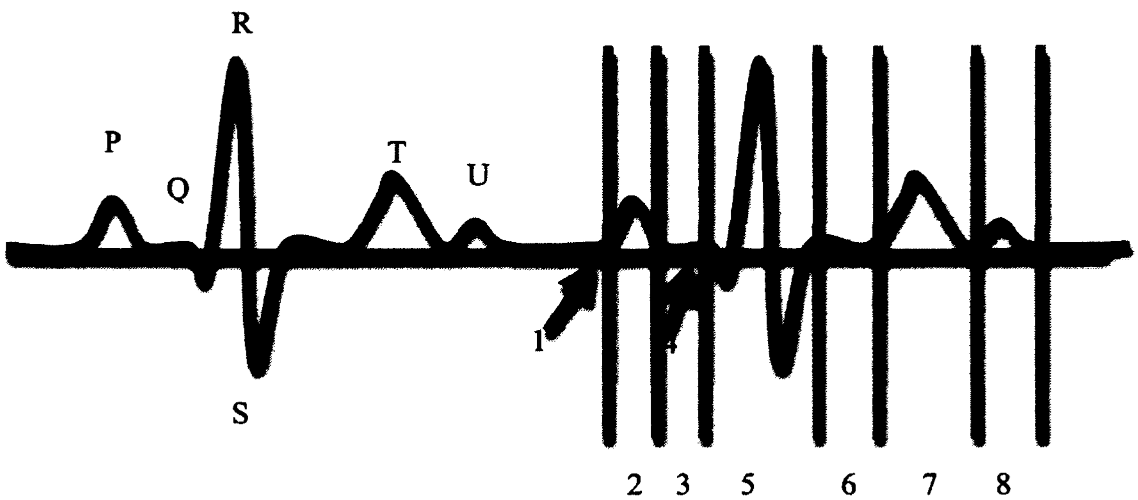
*Figure 1: Electrocardiogram reading including electrical events.*




| | Electrical Events |
|---|---|
| 1. | Sinoatrial node |
| 2. | Atrial depolarization |
| 3. | Atrioventricular node depolarization |
| 4. | Atrial repolarization |
| 5. | Ventricular depolarization |
| 6. | Ventricular activation |
| 7. | Ventricular repolarization |
| 8. | Ventricular repolarization after-potentials |

*Note: adapted from Stern, Ray & Quigley, 2001.*

Figure 2

Average change in HR for each condition for activity and recovery with error bars representing the SEM.

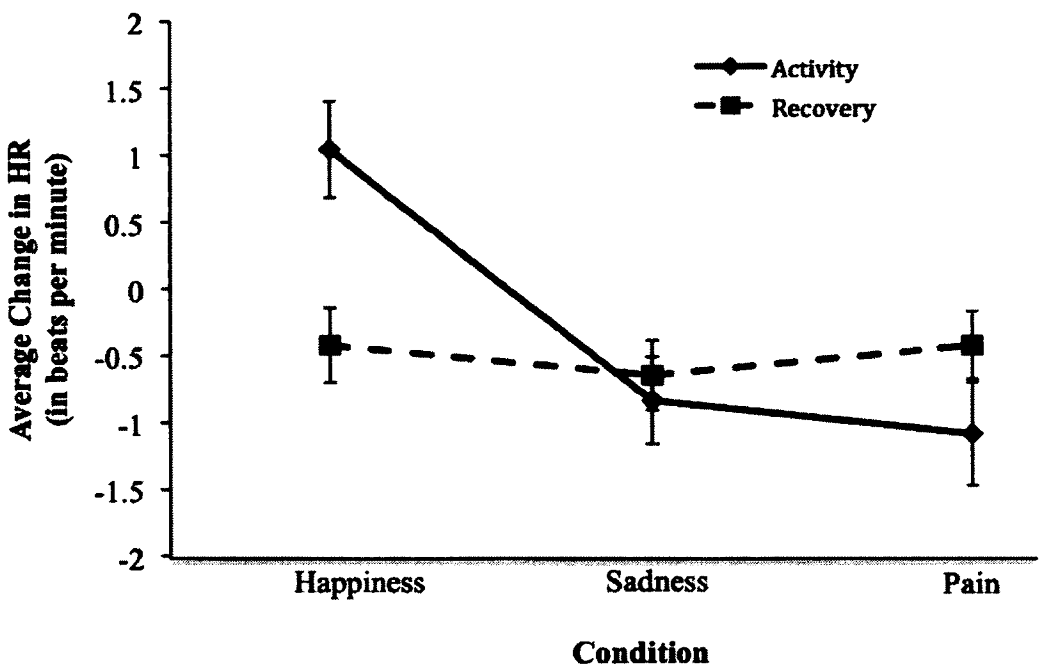


Figure 3

Average change in RR for each condition with error bars representing the SEM.

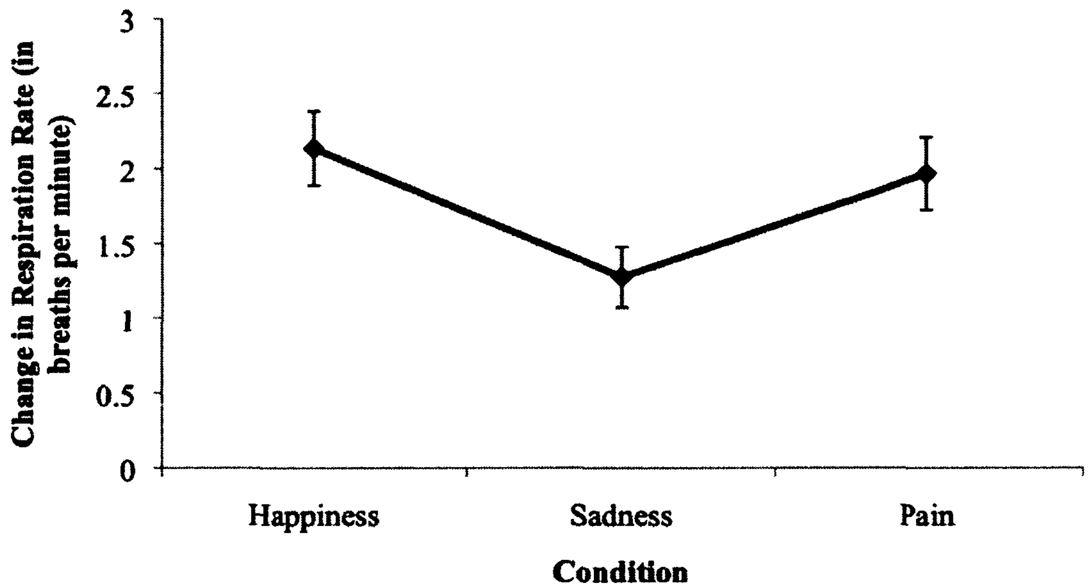
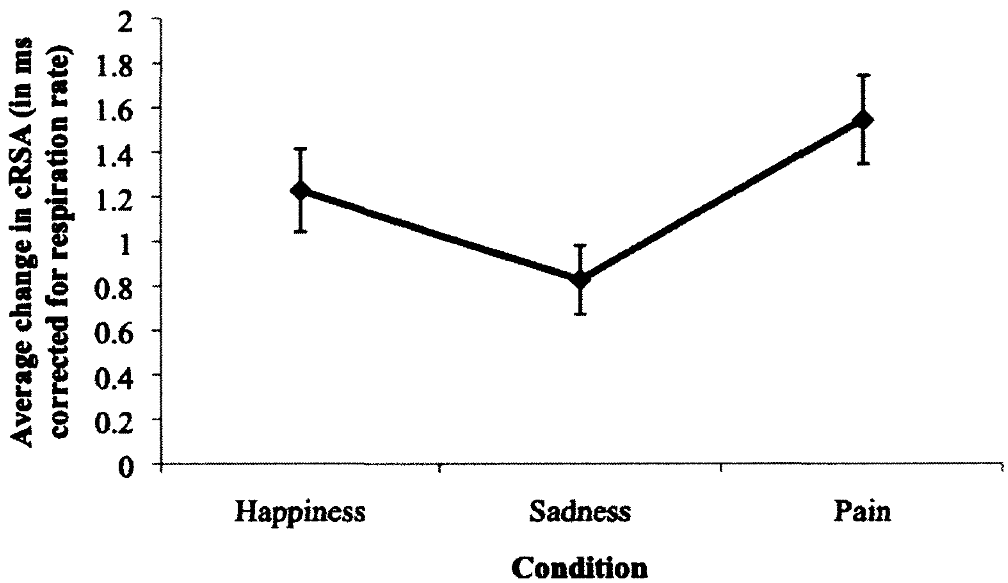


Figure 4

Average change in cRSA for each condition with error bars representing the SEM.



# Appendix 1

## Interpersonal Reactivity Index

**Interpersonal Reactivity Index**

The following statements inquire about your thoughts and feelings in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate letter on the scale at the top of the page: A, B, C, D, or E. When you have decided on your answer, fill in the letter on the answer sheet next to the item number. READ EACH ITEM CAREFULLY BEFORE RESPONDING. Answer as honestly as you can. Thank you.

<u>ANSWER SCALE</u>:

| A | B | C | D | E |
|---|---|---|---|---|
| **DOES NOT DESCRIBE ME WELL** | | | | **DESCRIBES ME VERY WELL** |

1. I daydream and fantasize, with some regularity, about things that might happen to me. __________
2. I often have tender, concerned feelings for people less fortunate than me. __________
3. I sometimes find it difficult to see things from the "other guy's" point of view. __________
4. Sometimes I don't feel very sorry for other people when they are having problems. __________
5. I really get involved with the feelings of the characters in a novel. __________
6. In emergency situations, I feel apprehensive and ill-at-ease. __________
7. I am usually objective when I watch a movie or play, and I don't often get completely caught up in it. __________
8. I try to look at everybody's side of a disagreement before I make a decision. __________
9. When I see someone being taken advantage of, I feel kind of protective towards them. __________
10. I sometimes feel helpless when I am in the middle of a very emotional situation. __________

11. I sometimes try to understand my friends better by imagining how things look from their perspective. ____________

12. Becoming extremely involved in a good book or movie is somewhat rare for me. ____________

13. When I see someone get hurt, I tend to remain calm. ____________

14. Other people's misfortunes do not usually disturb me a great deal. ____________

15. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments. ____________

16. After seeing a play or movie, I have felt as though I were one of the characters. ____________

17. Being in a tense emotional situation scares me. ____________

18. When I see someone being treated unfairly, I sometimes don't feel very much pity for them. ____________

19. I am usually pretty effective in dealing with emergencies. ____________

20. I am often quite touched by things that I see happen. ____________

21. I believe that there are two sides to every question and try to look at them both. ____________

22. I would describe myself as a pretty soft-hearted person. ____________

23. When I watch a good movie, I can very easily put myself in the place of a leading character. ____________

24. I tend to lose control during emergencies. ____________

25. When I'm upset at someone, I usually try to "put myself in his shoes" for a while. ____________

26. When I am reading an interesting story or novel, I imagine how I would feel if the events in the story were happening to me. ____________

27. When I see someone who badly needs help in an emergency, I go to pieces. ____________

28. Before criticizing somebody, I try to imagine how I would feel if I were in their place. ____________

# Appendix 2

## Experience in Close Relationships - Revised

**Experience in Close Relationships - Revised**

The statements below concern how you feel in emotionally intimate relationships. We are interested in how you *generally* experience close relationships of any type, not just in what is happening in a current romantic relationship. Respond to each statement by circling the number to indicate how much you agree or disagree with the statement.

Answer Scale:

| | | | | | | |
|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **Strong Disagree** | | | | | | **Strongly Agree** |

1. It's not difficult for me to get close to my significant others.

   1 2 3 4 5 6 7

2. I'm afraid that I will lose the love of my significant others.

   1 2 3 4 5 6 7

3. I worry a lot about my relationships.

   1 2 3 4 5 6 7

4. When my significant others are out of sight, I worry that they might become interested in someone else.

   1 2 3 4 5 6 7

5. I prefer not to show significant others how I feel deep down.

   1 2 3 4 5 6 7

6. When I show my feelings for significant others, I'm afraid he or she will not feel the same about me.

   1 2 3 4 5 6 7

**1 2 3 4 5 6 7**

**Strong Disagree** **Strongly Agree**

7. My significant others make me doubt myself.
   1 2 3 4 5 6 7

8 I feel comfortable sharing my private thoughts and feelings with my significant others.
   1 2 3 4 5 6 7

9 I find it difficult to allow myself to depend on others.
   1 2 3 4 5 6 7

10. I often worry that my significant others don't really love me.
   1 2 3 4 5 6 7

11. I am very comfortable being close to significant others.
   1 2 3 4 5 6 7

12. I find that my significant others don't want to get as close as I would like.
   1 2 3 4 5 6 7

13. I don't feel comfortable opening up to significant others.
   1 2 3 4 5 6 7

14. Sometimes significant others change their feelings about me for no apparent reason.
   1 2 3 4 5 6 7

15 I prefer not to be too close to significant others.
   1 2 3 4 5 6 7

**1 2 3 4 5 6 7**

**Strong Disagree** **Strongly Agree**

16 I often worry that my significant others will not want to stay with me.

1 2 3 4 5 6 7

17. I get uncomfortable when a significant other wants to be very close.

1 2 3 4 5 6 7

18. I do not often worry about being abandoned.

1 2 3 4 5 6 7

19. I find it relatively easy to get close to my significant others.

1 2 3 4 5 6 7

20. I'm afraid that once a significant other gets to know me, he or she won't like who I am.

1 2 3 4 5 6 7

21. I usually discuss my problems and concerns with my significant others.

1 2 3 4 5 6 7

22. It helps to turn to my significant others in times of need.

1 2 3 4 5 6 7

23. I rarely worry about my significant others leaving me.

1 2 3 4 5 6 7

24. I tell my significant others just about everything.

1 2 3 4 5 6 7

| | | | | | | |
|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | **7** |

**Strong Disagree** **Strongly Agree**

25. I worry that significant others won't care about me as much as I care about them.

    1 2 3 4 5 6 7

26 I often wish that my significant others' feelings for me were as strong as my feelings for him or her.

    1 2 3 4 5 6 7

27. I talk things over with my significant others.

    1 2 3 4 5 6 7

28 I worry that I won't measure up to other people.

    1 2 3 4 5 6 7

29. My significant others only seem to notice me when I'm angry.

    1 2 3 4 5 6 7

30. I am nervous when significant others get too close to me.

    1 2 3 4 5 6 7

31. It makes me mad that I don't get the affection and support I need from my significant others.

    1 2 3 4 5 6 7

32. I feel comfortable depending on significant others.

    1 2 3 4 5 6 7

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|

**Strong Disagree** **Strongly Agree**

33. I find it easy to depend on significant others.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|

34 My desire to be very close sometimes scares people away.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|

35 It's easy for me to be affectionate with my significant others.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|

36 My significant others really understand me and my needs.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|

# Appendix 3

## Video Stimuli

Table 1

*Mean ratings for the video clip selection and exclusion for the Happiness category.*

| | Happiness | Sadness | Pain |
|---|---|---|---|
| Clip (length in seconds) | *M (SD)* | *M (SD)* | *M (SD)* |
| 1. Baby laughing (25s)* | 7.80 (2.04) | 0.00 (0.00) | 0.10 (0.32) |
| 2. Marriage proposal (39s)* | 8.50 (1.18) | 0.30 (0.95) | 0.00 (0.00) |
| 3. Child spinning on chair | 7.50 (1.84) | 0.00 (0.00) | 0.00 (0.00) |
| 4. Man laughing (27s)* | 7.60 (2.17) | 0.10 (0.32) | 0.50 (1.08) |
| 5. Wedding song | 6.90 (1.66) | 0.00 (0.00) | 0.00 (0.00) |
| 6. Wedding hugs (37s)* | 7.60 (1.65) | 0.20 (0.63) | 0.00 (0.00) |
| 7. Show host laughing (34s)* | 7.70 (1.25) | 0.00 (0.00) | 0.20 (0.63) |
| 8. Bride laughing (45s)* | 7.60 (1.17) | 0.00 (0.00) | 0.20 (0.63) |
| 9. Infant laughing at Wii (35s)* | 8.30 (1.42) | 0.00 (0.00) | 0.00 (0.00) |
| 10. Bride and groom laughing | 6.80 (1.32) | 0.40 (1.26) | 0.00 (0.00) |
| 11. Woman laughing | 7.50 (2.01) | 0.20 (0.63) | 0.50 (1.08) |

*Indicates clips selected for use in this study

Table 2

*Mean ratings for the video clip selection and exclusion for the Sadness category.*

| Clip (length in seconds) | Happiness *M (SD)* | Sadness *M (SD)* | Pain *M (SD)* |
|---|---|---|---|
| 1. Report about dog killed (43s)* | 0.00 (0.00) | 6.70 (1.42) | 1.40 (2.67) |
| 2. Teenager killed in accident (37s)* | 0.00 (0.00) | 7.70 (1.34) | 1.40 (2.95) |
| 3. Mother grieving for son (23s)* | 0.00 (0.00) | 8.10 (1.29) | 1.10 (3.14) |
| 4. Mother dying of cancer (41s)* | 0.00 (0.00) | 7.70 (1.77) | 2.20 (3.46) |
| 5. Children killed/injured in fire (31s)* | 0.00 (0.00) | 9.00 (1.05) | 1.60 (3.34) |
| 6. Injured girl's family speaks | 0.40 (1.26) | 6.10 (1.52) | 1.20 (2.82) |
| 7. Woman giving speech after loss (36s)* | 0.00 (0.00) | 7.20 (1.48) | 1.30 (2.83) |
| 8. High school football player's funeral | 0.30 (0.95) | 6.20 (1.62) | 0.80 (2.53) |
| 9. Mother killed (21s)* | 0.00 (0.00) | 7.60 (1.26) | 1.10 (2.85) |
| 10. Father grieving son's death | 0.00 (0.00) | 6.30 (1.34) | 0.90 (2.51) |
| 11. Girl discusses break-up | 0.00 (0.00) | 5.20 (1.99) | 0.90 (2.23) |

*Indicates clips selected for use in this study

Table 3

*Mean ratings for the video clip selection and exclusion for the Pain category.*

| | Happiness | Sadness | Pain |
|---|---|---|---|
| Clip (length in seconds) | *M (SD)* | *M (SD)* | *M (SD)* |
| 1. MMA broken leg (6s)* | 0.60 (1.90) | 0.80 (1.75) | 7.50 (2.42) |
| 2. Fall from swings (17s)* | 0.00 (0.00) | 0.70 (1.64) | 7.10 (1.52) |
| 3. Fall off stage (13s)* | 0.40 (1.26) | 1.20 (2.53) | 6.22 (2.59) |
| 4. Man breaks his leg lifting weights (21s)* | 0.00 (0.00) | 0.00 (0.00) | 8.10 (1.52) |
| 5. Woman drops weights (21s)* | 0.00 (0.00) | 0.50 (1.58) | 6.90 (2.51) |
| 6. Male nipple pinched | 1.50 (2.72) | 0.00 (0.00) | 6.00 (1.63) |
| 7. Child kicked by horse (8s)* | 0.00 (0.00) | 1.20 (2.30) | 6.90 (1.66) |
| 8. Wrist broken skateboarding (35s)* | 0.00 (0.00) | 0.80 (1.93) | 8.80 (1.14) |
| 9. Soccer broken leg (16s)* | 0.00 (0.00) | 0.20 (0.63) | 8.70 (1.57) |
| 10. Basketball broken ankle (16s)* | 0.00 (0.00) | 1.60 (2.76) | 8.60 (1.26) |
| 11. Woman in labor (32s)* | 1.00 (2.54) | 0.30 (0.95) | 7.50 (1.18) |
| 12. Water birth (35s)* | 1.50 (3.17) | 0.20 (0.63) | 8.50 (3.06) |

*Indicates clips selected for use in this study

# Appendix 4

## Consent Form

**Consent Form**

**Heart to Heart: Connecting Empathy, Attachment, and Physiology**

Purpose and Objectives of the Study: The purpose of this study is to explore the relationships between empathy, adult attachment styles, and the cardiovascular changes that occur while watching various emotional video clips.

Possible Benefits: You will have the opportunity to participate in psychophysiological research that utilizes biofeedback information.

Procedure: You were recruited by either the Psychology Participant Pool, word-of-mouth, or by responding to a poster request for participants. In this study, you will be asked to complete one questionnaire regarding your empathy in general and another questionnaire regarding your adult attachment style. For the psychophysiological component you will be seated comfortably and cardiovascular electrodes will be attached to your wrists and one ankle to record your heart beat. You will also have a strap across your chest to measure your respiration. Once attached you will be asked to sit still for 10 minutes to achieve a baseline measurement followed by 30 minutes of stimuli and recovery.

Risks: There are no known physical risks and no known psychological risks to your participation, although it is possible that the tasks might cause you some momentary anxiety or social discomfort and that there might be some discomfort in sitting for 40 minutes.

Withdrawal from the study: You have a right to participate in this study and your participation is voluntary. You may choose to withdraw at any time during the study. You have the right to answer only those questions you chose to answer. If you do decide to withdraw your participation from the study, all of your data will be withdrawn and destroyed.

Confidentiality and Anonymity: In order to ensure anonymity you will be given a participant ID number and that number will be used to code your records. Your name will not be used. Your results will not be discussed with or revealed to anyone outside of the research team (Crystal Rollings, Cindy Hardy, and Ken Prkachin). Only grouped data will be reported in the final master's thesis report. Information will be stored in a secure location at UNBC and destroyed at the end of the master's thesis project. Individual results will not be released but if you would like information on the overall findings of the study please contact Crystal Rollings at the information provided below.

Use: The data collected is to be used for Crystal Rollings' master's thesis and any subsequent presentations or publications of the results.

Questions: Questions concerning this study can be directed to Crystal Rollings at rollings@unbc.ca or (250)960-6061. Concerns regarding this study may be directed to Dr. Cindy Hardy (250)960-5814, hardy@unbc.ca, Dr. Ken Prkachin, (250)960-6633, kmprk@unbc.ca, or the Office of Research (UNBC), 250-960-6735, reb@unbc.ca.

I, ______________________________________, have read the above description and agree to participate. A copy of this form has been given to me for my records. I understand that I am free to withdraw from this study at any time without penalty of any type.

______________________________________ ____________________

Signature Date

______________________________________ Researcher (Crystal Rollings)

# Appendix 5

## General Questionnaire

**General Questionnaire**

Please answer the questions on this form to the best of your ability. Remember that the information you provide will be treated as strictly confidential.

First Name:______________________________

Date of Birth (Month/Day/Yr): ________________

Gender: M F

Relationship Status: ________________________________________

Ethnicity:________________________________________________

Years of Post-secondary Education Completed: __________________

Current University Program:__________________________________

Current Year of Study:_______________________________________

Waist (inches): ____________ Hip (inches): _____________

Weight (lbs): ______________

<u>Present Health:</u>

Did you eat or exercise within the last 30 minutes? If yes please describe.

_______________________________________________________________________________

Have you consumed caffeine (or other stimulants) in the past 2 hrs? If yes what?

_______________________________________________________________________________

Have you consumed alcohol in the past 24 hrs? If so, how much and when (approx.)?

_______________________________________________________________________________

Do you smoke? If so approximately how many cigarettes per day?

_______________________________________________________________________________

List below any current health problem(s) you may be experiencing that we should be aware of:

_______________________________________________________________________________

List below any medications you are currently taking, or have taken in the past month; these include vitamins:

Have you undergone a physical examination by your physician in the past year? Yes No

## PAFFENBARGER PHYSICAL ACTIVITY QUESTIONNAIRE

PLEASE ANSWER THE FOLLOWING QUESTIONS BASED ON YOUR AVERAGE DAILY PHYSICAL ACTIVITY HABITS FOR THE PAST YEAR.

1) How many city blocks or their equivalent did you walk on an average day during the past year?

   _______________ blocks per day (12 blocks = 1 mile = 1.61 km)

2) How many flights of stairs did you climb up on an average day during the past year?

   _______________ flights per day (Let 1 flight = 10 steps)

3) List any sports, leisure, or recreational activities you have participated in on a regular basis during the past year. Enter the average number of times per week you took part in these activities and the average duration of these sessions. Include only time you were physically active (that is, actual playing or activity time).

| Sport/Recreation/Other Physical Activity | # times/week | Average time/episode Hours | Minutes |
|---|---|---|---|
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**To be completed by the researcher:**

| |
|---|
| Energy expenditure associated with walking:<br>_____ blocks walked/day * 7 days/week = ___ blocks walked/week _____ blocks walked/week * 8 kcal/block = _____ kcal energy expended/week walking<br>Energy expenditure associated with stairs:<br>_____ flights/day * 7 days/week = ___ flights/week _____ flights/week * 4 kcal/flight = _____ kcal energy expended/week<br>Energy expenditure associated with physical activities:<br>_____ MET/activity *times/week * hours/episode * weight (kg)<br>= _____ kcal energy expended/week<br><br>Total average kcal/week = _________________ |

# Appendix 6

## Procedural Information

**Procedural Information**

Thank you for your interest in participating for my study. Before we get started I am going to go over the consent form with you and then we will complete a few demographic and current health related questions. If you have any questions at any point please feel free to ask. Please ensure that your cel phone and any other electronic devices are turned off and that jewelry and watches are removed from your wrists and ankles. We can place your personal items on this desk over here. You should plan to be in the lab for approximately one hour, so if you need to go to the washroom I would urge you to go before we hook you up to the system. Following the video presentation I will ask you to complete a scale for empathy and another scale for attachment. These are brief scales and should take less than 15 minutes each to complete. Then you will be all done.

The purpose of this project is to look at the relationship between empathy, adult attachment, and physiology. The physiological relationship will be determined by recording your heart beat and breathing while you watch video clips depicting others in various emotional situations, that is happiness, sadness, and physical pain. The video clips were taken from Internet sources such as Youtube and were selected because they involve real people in real situations, situations that can happen to anyone (You, me, family members, friends) at any time.

Now I am going to hook you up to the biofeedback system so that we can measure your heartbeats and breathing during the video clips. First I will ask you to stand in front of the chair as if you are about to sit down. Then before you sit we will place this strap across your chest with the plastic component in line with your sternum, right at the front of your chest. Please exhale all the air in your lungs and I will tighten the strap so that it is nice and snug so that we get an accurate reading. With the chest strap comfortably attached you can now be seated. I will be attaching electrodes (no pain involved) to your wrists and your right ankle, so I will need you to remove your right shoe and slide your sock down below your heel or take your sock off, whichever is most comfortable for you. Before I attach the electrodes I need to wipe the areas that I will be attaching the electrodes to with a wet nap so that we can ensure a clean contact surface and once dry I will attach the electrodes. Are you comfortable with that? Now I will get you to adjust yourself to a comfortable position in the chair as you will need to stay as still as possible for the 40 minutes of recording, that includes no twiddling fingers or toes. Are you feeling comfortable? I am also going to turn off the lights to help make viewing of the monitor a bit easier. Now that you are all hooked up I am just going to go make sure that the recording devices are working properly so if you will excuse me for a few seconds I will return once I have confirmed with the computer in the other room. I will also get you to say a number out loud and clear so that you can get an idea of how loud you will need to talk in order for me to hear you from in the other room.

Ok so here is how the process is going to work. We will start off with a 10-minute baseline period during which a message will appear on the screen that says, "If you need to make any seating adjustments please do so now". Please only use this time if you need to make any small comfort adjustments, otherwise sit as still as possible. Once the message is gone please refrain from making any movements. Then we will continue with the stimuli presentation. There will be 5 minutes of clips per category (happiness, sadness, and physical pain). There will be a brief pause in between clips of no more than

15 seconds where you will only see a blank screen. Following each series of clips a message will appear on the screen asking you to rate aloud the clips on the degree of happiness, sadness and physical pain depicted of the series of clips as well as how much happiness, sadness, and physical pain that the you felt while watching the series of clips. The ratings will be on a 7-point likert scale where "0" indicates nothing at all and "6" indicates the most possible and will include all three emotional categories for each clip. Please ensure to give your response loud and clear so that I can hear you from the other room and only respond by saying a number. Does that make sense? Any questions so far? Each category of stimuli and rating will be separated by a 5-minute recovery period. With approximately 30 seconds left in the recovery period a message will then appear on the screen (for 20s) indicating to the participants that the presentation of clips is about to begin and that they ensure that they are seated comfortably and that they can make small adjustments to ensure comfort while the message remains on the screen. Please only make any movements when the message is on the screen and indicates that it is safe to do so. This process will continue until all 3 categories have been viewed. So it will go baseline-movement message-videos-recovery-movement-video and so on. Any questions or concerns at this point? During the recording I will be in the room located directly behind you. Ok, if there are no questions or concerns lets begin. Sit back and relax.